

# Solution Manual for Modern Semiconductor Devices for Integrated Circuits Chenming C. Hu

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## Chapter 1

### *Visualization of the Silicon Crystal*

- 1.1 (a) Please refer to Figure 1-2. The 8 corner atoms are shared by 8 unit cells and therefore contribute 1 atom. Similarly, the 6 face atoms are each shared by 2 unit cells and contribute 3 atoms. And, 4 atoms are located inside the unit cell. Hence, there are total 8 silicon atoms in each unit cell.

- (b) The volume of the unit cell is

$$V_{\text{unit cell}} = (5.43 \text{ \AA})^3 = (5.43 \times 10^{-8} \text{ cm})^3 = 1.60 \times 10^{-22} \text{ cm}^3,$$

and one unit cell contains 8 silicon atoms. The atomic density of silicon is

$$N_{\text{Si}} = \frac{8 \text{ silicon atoms}}{V_{\text{unit cell}}} = 5.00 \times 10^{22} \text{ (silicon atoms) cm}^{-3}.$$

Hence, there are  $5.00 \times 10^{22}$  silicon atoms in one cubic centimeter.

- (c) In order to find the density of silicon, we need to calculate how heavy an individual silicon atom is

$$\text{Mass}_{\text{1 Si atom}} = \frac{28.1 \text{ (g/mole)}}{6.02 \times 10^{23} \text{ (atoms/mole)}} = 4.67 \times 10^{-23} \text{ (g/atom)}.$$

Therefore, the density of silicon ( $\rho_{\text{Si}}$ ) in  $\text{g/cm}^3$  is

$$\rho_{\text{Si}} = N_{\text{Si}} \times \text{Mass}_{\text{1 Si atom}} = 2.33 \text{ g/cm}^3.$$

### *Fermi Function*

# Modern Semiconductor Devices For Integrated Circuits Solution Manual

**L Cohen**



## **Modern Semiconductor Devices For Integrated Circuits Solution Manual:**

*Modern Semiconductor Devices for Integrated Circuits* Chenming Hu, 2010 For courses in semiconductor devices Prepare your students for the semiconductor device technologies of today and tomorrow Modern Semiconductor Devices for Integrated Circuits First Edition introduces students to the world of modern semiconductor devices with an emphasis on integrated circuit applications Written by an experienced teacher researcher and expert in industry practices this succinct and forward looking text is appropriate for both undergraduate and graduate students and serves as a suitable reference text for practicing engineers      Fundamentals of Power Semiconductor Devices B. Jayant Baliga, 2018-09-28 Fundamentals of Power Semiconductor Devices provides an in depth treatment of the physics of operation of power semiconductor devices that are commonly used by the power electronics industry Analytical models for explaining the operation of all power semiconductor devices are shown The treatment here focuses on silicon devices but includes the unique attributes and design requirements for emerging silicon carbide devices The book will appeal to practicing engineers in the power semiconductor device community      **The IGBT Device** B. Jayant Baliga, 2015-03-06 The IGBT device has proved to be a highly important Power Semiconductor providing the basis for adjustable speed motor drives used in air conditioning and refrigeration and railway locomotives electronic ignition systems for gasolinepowered motor vehicles and energy saving compact fluorescent light bulbs Recent applications include plasma displays flat screen TVs and electric power transmission systems alternative energy systems and energy storage This book is the first available to cover the applications of the IGBT and provide the essential information needed by applications engineers to design new products using the device in sectors including consumer industrial lighting transportation medical and renewable energy The author B Jayant Baliga invented the IGBT in 1980 while working for GE His book will unlock IGBT for a new generation of engineering applications making it essential reading for a wide audience of electrical engineers and design engineers as well as an important publication for semiconductor specialists Essential design information for applications engineers utilizing IGBTs in the consumer industrial lighting transportation medical and renewable energy sectors Readers will learn the methodology for the design of IGBT chips including edge terminations cell topologies gate layouts and integrated current sensors The first book to cover applications of the IGBT a device manufactured around the world by more than a dozen companies with sales exceeding 5 Billion written by the inventor of the device      Modern Silicon Carbide Power Devices B Jayant Baliga, 2023-09-18 Silicon Carbide power devices are being increasingly adopted for many applications such as electric vehicles and charging stations There is a large demand for a resource to learn and understand the basic physics of operation of these devices to create engineers with in depth knowledge about them This unique compendium provides a comprehensive design guide for Silicon Carbide power devices It systematically describes the device structures and analytical models for computing their characteristics The device structures included are the Schottky diode JBS rectifier power MOSFET JBSFET IGBT and BiDFET

Unique structures that address achieving excellent voltage blocking and on resistance are emphasized This useful textbook and reference innovations for achieving superior high frequency operation and highlights manufacturing technology for the devices The book will benefit professionals academics researchers and graduate students in the fields of electrical and electronic engineering circuits and systems semiconductors and energy studies

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**Advanced High Voltage Power Device Concepts** B. Jayant Baliga, 2011-09-21 The devices described in Advanced MOS Gated Thyristor Concepts are utilized in microelectronics production equipment in power transmission equipment and for very high power motor control in electric trains steel mills etc Advanced concepts that enable improving the performance of power thyristors are discussed here along with devices with blocking voltage capabilities of 5 000 V 10 000 V and 15 000 V Throughout the book analytical models are generated to allow a simple analysis of the structures and to obtain insight into the underlying physics The results of two dimensional simulations are provided to corroborate the analytical models and give greater insight into the device operation

**Gallium Nitride And Silicon Carbide Power Devices** B Jayant Baliga, 2016-12-12 During the last 30 years significant progress has been made to improve our understanding of gallium nitride and silicon carbide device structures resulting in experimental demonstration of their enhanced performances for

power electronic systems Gallium nitride power devices made by the growth of the material on silicon substrates have gained a lot of interest Power device products made from these materials have become available during the last five years from many companies This comprehensive book discusses the physics of operation and design of gallium nitride and silicon carbide power devices It can be used as a reference by practicing engineers in the power electronics industry and as a textbook for a power device or power electronics course in universities

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