| Course Type | Course Code | Name of Course | L | T | P | Credit |
|---|---|---|---|---|---|---|
| DE | NPHD513 | Semiconductor Physics & Technology | 3 | 0 | 0 | 3 |

**Prerequisites:**

Basics of solid state physics, semiconductor physics, and electronics.

**Course Objective**

To understand the physics of semiconductor, basic theory of Metal Semiconductor contacts and PN junction, construction and operation of semiconductor devices, operation and structure of MOS transistors, and basic theory of IC technology.

**Learning Outcomes**

Upon successful completion of this course, students will:

- Describe the different crystal growth techniques and wafer production using semiconductor materials.
- Understand the working principal of electronic devises (PN Diode, Photodetector, Solar cell, Light Emitting Diodes, Laser Diodes and semiconductor memory).
- Apply the knowledge of memory expansion to design required expanded memory for specific
- application.

| Unit No. | Topics to be Covered | Lecture Hours | Learning Outcome |
|---|---|---|---|
| 1 | **Semiconductor Physics:** Semiconductor Materials, Crystal Structure, Energy Bands, Carrier Concentrations, Carrier Transport Phenomena, Continuity Equation, Thermionic Emission Process, Tunneling Process, High Field Effects. | 5 | To understand semiconductor physics and transport properties |
| 2 | **Semiconductor Devices:** p-n Junction, Thermal Equilibrium Condition, Depletion Region and Capacitance, IV and CV characteristics, Charge storage, Transient Behavior, Junction Breakdown, Metal Semiconductor Contacts, Tunnel diode-applications of tunneling, Photonic Devices-LEDs, Semiconductor Laser, Photodiode, Bipolar Transistor, Thyristor, MOSFET Fundamentals and Scaling and MESFET | 9 | In this unit, students will learn about the basic features of solid-state electronics phenomena. |
| 3 | **Semiconductor Crystal growth and wafer production:** Introduction to crystal growth techniques –Bulk semiconductor growth- Semiconductor-Grade Silicon-Czochralski Growth (Cz)- Float Zone (FZ) techniques, Zone melting, Bridgmann techniques. Basic Process Steps for Wafer Preparation. | 7 | This unit will help student to understand basis crystal growth techniques and wafer production. |
| 4 | **Photolithography:** Concepts of Clean room and safety requirements. Principles and methods of lithographic techniques used in semiconductor manufacturing as well as prototyping and production of nanometer-scale devices. Thin film deposition (MOCVD, CVD, MBE) and ion-implantation process, optical lithography, wet and dry etching techniques, electron beam lithography, focused ion beam lithography, X-ray lithography. Basic fabrication steps and their importance. | 9 | To understand lithographic techniques and fabrication of nanoscale pattern process by using single crystal wafer. |
| 5 | **Semiconductor Fabrication Technology: An** overview of processing of semiconductor devices and integrated circuits. Introduction into modern qubits semiconductor technologies and Future of the Semiconductor Industry. | 6 | To learn industrial technology, that leads to product development. |
| 6 | **Semiconductor Memory Technology :** Semiconductor memory organization, Random Access Memory (RAM) (static and dynamic), Advanced Memory Technologies, Modern CMOS Technology and Introduction to System-on-Chip A Practical Approach for Industrial applications. | 6 | This unit focuses on the basic semiconductor memory devices and semiconductor industrial technology. |
| | Total | 42 | |

## Text Books:


1. G. S. May and S. M. Sze, Fundamentals of Semiconductor Fabrication, Wiley India, 2004
2. S.M. Sze, Semiconductors Devices, Physics and Technology, (2/e), Wiley, 2002.


## Reference Books:


1. Semiconductor Physics and Devices, Donald A. Neamen, Mc Graw Hill, 2012.
2. BenG. Streetman, Solid State Electronic Devices, Prentice Hall, 2006.