

B.Tech III Year I Semester

JNTUA COLLEGE OF ENGINEERING (AUTONOMOUS) PULIVENDULA

19ABS32-PHYSICS OF ELECTRONIC MATERIALS

(Open Elective-I)

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Course Objectives:

- Be able to explain the fundamentals of materials.
- Be able to explain the kinds of semiconductor materials, their physical properties, and their applications.
- Be able to explain the kinds of magnetic materials, their physical properties, advances and their applications.
- Be able to explain the kinds of dielectric materials, their physical properties, advances and their applications.

UNIT – 1: Fundamentals of Materials**9 Hrs****Content of the Unit – I**

Introduction, Phase rule, Phase Diagram, Elementary idea of Nucleation and Growth, Methods of crystal growth. Elementary idea of point, line and planar defects. Concept of thin films, preparation of thin films, Deposition of thin film using sputtering methods (RT and glow discharge).

Learning Outcomes:

At the end of this unit, the student will be able to

- Understand the basic concepts of Phase and Phase diagram
- Understand the straight forward information of Nucleation and Growth
- Explain the preparation and deposition of Thin film using various methods
- Illustrate the methods of Crystal growth
- Summarize the different defects in crystal growth

UNIT – II: Semiconductors**9 Hrs****Content of the Unit – II**

Introduction, charge carriers in semiconductors, effective mass, Diffusion and drift, diffusion length, diffusion and recombination. The Fermi level & Fermi dirac distribution, Temperature dependence of carrier concentration, Invariance of the Fermi level at equilibrium. Band structure, PN junctions and their typical characteristics under equilibrium and under bias, Transistors, MOSFETs.

Learning Outcomes:

At the end of this unit, the student will be able to

- Understand the basics concepts regarding drift, diffusion, diffusion length and recombination.
- Classifies the energy bands of a Semiconductors
- Analyse how the position of the fermi level changes with carrier concentration and temperature.
- Explain the concepts regarding PN junctions, Transistors and MOSFETs.

UNIT – III: Optoelectronics**9 Hrs****Content of the Unit – III**

Introduction, Optoelectronic concepts, Hetrostructure p-n junction, Schottky junction and Ohmic contacts, Light emission and absorption, amplification and modulation in semiconductors, Semiconductor Light sources [Light emitting diodes (LEDs) , LASER, vertical cavity surface emitting laser (VCSEL), Quantum well laser {device structure – characteristics – Materials and applications}] and semiconductor Photo detectors [General Characteristics, Responsivity and Impulse response, photoconductors, semiconductor photodiodes].

Learning Outcomes:

At the end of this unit, the student will be able to

- Understand the basic concepts of PN junction and Schottky junction

- Explain about absorption, emission, amplification and modulation
- Illustrate various semiconductor light sources and their structure
- Identifies the characteristics and applications of optoelectronic devices
- Elucidate semiconductor photodetectors

UNIT – IV: Dielectric Materials and their applications

9 Hrs

Content of the Unit – IV

Introduction, Dielectric properties, Electronic polarisability and susceptibility, dielectric constant and frequency dependence of polarization, Dielectric strength and dielectric loss, Piezoelectric properties.

Learning Outcomes:

At the end of this unit, the student will be able to

- Understand the concepts of dielectric constant, polarisability, susceptibility
- Describe how the polarisation of the dielectric constant depends on the frequency
- Explain about dielectric strength and dielectric loss
- Comprehend dielectric and piezoelectric properties

UNIT – V: Magnetic Materials and their applications

9 Hrs

Content of the Unit – V

Introduction, Magnetism & various contributions to para and dia magnetism, Ferro and Ferri magnetism and ferrites, concepts of Spin waves and Magnons, antiferromagnetism, domains and domain walls, coercive force, hysteresis, Nanomagnetism, Superparamagnetism – Properties and applications.

Learning Outcomes:

At the end of this unit, the student will be able to

- Differentiate different types of magnetic materials depending upon their properties
- Understand the concepts of Spin waves and Magnons
- Interpret the concepts of domains and domain walls
- Explain about the properties of Nanomagnetism, Super paramagnetism
- Identify the applications of magnetic materials

Text Books:

1. S.O. Kasap Principles of Electronic Materials and Devices, 3rd edition, McGraw-Hill Education (India) Pvt. Ltd., 2007.
2. Electrical Engineering Materials”, by A.J. Dekker, PHI Pub.
3. “Electronic Components and Materials” Grover and Jamwal, DhanpatRai and Co.

Reference Books:

1. B.G. Streetman and S. Banerjee, Solid State Electronic Devices, 6th edition, PHI Learning,
2. Eugene A. Irene, Electronic Materials Science, Wiley, 2005
3. Wei Gao, Zhengwei Li, Nigel Sammes, An Introduction to Electronic Materials for Engineers, 2nd Edition, World Scientific Publishing Co. Pvt. Ltd., 2011
4. W D Callister, Materials Science and Engineering – An Introduction, Jr., John Willey and Sons, Inc, New York, 7th edition, 2007.
5. “A First Course In Material Science” by Raghvan, McGraw Hill Pub.
6. “Solid State Physics” by S.O.Pillai, New Age Publication.
7. ‘The Science and Engineering of materials’ by Donald R. Askeland, Chapman & Hall Pub.

Course Outcomes:

At the end of this Course the student will be able to

- Recognize the need of semiconductors
- Dielectric and magnetic materials which they will be able to utilize for the concerned engineering application

