BACHELORS WITH PHYSICS AS MAJOR
5th SEMESTER

PHY522J3 PHYSICS _ ELECTRONICS

CREDITS: THEORY – 4, PRACTICAL - 2

THEORY (4 CREDITS: 60 HOURS)

LEARNING OUTCOMES:

The learning outcomes cover a wide range of topics related to semiconductor devices, electronic components, and digital systems. Students completing this course should have a strong understanding of these subjects and their practical applications.

1. *Understand the classification of solids based on the energy band theory.*
2. *Analyze the formation and characteristics of a PN junction.*
3. *Derive the current equations for diffusion and drift current in a PN diode.*
4. *Explore the switching characteristics of a PN diode.*
5. *Understand the principles of transistor biasing.*
6. *Explain the basic structure and operation of a Junction Field-Effect Transistor (JFET).*
7. *Analyze the biasing of FET and its operation as a voltage variable resistor (VVR).*
8. *Explain the structure and working of Metal-Oxide-Semiconductor (MOS) devices, including NMOS, PMOS, and CMOS.*
9. *Design and analyze the working of half-wave, full-wave, and bridge rectifiers.*
10. *Determine the efficiency, ripple factor, and peak inverse voltage (PIV) for each type of rectifier.*
11. *Explain the operation of the Zener diode and its applications in voltage regulation.*
12. *Analyze the characteristics of operational amplifiers (Op-amps) and their applications as summer, integrator, and differentiator circuits.*
13. *Understand the physics of Light Emitting Diodes (LEDs).*
14. *Explain the working principles of solar cells and semiconductor lasers.*
15. *Analyze number systems and codes, including binary representation, addition, and subtraction.*
16. *Explain the fundamentals of logic gates, different logic families, and their comparative study.*

Unit-I (15 HOURS)

Classification of solids based on energy band theory, E-K diagram, Concept of effective mass, Mobility and conductivity, PN junction, PN junction Diode VI characteristics, Current components in PN diode-Diode current, Reverse saturation current, Majority carrier current components, Current Equations – Diffusion and Drift current, Switching Characteristics of PN Diode. Transistor Biasing.

Unit-II (15 HOURS)

JFET: Basic structure and operation of JFET, calculation of pinch off voltage, volt-ampere characteristics of JFET, the FET small signal model, FET Biasing, FET as a voltage variable resistor (VVR).

MOS structure; NMOS, PMOS and CMOS, MOSFET working and MOSFET characteristics. Switching Characteristics of MOSFET.

Unit-III (15 HOURS)

Rectifiers: Design and working of a half wave, full wave and bridge Rectifier, determination of Efficiency, ripple factor and PIV for each rectifier. Filters: definition, Types of filters used in rectifiers. Zener diode, its application in voltage regulation. IC 7805 voltage Regulator. Regulated Power supply. Op-amplifier characteristics and its application as summer, integrator and Differentiator.

Unit-IV (15 HOURS)

Optoelectronic Devices: Light emitting diodes, Physics of LED, materials for LED. Solar-cells, Semiconductor Laser; population inversion at junction, optical gain and threshold current for lasing.

Number System and codes, Binary Addition and subtraction, Signed and unsigned binary number. 1's and 2's complement representation. Logic Gates, logic families and their comparative study.

PRACTICALS (2 CREDITS: 60 HOURS)

1. To study characteristics of a PN Junction diode.
2. To study characteristics of a transistor
3. Characteristics of a Tunnel Diode.
4. Characteristics of a Solar Cell.
5. To study the Characteristics of an LED.
6. To study Zener Diode as a Voltage Regulator.
7. To study logic Gates.
8. To study OP-Amps as Adder and a subtracter circuit.
9. To study a Full wave rectifier.
10. To study transistor as a switch.

TEXT BOOKS:

1. Semiconductor Devices Physics and Technology, S M Sze, (2007), John Wiley and Sons Inc. Asia.
2. Solid State Electronic Devices, Ben G Streetman, Sanjay Banerjee, (Fifth edition, 2000), Pearson Education, Asia.
3. Semiconductor Optoelectronic Devices, Pallab Bhattacharya, (Second Edition, 1997), Pearson education, Asia.
4. The art of electronics, Paul Horowitz and Winfield Hill, (Second Edition, 1992), Foundation Books, New Delhi.
5. Electronic Principles, A P Malvino, (Sixth Edition, 1999), Tata McGraw Hill, New Delhi.
6. Op-Amps and Linear Integrated Circuits, Ramakant A Gayakwad, (Third Edition, 2004), Eastern Economy Edition.
7. Electronic Devices and Circuit Theory by Robert L. Boylestad and Louis Nashelsky