Semiconductor Physics (BTPH104-18)

&

Semiconductor and optoelectronics Physics (BTPH105-18)

Branch CSE/ECE

UNIT – I

ELECTRONIC MATERIALS

Q1. What is free electron theory of metals?

Q2. State assumptions of free electron theory?

Q3. Why free electrons in a metal cannot escape from the metal?

Q4. Define density of states.

Q5. A metal gives one free electron per atom. The density of metal is 10.5 gcm^{-3} and atomic weight is 108. Calculate the Fermi energy?

Q6. Discuss Bloch's theorem.

Q7. Describe the extended, periodic and reduced zone scheme representing E-k relationship.

Q8. Derive an expression for a free electron gas in three dimensions and also prove that the average kinetic energy of electron is 3/5 E_o.

Q9. Discuss in detail Kronig-penny model.

Q10. What are direct and indirect band gaps?

Q11. Differentiate between metals, semiconductors and insulators with suitable examples.

Q12. Derive expression for density of states in 2 dimensions.

Q13. Derive Schrodinger's equation for a particle in a 1D infinite well.

UNIT-II

SEMICONDUCTORS

Q1. What do you mean by valence band, conduction band and forbidden band?

Q2. What is a semiconductor? What are its different characteristics?

Q3. Semiconductors have negative temperature coefficient of resistance. Explain?

Q4. Differentiate between intrinsic and extrinsic semiconductors.

Q5. What is the approximate value of energy gap in (a) insulators (b) semiconductors?

Q6. What do you mean by majority and minority carriers in intrinsic semiconductors?

Q7. Derive an expression for temperature dependence of electron and hole concentration in intrinsic semiconductor?

Q8. Show mathematically, that for intrinsic semiconductor, the Fermi level lies exactly half way between the top of the valence band and bottom of conduction band?

Q9. Differentiate between ohmic and Schottky metal semiconductor junction?

Q10. For an intrinsic semiconductor having a band gap $E_g = 0.7$ eV, calculate the density of holes and electrons at room temperature (27^o C) ?

UNIT – III

OPTOELECTRONIC DEVICES

Q1. What are radiative and non-radiative recombination mechanisms in semiconductors?

Q2. Write a short note on the materials used for the fabrication of optoelectronic devices.

Q3. Briefly explain how population inversion is achieved at a semiconductor junction.

Q4. Discuss in detail optical transitions (absorption, spontaneous emission and stimulated emission) in bulk semiconductors.

Q5. Discuss working principle of semiconductor laser.

Q6. What are semiconductor light emitting diodes.

Q7. Discuss working principle of photodetectors. Discuss their characteristics and working principle.

Q8. How are PIN and avalanche photodetectors different from each other?

Q9. Write a brief note on Fermi Golden rule?

UNIT- IV

MEASUREMENT TECHNIQUES

Q1. Why semiconductor laser is used to measure divergence? How can divergence and wavelength be measured using semiconductor laser?

Q2. Which property of the material can be measured using Hot point probe?

Q3. Discuss Four point probe and Vander Paw method to determine the resistivity and hall

mobility of a material.

Q4. Explain why hall measurement is not useful for metals?

Q5. Why Four probe method is more appropriate for measurement of resistivity of a semiconductor than two probe method?

Q6. What is knee voltage in p-n junction?

Q7. What is hall mobility?

Q8. Draw V-I characteristics of a typical diode. What information it depicts?