Reg. No. : E N G G T R E E . C O M

Question Paper Code : 70183

B.E./B.Tech. DEGREE EXAMINATIONS, NOVEMBER/DECEMBER 2022.

Second Semester

Electronics and Communication Engineering

PH 3254 — PHYSICS FOR ELECTRONICS ENGINEERING

(Common to Electronics and Telecommunication Engineering)

(Regulations 2021)

Time : Three hours Maximum : 100 marks

Answer ALL questions.

PART A — (10 × 2 = 20 marks)

1. Define unit cell.
2. Find the maximum radius of the interstitial sphere that can fit into the void at (1/2, ½, ½) between the atoms in the BCC structure.
3. Calculate Lorentz number for copper at 293 K, if the electrical conductivity and thermal conductivity are $1.72 \times 10^{-8} \Omega m$ and 386 W/mK respectively.
4. Define Fermi surface or Fermi sphere.
5. How are holes generated in p- type semiconductors?
6. The intrinsic carrier density at room temperature in Ge is $2.37 \times 10^{19}/m^3$. If the electron and hole mobilities are 0.38 and 0.18 m^2/Vs respectively, calculate the resistivity.
7. Differentiate the optical absorption process that occur between direct and indirect bandgap semiconductors.
8. Give any two points that differentiate laser diode and LED.
9. Draw the density of states for bulk and quantum well structures.
10. Is energy band gap of nanomaterial greater than its bulk counterpart? If so give reason.

PART B — (5 × 16 = 80 marks)

11. (a) (i) Calculate the packing factors of SC and FCC with neat diagram. (4+6 =10)

(ii) Mention any five crystal systems, their unit vectors and angles in tabular form. (6)

Or

(b) (i) Discuss briefly the point and line imperfections in crystal with neat diagram. (10)

(ii) Calculate the equilibrium concentrations of point imperfections at 300 K in the case of copper. The enthalpy of formation of point imperfections is 120KJ/mol. Gas Constant = 8.314 kJ/molK. (6)

12. (a) (i) Derive the expression for density of energy states for solids and find the carrier concentration at any temperature. (10)

(ii) Using the expression of Fermi-Dirac distribution function, find the probability of finding the electron at

(i) T = 0K and $E<E_f$

(ii) T = 0K and $E = E_f$ (6)

Or

(b) (i) Briefly discuss paramagnetism and ferromagnetism, in magnetic materials and their properties. (10)

(ii) A paramagnetic material has a magnetic field intensity of 10^4 A/m. If the susceptibility of the material at room temperature is 3.7×10^{-3}, calculate magnetization and flux density in the material. (6)

13. (a) (i) Derive the expression for carrier concentration in intrinsic semiconductors. (10)

(ii) For an intrinsic semiconductor with gap width $E_g = 0.7eV$, calculate the concentration of intrinsic charge carriers at 300 K assuming that $m^*e = m^*h = m_0$ (rest mass of electron). (6)

Or

(b) (i) Describe the variation of carrier concentration with temperature in n -type semiconductor with diagram. (10)

(ii) Suppose that the effective mass of holes in a material is 4 times that of electrons. At what temperature would Fermi level be shifted by 10% from the middle of the forbidden energy gap? Given $E_g = 1eV$. (6)

14. (a) Explain briefly with expression for optical absorption and emission processes in the direct and indirect band gap semiconductor. (16)

Or

(b) Describe briefly the working principle, energy bands and spectral characteristic of double heterojunction laser diode with neat diagram. (16)

15. (a) Explain briefly the density of states for quantum well and quantum wire. In which way is it superior to bulk materials? (16)

Or

(b) Explain briefly the operation of single electron transistor using single electron phenomenon with neat diagram. (16)
