

06/07/2023

(2 Hours)

N.B : (1) Question No.1 is compulsory.

Total Marks – 60

- (2) Attempt any three questions from Q.no 2 to Q.no 6.
(3) Assume suitable data and symbol if required.
(4) Figures to the right indicate full marks.

Q1) Attempt any FIVE from the following.

- Draw the following with reference to cubic unit cell (002), (101) and (111). 0.5 $\frac{1}{5} \textcircled{5} = \text{new}$ 13
- Calculate the conductivity of a Ge specimen if the donor impurity added to Ge is 1.2×10^{23} atoms/m³. Given mobility of electron is 3800 cm²/V-sec. 3
- What is principle of solar cell? Write its advantages and disadvantages? 0.5 3
- Draw and explain Fermi level diagram of p-n junction diode. 3
- An electron has a speed of 400 m/sec with uncertainty of 0.01%. Find the accuracy in its position. 3
- Define superconductivity, critical temperature and critical magnetic field. 3
- The Bragg angle corresponding to the first order reflection from (1 1 1) planes of a crystal is 30°. Wavelength of X-ray is 1.75 Å. Determine interplanar spacing and lattice constant of the crystal. 3

Q2)a) Derive the conditions for the maxima and minima due to interference of light in a wedge shaped film. 8

- Derive Bragg's equation for x ray diffraction in crystals. If X-rays of wavelength 1.549 Å is reflected from a crystal with interplanar spacing 4.255 Å, calculate the smallest glancing angle and the highest order of reflection that can be observed. 7

Q3)a) Derive Schrodinger Time Independent Wave Equation. Find the lowest energy of a neutron within a nucleus of dimension 10^{-14} m. given mass of a neutron 1.67×10^{-27} kg. 8

- Draw and explain the energy band diagram for a p-n junction in forward and reverse biased mode. 7

Q4)a) Define drift current, diffusion current and mobility of charge carriers and state its S.I units. 0.5 5

- Describe in detail the concept of anti-reflecting film with a proper ray diagram. 5
- Explain phase velocity of a wave and group velocity of matter waves. 5

Q5)a) Explain formation of Newton's rings with experimental arrangement? Also give characteristics of Newton's rings. 5

- Define Fermi level and explain it in detail for conductors. 5
- Explain de-Broglie hypothesis of matter waves and deduce the expression for wavelength. 5

Q6)a) What are type- I and type-II superconductors? 5

- Find the thickness of the soap film which appear yellow (wavelength 5896 Å) in reflection when it is illuminated by white light at an angle of 45°. Given refractive index of the film is 1.33. 5

- The minimum energy possible for a particle trapped in a 1-d box is 3.2×10^{-18} J. What are the next three energies in eV the particle can have? 5

$$L = \sqrt{\frac{n^2 h^2}{8mE}} = \sqrt{\frac{1 \times 6.63 \times 10^{-34}}{8 \times 9.1 \times 10^{-31} \times 3.2 \times 10^{-18}}}$$