

Applied Physics-I

Q.P. Code : 1027

(REVISED COURSE)

(2 Hours)

[Total Marks : 60

- N.B. : (1) Question No. 1 is compulsory.
 (2) Attempt any three questions from question no. 2 to 6.
 (3) Use suitable data wherever required.
 (4) Figures to the right indicate full marks.

1. Attempt any five from the following : 15
- Draw the following in a cubic unit cell
 $(0\ 1\ 2)$, $(\bar{1}\ \bar{2}\ 3)$, $[1\ 2\ 1]$
 - Define the term space lattice, unit cell and lattice parameter.
 - Determine the lattice constant for FCC lead crystal of radius $1.746\ \text{\AA}$ and also find the spacing of $(2\ 2\ 0)$ plane.
 - Define : drift current, diffusion current and mobility of charge carriers.
 - What is the probability of an electron being thermally promoted to conduction band in diamond at 27°C , if band gap is $5.6\ \text{eV}$ wide.
 - Why soft magnetic materials are used in core of transformers ?
 - Calculate the electronic polarizability of Ar. Given number of Ar atoms at NTP = $2.7 \times 10^{25}/\text{m}^3$ and dielectric constant of Ar = 1.0024 .
2. (a) Show that for intrinsic semiconductors the Fermi level lies midway between the conduction band and the valence band. Draw the energy level diagram as a function of temperature for n-type of semi-conductor. 8
- (b) Cu has FCC structure. If the interplanar spacing d is $2.08\ \text{\AA}$ for the set of (111) planes. Find the density and diameter of Cu atom. Given atomic weight of Cu is 63.54 . 7
3. (a) What is hysteresis ? Draw a hysteresis loop for ferromagnetic material and explain the various important points on it. For a transformer which kind of material will you prefer the one with small hysteresis area or the big one ? 8
- (b) Derive Bragg's law. X-rays of unknown wavelength give first order Bragg's reflection at glancing angle of 20° with $(2\ 1\ 2)$ planes of copper having FCC structure. Find the wavelength of X-rays, if the lattice constant for copper is $3.615\ \text{\AA}$. 7
4. (a) Discuss Diamond structure with neat diagram and also determine the effective number of atoms/unit cell, co-ordination number and atomic radius in terms of lattice constant. 5
- (b) Classify solids on the basis of energy band diagram. 5
- (c) Explain orientational polarization with suitable diagram and write the mathematical expression of orientational polarizability. 5

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5. (a) Calculate the number of atoms per unit cell of a metal having the lattice parameter 2.9 \AA and density 7.87 gm/cm^3 . Atomic weight of metal is 55.85. Avogadro number is $6.023 \times 10^{23} / \text{gm mole}$. 5
- (b) What is Hall effect? Mention its significance. How mobility can be determined by using Hall effect? 5
- (c) The reverberation time is found to be 1.5 second for an empty Hall and it is found to be 1.0 second when a curtain cloth of 20 m^2 is suspended at the centre of the Hall. If the dimensions of the hall are $10 \times 8 \times 6 \text{ m}^3$, calculate the coefficient of absorption of curtain cloth. 5
6. (a) Describe principle, construction and working of magnetostriction oscillator to produce ultrasonic waves. 5
- (b) Explain various point defects in crystals. 5
- (c) Explain how a voltage difference is generated in a p-n junction when it is used in a photovoltaic solar cell. 5
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