

Note: (1) All questions are compulsory.

- (2) Figures to the right indicate maximum marks.
- (3) Use of non-programmable calculators is permitted.
- (4) Symbols used have their usual meaning.

Q.1. (A) Choose correct alternative in each of the following: (12)

(i) The unit of absorption coefficient of sound is

- a) phon b) sone c) sone d) watt/m²

(ii) The refractive index of core of optical fibre is

- a) Larger than that of cladding material
- b) Smaller than that of cladding material
- c) Equal to the refractive index of cladding material
- d) None of these

(iii) Example of crystal with perfect covalent bonding is

- a) Diamond b) methane c) NaCl d) sugar

(iv) The magnetic material to be used for data storage should have

- a) Narrow hysteresis loop
- b) Square hysteresis loop
- c) Low retentivity and low coercivity
- d) None of these

(v) The magnetic moment of any electron is always

- a) Less than Bohr magneton (μ_B)
- b) Greater than Bohr magneton
- c) Both (a) and (b)
- d) Equal to Bohr magneton

(vi) Liquid crystal display is actually a combination of two states of matter

- a) Solid-solid b) solid-liquid c) liquid-liquid d) none of these

Q.1. (B) Answer in one statement: (03)

- (i) What is metastable state?
- (ii) Define primitive cell.
- (iii) Define resistivity.

Q.1. (C) Fill in the blanks: (05)

- (i) Through holography we can produce _____ dimensional images of objects.
- (ii) The refractive index of core of an optical fibre is _____ than cladding material.
- (iii) The SI unit of conductivity is _____.
- (iv) The magnetic moment of any electron is always _____ than Bohr magneton.
- (v) The number of atoms per unit cell in FCC structure is _____.

Q.2. (A) Attempt any one: (08)

- (i) What is meant by reverberation and reverberation time? explain the causes to form reverberation in a hall. How it can be minimised?
- (ii) With the help of a neat labelled diagram of optical resonator explain the basic principle of laser. Also explain the process of amplification.

Q.2. (B) Attempt any one: (08)

- (i) Describe the structure of a step-index optical fibre. Explain the propagation of light through it.
- (ii) Define absorption coefficient of a material and hence determine the relation between reverberation time of a hall and absorption coefficient.

Q.2. (C) Attempt any one: (04)

- (i) The room has wall area 200 m^2 , the floor area is 180 m^2 and the ceiling area is 180 m^2 . The volume of the auditorium is 845 m^3 . The average sound absorption coefficient for the walls is 0.028, for ceiling is 0.65 and for the floor is 0.06. Calculate the average sound absorption coefficient and the reverberation time.
- (ii) The core and the cladding of an optical fibre have refractive indices 1.432 and 1.413 respectively. Find the acceptance angle in air; and the critical angle for core/cladding interface.

Q.3. (A) Attempt any one: (08)

- (i) Show that in cubic crystal the distance between adjacent planes with miller indices (hkl) is given by, $d_{hkl} = a / (h^2 + k^2 + l^2)^{1/2}$, where a is the lattice constant.
- (ii) Discuss the crystal structures of diamond, caesium chloride, sodium chloride and zinc sulphide.

Q.3. (B) Attempt any one: (08)

- (i) Obtain distribution of atoms in the atomic planes of simple cubic crystal for (010), (110) and (111) planes.
- (ii) What is a close-packed structure? Explain with suitable diagram the HCP and FCC close-packed structures.

Q.3. (C) Attempt any one: (04)

- (i) Copper has FCC structure and its atomic radius is 1.278 \AA . Calculate the interplanar spacing for the (111) and (321) planes.
- (ii) The lattice constant of the unit cell of a bcc structure is 0.287 nm . Find the number of atoms/ mm^2 of the planes (100), (110) and (111).

Q.4. (A) Attempt any one: (08)

- (i) Mention any four important characteristics of semiconducting materials and any two applications.
- (ii) Explain hysteresis curve of ferromagnetic materials on the basis of domain theory.

Q.4. (B) Attempt any one: (08)

- (i) How are materials classified according to their magnetic properties? Explain.
- (ii) Mention any four important characteristics of insulating materials and any two applications.

Q.4. (C) Attempt any one: (04)

- (i) A metal wire has a resistance of 2.52Ω at 0°C . If its temperature coefficient of resistance is $3.8 \times 10^{-3} / ^\circ \text{C}$, find the resistance of wire at 55°C .
- (ii) Find the relative permeability of ferromagnetic material if a magnetic field of strength 220 A/m produces magnetization of 3300 A/m in it.

Q.5. Attempt any four: (20)

- (i) State the factors affecting the acoustics of building.
- (ii) Explain the applications of fibre optics.
- (iii) Explain crystal lattice and Miller indices.
- (iv) What is a Bravais or space lattice? How is it related to crystal structure?
- (v) Write a note on dielectric materials.
- (vi) Compare paramagnetic and ferromagnetic materials.