QP Code : **1030**

(OLD COURSE)

(2 Hours) [Total Marks : 75

N.B. : (1) Question No.1 is **compulsory**.
(2) Attempt any **four** questions from Question Nos. **2** to **7**.
(3) Use **suitable data** wherever **required**.
(4) **Figures** to the **right** indicate **full** marks.
(5) Illustrate your answer with **sketches** wherever **necessary**.

1. (a) Define space lattice, unit cell, lattice parameter, atomic basis ?   15
(b) What are liquid crystals ? State different phases.
(c) What is Fermi level ? Write Fermi-Dirac distribution function.
(d) The mobility of hole is $0.025 m^2$/v-sec. What would be resistivity of p-type silicon if the Hall Coefficient of the sample is 2.25×10^{-5} m^3/v-sec.
(e) What is Meissner effect in superconductors ?
(f) What is reverberation and reverberation time ?
(g) State with neat diagram: Direct and inverse piezoelectric effect.

2. (a) Explain Diamond crystal structure with proper diagram. Calculate the number of atoms per unit cell, atomic radius and atomic packing factor for Diamond unit cell.   8
(b) What is Hall effect ? Obtain an expression for Hall voltage and mobility of electrons in metals. Give two applications based on Hall effect.   7

3. (a) Define Critical temperature and critical magnetic field for superconductors. Also, discuss type-I and type-II superconductors.   8
(b) Explain the construction and working of C.R.O.   7

4. (a) Silicon has same crystal structure as diamond. Its density is 2.33×10^3 kg/m^3 and atomic weight is 28.9. Calculate the lattice constant and atomic radius of it.   5
(b) Show that Fermi level in intrinsic semiconductor lies at the centre of the forbidden band. $E_F = E_C + E_V/2$ or $E_F = E_g/2$.   5
(c) Explain in brief the conditions necessary for good acoustical design of an auditorium.   5

5. (a) Calculate the smallest glancing angle at which X-ray of 1.549 A° will be reflected from crystal having spacing of 4.255 A°. What is highest order reflection that can be observed.   5
(b) Explain the formation of barrier potential in P-N junction.   5
(c) Find the natural frequency of vibration of a quartz plate of thickness 2 mm. Given that Youngs modulus for quartz = 8×10^{10} N/m^2 and the density = 2650 kg/m^3. Also calculate the change in thickness required if the same plate is to be used to produced ultrasonic waves of frequency 3MHz.   5

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QP-Con. 12276-15.

6. (a) Derive the Braggs law for the diffraction of X-rays in crystals. Give its importance.   5

   (b) Show that superconductors are perfect diamagnetic materials.   5

   (c) An ultrasonic beam of wavelength sent by a ship returns from sea bed after 2 sec.   5
   If the velocity of ultrasonic beam in sea water is 1510 m/s at 0°C, its salinity at
   30°C is 29 gm/lit, calculate the depth of sea bed at 30°C and frequency of ultrasonic
   beam.

7. (a) What is defect ? Explain various point defects in crystals.   5

   (b) A hall of volume 5500 m³ is found to have a reverberation time of 2.3 sec.   5
   The sound absorbing surface of hall has an area of 750 m². Calculate the average
   absorption coefficient.

   (c) Explain how the C.R.O. can be used to determine (i) dc voltage (ii) ac voltage   5
   (iii) time period/frequency.

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