Q.P. Code : 5028

(REVISED COURSE)

(2 Hours)

[Total marks : 60]

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

(2) Attempt any three questions from remaining Question No's **2** to **6**

(3) Assume suitable data wherever required.

(4) Figures to the right indicate marks.

1. Attempt any five.

(15)

a) Draw the unit cell and Basis of DC structure.

b) Draw the following w.r.t. a cubic unit cell:

$(1\ \bar{1}\ 1)$ $[\bar{1}\ 1\ 1]$ $(1\ 2\ 3)$

c) Draw a neat labelled Energy band diagram to show the variation of Fermi Level with doping concentration in N-Type semi-conductors.

d) Calculate electronic polarizability of Argon atom. Given relative permittivity is 1.0024 at NTP and the gas contains 2.7×10^{25} atoms per m^3

e) What are the properties of soft magnetic materials? Briefly explain one application.

f) Monochromatic high energy x-rays are incident on a crystal. If 1st order reflection is observed at an angle 3.4°, at what angle would 2nd order reflection be expected.

g) A class room has dimensions $20 \times 15 \times 5$ m^3. The reverberation time is 3.5 sec. Calculate the total absorption of its surface and average absorption co efficient.

2.   a) Draw the unit cell of HCP. Derive the number of atoms / unit cell, the c/a ratio and the packing fraction.   (5 + 3)

Calculate the ratio of the number of vacancies to the number of atoms when the average energy required to create a vacancy is 0.95 ev at 500 k.

b) Explain Hall effect & its significance. With a neat diagram derive the expression for the Hall voltage & Hall co-efficient.   (7)

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3.   a) Draw the hysteresis loop for a ferromagnetic material. Prove that in a   (4 + 4)
     ferromagnetic material, the power loss / unit volume in a hysteresis cycle is equal to
     the area under the hysteresis loop.

     A solenoid consisting of 500 turns and carrying 5amp is 0.5m long. Calculate (i) magneto
     motive force & (ii) total flux if the area of the cross-section is 0.0004m^2. (Assume the
     medium is air)

     b) With a neat labelled diagram explain the principle, construction and working of a
     piezoelectric oscillator.

4.   a) Explain analysis of crystal structure using Bragg's X-ray spectrometer.   (5)

     b) An Ultrasonic-beam of 1 cm wavelength sent by a ship returns from sea bed after 2 sec.   (5)
     If the salinity of sea water at 30^0 C is 29 gm / lit. calculate the depth of sea bed at 30^0 C
     and the frequency of ultrasonic beam.

     c) Explain Critical Configuration & find the Critical radius ratio of an ionic crystal for ligancy 6. (5)

5.   a) Explain ionic polarization & derive the expression for ionic polarizability.   (5)

     b) In a solid, consider the energy level lying 0.012ev below Fermi level. What is the.   (5)
     probability of this level not being occupied by an electron?
     Given T = 300 kelvin. K_B = 1.38 x 10^{-23} J/K.

     c) For an intrinsic semiconductor show that the Fermi level lies in the centre of the   (5)
     forbidden energy gap.

6.   a) What is reverberation? Define Reverberation time. Explain its role in acoustics.   (5)

     b) Explain the principle, construction & working of a LED.   (5)

     c) Describe the types of liquid crystals & their properties.   (5)

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