This question paper contains 4 printed pages. *Your Roll No. .....*

Sl. No. of Ques. Paper	: 942	G
Unique Paper Code	: 251102	
Name of Paper	: ELHT-102 : Engineering Materials	
Name of Course	: B.Sc. (Hons.) Electronics	
Semester	: I	
Duration :	: 3 hours	
Maximum Marks	: 75	

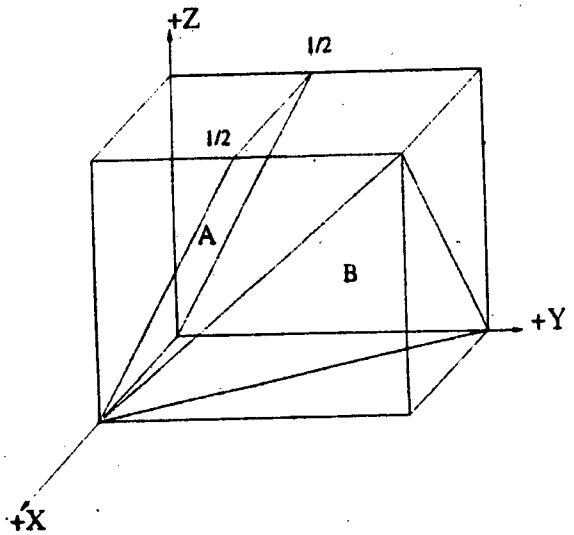
(Write your Roll No. on the top immediately on receipt of this question paper.)

Attempt five questions in all. Question No. 1 is compulsory.

Use of non-programmable scientific calculator is allowed.

1. Attempt any *five*:

(a) Determine the Miller indices for the planes shown in the following unit cell:



(b) Find the packing factor for a FCC crystal lattice.

(c) A tensile stress is to be applied along the long axis of a cylindrical brass rod that has a diameter of 10 nm. Determine the magnitude of the load required to produce a $2{\cdot}5\times10^{-3}$ mm change in diameter if the deformation is entirely elastic. (Given Poisson's ratio for Brass=0·34, Modulus of elasticity for Brass =97 GPa.)

P. T. O.

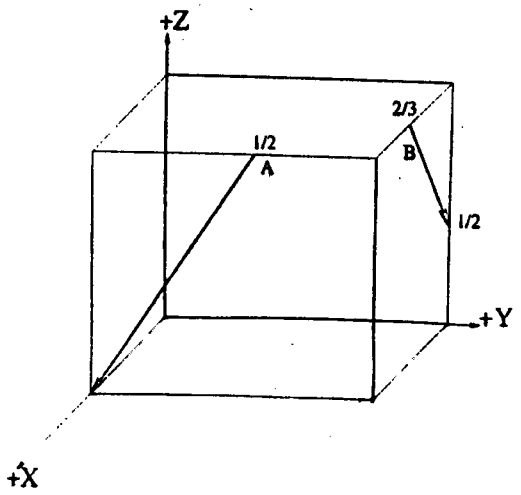
(d) Define relaxation time, collision time and mean free path of electrons in metals.

(e) What are Type I and Type II superconductors?

(f) Calculate the (i) saturation magnetization, (ii) saturation flux density, for nickel which has a density of 8·90 g/cm^3. Given, net magnetic moment per atom 0·60 μ_B and the atomic weight of Nickel=58·71 g/mol. 3×5

2. (a) What are the various types of imperfections found in solid materials? What are the effects of point defects on the properties of crystal? 9

(b) Determine the Miller indices for the directions shown in the following cubic cell: 3



(c) The metal Niobium has a BCC crystal structure. If the angle of diffraction for the (211) set of planes occurs at 2θ=75·99° (first order reflection) when monochromatic X-radiation having a wavelength of 0·1659 nm is used, compute:

(i) interplanar spacing for this set of planes.

(ii) atomic radius for the Niobium atom. 3

3. (a) What are the drawbacks of Einstein theory on specific heat of solids? Derive an expression for the specific heat of solids on the basis of Debye model and discuss its variation with temperature. 7

(b) Given, Debye temperature of sodium chloride as 288 K. Calculate the maximum frequency of vibration of the phonons and the specific heat at constant volume of NaCl at 20 K. 4

(c) What do you understand by the term thermoelectricity? Explain the Seebeck, Peltier and Thomson effects. 4

4. (a) Derive an expression for critical resolved shear stress. 5

(b) Define tensile strength, yield strength, toughness, creep, fatigue strength, fatigue life. 6

(c) A cylindrical specimen of steel having an original diameter of 12·8 mm is tensile tested to fracture and found to have an engineering fracture strength of 460 MPa.

If its cross-sectional diameter at fracture is 10·7 mm, determine:

(i) its ductility

(ii) true stress at fracture. 4

5. (a) Explain the Langevin's theory of paramagnetism. 5

(b) Explain Hall effect. Derive an expression for Hall coefficient. 5

(c) A Ge sample is oriented normal to 5×10^{-5} Wb/cm^2 magnetic field. A current of 1 mA is passed through it by applying a potential difference of 400 mV. The length of the sample is 2 cm and its breadth and width are 1 cm each. The Hall voltage measured normal to the current and the magnetic field is 6 mV. A right handed system has been adopted to designate the three perpendicular directions. Find the mobility and concentration of majority carriers. 5

6. (a) Derive an expression for macroscopic and microscopic electric field when a dielectric material is kept in an external electric field and hence, derive Claussius-Mossotti equation. 7

(b) Discuss briefly the various polarization mechanisms in dielectrics. Derive an expression for total polarization for a dielectric. 5

(c) There are 10^{27} HCl molecules/m^3 in HCl vapour. Determine the orientational polarization at room temperature if the vapour is subjected to an electric field of 10^6 V/m. The permanent dipole moment of HCl molecule is 1·04 Debye.

Given 1 Debye $=3\cdot33\times10^{-30}$ Coul-m. 3

7. (a) Explain the temperature and frequency dependence of dielectric constant. 5

(b) Write short notes on any *two* of the following:

P. T. O.

(i) Structure and applications of ceramics.

(ii) Classification and properties of polymers

(iii) Magnetic hysteresis. 5×2