[This question paper contains 4 printed pages.]

Sr. No. of Question Paper : 8732 C Roll No.....

Unique Paper Code : 251102

Name of the Paper : ELHT-102 : Engineering Materials

Name of the Course : B.Sc. (H) Electronics, Part I

Semester : I

Duration : 3 Hours

Maximum Marks : 75

Instructions for Candidates

1. Write your Roll No. on the top immediately on receipt of this question paper.
2. Attempt any five questions.
3. Question number One is compulsory.
4. Use of scientific calculator is allowed.

1. Attempt any five : (3x5)

(i) Obtain the Miller indices of a plane which intercepts at a, b/2, 3c in a simple Cubic unit cell. Draw a neat diagram showing the plane. (Where a, b, c are lattice parameters).

(ii) Discuss the concept of phonons in the elastic waves.

(iii) Explain and derive the expression for critical resolved shear stress.

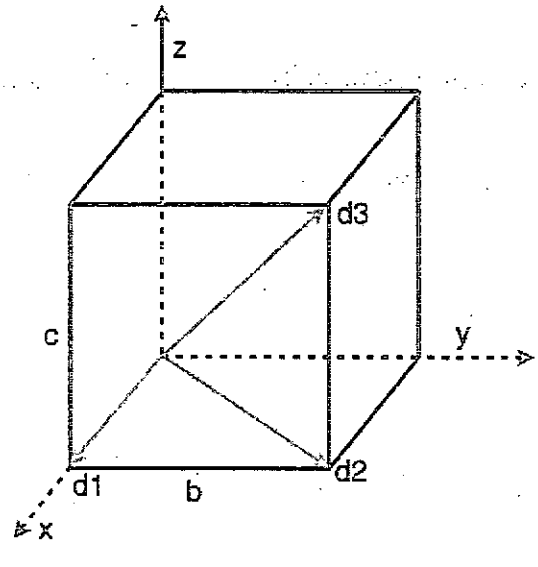
(iv) State the various sources of magnetic moment in an atom in response to external magnetic field.

(v) Show with the help of diagram, the variation of spontaneous polarization with temperature.

(vi) What is super conductivity ? Explain the effect of magnetic field on superconductors. Also give a few applications of superconductors.

2. (a) What are the point, line and surface imperfections found in solid materials ? Illustrate these imperfections with suitable sketches. (6)

(b) Determine indices of the directions shown in the diagram. (3)



(c) What do you understand by Miller indices of a crystal plane ? What are their significances ? Derive an expression for the interplanar spacing with (hkl) indices in the case of a cubic structure. (6)

3. (a) Consider a tensile specimen of 5mm diameter and 25 mm gauge length. If the diameter is reduced to 4mm through plastic deformation (uniform along the gauge length), calculate the following : (6)

(i) What is the length of the gauge after deformation ?

(ii) What is the engineering stress, engineering strain, true stress and true strain at the end of deformation where the load is 500N.

(b) A steel wire of original diameter 12.8 mm is subjected to a tensile load upto fracture. Its diameter at fracture is 10.7 mm. Find its ductility. (4)

(c) Using the typical S-N curve, describe fatigue strength and fatigue lifetime of a given material. (5)

4. (a) Discuss the shortcomings in the Einstein model for specific heat of solids. Obtain an expression for specific heat on the basis of Debye model and discuss how it improves upon the shortcomings of Einstein model. (7)

(b) Given the Debye frequency of sodium as 3.3×10^{12} Hz, calculate its molar specific heat at 10K assuming Debye T^3 law. ($k_B = 1.38 \times 10^{-23}$, Avagadro number = 6.023×10^{26} $(kg.mole)^{-1}$) (4)

(c) Calculate the heat flux through a sheet of brass 7.5mm thick if the temperature at the two faces are 150 and 50°C. (Thermal conductivity of brass is 120W/mK). If the area of the sheet is $0.5m^2$, calculate the total heat energy transmitted per hour. (4)

5. (a) Define mobility of a carrier of current. How is it related to the Hall coefficient ? Is the mobility of an electron in the conduction band of a semiconductor the same as the mobility of an electron (or hole) in the valence band? Give reason for your answer. (6)

(b) How do temperature and impurities affect electrical resistivity of metals ? (4)

(c) Calculate the Hall coefficient of Sodium of a free electron model given that sodium has bcc structure with side equal to 0.428nm. (5)

6. (a) Explain the Langevin's classical theory of diamagnetism. (5)

(b) Briefly describe the phenomenon of magnetic hysteresis with the help of domains. Why it occurs for ferromagnetic materials ? (4+1)

(c) A paramagnetic salt contains 10^{26} ions/m^3 with magnetic moment $0.1\mu_B$. Calculate the magnetization in a field of 1T at 300K. (5)

7. (a) Explain the various polarization mechanisms in dielectrics. Derive the expression for total polarization for a dielectric. (5)

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

(i) Characteristic properties and applications of polymers

(ii) Structure and mechanical properties of ceramics

(iii) Microcomposites and Macrocomposites

(iv) Superconductivity (5x2)