(Following Paper ID and Roll No. to be filled in your Answer Book)

PAPER ID : 0209 Roll No. | | | | | | | | | | |

B. Tech.

(SEM. IV) THEORY EXAMINATION 2010-11

ELECTRICAL AND ELECTRONICS ENGINEERING MATERIALS

Time : 2 Hours *Total Marks : 50*

Note : (1) Attempt **all** the questions.

(2) **All** questions carry equal marks.

1. Attempt any **four** parts of the following : **(4×5=20)**

(a) Define the atomic packing factor and coordination number.

(b) The potential energy of two particles in the field of each other is given by :

$$V(r) = -\frac{A}{\gamma^2} + \frac{B}{\gamma^{10}}$$

Show that the potential energy in the stable configuration is equal to

$$\frac{-4}{5}\left(\frac{A}{\gamma_0^2}\right).$$

(c) Explain the "Miller Indices". Also mention its significances in Material Sciences.

(d) Determine the atomic radius of the following :

(i) SIMPLE CUBIC CRYSTAL

(ii) Boby centred Cubic Crystal (BCC)

(iii) Face centred Cubic Crystal (FCC).

(e) Copper has an FCC crystal structure and an atomic radius of 1.278Å. Calculate the density of copper. The atomic weight of copper is 63.54 gm/mol.

(f) What is the difference between Schottky defect and Frenkel defect in crystal lattices ? Also mention their significances.

2. Attempt any **two** parts of the following : **(2×10=20)**

(a) Show that the expression for electrical conductivity of metal is given as :

$$\sigma = \frac{ne^2\tau}{m}$$

The symbols having their usual meanings.

(b) A density of silver is 10.5×10^3 Kg/m^3. The atomic weight of silver is 107.9. Assuming that each silver atom provides one conduction electron, calculate the density of electrons. The conductivity of silver at 20°C is 6.8×10^7 $\Omega^{-1}\cdot m^{-1}$. Calculate the mobility of electrons in silver.

(c) Explain the "Meissner Effect". Also explain Type-I and II super conductors with their examples.

Estimate the London penetration depth from the following data :

$T_c = 3.7$ K

density $= 7.3 \times 10^3$ Kg/m^3

Atomic weight = 118.7

Effective mass = $1.9\ m_0$

3. Attempt any **two** parts of the following : **(2×10=20)**

(a) Explain the Hall Effect in semi conductor materials with related diagram and expressions. Also mention its importances in semiconductor materials.

An electric field of 100 V/m is applied to a sample of n-type semicondutor whose Hall Coefficient is –0.0125 m^3/c. Determine the current density in the sample assuming $\mu_e = 0.36\ m^2\ V^{-1}\ sec^{-1}$.

(b) Explain the V-I Characteristics of P-N Junction diode and its temperature dependence.

Find the increase in temperature DT necessary to increase I_0 by a factor of 100.

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

(i) CONTINUITY EQUATIONS

(ii) SPACE CHARGE CAPACITANCE

(iii) MOBILITY OF SEMICONDUCTORS.

4. Attempt any **two** parts of the following : **(2×10=20)**

(a) Write short notes on any two parts of the following :

(i) DIAMAGNETIC MATERIALS

(ii) PARAMAGNETIC MATERIALS

(iii) FERROMAGNETIC MATERIALS.

(b) Define relative permeability. Show that the relative permeability :

$$\boxed{\mu_r = 1 + \chi}$$

where χ is the magnetic susceptibility.

(c) Define magnetostriction and magnetostrictive energy. What is the cause of magneticstriction in ferromagnetic materials ? A magnetic field strength in copper is 10^6 A/m. If the magnetic susceptibility of copper is 0.8×10^{-5}, calculate the flux density and magnetization in copper.

5. Attempt any **two** parts of the following : **(2×10=20)**

(a) What do you mean by "ANTIFERROMAGNETISM" ? Which materials show this type of behaviour ?

Calculate the average magnetic moment along the field direction per spin in Bohr Magneton when a paramagnetic spin system is subjected to a uniform field of 10^6 A/m at 27°C.

(b) Explain the temperature dependency on the magnetic susceptibility of diamagnetic, paramagnetic, ferromagnetic, antiferromagnetic and ferrimagnetic materials.

(c) Define ferrimagnetism. What are ferrites ? Give some applications where ferrimagnetic materials are used. Explain what is magnetic anisotropy. How anisotropy can be induced by magnetic annealing ?