Registration No. :

Total number of printed pages – 3

B. Tech

BSMS 1213

Third Semester Examination – 2012-13

MATERIAL SCIENCE AND ENGINEERING

Full Marks – 70

Time : 3 Hours

*Answer Question No. 1 which is compulsory and any **five** from the rest.*

The figures in the right-hand margin indicate marks.

1. Answer the following questions :   2×10

   (a) Give two mechanical properties of semiconductor material.

   (b) Show the plastic deformation region from strain and stress graph.

   (c) Draw the cooling curves with proper labeling of an alloy.

   (d) Why are metals not brittle in nature ?

   (e) Give two applications of laser in your PC.

   (f) Give two common applications of ferroelectric material.

   (g) What are different types of corrosion ?

   (h) Draw the block diagram of fiber optics communication system and mention its components.

   (i) What is the composition of natural rubber ?

   (j) What is fiber-reinforced composite ?

2. (a) How the economic considerations affect the material selection for engineering purposes ?   5

   (b) Broadly discuss the mechanism of fracture in engineering materials.   5

P.T.O.

3. (a) Find an expression for electrical conductivity by using Ohm's law. 4

(b) Derive the Widemann-Frentz Law. 3

(c) A conductor wire has a resistivity of 1.54×10^{-8} Ω m at room temperature. There are 5.8×10^{28} conduction electrons per m^3. Calculate the relaxation time and mobility of electrons and also calculate the average drift velocity of the electron when electric field applied to conduction is 1 V cm^{-1}. 3

4. (a) Answer the following : 6

   (i) Distinguish between type I and type II superconductor.

   (ii) Distinguish between diamagnetic and paramagnetic materials.

(b) Superconducting Tin has a critical temperature of 4.7K at zero magnetic field and a critical field of 0.0206 Tesla at 0K. Find the critical field at 4K. 2

(c) Write a short note on piezoelectric material. 2

5. (a) What do you understand about polarization ? Write the equations of different type polarizations and show graphically how the total polarization behaves with the temperature. 4

(b) Calculate the shift of electron clouds with respect to the nucleaus in Helium atom when electric field of 10^6 Volt/m is applied. The polarizability of Helium is 1.6×10^{-40} Farad.m^2. 2

(c) How does the dielectric constant depend on temperature and frequency ? 4

6. (a) Write the advantages of fiber optics cable over metallic cable. 4

(b) Draw the diagram of three level laser systems and discuss the various steps of operation. 3

(c) Derive an expression for absorption coefficient of a material. 3

7. (a) Distinguish between thermoplastic and thermosetting of polymer. 4

(b) Teflon is used in reaction vessels and frying pans. Why ?   2

(c) Write down the structures of following polymers :   2

Silicon rubber, Nylon-6.

(d) What is a short fiber composite ? What is its stress character and strength ?

2

8. (a) Describe briefly the mechanism of corrosion by electrochemical corrosion.

3

(b) How commercial ceramics are classified ? Discuss the mechanical properties

of ceramics.   4

(c) Write a short note on SMART material.   3

[Avogadro No 6.022×10^{23} /mole, $k = 1.38 \times 10^{-23}$ J/K or 8.62×10^{-5} eV/K,
Plank's constant, $h = 6.624 \times 10^{-34}$ J sec, Velocity of Light, $c = 2.998 \times 10^{8}$ m/sec
Electron mass $= 9.1 \times 10^{-31}$ kg, Electronic charge $= 1.6 \times 10^{-19}$ C. 1eV $= 1.602 \times 10^{-19}$ J,
$\varepsilon_o = 8,854 \times 10^{-12}$ F/m, $\mu_o = 4\pi \times 10^{-7} = 1,257 \times 10^{-6}$ H/m]