Exam.Code:1031
Sub. Code: 7553

2123

M. Tech. (Material Science and Technology)
Third Semester
MT-303: Magnetism and Superconductivity

Time allowed: 3 Hours

Max. Marks: 50

NOTE: Attempt five questions in all, including Question No. I which is compulsory and selecting two questions from each Unit.

x-x-x

I. Attempt any five of the following:-

a) What is meant by anisotropy energy in ferromagnetic materials?

b) Explain the origin of diamagnetism in a free atom.

c) Differentiate between CIP and CPP giant magnetoresistance measurement configurations.

d) Why is superconductivity a low temperature phenomena?

e) Differentiate between type I and type II superconductors.

f) At what temperature the superconducting energy gap vanishes and why? (5x2)

UNIT - I

II. a) Draw the B-H curve for a ferromagnetic material and identify the retentivity and the coercive field on the curve. What is energy loss per cycle?

b) An atom contains 10 electrons revolving in a circular path of radius 10^{11}m. Assuming homogeneous charge distribution, calculate the orbital dipole moment of the molecule in term of Bohr magneton. (7,3)

III. Explain the physical basis of diamagnetism and paramagnetism of materials. Describe the Weiss molecular field theory of ferromagnetism and derive Curie-Weiss law. (10)

IV. a) With a suitable schematic diagram, explain the basic principle, construction and working of vibrating sample magnetometer.

b) Describe CMR effect qualitatively by *double-exchange* interaction between manganese ions Mn^{4+} and Mn^{3+}. (5,5)

UNIT - II

V. a) How are cooper pairs formed? Explain the BCS theory of superconductivity and discuss the energy gap based on this theory.

b) Discuss the thermodynamics of superconductor and derive Rutger's formula for specific heat. (5,5)

P.T.O.

VI. a) Explain the DC Josephson effect. Show that the super current of superconducting pairs across the junction depends on the phase difference.

b) Calculate the London penetration depth for lead at 5.15 K if the penetration depth at 0 K is 37 nm. The critical temperature of lead is 7.19 K. (6,4)

VII. a) How are vortices formed in a superconductor? How is pinning of the vortex achieved?

b) Cite the potential applications of HTSCs. (5,5)

x-x-x