Exam.Code:1031
Sub. Code: 7861

2021

M. Tech. (Material Science and Technology)

Third Semester

MST-301: Magnetism and Super Conductivity

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) Explain variation of the superconducting transition temperature with magnetic fields.

b) Explain, graphically, the variation of the penetration depth with temperature.

c) What are the spintronic devices? List out their applications.

d) What is specific heat? Discuss its variations with temperature for normal and superconducting material.

e) The critical temperature for mercury with isotopic mass 199.5 is 4.185 K. Calculate its critical temperature when its isotopic mass changes to 203.4.

f) Show that superconductor behaves as perfect diamagnetic material.

g) Show, graphically, the variation of susceptibility with temperature for ferromagnetic, paramagnetic and anti-ferromagnetic material. (5x2)

UNIT – I

II. a) Describe Neel's theory of anti-ferromagnetism and show how the ferromagnetic behaviour of ferrites can be explained with Neel's theory.

b) Draw B-H curve for a ferromagnetic material and identify the retentivity, and the coercive field on the curve. What is the energy loss per cycle? (6,4)

III. a) What are the failures of Langevin's theory? Describe how it was fixed with Weiss theory.

b) A magnetic material has a magnetization of 3300 ampere/meter and flux density of 0.0044 Wb/m^2. Calculate the magnetizing force and the relative permeability of the material. (6,4)

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IV. a) Describe variation of the spontaneous magnetization with temperature.

b) Write a short note on Giant and Colossal magnetoresistance.

c) Explain the principle of Gouy method to determine the magnetic susceptibility. (3,4,3)

UNIT – II

V. a) What do you understand by superconductivity? Describes the London theory, including mathematical aspects, for the explanation of the phenomena of superconductivity.

b) What do you understand by the penetration depth and the coherence length in superconductivity? What is the relation between these two quantities? (6,4)

VI. a) Explain the BCS theory to describe the phenomena of superconductivity!

b) The London penetration depths for Pb at 3 K and 7.1 K are 39.6 nm and 173 nm, respectively. Calculate its transition temperature and as well as penetration depth at 0 K. (6,4)

VII. a) Describe the principle of a superconducting quantum interface device (SQUID). List out their potential engineering applications.

b) Discuss thermodynamics of the superconducting transition and derive Rutger's formula for specific heat.

c) A superconducting Pb has a critical temperature of 3.7 K in zero magnetic field and critical field at 0.0306 Tesia at 0 K. Find the critical field at 2 K. (4,3,3)

x-x-x