Register Number:
Date:

ST.JOSEPH'S COLLEGE (AUTONOMOUS), BANGALORE-27.

M.Sc. PHYSICS - IV SEMESTER
SEMESTER EXAMINATION: APRIL 2019
PH-DE0517: MATERIAL SCIENCE

Time: 2.5 hours **Max Marks: 70**

This paper contains three printed pages

PART – A

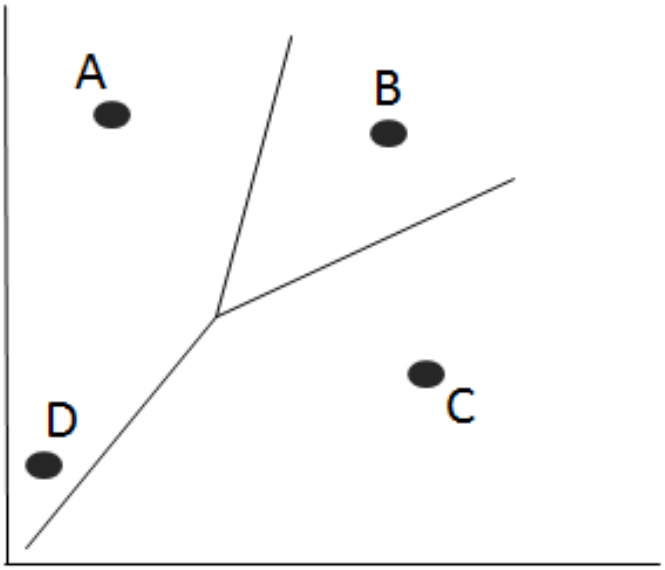
Answer any 5 questions. Each question carries 10 marks. (5x10=50)

1. What is Nano phase Materials?. Discuss how the mechanical and magnetic properties of Nano- materials vary with particle size and discuss the applications of nano-materials. (2+6+2)
2. (a).Define: (i) Quenching , (ii) Martensite and (iii) Austenite Phases
   (b).State the properties of hard magnetic materials.
   (c).How does Piezoresponse Microscopy help in imaging and manipulation ferroelectric domains? (2+2+6)
3. (a). Derive the expression for Lever rule with Tie line
   (b). Substantiate Iron-Carbon equilibrium diagram. (5+5)
4. What is thermal expansion?. Discuss and obtain the expression of thermal expansion coefficient for one dimension (1D), two dimensions (2D) and three dimensions (3D) with suitable diagrams. (2+8)
5. (a). What is alloying?. Discuss the alloying effects on copper (Cu) and also explain in terms of electrical resistivity and conductivity of Cu varied. (6)
   (b). Describe the low and high resistivity materials and their applications. (4)
6. (a).Discuss the origin of diamagnetism in a free atom. (2)
   (b).Obtain Langevin's diamagnetism equation for the diamagnetic susceptibility. (8)
7. (a).Discuss in detail about the properties and application of dielectric materials?. (7)
   (b).Describe the difference between insulator and dielectric material with suitable examples? (3)

PART – B

Answer any 4 questions. Each question carries 5 marks. (4x5=20)

8. A binary alloy having 28 wt% Copper (Cu) and remaining Silver (Ag) which is solidifies at 779 °C. The solid consists of two phases α and β. The phase α has 9% of Cu whereas β has 8% of Ag at 779 °C. At room temperature these are pure Ag and Cu respectively.
   (a). Label all fields and lines. Melting points of Cu & Ag are 1083 °C & 960 °C respectively.
   (b). Estimate the amount of α and β in the above alloy at 779 °C and at room temperature.
9.



From the figure what phase change corresponds to each of these below

$A \longrightarrow B,\ B \longrightarrow C,\ C \longrightarrow D,\ D \longrightarrow C,\ C \longrightarrow B,\ B \longrightarrow A$

10. (a). What are the degrees of freedom of a system of two components when the number of phases is one, Two, Three, and four?
    (b). At atmospheric pressure (pressure arbitrarily chosen), a material of unknown composition shows four phases in equilibrium at 987 K. what is the minimum number of components in the system.
11. A steel rod with mass 2 kg absorbs heat 100 calories when its temperature rises from 20°C to 70°C. What is the specific heat of the steel rod?.

12. In Nickle ferrite ($NiFe_2O_4$) crystal, the ferric ions are anti-ferromagnetically coupled. The Magnetization is due to the nickle ions. When zinc is added to Nickle ferrite, the magnetization of the crystal increases, even though the zinc ions are not ferromagnetic. Explain how this could happened?.
13. (a). Seebeck voltage for Copper (Cu) - Constantan (Cn) thermocouple is given by the linear relation V= a + bT, where, T is the absolute temperature of the hot junction and a, b are constants given by

    Cu : a= 0.6 mV b= 0.008 mV/K,

    Cn : a = -20 mV b = - 0.056mV/K.

    Calculate the thermoelectric power, when the hot junction at 100 °C?.

    (b). Compute the thermo-emf of a copper (Cu) -constantan (Cn) thermocouple with its junctions at 0 °C and 100 °C.