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

M.Sc. PHYSICS - IV SEMESTER
SEMESTER EXAMINATION: APRIL 2018.
PH-DE0517: MATERIAL SCIENCE

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

This paper contains 3 printed pages

PART – A
Answer any 7 questions. Each question carries 10 marks.   (7x10=70)

1. (i)   What is a shape memory alloy?   (2 marks each)

    (ii) How do they work? What are the martensite and austenite phases?

    (iii) How much deformation can a shape memory alloy take and still recover?

    (iv) What metals exhibit shape memory characteristics?

    (v)   Where are the applications for shape memory alloys?

2.   (a)   (i) Draw the schematic diagram of X-ray Photoelectron Spectroscopy.   (2)

          (ii) Explain the basic principle, X-ray source and applications of X-ray   (3)
              Photoelectron Spectroscopy.

     (b)   How does Piezoresponse microscopy help in imaging and manipulation of
           ferroelectric domains?   (5)

3. What are the four possible equilibria of water system and discuss its significance of

    phase diagram.

4. Describe langevin's theory of diamagnetism. Show that the Magnetic susceptibility is

    negative and independent of temperature.

5. (a)   (5+5)
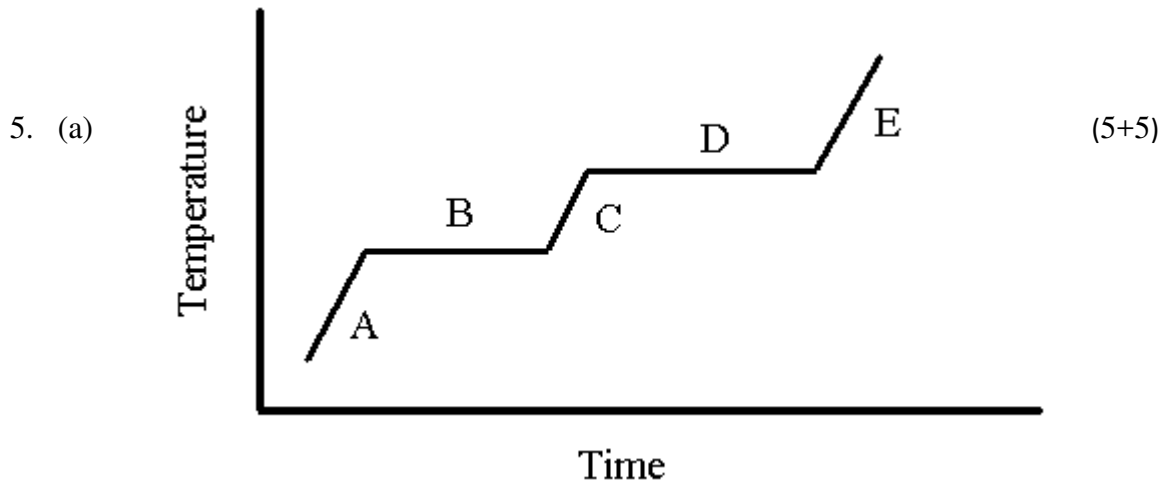
A pure solid substance is heated as indicated in the diagram above. Use the diagram answer following questions

1. On which portion(s) of the graph is only a liquid present?

2. On which portion(s) of the graph is a liquid (and maybe other phases of matter) present?

3. On which portion(s) of the graph is only a gas present?

4. Which section of the graph indicates the freezing point?

5. Which section of the graph indicates the melting point?

(b) Draw schematic phase diagrams for binary systems with (a) complete liquid and solid solubility (b) complete liquid but zero solid solubility and (c) complete liquid and limited solid solubility. (In your sketches label phase fields and give characteristic temperatures.)

6. (a) A 10 kW drilling machine is used to drill a bore in a small aluminum block of mass 10 Kg. How much is the rise in temperature of the block in 2.5 minutes, assuming 50% of power is used up in heating the machine itself or lost to the surroundings. Specific heat of aluminum = 0.91 $Jg^{-1}k^{-1}$ (5+5)

(b) A steel tape 2 m long is correctly calibrated for a temperature of 27 ^{o}C. The length of a steel rod measured by this tape is found to be 64 cm on a hot day when temperature is 45 ^{o}C. What is the actual temperature of the steel rod on that day? What is the length of the same rod on a day when temperature is 27 ^{o}C.

7. (a) What are the importance of hysteresis curves?   (5)

(b) What is antiferromagnetic materials and mention its properties   (3)

(c) What are ferrites?   (2)

8. (a) What are the basic entities responsible for thermal conduction of a solid?

    (b) Define Coefficient of Thermal Conductivity?   (2 marks each)

    (c) Define thermal Diffusivity.

    (d) Derive the unit for thermal conductivity.

    (e) What is meant by temperature gradient?

9. (a) What is Seebeck coefficient of metals.   (2 marks each)

    (b) Write vector differential equation of Seebeck coefficient.

    (c) What is chromel and alumel?

    (d) Define (i) Law of intermediate metals. (ii) Law of intermediate temperatures.

10.   (a) If two phases are at equilibrium state (constant temperature, pressure) show that

        the chemical potential of both phases are equal.   (5+3+2)

    (b) What is substitutional solid solution Hume- Rothery rules?

    (c) What is the difference between a miscible and immiscible liquid?