INDIAN INSTITUTE OF INFORMATION TECHNOLOGY BHAGALPUR

ME 103 [Engineering Materials]

Autumn 2024-25, Mid Semester Examination

Time: 10:00 AM to 12:00 PM (120 minutes), Full marks: 30, Date: 05th October, 2024

INSTRUCTIONS:

- All questions are compulsory.
- Invigilator should allow Scientific Calculator, Compass, Scale etc. to the students for this subject.
- Don't write anything on the question paper.

1. a. Define Weiss Zone Law? Find out the common direction of the planes (001) and (110) by Weiss Zone Law. [2]

   b. Direction of Miller indices in cubic unit cell is [112]. Determine the direction of same miller indices for hexagonal unit cell. [2]

   c. Proof inter planer spacing is $d_{(hkl)} = \frac{a}{\sqrt{h^2+k^2+l^2}}$ for a given plane (hkl) of a cubic crystal where "a" is lattice parameter. [3]

   d. Write the name of all the members in the family <123> in a cubic crystal. [2]

   e. The atomic radius of pure iron in room temperature is 1.26 Å. Find the inter-planer spacing of (220) planes. At 950° C temperature what will be the inter-planer spacing for same plane. [2]

   f. A crystal lattice plane (326) makes an intercept of 1.5 Å on X-axis in a crystal having lattice constant 1.5 Å, 2 Å and 2 Å respectively on X, Y and Z axis, Find Y and Z intercept. [3]

2. a. Define atomic bond energy in terms of potential energy. Draw the graph and explain. [2]

   b. Explain the followings [4]

   i. Screw Dislocation ii. Edge dislocation

   iii. Stacking fault defect iv. Free surface defect

3. a. Draw the copper and zinc alloy phase diagram and explain it with respect to the changes in mechanical properties of the alloy. [5]

   b. Two metals A and B have their melting points at 600° C and 400° C respectively. These metals do not form any compound or intermediate phase. The maximum solubility in each other is 4% which remains the same until 0° C. An eutectic reaction takes place between 65% A and 35% B at 300° C.

   i. Draw the phase diagram of A-B and label all the important points and fields. [3]

   ii. Find the temperature at which a 20% A – 80% B alloy starts and completes solidification. [1]

   iii. Find the temperature at which the same alloy is composed of 50% liquid and 50% solid. [1]

INDIAN INSTITUTE OF INFORMATION TECHNOLOGY BHAGALPUR

ME 103 [Engineering Materials]

Autumn 2024-25, End Semester Examination

Time: 10:00 AM to 01:00 PM (180 minutes), Full marks: 50, Date: 27th November, 2024

INSTRUCTIONS:

- All questions are compulsory.
- Invigilator should allow Scientific Calculator, Compass, Scale etc. to the students for this subject.
- Don't write anything on the question paper.

1. a. Draw the planes in the cubic cell by miller indices (102) and (201). [2]
   b. In a cubic unit cell, calculate the angle between the planes (111) and (101). [2]
   c. Aluminium has FCC structure. Its density is 2700 kg/m^3. Find the unit cell dimensions and atomic diameter. Given at. weight of Al = 26.98. [2]
   d. Determine the planar density of Ni (FCC) in (100) plane. Rradius of Ni atom = 1.245 Å. [2]
   e. Explain the followings [2]
   (i) Grain Boundary surface defects (ii) Twin Boundary defects

2. a. What is the method for purification of semiconductor rod? What principle that is used in this method? [2]
   b. Why the metallization process is needed for fabrication of IC. What are the drawbacks of Aluminium (Al) when used in metallization process? [2]
   c. Explain the different steps of photo lithography. [3]
   d. Established the equation of average rate of change in concentration in time interval Δt is the rate of change of total mass flux with x-coordinate in diffusion. [2]
   e. What are advantages of ion-implantation Process over diffusion process? [1]

3. a. Draw the Iron-Carbon equilibrium phase diagram and explain the significance of following phases (a) α-ferrite, (b) Austenite (c) Eutectic and (d) Eutectoid. [4]
   b. What is normalizing? Explain this process with the phase diagram. [3]
   c. Explain the flame hardening process with the sketch. [3]

4. a. Draw the true stress-strain and engineering stress-strain curve and explain the difference between them. [3]
   b. A circular rod of diameter 16 mm and 500 mm long is subjected to a tensile force of 40 kN. The modulus of elasticity for steel may be taken as 200 kN/mm^2. Find the stress, strain and elongation of the bar due to applied load. [3]
   c. A specimen of silicon is 0.2 mm long and has a cross section of 0.2 mm × 0.2 mm. One volt impressed across the bar results in a current of 8 mA. Assuming that the current is due to electrons, calculate (a) concentration of free electrons and (b) the drift velocity. Given at 300 K, μ_n = 1300 cm^2/ V-s and q = 1.60 × 10^{-19} C. [4]

5. a. List the ceramics manufacturing steps. Explain the iso-static process with the neat sketch. [4]
   b. With the neat diagram explain the vacuum bag type composite manufacturing process. [3]
   c. Calculate the modulus of elasticity, tensile strength and the fraction of the load carried by the fibre for the following composite material stressed under iso-strain condition. The composite consists of a continuous glass fibre reinforced epoxy resin produced by using 60% by volume of E-glass fiber having a modulus of elasticity of 72400 × 10^6 N/m^2 and a tensile strength of 2400 × 10^6 N/m^2 and a hardened epoxy resin with a modulus of elasticity of 3100 × 10^6 N/m^2 and a tensile strength of 60 × 10^6 N/m^2. Also, find the modulus of elasticity of the composite when stressed under iso-stress [3]