Code No: 07A50802 **R07** **Set No. 2**

III B.Tech I Semester Examinations,November 2010
MATERIAL SCIENCE FOR CHEMICAL ENGINEERS
Chemical Engineering

Time: 3 hours **Max Marks: 80**

Answer any FIVE Questions
All Questions carry equal marks

⋆ ⋆ ⋆ ⋆ ⋆

1. (a) Distinguish between cold working and hot working.
   (b) Explain with neat sketches how plastic deformation happens in materials.[8+8]
2. Draw the phase diagrams for Pb-Sn and Cu-Ni systems:
   (a) Indicate the phase compositions in the above phase diagrams.
   (b) Write a note on eutectic temperature and composition for the above systems.
   (c) Explain the terms liquidus and solidus. [6+8+2]
3. (a) A tensile load of 200 N is applied to an aluminum - boron composite (Aluminum matrix) of 1 mm^2 cross sectional area. The volume of the parallel fibers is 40 %. What is the stress in the fibers, when the load axis is:
      i. Parallel to the fibers
      ii. Perpendicular to the fibers.

      Data:
      Young's modulus: Aluminum - 71 GNm^{-2} and Boron 440 GNm^{-2}
   (b) Explain the fatigue test S - N curve. How are the data for the S - N curve obtained?
   (c) Describe four major factors which affect the fatigue strength of a metal. [6+6+4]
4. (a) Explain the nature of bond in water molecule.
   (b) Write a note on ionization potential. [8+8]
5. (a) In a neat sketch, draw Burgers circuits and determine Burgers vectors at two different locations of the same curved dislocation line.
   (b) Discuss on the imperfections that arise due to deviations in stoichiometric formula. [8+8]
6. (a) Describe the corrosion behavior of a passive metal in different regions of a polarization curve. Explain the reasons for the different behavior in each region.
   (b) A copper surface is corroding in sea water at a current density of 2.45×10^{-6} A/cm^2. What is the corrosion rate? [11+5]

7. Small thin pieces of 0.3 mm thick hot rolled strips of an eutectoid plain carbon steel are heated for 1 hr at 850 ^{0}C and then given the heat treatments listed below. Draw a TTT diagram and discuss the microstructures of the samples after each heat treatment.

   (a) Water-quench to room temperature

   (b) Hot-quench in molten salt to 690 ^{0}C and hold 2 hours; water-quench

   (c) Hot-quench to 610^{0}C and hold 3 minutes; water-quench

   (d) Hot-quench to 580^{0}C and hold 2 seconds; water-quench

   (e) Hot-quench to 450^{0}C and hold 1 hour; water-quench

   (f) Hot-quench to 300^{0}C and hold 30 minutes; water-quench

   (g) Hot-quench to 300^{0}C and hold 5 hours; water-quench. [16]

8. (a) Discuss the factors, which affect the long - range arrangement of ionic crystals.

   (b) Find the critical radius ratio for tetrahedral, octahedral and eight - fold coordination around a central cation in an ionic crystal. [8+8]

⋆ ⋆ ⋆ ⋆ ⋆

Code No: 07A50802 **R07** **Set No. 4**

III B.Tech I Semester Examinations,November 2010
MATERIAL SCIENCE FOR CHEMICAL ENGINEERS
Chemical Engineering

Time: 3 hours **Max Marks: 80**

Answer any FIVE Questions
All Questions carry equal marks

⋆ ⋆ ⋆ ⋆ ⋆

1. Discuss the usual methods used in determining the structure of a crystal. State also how to determine lattice parameter of a cubic crystal by the diffraction method. [16]

2. (a) Discuss why most important engineering metals and alloys belong to the three transition series.
   (b) Discuss the properties of a hydrogen bond. [10+6]

3. (a) Derive and discuss the phase rule enunciated by Gibbs.
   (b) What are phase diagrams? Classify them and explain in detail. [8+8]

4. (a) Explain with neat sketches the mechanism for 'dislocation' and 'twinning' as related to plastic deformation.
   (b) Derive an equation for the calculation of critical resolved shear stress for a single crystal. [8+8]

5. (a) Discuss and compare the type of inert protective coatings.
   (b) Explain with examples the advantages and disadvantages of anodic protection.
   (c) Calculate the - Bedworth ratio for the following case and comment on result.
   Metal : Chromium; oxide : Cr_2O_3
   Density of metal and oxide (g/cm^3) : 7.20 and 5.21 [6+5+5]

6. (a) Discuss why T-T-T curves are C-shaped, taking the reference of eutectoid steel.
   (b) Explain what happens when steel is normalized to yield fine pearlite. [8+8]

7. (a) Explain fracture strengthening mechanism in soilds.
   (b) Discuss the effects of increasing stress on the shape of the creep curve of a metal. [8+8]

8. (a) The Burger vector of a mixed dislocation line is 1/2 [110]. The dislocation line lies along the [112] direction. Find the slip plane on which this dislocation lies. Find also the screw and edge components of the Burgers vector.
   (b) Discuss about stacking faults in crystals. [8+8]

⋆ ⋆ ⋆ ⋆ ⋆

Code No: 07A50802 **R07** **Set No. 1**

III B.Tech I Semester Examinations,November 2010
MATERIAL SCIENCE FOR CHEMICAL ENGINEERS
Chemical Engineering

Time: 3 hours **Max Marks: 80**

Answer any FIVE Questions
All Questions carry equal marks

⋆ ⋆ ⋆ ⋆ ⋆

1. (a) Discuss in detail the types of corrosion with examples.
   (b) Briefly discuss the methods to combat corrosion. [8+8]
2. Write short notes on the following:
   (a) Point imperfections
   (b) Surface imperfections
   (c) Line imperfections. [5+5+6]
3. (a) Discuss how ligancy rules determine the local packing around a cation, during the formation of ionic crystal, with the help of an example.
   (b) Define coordination number for an ionic crytsal. Predict the coordination number for the ionic solids CsCl and NaCl. Use the following ionic radii for the prediction: $Cs^+ = 0.170$ nm $Na^+ = 0.102$ nm $Cl^- = 0.181$ nm [10+6]
4. (a) With the help of an example, explain how to determine the fractions of two co-existing phases.
   (b) Distinguish between Tie-line rule and lever rule. [8+8]
5. (a) Discuss in detail the ductile-brittle transition mechanism in various materials.
   (b) Explain the structural changes that take place when a ductile metal fails under cyclic stresses. [8+8]
6. (a) Write short notes on induced and fluctuating dipole attractions.
   (b) Giving suitable examples, discuss the factors that promote the formation of ion and ionic compounds. [8+8]
7. Explain the austempering process for a plain-carbon steel. Draw a cooling curve for an austempered austenitized eutectoid plain-carbon steel, using an isothermal transformation diagram. [16]
8. Discuss the following:
   (a) Four parameter model to predict viscoelastic behavior of materials.
   (b) What is a slip system? How many slip systems are there in FCC and HCP metals? [8+8]

⋆ ⋆ ⋆ ⋆ ⋆

Code No: 07A50802 **R07** **Set No. 3**

III B.Tech I Semester Examinations,November 2010
MATERIAL SCIENCE FOR CHEMICAL ENGINEERS
Chemical Engineering

Time: 3 hours **Max Marks: 80**

Answer any FIVE Questions
All Questions carry equal marks

⋆ ⋆ ⋆ ⋆ ⋆

1. Write short notes on:
   (a) Brasses
   (b) Carbon steels
   (c) Alloy steels. [4+6+6]
2. Write on the following:
   (a) Deformation induced by shear stresses
   (b) Property changes due to hot working. [8+8]
3. (a) Explain the nature and bonds involved in Nacl.
   (b) Discuss the following:
      i. Properties of ionic solids
      ii. Primary bonds. [8+8]
4. Draw neat sketches of the phase diagrams of the following systems and explain the salient features.
   (a) Fe-Fe_3C
   (b) Pb-Sn. [16]
5. (a) Derive a relationship between the length of the side a of the BCC unit cell and the radius of its atoms.
   (b) Calculate the atomic packing factor(APF) for the BCC unit cell, assuming the atoms to be hard spheres.
   (c) Express the edge, face diagonal and body diagonal of the unit cell in terms of the atomic radius r for Bcc crystals. [4+6+6]
6. Write in detail n the following, with suitable examples:
   (a) Frenkel defect
   (b) Equilibrium concentration of vacancies
   (c) Burger vectors
   (d) Screw dislocation
   (e) Glide motion. [3+3+4+3+3]

Code No: 07A50802 **R07** **Set No. 3**

7. (a) Explain how introducing compressive stresses in surface layers increase the fracture strength.
   (b) Explain the different fibers used in fiber reinforced plastics along with their properties. [8+8]

8. (a) Discuss the types of alloys used for moderate and highly oxidizing conditions for corrosion resistance.
   (b) What is intergranular corrosion? Describe the metallurgical condition that causes intergranular corrosion in an austenitic stainless steel. [8+8]

⋆ ⋆ ⋆ ⋆ ⋆