

Code No: 07A50802

R07**Set No. 2**

III B.Tech I Semester Examinations, May 2011
MATERIAL SCIENCE FOR CHEMICAL ENGINEERS
Chemical Engineering

Time: 3 hours

Max Marks: 80

Answer any FIVE Questions
 All Questions carry equal marks

1. Explain the following:
 - (a) Intergranular corrosion
 - (b) Protective oxide films
 - (c) Concentration polarization
 - (d) Passivation. [4+4+4+4]
2. (a) Differentiate between the terms resolved shear stress and critical shear stress.
 (b) Distinguish among the three elastic moduli.
 (c) Explain how dislocations are important in plastic deformation of metals. [6+4+6]
3. Explain the formation of various carbon steels with the help of Fe-Fe₃C phase diagram. [16]
4. (a) What types of stresses are induced when austenite is quenched to obtain martensite? Explain.
 (b) Discuss the advantages and disadvantages of adding alloying elements to steel. [8+8]
5. (a) What are the densest packed planes and why, in the following:
 - i. The FCC structure or
 - ii. The HCP structure
 (b) Calculate a value for the density of FCC lead in grams per cubic centimeter from its lattice constant a of 0.495 nm and its atomic mass of 207.19 g/mol. [10+6]
6. (a) Discuss the structural changes which occur in a ductile metal in the fatigue process.
 (b) Mention the differences between ductile and brittle fractures. [8+8]
7. (a) Distinguish between the direction of dislocation line, the burger vector, and the direction of motion for both edge and screw dislocations, differentiating between positive and negative type.
 (b) Show both graphically and analytically that the first two dislocations and to give the third dislocation in the following reaction:

$$\frac{1}{6} [2\bar{1}\bar{1}] + \frac{1}{6} [121] \rightarrow \frac{1}{2} [110]$$
 [8+8]

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8. The potential energy W of a system of two atoms varies as a function of their distance of separation 'r' as follows: $W = -A/r^n + B/r^m$ Show that at equilibrium:

(a) $r = r_o(mB/nA)^{1/m-n}$

(b) The energy of attraction is m/n times the energy of repulsion, and

(c) The bond energy $W_o = [A/r_o^n][(m-n)/m]$. [16]

FIRSTRANKER

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R07**Set No. 4**

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1. (a) Discuss on the following:
 - i. Twin boundaries
 - ii. Grain boundary
 - iii. Frenkel and Schottky defects. [5+5+6]
2. (a) Explain with examples, how dipole attractions result in a profound alteration of physical properties.
- (b) Explain the nature of bonds which are partially covalent and partially ionic. [10+6]
3. (a) Discuss with examples how alloying addition improves corrosion resistance.
- (b) Explain galvanic protection with examples. [8+8]
4. Draw and explain the phase diagram of Fe-Fe₃C system. Identify three invariant reactions in the above system and explain in detail. [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. (a) Discuss the atomic model of elastic behavior.
- (b) Explain the strain - time relationship for a Voigt - Kelvin element. [10+6]
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. (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]

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1. (a) Discuss the major factors that must be taken into account in the packing of ions in an ionic crystal.
 (b) Explain the following:
 - i. Electric dipole moment
 - ii. Electro negativity. [6+10]
2. Write short notes on:
 - (a) Brasses
 - (b) Carbon steels
 - (c) Alloy steels. [4+6+6]
3. Explain the following:
 - (a) Critical resolved shear stress
 - (b) Strain hardening
 - (c) Property changes during recrystallization. [6+4+6]
4. (a) The average density of a carbon-fiber-epoxy composite is 1.546 g/cm^3 . The density of Epoxy resin is 1.21 g/cm^3 and that of the carbon fibers is 1.73 g/cm^3 .
 - i. What is the volume percentage of carbon fibers in the composite?
 - ii. What are the weight percentages of epoxy resin and carbon fibers in the composite?
 (b) Mention two of the most important matrix plastics for fiber - reinforced plastics. Also write the advantages of each type.
 (c) Explain what isostress and isostrain conditions in composites are. [16]
5. (a) Describe the atomic arrangement in detail at planar boundaries.
 (b) Discuss on the imperfections in ionic crystals. [8+8]
6. Explain the following phase diagrams with examples:
 - (a) Eutectic phase diagram
 - (b) Peritectic phase diagram. [16]
7. What are the closest packed directions in the following:

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- (a) The FCC structure
- (b) The HCP structure.

Defend your answer.

[16]

8. (a) Discuss the combinations of metals and environments which have good corrosion resistance.
- (b) If a sacrificial zinc anode shows 1.15 kg loss in 70 days, what is the average current produced by the corrosion process in this period?
- (c) Discuss the methods of avoiding intergranular corrosion with examples. [6+4+6]

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R07**Set No. 3**

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1. Write a note on the following:
 - (a) Stresses and strains in crystals due to point imperfections
 - (b) Dislocation properties. [8+8]
2. (a) Give the electronic configuration of fluorine and F^- ion. Compare their sizes.
 (b) Make a brief account of hydrogen bonds. [8+8]
3. (a) Explain the mechanism of creep and the methods to increase creep resistance in materials.
 (b) Explain how the composite materials are superior in terms of properties and applications. [8+8]
4. (a) Explain how during the heat treatment, a metal tries to approach the equilibrium state.
 (b) Discuss various annealing processes during heat treatment of steels. [8+8]
5. (a) Compare the advantages and disadvantages of different types of inert protective coatings.
 (b) Explain the phenomenon of Polarization and Passivation in corrosion. [6+10]
6. (a) Calculate the radius of the largest atom which could exist interstitially in FCC copper without crowding (The radius may be derived as a function of the lattice parameter 'a').
 (b) What is the coordination number of the interstitial site? [10+6]
7. (a) Dendritic growths cannot be identified by an etching technique in pure materials. Why?
 (b) Explain briefly various applications of phase rule. [8+8]
8. (a) Discuss the reasons of high hardness and strength in Fe-C martensites of plain-carbon steels when their carbon content is high.
 (b) How does TTT diagram for a hypoeutectoid plain carbon steel differ from that of a eutectoid one? Discuss. [8+8]
