

II B.Tech II Semester Regular Examinations, Apr/May 2008
MATERIAL SCIENCE FOR CHEMICAL ENGINEERS
(Chemical Engineering)

Time: 3 hours

Max Marks: 80

Answer any FIVE Questions
All Questions carry equal marks

1. (a) Calculate the limits within which the energy difference of an electronic transition should be, in order that the emitted or absorbed radiation is in the visible range (3900 to 7800 Å) of the electro magnetic spectrum.
(b) Give the electronic configuration of the fluorine atom and the F^- ion. Compare their sizes. [10+6]
2. State the usual methods used in determining the structure of a crystal. State also how to determine lattice parameters of a cubic crystal by the diffraction method. [16]
3. How do you expect dislocation motion to be effected by grain boundaries? Explain. [16]
4. (a) What are the degrees of freedom of a system of two components, when the number of phases is one, two, three, etc?
(b) Draw and explain pressure-temperature diagram for one component system of iron. [8+8]
5. (a) Discuss about:
 - i. Molybdenum steels
 - ii. Silicon steels
 - iii. Nickel-chromium steels.(b) Write a brief note on stainless steels. [4+4+4+4]
6. (a) Differentiate between anelastic and viscoelastic behavior.
(b) Explain the macroscopic models of Maxwell and Voigt-Kelvin used to describe viscoelastic behavior of materials. [4+12]
7. (a) Explain how a fatigue fracture occurs and give examples of fatigue fracture.
(b) Suggest ways to improve the fatigue life of a component.
(c) Discuss about creep resistant materials. [4+4+8]
8. (a) The rate of oxidation of a metal at an elevated temperature depends on the nature of the oxide layer that forms on the metal surface. Discuss in detail.
(b) Suggest various ways of improving the oxidation resistance of materials.
(c) Obtain an expression for functional dependence of oxide thickness on time. [8+4+4]

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1. (a) Explain:
 - i. Bond length
 - ii. Bond energy.(b) Describe the various types of bonds that can occur in substances with suitable examples.
(c) Write about σ bonds and Π bonds with examples. [6+5+5]
2. State the usual methods used in determining the structure of a crystal. State also how to determine lattice parameters of a cubic crystal by the diffraction method. [16]
3. How do you expect dislocation motion to be effected by grain boundaries? Explain. [16]
4. (a) Explain a single component system phase diagram with an example.
(b) Discuss the phase rule with reference to two components system forming Eutectic? [8+8]
5. (a) Describe the special features of the martensitic transformation as compared to other transformations in steels.
(b) Draw the T-T-T diagram for a eutectoid steel and describe its characteristics. [8+8]
6. Describe the processes of austempering and martempering and give the principal advantages of these processes compared with the conventional quench and temper methods. [16]
7. (a) Explain how a fatigue fracture occurs and give examples of fatigue fracture.
(b) Suggest ways to improve the fatigue life of a component.
(c) Discuss about creep resistant materials. [4+4+8]
8. Write short notes on:
 - (a) Inhibitors
 - (b) Coatings
 - (c) Stress corrosion
 - (d) Pitting corrosion. [4×4=16]

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1. (a) How chemical bonds are grouped and what is the range of bond energy for each group.
(b) Explain relation ship between atomic size and the bond length with neat sketch. [8+8]
2. (a) Explain why there is no end centered cubic space lattice.
(b) Explain with neat sketch why a (100) refraction in not possible from an FCC crystal. [8+8]
3. How do you expect dislocation motion to be effected by grain boundaries? Explain. [16]
4. (a) In the Pb-Sn system, calculate the alloy composition at which the fraction of total α is $2^{1/2}$ times the fraction of the β phase at 182°C .
(b) For soldering with Pb-Sn alloys, at least 85% of the eutectic mixture is preferred in the microstructure. Determine the composition limits of tin that will satisfy this condition. [8+8]
5. (a) Describe the special features of the martensitic transformation as compared to other transformations in steels.
(b) Describe the time-temperature-transformation characteristics of the eutectoid steel with a suitable diagram. [8+8]
6. (a) What is plastic deformation? How is it different from creep?
(b) With the help of a tensile load-elongation curve and true stress-true strain curve for a ductile material, explain plastic deformation.
(c) Explain super plastic behavior. [4+8+4]
7. What are composite materials? What are the different types of composite materials? Describe each one of them. [16]
8. (a) Discuss in detail about the mechanisms of oxidation and oxidation resistant materials.
(b) Derive the expression for the parabolic law of oxidation. [12+4]

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1. Explain what types of bonding would be expected for each of the following materials: brass (a copper-zinc alloy), rubber, barium sulfide, solid xenon, bronze, nylon and aluminium phosphide? [16]
2. (a) Define packing efficiency, density and coordinating number.
(b) The density of cubic manganese is 7440 kg m^{-3} . The lattice parameter $a=8.92 \text{ \AA}$. Find the number of atoms in the unit cell. List the possible space lattice. [6+10]
3. How do you expect dislocation motion to be effected by grain boundaries? Explain. [16]
4. (a) Explain a single component system phase diagram with an example.
(b) Write short notes on the following:
 - i. Binary phase diagrams
 - ii. Transformation curves. [8+8]
5. (a) Describe the special features of the martensitic transformation as compared to other transformations in steels.
(b) Describe the time-temperature-transformation characteristics of the eutectoid steel with a suitable diagram. [8+8]
6. Describe the process of work-hardening, dynamic recovery, cold working and hot working. [16]
7. (a) Explain how a fatigue fracture occurs and give examples of fatigue fracture.
(b) Suggest ways to improve the fatigue life of a component.
(c) Discuss about creep resistant materials. [4+4+8]
8. (a) Explain passivation and polarization in detail.
(b) Discuss about cathodic protection and galvanic protection. [8+8]
