

II B.Tech I Semester Regular Examinations, November 2006

PHYSICAL METALLURGY
(Metallurgy & Material Technology)

Time: 3 hours

Max Marks: 80

Answer any FIVE Questions
All Questions carry equal marks

1. (a) Name various methods of illumination in metallurgical microscope and briefly explain each one of them.
(b) What is conical stop illumination? Discuss its features. [8+8]
2. (a) Discuss slip systems associated with BCC, FCC and HCP structures.
(b) What is the procedure to be followed to determine the Miller Indices of a plane? Schematically represent the Miller Indices of (111), (010) and (110) planes. [8+8]
3. (a) Explain the following with respect to the formation of substitutional solid solutions.
 - i. crystal structure factor
 - ii. relative size factor(b) Define and explain the terms
 - i. phase and
 - ii. system(c) Draw the cooling curve for long freezing range alloys and explain the salient points in it. [6+4+6]
4. (a) For a two component system derive the total number of variables and degrees of freedom when the number of phases are one, two, three and four.
(b) Consider an alloy of 65 wt% Cu and 35 wt% Al. Calculate the composition of the alloy in Atomic percentage.
Atomic weight of Cu = 63.54.
Atomic weight of Al = 26.98. [8+8]
5. (a) Explain with neat diagrams how the micro-structure of a pure metal may change with additions of alloying elements.
(b) What is allotropy & Discuss various allotropic forms of Iron & their properties. [8+8]
6. Draw the copper rich portion of the Cu-Zn phase diagram and label the various points, phases and explain the slow cooling of 70-30 Cu-Zn Alloy. [16]
7. (a) Explain the mechanism of Bainitic transformation.
(b) Distinguish between athermal martensite and isothermal martensite.

- (c) Explain the term inter lamellar spacing of pearlite. Discuss the parameters which control the inter lamellar spacing. [7+5+4]
8. What do you mean by TTT diagrams. Describe the method of constructing TTT diagrams for an eutectoid steels. Label the various phases in the TTT diagram. [16]

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1. (a) Name various methods of illumination in metallurgical microscope and briefly explain each one of them.
(b) What is conical stop illumination? Discuss its features. [8+8]
2. Write short notes on the following:
(a) Hume-Rothery classification of metals
(b) Packing efficiency of FCC structure. [8+8]
3. (a) Distinguish between a commercially pure metal and an alloy. (4)
(b) An alloy is more useful than pure metal? Discuss. (4)
(c) What is a master alloy? What are its chief characteristics? (4)
(d) What is an interstitial solid solution? Name the five elements which commonly form interstitial solid solutions. [4+4+4+4]
4. (a) For a two component system derive the total number of variables and degrees of freedom when the number of phases are one, two, three and four.
(b) Consider an alloy of 65 wt% Cu and 35 wt% Al. Calculate the composition of the alloy in Atomic percentage.
Atomic weight of Cu = 63.54.
Atomic weight of Al = 26.98. [8+8]
5. Distinguish between peritectoid & Eutectoid reaction. What is the practical importance of the alloys undergoing these transformations [with examples.] [16]
6. (a) Compute the mass fraction of ferrite and cementite in pearlite.
(b) Explain the differences between hypo eutectoid and hypereutectoid steels.
(c) In a hypo eutectoid steel both eutectoid and proeutectoid ferrite exist. Explain the differences between them. [5+5+6]
7. (a) Compare and contrast the structural features of pearlite with that of Bainite.
(b) "Steel is made hard by Quenching". State at least three conditions which must be fulfilled to justify the above statement. [8+8]
8. (a) Draw the isothermal transformation diagram for an eutectoid steel. Superimpose various continuous cooling transformation lines on it and explain the phase transformation during such cooling.

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- (b) How does a continuous cooling transformation diagram differ from an isothermal transformation diagram. [10+6]

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1. Give an account on the following:
 - (a) Condenser system
 - (b) Light filters
 - (c) Objective lens [6+5+5]
2. Discuss BCC, FCC and HCP structures with examples. [16]
3. (a) What is a solid solution? Give the classification and explain the rules for the formation of solid solutions.
(b) Explain why atomic size difference is only 4.2% still Zn can dissolve up to 38.4% in Cu? [8+8]
4. (a) What are the important characteristics of grain boundaries? Discuss the role of grain boundaries for low temperature and high temperature applications.
(b) Differentiate between a crystal, a dendrite, a grain and a grain boundary. [8+8]
5. (a) What is allotropy? What is allotropic transformation? Give any three examples which show allotropic transformation and explain them.
(b) Explain the allotropic transformation of Iron. [9+7]
6. (a) Explain the phase changes that take place when an eutectoid steel is cooled from 900^o C to RT.
(b) Distinguish between steels and cast irons and highlight the importance of each of them as engineering materials. [7+9]
7. (a) Explain the mechanism of heat removal from a work piece during Quenching.
(b) Explain the martensitic transformation by bain distortion method. [7+9]
8. (a) 'In a TTT curve the incubation period is initially large (at =700^oC), which decreases (as the amount of under cooling increases) to a minimum at the nose of the curve and then increases'. Justify the correctness/in correctness of the above statement. Give the necessary reasons
(b) CCT curve of eutectoid steel is displaced towards right and lowered as compared to its TTT curves. Explain, why? [10+6]

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1. (a) What is aperture diaphragm? Indicate its main purpose.
(b) What are the properties of objectives?
(c) Name two different types of diaphragms used in metallurgical microscopes and briefly explain each one of them. [6+4+6]
2. (a) Define space lattice and unit cell. Name three important types of space lattices and briefly explain each one of them with neat sketches.
(b) Prove that the packing factor for FCC metals is 0.74. [9+7]
3. (a) What is a solid solution? Give the classification and explain the rules for the formation of solid solutions.
(b) Explain why atomic size difference is only 4.2% still Zn can dissolve up to 38.4% in Cu? [8+8]
4. (a) Explain why is the grain boundary irregular.
(b) Distinguish clearly between low angle, grain boundary and high angle grain boundary. [6+10]
5. What are the various types of derived two dimensional phase diagrams from ternary phase diagram? Explain them fully. [16]
6. (a) Discuss briefly all the possible Alloy phases in binary alloy.
(b) Discuss the properties & Applications of copper and its Alloys. [8+8]
7. (a) Compare and contrast the structural features of pearlite with that of Bainite.
(b) "Steel is made hard by Quenching". State at least three conditions which must be fulfilled to justify the above statement. [8+8]
8. (a) What do you mean by the term incubation period? Explain.
(b) Why do you obtain a 'C' shape for the TTT diagrams? (eutectoid steels). Explain.
(c) What information may be obtained from TTT diagram? Explain. [6+5+5]
