

II B.Tech. I Semester Regular Examinations, November -2005**PHYSICAL METALLURGY
(Metallurgy & Material Technology)****Time: 3 hours****Max Marks: 80****Answer any FIVE Questions
All Questions carry equal marks**

1. (a) Name various parts of an optical microscope and briefly explain each one of them.
(b) Differentiate between optical microscope and scanning electron microscope. [8+8]
2. (a) The atomic radius of Iron is 1.24 \AA . Calculate the lattice parameter of BCC and FCC iron.
(b) Determine the number of lattice points per unit cell in the simple cubic, face centered cubic and body centered cubic crystal systems. [7+9]
3. Write short notes on the following:
(a) Transformation of indices
(b) Miller indices of a plane and direction. [8+8]
4. (a) Cu can dissolve any amount of Ni in solid state and vice-versa. Justify the above statement with the help of Hume Rothery rules for the formation of solid solutions.
(b) What is the difference between random and ordered solid solution?
(c) What is the role of energy of like bonds and unlike bonds in them? [6+4+6]
5. (a) Explain the lever rule as applied to equilibrium diagrams.
(b) "Eutectic composition usually does not show coring whereas a solid solution may show coring". Explain why. [8+8]
6. (a) Explain Eutectoid and peritectoid reactions with suitable examples.
(b) Explain in detail the construction of a phase diagram for an EUTECTIC system by thermal analysis method and label the phases in it. [8+8]
7. (a) What is cementite ? What type of compound is it. Explain its properties.
(b) Why does proeutectoid product form at grain boundaries of Austenite.
(c) What is normally the form in which proeutectic ferrite & Pro eutectoid cementite form?.How to distinguish between these phases, particularly when the two steels have a carbon content of 0.7% & 0.9% [6+5+5]
8. (a) Differentiate between CCC & TTT diagrams.
(b) Explain about the bainitic transformation. [10+6]

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1. Write short notes on the following:
 - (a) Filters
 - (b) Interference methods
 - (c) Phase contrast [5+6+5]
2. (a) What are the seven important crystal systems and define them with reference to lattice parameters and angle between them.
(b) Prove that the packing factor for BCC metals is 0.68. [9+7]
3. (a) Discuss procedure for finding the Miller indices for directions with suitable examples.
(b) Why titanium and magnesium exhibit poor ductility? [8+8]
4. (a) What are the different types of solid solutions. Explain interstitial solid solution with suitable examples.
(b) Discuss in detail the necessity of alloying and explain the same with four specific examples. [8+8]
5. (a) With reference to a hypothetical equilibrium a diagram describe how coring occurs during solidification, under normal industrial conditions of a solid-solution alloy. [8]
(b) Describe how coring is prevented or removed by
 - i. Cooling under equilibrium conditions
 - ii. Annealing after normal solidification. [4+4]
6. What is an invariant reaction. What are the various invariant reactions in equilibrium diagrams of the Binary type and Explain them fully with suitable examples. [16]
7. Discuss critically the changes that take place during slow cooling of 0.5% carbon steels from Austenitic range. What is the effect of increasing cooling rate on
 - (a) Temperature of austenitic transformation.
 - (b) Fineness of pearlite.
 - (c) Amount of proeutectoid constituents. [5+5+6]

8. (a) Differentiate between CCC & TTT diagrams.
(b) Explain about the bainitic transformation.

[10+6]

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1. (a) Give an account on resolution and depth of field.
(b) Name the characteristics that can be measured using polarized light and discuss. [8+8]
2. (a) The atomic radius of Iron is 1.24 \AA . Calculate the lattice parameter of BCC and FCC iron.
(b) Determine the number of lattice points per unit cell in the simple cubic, face centered cubic and body centered cubic crystal systems. [7+9]
3. (a) What is allotropy? Discuss various allotropic forms of iron and their properties.
(b) Explain why increase of pressure may give allotropic transformation to close packed structure? [8+8]
4. (a) What is a solid solution? What is an intermetallic compound? Distinguish between solid solution and intermetallic compound with examples.
(b) Explain with neat diagrams how the micro - structure of a pure metal may change with addition of alloying elements. [8+8]
5. (a) What is coring? Which alloys show cored structure and under what conditions?
(b) Is coring desirable? If no explain methods of eliminating coring? [8+8]
6. Explain any THREE of the following:
 - (a) Incongruent melting alloys
 - (b) PSUEDO-EUTECTIC alloys.
 - (c) Construction of phase diagrams by Metallographic method.
 - (d) Raoult's law. [16]
7. Distinguish between peritectoid & Eutectoid reaction. What is the practical importance of the alloys undergoing these transformations [with examples] [16]
8. (a) Draw the T-T-T diagram for a eutectoid steel label the various regions & lines. Explain the effect of various elements on the position and shape of T-T-T diagram..
(b) Explain the Pearlitic & Martensitic transformation. [8+8]

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1. (a) What are the fundamental assumptions and laws on which light optical theory depends? Briefly explain each one of them.
(b) Differentiate between upright and inverted microscopes. [10+6]
2. (a) With a neat sketch, show the octahedral positions in FCC structure. Also calculate the radius of the octahedral void in the FCC structure relative to the radius of the atom.
(b) What is stacking sequence? Write the stacking sequence for FCC and HCP metals. [10+6]
3. (a) Give an account on Miller indices of planes with examples.
(b) Explain Miller indices of direction with examples. [8+8]
4. (a) Explain briefly the effect of alloying elements on the properties of steel as a substitutional and interstitial alloying element.
(b) Give a detailed account of chemical compounds and size factor compounds. [8+8]
5. (a) Suppose that the solid nickel was able to nucleate homogeneously with an under cooling of only 22°C. How many atoms would have the group together spontaneously for this to occur.
Assume that the lattice parameter of the solid FCC nickel is 0.356 nm.
Data
Nickel freezing temperature : 1453°C
Surface energy : $255 \times 10^{-3} \text{ J/m}^2$
Latent heat of fusion : $2756 \times 10^6 \text{ J/m}^2$
(b) Explain the difference between planar growth and dendritic growth. [8+8]
6. Explain any THREE of the following:
(a) Incongruent melting alloys
(b) PSUEDO-EUJECTIC alloys.
(c) Construction of phase diagrams by Metallographic method.
(d) Raoult's law. [16]
7. (a) Classify copper alloys. Discuss the mechanism of increasing strength of copper alloys.

- (b) Calculate the relative amounts of various phases that are present in 0.5% C steel, just above & just below the peritectic temperature. [8+8]
8. (a) Draw the T-T-T diagram for a eutectoid steel label the various regions & lines. Explain the effect of various elements on the position and shape of T-T-T diagram..
- (b) Explain the Pearlitic & Martensitic transformation. [8+8]
