

II B.Tech. II Semester Regular Examinations, April/May -2005
METALLURGY AND MATERIAL SCIENCE
(Common to Mechanical Engineering, Mechatronics and Production Engineering)

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

Answer any FIVE Questions
All Questions carry equal marks

1. (a) Draw a neat sketch of CPH crystal structure and calculate the theoretical c/a ratio for the above structure.
(b) Define the term co-ordination number. What is the significance of co-ordination number? Calculate the Co-ordination number of three cubic space lattices.
2. (a) The Maximum solubility of carbon in gamma solid solution is 2% (interstitial void space is 26%) that of alpha Iron is 0.025%. (interstitial void space is 32%). Explain the reasons for the above behavior with neat sketches.
(b) Taking only 45 of the most common metals. Calculate maximum the number of possibly binary; ternary and tetranary alloy systems.
3. Draw the equilibrium diagram of Cu and Zinc system. For an alloy composition of 74% Cu and 26% zinc name the phases present at the following temperatures.
 - (a) 500⁰c
 - (b) 680⁰c
 - (c) 850⁰c.

Name the important points; lines and phases in the Cu-Zinc phase diagram.

4. (a) Give at least 3 advantages of steels over the family of cast irons.
(b) What are the various heat treatments given to cast irons? Explain them in brief.
5. (a) What are the requirements of an age-hardenable alloy.
(b) Give a typical heat treatment schedule for duralumin and explain the relevant microstructural changes.
6. (a) Explain why copper is a suitable material for Automobile radiators.
(b) What is dezincification? How it may be minimized.
(c) How does the addition of lead to brass improve its machinability.
7. (a) Write a short note on ceramic tools.
(b) List out the advantages and disadvantages of ceramic tools.
(c) List out the electrical properties of ceramic materials.
(d) Give reasons why there exist many types of ceramics?

8. (a) What do you understand by particulate strengthened composite materials? Discuss in detail.
- (b) What is a whisker? Give the importance of Whisker composites. Explain how the strength is imported by whiskers.

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1. (a) Draw the close packed planes and directions in simple cube, BCC and FCC crystals and find out the Miller indices of the planes.
(b) Explain briefly about the various types of crystal imperfections, with the help of neat sketches.
2. (a) Draw the cooling curves for a pure metal and a solid solution and explain the differences.
(b) 'Interstitial compounds are metallic where as inter metallic compounds are non-metallic'. Explain.
3. (a) Distinguish between
 - i. Terminal phase &
 - ii. intermediate phase.
(b) Draw a binary phase diagram where in two components are completely soluble in liquid state but only partly soluble in solid state. Label the important points; lines and phases in it. Explain the solidification process of a hypoeutectic alloy.
4. (a) Explain the Malleabilizing treatment given to white iron castings. Sketch the typical microstructure of malleable cast iron label the phases in it.
(b) What is High speed steel? Give the typical composition of High speed steel. Explain the part played by each of the alloying elements in tool steels. Explain the heat treatment process of High speed steel.
5. (a) Compare the annealing and normalizing of plain carbon steel, explaining the differences in thermal cycles given when the composition of steel increases from hypo to hyper eutectoid.
(b) Discuss the differences in microstructure and properties attained in a 0.8% C steel if
 - i. isothermally annealed at 700⁰ C
 - ii. isothermally held at 700⁰ C for a long time without any reaction and then quenched in water.
6. (a) Explain the various heat treatments and surface treatments to be done on aluminium and it's alloys to improve their performance.

- (b) Explain heat treatment, properties and applications of Ti - 6Al - 4V alloys.
- 7. (a) Differentiate between ceramic and non-ceramic materials.
(b) How ceramic components are formed? Explain.
(c) Compare the properties of crystalline ceramics and glass ceramics.
- 8. (a) Explain various phases in fibrous composites. Explain their functions.
(b) Write an essay why composites are very common in the aerospace industry. Explain with suitable examples.

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(b) Explain briefly about the various types of crystal imperfections, with the help of neat sketches.
2. (a) How are alloys classified according to the microstructures. Explain them fully with suitable examples.
(b) Explain the term 'Equilibrium conditions'.
(c) What do you mean by intermediate alloy phase? Explain any one type of intermediate alloy phase with suitable examples.
3. (a) "What do you understand by the term equilibrium diagram? Explain with an example.
(b) Explain the various applications of phase diagrams.
(c) What is lever rule? Explain how it is useful.
4. (a) Explain the difference in Microstructure and properties of white and gray cast Iron.
(b) Assume that a C clamp is to be made up of cast Iron. Select a suitable type of cast Iron and explain the reasons for the selection.
5. (a) What are the limitations of Austempering?
(b) What are the limitations of Martempering?
(c) 'Normalized steels are stronger than annealed steels'. Explain.
(d) Discuss the necessity and importance of surface hardening.
6. (a) Explain why copper is a suitable material for Automobile radiators.
(b) What is dezincification? How it may be minimized.
(c) How does the addition of lead to brass improve its machinability.
7. (a) What types of ingredients are added to ceramic particles in preparing ceramic raw materials for processing?
(b) Describe two methods for preparing ceramic raw materials for processing.
(c) Describe the four stages in the manufacture of spark plug insulator.

8. (a) What do you understand by particulate strengthened composite materials? Discuss in detail.
- (b) What is a whisker? Give the importance of Whisker composites. Explain how the strength is imparted by whiskers.

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1. (a) Derive the relationship between atomic radius and lattice parameter for FCC materials and calculate its packing factor.
(b) Draw a neat sketch of BCC crystal structure and calculate its packing factor and find out the effective number of atoms.
2. (a) Distinguish fully between interstecial compounds and interstecial solid solutions.
(b) Draw the cooling curves for a pure metal, solid solution, compound and explain the differences.
3. (a) Draw a neat sketch of $Fe-Fe_3C$ diagram and label all important points, lines and phases in it.
(b) Explain the solidification of hypo eutectic cast Iron.
4. (a) Explain the difference in Microstructure and properties of white and gray cast Iron.
(b) Assume that a C clamp is to be made up of cast Iron. Select a suitable type of cast Iron and explain the reasons for the selection.
5. (a) What are the limitations of Austempering?
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6. (a) Explain why copper is a suitable material for Automobile radiators.
(b) What is dezincification? How it may be minimized.
(c) How does the addition of lead to brass improve its machinability.
7. (a) Discuss sintering, hot pressing and liquid phase sintering as applicable to the processing of ceramic components.
(b) Explain in detail about the production and forming of glass.
8. (a) Define composite materials.
(b) What unique properties have they over the conventional materials?
(c) How do the composite materials differ from metallic alloys?

- (d) Mention some composite materials with their applications. Give their properties.

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