Code No: RR220302 **Set No. 1**

II B.Tech II Semester Regular Examinations, Apr/May 2006
METALLURGY AND MATERIAL SCIENCE
(Common to Mechanical Engineering, Mechatronics, Production Engineering and Automobile Engineering)

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

Answer any FIVE Questions
All Questions carry equal marks

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1. (a) Draw a neat sketch of CPH crystal structure and calculate the theoretical c/a ratio for the above structure. [8]
   (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. [8]
2. (a) The Maximum solubility of carbon in gamma solid solution is 2% (interstecial void space is 26%) that of alpha Iron is 0.025%). (interstecial void space is 32%). Explain the reasons for the above behavior with neat sketches. [10]
   (b) Taking only 45 of the most common metals. Calculate maximum the number of possibly binary; ternary and tetranary alloy systems. [6]
3. (a) Draw a neat sketch of $Fe-Fe_3$C diagram and label all important points, lines and phases in it. [10]
   (b) Explain the solidification of hypo eutectic cast Iron. [6]
4. (a) What is the disadvantage of too high a first stage annealing temperature for Malleable Cast Iron? Explain. [8]
   (b) Why are alloying elements added to steels? Give some examples of common alloying elements and their effect on the properties of steel.. [8]
5. (a) What are the requirements of an age-hardenable alloy. [4]
   (b) Give a typical heat treatment schedule for duralumin and explain the relevant microstructural changes. [12]
6. (a) 'Explain what is meant by alpha or beta stabilizer. [5]
   (b) Explain why the two phase titanium alloys are stronger than the single phase alpha alloys. [6]
   (c) How may alpha-beta titanium alloys be strengthened. [5]
7. (a) Compare the physical, chemical and mechanical properties of ceramics with those of metals. [9]
   (b) Discuss the different types of bonding in ceramics. [7]
8. (a) What is a hybrid composite? Give important advantages of hybrid composites over normal fiber composites. [8]

(b) Why composite materials are considered now a days as structural materials in engineering applications? Reason out. [8]

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1. (a) Discuss the characteristics of the unit cells of simple cubic and tetragonal type. [6]
   (b) Explain the term MOTIF. [4]
   (c) Explain the Schottky defect fully with the help of a neat sketch. [6]
2. (a) What are the conditions that are favorable for extensive solid solubility of one element in another? Explain them. [8]
   (b) Draw the cooling curves for short freezing range alloys and long freezing range alloys and explain salient points in it. [8]
3. (a) "What do you understand by the term equillibrium diagram? Explain with an example. [8]
   (b) Explain the various applications of phase diagrams. [4]
   (c) What is lever rule? Explain how it is useful. [4]
4. (a) Give at least 3 advantages of steels over the family of cast irons. [6]
   (b) What are the various heat treatments given to cast irons? Explain them in brief. [10]
5. (a) What are the limitations of Austempering? [4x4=16]
   (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) Why is Muntz metal heat treatable? Describe a typical heat treatment and the resulting microstructure. [4x4=16]
   (b) What properties would be important in the choice of a copper alloy spring?
   (c) Why is 'Manganese bronze' a misnomer?
   (d) Differentiate between the terms brass and bronze.
7. (a) What is the basic composition of soda-lime glass? Give its advantages, disadvantages and applications. [7]
   (b) What is the purpose of MgO and Al_2O_3 additions to soda-lime glass? [5]

(c) What is chemically strengthened glass? Why is chemically strengthened glass stronger in tension than annealed glass? [4]

8. (a) Explain what is meant by chemical bonding and mechanical bonding as it relates to a fiber-matrix interface. [5]

(b) Explain why it is necessary to thoroughly clean the surfaces of glass fibers to achieve a strong bond with epoxy matrix. [5]

(c) Explain why a strong interface is detrimental to the properties of ceramic-matrix composites. [6]

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Code No: RR220302 **Set No. 3**

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Answer any FIVE Questions
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1. (a) Name various types of inter atomic bonds by giving 2 examples for each one of them. [6]
   (b) Give axial and angular relationships of the various crystal systems. [6]
   (c) Calculate the radius of an atom of a crystal with a body centered cubic structure and a lattice constant of 4^0A. [5]

2. (a) The Maximum solubility of carbon in gamma solid solution is 2% (interstecial void space is 26%) that of alpha Iron is 0.025%). (interstecial void space is 32%). Explain the reasons for the above behavior with neat sketches. [10]
   (b) Taking only 45 of the most common metals. Calculate maximum the number of possibly binary; ternary and tetranary alloy systems. [6]

3. (a) Distinguish between microsegregation and macrosegregation. [6]
   (b) Explain the following: [10]
      i. Liquidus line
      ii. Solidus line
      iii. Solvus line
      iv. congruent melting alloys.

4. (a) Explain the effect of S, Mn, Si and phosporus on the properties of plain carbon steels. [4]
   (b) What is Red shortness and cold-shortness? [6]
   (c) What is burnt steel? How would you differentiate between burnt and over heated conditions? Can you restore burnt or over heated steels? [6]

5. (a) What are the requirements of an age-hardenable alloy. [4]
   (b) Give a typical heat treatment schedule for duralumin and explain the relevant microstructural changes. [12]

6. (a) Describe the effect of increasing zinc content on the properties of brasses. [6]
   (b) What is season cracking of brasses? How it is avoided? [5]
   (c) What is equivalent zinc of a brass? Explain its significance and usefulness. [5]

7. (a) Explain how dispersion strengthened composites are made by P/M method. [8]

(b) Write an essay on the present state of P/M industry in India. [8]

8. (a) Explain how the composite materials are produced by liquid metallurgy route. [8]

(b) What are the various solid state compaction processes that are used for the production of composite materials? Explain them. [8]

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1. (a) Derive the relationship between atomic radius and lattice parameter for FCC materials and calculate it's packing factor. [8]
   (b) Draw a neat sketch of BCC crystal structure and calculate its packing factor and find out the effective number of atoms. [8]
2. (a) Derive the degrees of freedom for a system, which has equal number of components and phases. [7]
   (b) Explain the following terms:
      i. Supercooling
      ii. Valence factor (Hume Rothery rules)
      iii. Random solid solutions. [9]
3. (a) Define and explain the structural phases. [3x3=9]
      i. Ferrite
      ii. Austenite
      iii. Cementite.
   (b) Describe the construction of the phase diagram for 2 metals completely soluble in liquid state and insoluble in solid state. [7]
4. (a) Explain the Malleabilizing treatment given to white iron castings. Sketch the typical microstructure of malleable cast iron label the phases in it. [8]
   (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. [8]
5. (a) Explain mechanism and kinetics of pearlite into austenite on heating steel.[8]
   (b) Discusss the effect of alloying elements on eutectoid transformation in steels. [8]
6. (a) What are the castable types of Aluminium alloys you know? Give the composition and industrial uses of LM6 alloys. [8]
   (b) Give examples of non-heat treatable type of aluminium alloys. What are their applications. [8]
7. (a) Give the composition and uses of common window glass (soda-lime glass) and boro-silicate glass. [6]

(b) Although glass is non-crystalline and is classified as a super-cooled liquid, what microstructural characteristics make it behave as a solid material? [6]

(c) Why must glass products be annealed after forming operations? [4]

8. (a) Explain how the crack propagates in the C-C composites if the bonding between the matrix and the fiber is poor. [8]

(b) Write an essay on modern composite materials with respect to reinforcement; matrices and the associated failure problems. [8]

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