

II B.Tech I Semester Regular Examinations, November 2008
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

1. (a) What is the importance of grain size in steel? How do you determine grain size of the given steel?
(b) Explain why grains are stronger than grain boundaries at high temperature and grain boundaries are stronger than grains at room temperatures? [8+8]
2. (a) Distinguish between commercially pure metal and an alloy?
(b) What is a master alloy? What are its chief characteristics?
(c) Justify the statement “ Alloy is a material which is expected of a metal, but it is not a pure metallic element”. [6+6+4]
3. (a) Name possible types of Cementite in Fe-Fe₃C diagram? Explain why proeutectoid product forms at grain boundaries of austenite ?
(b) Differentiate between
 - i. Proeutectoid ferrite and eutectoid ferrite
 - ii. Hypoeutectic and Hyper eutectic white cast iron. [8+8]
4. What are four basic types of cast Irons? Explain them with respect to properties, microstructure with a diagram and applications? [16]
5. (a) What is an alloy? Give two examples.
(b) Discuss in detail the effect of alloying elements in steels. [4+12]
6. (a) Alpha brasses are cold worked while Alpha-Beta brasses are hot worked. Explain.
(b) Extensive coring occurs in cast bronzes compared to cast brasses. Give reasons.
(c) What is dezincification? What are its effects? How is it prevented? [7+4+5]
7. (a) In a heterogeneous multiphase refractory, what are the microstructural features present? Mention their applications.
(b) Why chemically synthesized magnesium-aluminate spinel is used exclusively as refractory in molten salt electrolysis cell for producing magnesium? [10+6]
8. (a) What is aspect ratio? Why is it so important?

Code No: 07A3EC09

Set No. 1

(b) Discuss briefly about whisker reinforced composites?

[6+10]

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1. (a) Define crystallization of metal? How is that commercial alloy invariably solidify with heterogeneous nucleation?
(b) What factor favours the formation of fine grained material? How is a large single crystal being produced? [8+8]
2. (a) Discuss in detail the necessity of alloying with few examples.
(b) Explain how are alloys actually made in industry? [8+8]
3. (a) Define cast irons ? Explain the cooling history of 4.3% C in Fe-Fe₃C system by drawing cooling curve?
(b) Calculate proportionate of different phases for 2.8%C in Fe-Fe₃C diagram at 1200⁰C, 1173⁰C, and 600⁰C. Also draw the microstructures at room temperature? [6+10]
4. (a) Why stainless steels are stainless?
(b) Is it possible to harden 18%Cr-8%Ni steels by heat treatment?
(c) Why Austenitic stainless steels prone to welddecay? How can you avoid weld decay? [2+7+7]
5. (a) Distinguish between hardness and hardenability.
(b) Critically discuss Pack carburizing of steels. [5+11]
6. (a) What are light metals? Explain the important characteristics of aluminium and its alloys.
(b) Describe alloy and temper designation of Al and its alloys. [8+8]
7. (a) Calculate the density of FeO which has an NaCl-type structure. (assume stoichiometry). Radius of Iron is 0.74A⁰ & oxygen is 1.40 A⁰.
(b) Discuss briefly the structure, properties and uses of Al₂O₃. [6+10]
8. (a) Explain how to improve damping ability of a composite.
(b) Compare and contrast whisker and particulate reinforced composites. [6+10]

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1. (a) Define grain and grain boundary? How does the presence of grain boundary affect the physical and mechanical properties of metals?
(b) What is the effect of heating rate and cooling rate of steel on grain growth and properties of steel?(Consider heating to Austenite zone and cooling from the same zone)? [8+8]
2. (a) What are intermediate phases? Discuss various types of intermediate phases?
(b) What is the importance of ratio of radius of interstitial to solvent atom in interstitial compounds? [8+8]
3. (a) Discuss the effect of alloying elements in Fe-Fe₃C diagram?
(b) Discuss the effect of carbon on
 - i. Mechanical properties
 - ii. Grain size. [8+8]
4. (a) Give the heat treatment and applications for the following steels
 - i. Austenitic stainless steels
 - ii. Martensitic stainless steels
 - iii. Ferritic stainless steels
 - iv. Precipitation hardening stainless steels.
(b) Explain each type of steel with chemical composition, microstructure, properties and applications? [16]
5. (a) What is the difference between Iron-Cementite and Iron-graphite phase diagram?
(b) Draw T-T-T diagram for a eutectoid steel and explain the effect of cooling rate on the transformation products and hardness obtained. [6+10]
6. (a) Differentiate between oxygen free high conductivity copper and electrolytic tough pitch copper. Indicate their relative conductivities.
(b) For any three important brasses, give composition, treatment, structure, properties and applications. [4+12]
7. Discuss the effect of the following factors on mechanical behaviour of ceramic materials:

Code No: 07A3EC09

Set No. 3

(a) grain size and shape

(b) Purity and

(c) Porosity

[8+4+4]

8. (a) What are laminates? Indicate their characteristics.

(b) Compare and contrast carbon matrices with glass matrices.

[6+10]

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1. Write a short note on
 - (a) Nucleation and growth
 - (b) Micro segregation and macro segregation
 - (c) Homogeneous and Heterogeneous nucleation
 - (d) Directional solidification. [4+4+4+4]

2.
 - (a) Why is an octahedral void called Octahedral?
 - (b) Draw a unit cell of FCC and also show atleast one octahedral void in it. How many such voids are present in it?
 - (c) Draw a unit cell of BCC and show atleast one octahedral void in it. How many such voids are present in it?
 - (d) Draw a unit cell of HCP. Show one of the octahedral holes in it. How many octahedral holes are present in it? [4+4+4+4]

3. Duralumin alloy rivets used in aircraft construction are kept at -40°C after solution treatment. Whenever required they are taken out and riveted on the spot. Explain the reason for keeping them at -40°C and also explain how rivets operation at room temperature strengthen the rivets? [16]

4.
 - (a) Give the classification of stainless steels?
 - (b) Explain each type of steel with chemical composition, microstructure, properties and applications? [4+12]

5.
 - (a) What is Martensite? Distinguish between Lath Martensite and Accicular martensite.
 - (b) Discuss briefly Nitriding of steels. [8+8]

6. Discuss the following alloys:
 - (a) Cupronickels
 - (b) Beryllium Bronzes. [8+8]

7.
 - (a) Compare the properties of crystalline ceramics and glass ceramics.
 - (b) Why annealing and tempering operations are performed on glass? Describe. [10+6]

Code No: 07A3EC09

Set No. 4

8. (a) What is the role of matrix in a composite material? Discuss various types matrix materials.
- (b) Indicate any one important metal matrix composite and mention its characteristics, properties and applications. [8+8]
