

II B.Tech II Semester Supplementary Examinations, Aug/Sep 2007
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) Explain crystallization process in pure metals.
(b) What is bonding energy, bond length and atomic Radii? Explain them. [8+8]
2. (a) What are size factor compounds? Explain with suitable examples.
(b) Discuss the conditions that are most favourable for the formation of compounds and solid solutions.
(c) Distinguish between an alloy and alloy system with suitable examples. [6+6+4]
3. Explain in detail the following:
 - (a) Gibb's phase rule
 - (b) Raoult's law
 - (c) Eutectic alloys
 - (d) Cooling curves. [4 × 4 = 16]
4. Discuss the various types of cast irons with regard to their manufacture, composition, microstructure and appearance of fractures. [16]
5. (a) What are the advantages of gas carburizing compared with pack carburizing?
(b) What are the limitations of Austempering?
(c) What are the principal advantages of Austempering compared with the conventional quench and temper method? [6+4+6]
6. (a) Explain about Alpha and Alpha-Beta Alloys of Titanium .
(b) Which Aluminium casting alloy develops the highest mechanical properties?. Why?
(c) What is meant by anodizing of Aluminium? Explain . [6+5+5]
7. (a) Define the term ceramics. Give example for different traditional ceramics.
(b) What are structural ceramics? Discuss the important structural ceramics with examples and applications.
(c) What are the important characteristics of ceramics. [6+6+4]
8. (a) Define the term composites. What factors influence the final properties of composites? Explain.

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Set No. 1

(b) Explain about Glass Fibre-Reinforced Polymer composites. [8+8]

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1. (a) Why does the resistance to electric current increase on raising temperature? Explain based on metallic bonding.
(b) Give the properties of covalent bonded solids.
(c) Explain why we should study the crystal structure of metals. [6+6+4]
2. (a) Why are alloys produced? Name few alloys. Write their properties, applications and appropriate composition.
(b) How is the solid solution different from intermetallic compounds? Describe. [8+8]
3. Explain the following structural phase.
 - (a) Ferrite
 - (b) Austenite
 - (c) Cementite.
 - (d) Pearlite. [4+4+4+4]
4. (a) What are cast Irons? Why are they named so? Give the importance of cast irons in the metallurgical curriculum.
(b) Explain the microstructure, properties and applications of
 - i. White Cast Iron
 - ii. S.G. Cast Iron. [8+8]
5. (a) Explain the effects of
 - i. Sub-zero treatment
 - ii. Addition of carbon
 - iii. quenching media on the hardness of steels.
(b) Explain the various stages in an heat treatment cycle. [9+7]
6. (a) Discuss the various types of Titanium alloys giving their composition, properties and uses.
(b) What are the major differences between ferrous and Non ferrous metals? How are non ferrous metals classified? Explain. [8+8]
7. (a) Define the term ceramics. Give example for different traditional ceramics.

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Set No. 2

- (b) What are structural ceramics? Discuss the important structural ceramics with examples and applications.
- (c) What are the important characteristics of ceramics. [6+6+4]
8. (a) Explain the rule of mixtures in composites, How this rule is useful in analyzing the strength of composites.
- (b) What is the most serious problem associated with ceramic matrix composites. How is this problem addressed?
- (c) What are the properties of reinforced materials? [7+5+4]

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1. (a) Explain briefly bonds in solids.
(b) Give the properties of covalent bonded solids or compounds? [8+8]
2. (a) What do you mean by electron-atom ratio? Explain how you calculate electron-atom ratio for a given compound.
(b) What is relative size factor? Explain it. Explain its importance in the formation of substitutional solid solutions.
(c) Why an interstitial compound is expressed by a chemical formula but not an interstitial solid solution. [6+6+4]
3. (a) What is polymorphism? Explain Polymorphic transformations with suitable examples.
(b) Discuss the importance of phases and phase diagrams to a metallurgist or a material scientist. [8+8]
4. (a) What are cast Irons? Why are they named so? Give the importance of cast irons in the metallurgical curriculum.
(b) Explain the microstructure, properties and applications of
 - i. White Cast Iron
 - ii. S.G. Cast Iron. [8+8]
5. Explain and indicate the temperature ranges of the following heat treatments on (Fe-Fe₃C) equilibrium diagram:
 - (a) Process Annealing
 - (b) Full Annealing. [8+8]
6. (a) Explain, what you understand by season cracking in brasses and how can it be prevented?
(b) What characteristics of Aluminium make it resistant to corrosion ?
(c) How does anodisation increase the corrosion resistance of Aluminium? Explain.
(d) Do soldered Aluminium joints have good resistance to corrosion? Why? [4 × 4 = 16]
7. (a) Define the term ceramics. Give example for different traditional ceramics.

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Set No. 3

- (b) What are structural ceramics? Discuss the important structural ceramics with examples and applications.
- (c) What are the important characteristics of ceramics. [6+6+4]
8. (a) Explain any two methods of manufacture of composites.
- (b) Discuss about the following with relevant examples and applications: [8+8]
- i. Continuous-fiber reinforced MMC's
 - ii. Discontinuous-fiber reinforced MMC's.

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1. (a) Bring out the differences between Crystal, dendrite, grain and grain boundary.
(b) What do you mean by bonds in solids? What are the various types of bonds?
Give examples for each of them. [8+8]
2. (a) Why are alloys produced? Name few alloys. Write their properties, applica-
tions and appropriate composition.
(b) How is the solid solution different from intermetallic compounds? Describe.
[8+8]
3. (a) what is the curie temperature? Give the curine temperature for pure Iron.
(b) Explain the limitations of Iron-Iron carbide phase diagram.
(c) Calculate the relative amounts of the structural constituents present in furnace
cooled steel containing.
 - i. 0.3%C
 - ii. 0.6%C
 - iii. 0.8%C
 - iv. 1.25%C.[4+4+8]
4. (a) State the differences between hypereutectoid, eutectoid and hypereutectoid
steels.
(b) What are the characteristic properties of tool and die steels? [9+7]
5. (a) Explain the effects of
 - i. Sub-zero treatment
 - ii. Addition of carbon
 - iii. quenching media on the hardness of steels.
(b) Explain the various stages in an heat treatment cycle. [9+7]
6. (a) Explain, what you understand by season cracking in brasses and how can it
be prevented?
(b) What characteristics of Aluminium make it resistant to corrosion ?
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plain.

(d) Do soldered Aluminium joints have good resistance to corrosion? Why?
[4 × 4 = 16]

7. (a) Write short notes on ceramics for wear applications.
(b) What are ceramic composites? Give few examples. Give their composition and uses.
(c) What are the applications of silicon carbide and Aluminum oxide? [5+6+5]
8. (a) Most fibre reinforced composites consist of three parts: the fibre, the matrix and the interface. describe the major function of these parts with examples.
(b) Define and explain the following terms: [9+7]
- i. Strength
 - ii. Specific strength and
 - iii. Specific stiffness.
