

MATERIALS SCIENCE & ENGINEERING BRANCH

FIFTH SEMESTER

ML-9304 – Heat Treatment of Metals and Alloys

(REGULATIONS 2008)

Time : 3 hrs.

Max. Mark : 100

- Instructions :
1. Read questions carefully. Write 'to the point' answers
 2. Draw neat sketches wherever necessary

Answer ALL Questions

Part – A (10 x 2 = 20 Marks)

1. What are the constituent phases and their relative amounts in a 0.8% C-steel.
2. Draw a cooling curve for austempering treatment superimposed on a TTT-diagram.
3. Compare between the microstructures obtained by annealing and normalizing processes.
4. Neatly draw any one type of batch furnaces showing different parts.
5. Write down the basic principle of flame hardening process.
6. What are the effects of alloying elements on M_s (Martensite start) temperature?
7. What is temper embrittlement?
8. Name four common types of defects observed in heat-treated steels.
9. Which of the Cu-alloys and Ni-alloys are age-hardenable?
10. What is mottled cast iron?

Part – B (5 x 16 = 80 Marks)

11. (a) Draw Fe-C equilibrium phase diagram and mention all the temperatures and compositions of the relevant points clearly. Also point out various phase transformation reactions. (8)
- (b) (i) For a given steel composition of 0.88% C, what are the phases present in the microstructure at room temperature?
- (ii) Applying lever rule, calculate the percentages of the phases present in above case.
- (iii) State the effect of Silicon (Si) on the Fe-C phase diagram. (2+4+2)

12. (a) (i) Describe the transformations in hypo-eutectoid steels. Draw the respective microstructures. (8)

(ii) Discuss the kinetics of formation of austenite. (8)

OR

(b) Write short notes on the followings: (i) Spheroidizing, (ii) Normalizing, (iii) Chromizing and (iv) Sub-zero treatment. (4x4)

13. (a) (i) What is a thermocouple? Give examples of two base-metal thermocouples. (2)

(ii) With neat sketch, discuss the construction and working of a radiation pyrometer. (6)

(iii) Classify furnaces based on heat-source, usage, fuel type and operation. (8)

OR

(b) (i) Discuss in detail the structural changes during tempering. What is the implication of 'temper colours'? (6+2)

(ii) Compare between the following processes:

(A) Gas carburizing Vs. Vacuum carburizing, (B) Carbonitriding Vs. Nitriding. (4+4)

14. (a) (i) Discuss Bainitic transformation with respect to transformation mechanisms, kinetics, process and microstructures evolved. (10)

(ii) Explain Bain distortion model for Martensite formation and state its limitation. (6)

OR

(b) (i) Define hardenability. Differentiate between hardness and hardenability. (2+2)

(ii) Name the factors that influence hardenability. Discuss the effects of these factors. (6)

(iii) Describe Jominy end-quench test for determination of hardenability. (6)

15. (a) (i) Draw the microstructures and explain the important features of the followings:

(A) Grey cast iron, (B) White cast iron, (C) Malleable cast iron, (D) Ductile cast iron. (8)

(ii) Discuss the malleabilization of white cast iron. (8)

OR

(b) Discuss about the following types of steels with respect to properties/ characteristics, applications, approximate composition and heat-treatment:

(i) Maraging steel, (ii) Austenitic stainless steel, (iii) Water-hardening tool steel, (iv) Valve steel. (4x4)