

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. Question Nos. 1 to 11 are compulsory

Answer ALL Questions

Part – A (10 x 2 = 20 Marks)

1. What are the maximum solubility of Carbon in alpha-iron and delta-iron?
2. Define hyper-eutectic cast iron.
3. Draw a cooling curve for which Austenite will transform to 50% Pearlite and 50% upper Bainite.
4. Draw TTT-diagram for hypo-eutectoid steel.
5. Which of the Cu-alloys and Ni-alloys are age-hardenable?
6. What is mottled cast iron?
7. Write down the basic principle of nitriding process.
8. Draw a representative peritectic phase diagram.
9. What are the differences between white cast iron and grey cast iron?
10. Name four factors that affect hardening process.

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) Explain the microstructural changes on cooling from a temperature of 1000°C to room temperature for a 1.2% carbon-steel. Draw the respective microstructures. (8)
12. (a) (i) For a given steel composition of 1.2% 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 Manganese (Mn) on the Fe-C phase diagram. (1+4+2)
- (iv) Write short notes on any three of the followings: (A) diffusion annealing, (B) stress relieving, (C) partial annealing and (D) spheroidizing (9)

OR

- (b) (i) What are the stages of annealing? Explain the stage-I annealing process in detail. (5)
- (ii) Define recrystallization temperature. (2)
- (iii) Name the factors that affect recrystallization temperature and explain the dependence on those process parameters. (2+5)
- (iv) Write down the Avrami equation in context of grain growth. (2)

13. (a) (i) Discuss in detail the transformation mechanisms and kinetics of any two of the following processes: (A) Pearlitic transformation, (B) Bainitic transformation, (C) Martensitic transformation. (10)
- (ii) Write short notes on: (A) Martempering, (ii) Temper embrittlement (6)

OR

- (b) (i) Differentiate between hardness and hardenability. (2)
- (ii) Name the factors that influence hardenability. Discuss the effects of these factors. (6)
- (iii) With the help of a neat sketch, explain the mechanism of heat removal from a work-piece during quenching. (5)
- (iv) Bring about a comparative study between the following two quenchants: water and aqueous solutions. (3)

14. (a) (i) What are the basic principle of working of a thermo-couple? (2)
- (ii) Write down any six criteria for selecting thermocouple material. (4)
- (iii) Name two noble-metal-thermocouples and two base-metal-thermocouples. (2)
- (iv) Write short notes on: (A) Salt bath furnaces, (B) Continuous furnaces, (C) Batch furnaces. (8)

OR

- (b) (i) Write short notes on: (A) Laser hardening, (B) Carbonitriding and (C) Boronizing. (8)
- (ii) Discuss in detail the structural changes during tempering. What is the implication of 'temper colours'? (6+2)

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) (i) Drawing a flow chart discuss the heat treatment processes of various cast irons. (6)
- (ii) What is SG iron? how to obtain it? (2)
- (iii) What are the various types of tool steels? Write short notes on any two of them. (8)