

Code No: 09A51804

R09

SET-1

B. Tech III Year I Semester Examinations, December-2011
HEAT TREATMENT TECHNOLOGY
(METALLURGY AND MATERIAL TECHNOLOGY)

Time: 3 hours

Max. Marks: 75

Answer any five questions
All questions carry equal marks

- 1.a) Draw Fe-Fe₃C phase diagram and indicate the points, lines and areas.
- b) What is an invariant reaction? Explain three invariant reactions in Fe-Fe₃C phase diagram with complete information. [7+8]
2. Discuss the reaction that take place between the following in a furnace under controlled atmospheres and explain their role. (a) Metal and oxygen (b) Metal and carbon (c) Different gases. [15]
- 3.a) What are TTT curves? Explain the construction of TTT curves for 0.8% C steel.
- b) Explain the phase transformations in 0.8% steel cooled from austenite to room temperature under different cooling rates. [7+8]
- 4.a) Which factors affect the properties of a gray cast iron? How are they controlled to obtain optimum properties?
- b) Find the weight percentages of ferrite, graphite and cementite in a pearlitic-ferritic gray cast iron containing 4.0% total carbon and 0.4% combined carbon. [7+8]
- 5.a) What is quench severity? List the industrial coolants mentioning their quench severity in the increasing order.
- b) What is tempering? Explain its importance in the heat treatment of metals and alloys.
- c) Discuss the mechanism of heat removal during quenching. [5+5+5]
6. Write short notes on the following:
a. Austempering b. Martempering c. Patenting. [5+5+5]
7. Distinguish between the following surface hardening processes:
a. Nitriding b. Cyaniding c. Carbonitriding. [5+5+5]
8. Classify the type of cast irons with respect to the following: Composition, Microstructure, Mechanical properties and Applications. [15]

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HEAT TREATMENT TECHNOLOGY

(METALLURGY AND MATERIAL TECHNOLOGY)

Time: 3 hours

Max. Marks: 75

**Answer any five questions
All questions carry equal marks**

- 1.a) Hypo eutectoid steels are completely austenitized while annealing where as hyper eutectoid steels are not. Why? Explain with proper reasons.
- b) Maximum solubility of carbon in γ -iron is 2.0% while in α -iron is only 0.025. Why?
- c) What ASTM stands for? How ASTM grain size is defined? [5+5+5]
2. Write short notes on the following:
 - a) Conveyor furnace
 - b) Pit furnace
 - c) Muffle furnace[5+5+5]
3. Distinguish between the following:
 - a. Pearlite, bainite and martensite
 - b. TTT curves and IT curves. [8+7]
- 4.a) Explain the difference in microstructure, composition and properties of white and gray cast iron.
- b) Differentiate between free and combined carbon. c. Discuss the effect of the amount of free carbon on the properties of gray cast iron. [7+8]
- 5.a) What is annealing? Explain different types of annealing treatments.
- b) Explain the effect of size and mass of the material during quenching. [7+8]
6. Write short notes on the following:
 - a. Spheroidizing
 - b. Ausforming
 - c. Cryoforming[5+5+5]
- 7.a) Compare and contrast between induction hardening and flame hardening.
- b) What is nitriding? Explain the conditions for nitriding of steels. [7+8]
- 8.a) Distinguish between alloy steels and plain carbon steels.
- b) Explain the necessity of adding alloying elements to the plain carbon steels.[7+8]

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SET-3

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HEAT TREATMENT TECHNOLOGY

(METALLURGY AND MATERIAL TECHNOLOGY)

Time: 3 hours

Max. Marks: 75

**Answer any five questions
All questions carry equal marks**

- 1.a) What is the grain size when 0.2% steel is observed at 200X and grain size number 4?
- b) Why fine grain steel exhibit yield strength near to ultimate tensile strength compared to coarse grain steel? C. Define the terms: A_{c1} , A_{r1} , $A_{1,3}$, A_{cm} and A_3 temperatures with respect to Fe-Fe₃C diagram. [7+8]
2. Write short notes on the following with neat sketches:
a) Batch furnaces b) Continuous furnaces [7+8]
- 3.a) Why mild steel cannot be hardened? Explain.
b) What is bainite? Distinguish between bainite and martensite.
c) Distinguish between upper bainite and lower bainite. [5+5+5]
- 4.a) Distinguish between first stage of graphitization and second stage of graphitization?
b) Explain the effect of malleabilizing cycle on microstructure. [7+8]
- 5.a) What is hardening? Explain the role of alloying elements on hardening of steels.
b) Compare and contrast between full annealing and normalizing. [7+8]
6. Write short notes on the following:
a. Sub-zero treatment b. Thermo-mechanical treatment [7+8]
7. Explain the following surface hardening treatments with respect to process, temperature and applications:
a. Pack carburizing b. Cyaniding c. Induction hardening. [5+5+5]
- 8.a) What are maraging steels? Why they are named so?
b) Explain the heat treatment of maraging steels. [7+8]

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HEAT TREATMENT TECHNOLOGY

(METALLURGY AND MATERIAL TECHNOLOGY)

Time: 3 hours

Max. Marks: 75

**Answer any five questions
All questions carry equal marks**

- 1.a) Distinguish the cooling behavior of pure copper and eutectic alloy of iron and carbon.
- b) Explain the role of austenite grain size.
- c) What is austenitization? Explain the role of austenitization temperature. [5+5+5]
2. What are commercially available industrial atmospheres? Explain their usage in heat treatment industry, along with advantages and disadvantages. [15]
- 3.a) What is martensite? Explain its characteristics.
- b) Explain with a neat sketch the phase transformations under different cooling rates when 0.4%C steel is cooled from austenite region to room temperature. [7+8]
- 4.a) Is it possible to make nodular iron by heat treatment? Explain.
- b) Why should the sulfur content be low in the manufacture of nodular iron?
- c) What is the disadvantage of too high a first-stage annealing temperature for malleable cast iron? Explain. [5+5+5]
- 5.a) Why fine grained steels are tougher than coarse grained steels?
- b) Hyper eutectoid steels are partially austenitised during annealing whereas in normalizing fully austenitised. Why?
- c) Annealed medium carbon steels exhibit low yield strength and high ductility whereas normalized steels exhibit high yield strength and toughness. Why?[5+5+5]
6. Write short notes on the following:
a. Cryoforming b. Spheroidizing c. Martempering [5+5+5]
- 7.a) What is surface hardening? Explain the necessity of annealing after carburizing.
- b) Discuss about flame hardening treatment. [7+8]
- 8.a) What is duralumin? Explain its important properties.
- b) Explain the heat treatment of duralumin. [7+8]

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