

THAPAR INSTITUTE OF ENGINEERING AND TECHNOLOGY
MECHANICAL ENGINEERING DEPARTMENT
B.E IIIrd YEAR (MECHANICAL)
ME-039 INDUSTRIAL METALLURGY AND MATERIALS

MARKS: 60

TIME: 3 Hrs

Note: Attempt five questions in all. Q1. is compulsory. All questions carry equal marks.
Answers should be brief & to the point. Attempt all parts of a question at one place.
Draw neat and labeled diagrams wherever required.
Evaluated answer sheets can be seen in the office of teacher incharge on 16.12.06 between 10.00-11.a.m.

Q1.

- a) What is the basic difference in the case hardening treatment given to low carbon steels and that given to medium carbon steels. Why does such a difference exist?
- b) What are the three basic reasons for carrying out carburizing and other related processes only at high temperatures? What are the drawbacks of making such temperatures exceptionally high?
- c) What is temper embrittlement? Explain the conditions under which it occurs and the various measures to eliminate it?
- d) State the Harris equation? State its significance. For which steels is this equation applicable?

(3X4)

Q2.

- a) Surface heat treatments come into picture where conventional treatments can't be used. Discuss.
- b) Explain the role of activators with an example in case of pack carburizing?
- c) Discuss the steps involved in isothermal annealing.
- d) What is fourth stage tempering? What type of microstructure and characteristics are obtained in the steel after receiving this treatment?

(3X4)

Q3.

- a) Discuss what is a CCT diagram? Draw this labeled diagram for eutectoid steel. Bring out the main points of difference between a CCT diagram and the corresponding TTT diagram for the eutectoid steel?
- b) What is Widmanstatten structure? Under what conditions does it get formed? What type of heat treatment can be given to eliminate it?
- c) What are the benefits derived by normalizing hypereutectoid steel rather than full annealing it? Under what conditions normalizing can not eliminate full annealing?
- d) Describe with an example the difference between hardness and hardenability.

(3X4)

Q4.

- a) What is the reason behind the high hardness of martensite? On what factors does the M_s temperature depend? Which alloying elements can increase this temperature?

- b) For a eutectoid steel, below the lower critical temperature, as the transformation temperature is decreased, the incubation period first decreases up to the knee and then starts increasing. Why?
- c) Draw a neat labeled Iron-Iron Carbide diagram? Mark all the critical temperature lines and also the invariant reaction points on it? Is this diagram a true equilibrium diagram? Explain.
- d) Why steels are generally rolled and forged between 800-1000°C temperature range? (3X4)

Q5.

- a) State and explain the Gibb's rule? What is the significance of this phase rule?
- b) How do the phases affect the properties of a metallic system? Explain with an example.
- c) What is meant by the term alloy? With the help of a line diagram, show the metallurgical classification of binary alloys.
- d) What are the factors on which coring depends? What are the consequences of this defect when present in steel?

(3X4)

Q6.

- a) What is meant by the term components of a system? Explain with examples.
- b) What are type II systems? Why are these called eutectic systems? With the help of thermal analysis technique, obtain the Pb-Sn equilibrium diagram.
- c) What are the main points of difference between inherently fine and inherently coarse grained steels?
- d) What do the A_0 , A_2 and A_{cm} lines signify?

(3X4)