Yogesh

08/12/2015

Total Pages—5

B.Tech-5th-PE

Materials Engg. and Metall.

Full Marks : 70

Time : 3 hours

Answer **Q. No. 1** which is compulsory and any **five** from the rest

The figures in the right-hand margin indicate marks

1. Answer the following : 2 × 10

(a) State Fick's law of diffusion. What is the driving force for diffusion and just show how it is incorporated in this law ?

(b) Differentiate between Frenkel and Schottky defects.

(c) What is burger vector ? What is its role in edge and skew dislocations ?

(d) What is lever rule ? Explain with an example.

(e) What is eutectic reaction ? Give an example.

(f) What is austempered ductile iron ?

(g) What is special about of Martensitic transformation of steel ?

(h) How does hardness change from low carbon steel to medium carbon steel to high carbon steel ? Explain.

(i) Give the composition and main properties of one high-speed steel ?

(j) What is critical cooling curve ? How and why is it critical ?

2. (a) What is work-hardening ? Explain how does it improve the strength of ductile metals ? 5

(b) How can one get back some properties of metals after cold-working through recovery, recrystallization and grain-growth ? Briefly explain. 5

3. (a) What type of point defect is seen in Copper-Nickel system ? State four favourable conditions that cause this type of defect in this system. 4

(b) What type of alloy system is seen in this Cu-Ni alloy ? Draw a phase diagram for Cu-Ni system and discuss the phase changes with microstructure for an alloy containing 65 wt% Cu and 35 wt% Ni being cooled from 1400 °C to room temperature. 6

4. (a) Draw a neat TTT diagram and show on it isothermal transformation lines for producing pearlite, bainite, martensite and their mixtures. Explain the transformations with micro-structures on the plot itself. 6

(b) How does continuous cooling transformation (CCT) diagram differ from TTT diagram ? Show it by drawing a CCT diagram. Also place cooling lines on it to show end products of pearlite, bainite, martensite and their mixtures. 4

5. (a) State the expressions (formulae) for linear as well as volume thermal expansion of materials. How do the linear and volume coefficients of expansion relate to each other when expansion is isotropic. Also state the effect of temperature on thermal expansion. 5

(b) What is age-hardening ? Explain through an example (with phase diagram and micro-structure) how solution heat-treatment and precipitation heat-treatment bring in the desired changes. 5

6. (a) Briefly discuss various types of annealing procedures used for ferrous alloys. Use diagrams wherever necessary. 6

(b) Also briefly discuss normalizing procedure for ferrous alloys indicating the advantages derived from the processing. 4

7. (a) Draw the eutectoid portion of the Iron-Cementite phase diagram (between 500-1000 °C, and 0 - 2 wt% C). Mark the

important phase fields, temperatures and compositions. Draw a vertical cooling line at 1 wt% C and describe, on the diagram itself, phases with microstructures at various relevant stages. 6

(b) Calculate the percentage of the cementite and austenite just above the eutectoid. 4

8. Write short notes (any *two*) : 5 + 5

(i) Stainless steel

(ii) Tilt, twist and twin boundaries

(iii) Spheroidizing.
