Registration No. :

Total number of printed pages – 3

B. Tech
PCME 4203

Third Semester Back Examination – 2014

INTRODUCTION TO PHYSICAL METALLURGY AND ENGG MATERIALS

BRANCH(S) : AUTO, MANUFACT, MANUTECH, MECH

QUESTION CODE : L 323

Full Marks – 70

Time : 3 Hours

Answer Question No. 1 which is compulsory and any **five** from the rest.
The figures in the right-hand margin indicate marks.

1. Answer the following questions : 2 × 10

   (a) What is the effect of atomic packing factor on formability ?

   (b) Differentiate between substitutional and interstitial solid solutions.

   (c) Draw the stress–strain diagram for brittle and ductile materials.

   (d) Within a cubic crystal show the directions [212] and [302].

   (e) Differentiate between homogeneous and heterogeneous nucleation.

   (f) What is recrystallisation ?

   (g) On the basis of microstructure, briefly explain why mild steel is ductile.

   (h) What is the effect of chromium on steel ?

   (i) Why usually hardening is followed by tempeing ?

   (j) Give some typical applications of grey cast iron and white cast iron.

2. (a) Sketch a screw and edge dislocation and indicate how they govern the plastic deformation in crystals. 5

(b) Calculate the number of vacancies per cubic meter in gold at 900°C. The energy for vacancies formation is 0.98eV/atom. Furthermore, the density and atomic weight for Au are 19.32g/cm³ and 196.9g/mol, respectively.   5

3. (a) Explain and find an expression for resolved shear stress. What is critical resolved shear stress ?   5

(b) A stress of 85 MPa is applied in the [001] direction, on an BCC single crystal. Calculate the resolved shear stress for the (011) [111] slip system.   5

4. (a) What are the Hume-Rothery rules for the solid solubility ?   3

(b) Differentiate between isomorphous phase diagram and binary eutectic phase diagram.   2

(c) Explain how a cored structure is produced in a 70% Cu-30% Ni alloy.   5

5. (a) Draw Iron-carbon equilibrium diagram. With respect to this diagram explain the eutectoid, eutectic and peritectic reactions indicating the temperatures and compositions where these reaction are taking place.   6

(b) From the iron-iron carbide phase diagram, for a 0.2%C steel, name the phases and their fractions at equilibrium at the following temperatures :   4

(i) just above eutectoid temperatures and

(ii) just below eutectoid temperature

6. (a) What is a T-T-T diagram ? Why it is also called as isothermal transformation diagram ? How is this transformation influenced by addition of chromium and nickel ?   5

(b) With the help of TTT diagram describe the full-annealing, normalizing and hardening heat treatment processes for a plain-carbon steel and also mention the types of microstructures produced by these processes.   5

7. (a) Define the hardenability of a steel. Define the hardness of a steel. Describe the Jominy hardenability test.   6

(b) Define stainless steel. For what purpose these are used ? Classify stainless steels on the basis of predominant phase constituent of the microstructre.

4

8. (a) Explain briefly how continuous-glass fibers are made. What is the difference between a fiber and a whisker ? 4

(b) What is the sintering process ? What occurs to the ceramic particles during sintering ? 4

(c) What do you mean by nanomaterial ? 2

_____