Registration No. : | | | | | | | | | | |

Total number of printed pages – 3

B. Tech

PCME 4203

Third Semester Regular Examination – 2014

INTRODUCTION TO PHYSICAL METALLURGY AND ENGG MATERIALS

BRANCH(S) : AUTO, MANUTECH, MECH

QUESTION CODE : H 393

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) Draw the $[1\bar{2}1]$ direction and $(\bar{2}10)$ plane in a cubic unit cell.

(b) Differentiate between substitutional and interstitial solid solutions.

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

(d) Calculate the length of the Burgers vector in copper, if it has FCC crystal structure and lattice constant of 0.36151 nm.

(e) Differentiate between recovery and recrystallisation.

(f) Contrast the microstructure between spheroidite and tempered martensite.

(g) If the grain size is refined then what happens to the strength of the specimen ?

(h) What are nanomaterials ?

(i) Differentiate between thermosetting and thermoplastic materials.

(j) What is sintering process ?

2. (a) Describe and illustrate the edge and screw dislocations. Draw Burgers circuit to show magnitude and direction of Bugers vector on a crystal having edge dislocation. 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/cm^3 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 single crystal of a metal that has the FCC crystal structure is oriented such that a tensile stress is applied parallel to the [100] direction. If the critical resolved shear stress for this material is 0.5 MPa, calculate the magnitude of applied stress necessary to cause slip to occur on the (111) plane in [011] direction. 5

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

(b) Draw binary isomorphous phase diagram of any two component system (say AB system) and show salient points on it 3

(c) Consider a Pb-70% Sn alloy. Determine 4

(i) The amounts and compositions of each phase at 184°C,

(ii) The amounts and compositions of each phase at 182°C

5. (a) Draw Iron-carbon equilibrium diagram and label the phase fields. Discuss in brief the different reactions that take place in this system. 5

(b) Consider 2.5 kg of austenite containing 0.65 wt% C, cooled to below the eutectoid temperature 5

(i) What is the proeutectoid phase ?

(ii) How many kilograms each of total ferrite and cementite form ?

(iii) How many kilograms each of pearlite and the proeutectoid phase form ?

Schematically sketch and label the resulting microstructure.

6. (a) Make a copy of the isothermal transformation diagram for an iron-carbon alloy of eutectoid compostion and then skrtch and label time-temperature paths on this diagram to produce the following microstructures : 5

(i) 100% coarse pearlite

(ii) 50% martensite and 50% austenite

(iii) 50% coarse pearlite, 25% bainite and 25% martensite.

(b) With respect to isothermal transformation diagram explain what transformations will take place when a steel with 0.5%C is cooled at a

(i) slow rate and

(ii) fast rate. How is this transformation influenced by addition of chromium and nickel ? 5

7. (a) Describe the Jominy end quench test. Draw the hardenability curves for plain carbon steel and different alloy steels. What is the significance of these curves. 5

(b) Describe how steel is designated. What are alloy steels ? Explain the composition , properties and applications of following stainless steels : 5

(i) austenitic and

(ii) martensitic.

8. (a) Discuss the structure of an optical fibre. What are various types of fibres ? Explain their advantages over conventional transmission devises. 5

(b) Explain briefly how the volume of fiber, fiber orientation, and fiber strength and modulus affect the properties of fiber-reinforced composites. 5
