

B.Tech. 3rd Semester Exam., 2013

MATERIAL SCIENCE

Time : 3 hours

Full Marks : 70

Instructions :

- (i) The marks are indicated in the right-hand margin.
- (ii) There are **NINE** questions in this paper.
- (iii) Attempt **FIVE** questions in all.
- (iv) Question No. 1 is compulsory.

1. Choose the correct answer (any seven) :

2×7=14

(a) Which is closest to the purest form of iron?

- (i) Cast iron
- (ii) Wrought iron
- (iii) Grey iron
- (iv) Mild steel

(b) The process of isothermal transformation to form bainite in steel, is known as

- (i) austempering
- (ii) austenitizing
- (iii) barkerising
- (iv) polymerization

(c) Which of the following is not a permanent magnetic material?

- (i) Chromium steel
- (ii) Silicon iron
- (iii) Cobalt steel
- (iv) Alnico

(d) Which one of the following materials is viscoelastic in nature?

- (i) Nylon
- (ii) Glass
- (iii) Rubber
- (iv) Graphite

(e) If the structure of a sample consists of pearlite, cementite and free carbon, the sample may be

- (i) cast iron
- (ii) alloy steel
- (iii) dead mild steel
- (iv) eutectoid steel

(f) Pearlite is obtained when steel is

- (i) quenched in oil
- (ii) cooled in still air
- (iii) slowly cooled in furnace
- (iv) quenched in water

- (g) A material having different properties in different directions, is known as
- (i) isotropic
 - (ii) amorphous
 - (iii) austenitic
 - (iv) anisotropic
- (h) Tempering of hardened steel is done to increase its
- (i) ductility
 - (ii) grain size
 - (iii) surface condition
 - (iv) carbon content
- (i) The fatigue strength of materials increases
- (i) with temperature
 - (ii) by providing scratches on the surface
 - (iii) by providing notches
 - (iv) by under-stressing the material
- (j) The capacity of a metal to exhibit considerable elastic recovery upon release, is known as
- (i) toughness
 - (ii) resilience
 - (iii) hardness
 - (iv) stiffness

2. (a) Give the classification of ceramic materials, organic materials, electrical materials and magnetic materials with their properties and applications. 8
- (b) Write short notes on : 6
- (i) Nanomaterials
 - (ii) Biomaterials
 - (iii) Optical fibre
3. (a) What is a 'phase diagram'? How is it classified? What useful information does it provide? 6
- (b) State Gibbs' phase rule. What is the minimum and maximum number of phases which could exist in a pure metal? 4
- (c) Discuss the Hume-Rothery rules for alloy formation. 4
4. Draw the iron-carbon phase diagram and discuss briefly the structure and properties of steel having 0.83% and 0.40% carbon when cooled from 1000 °C to room temperature. 14
5. (a) Draw a TTT diagram of eutectoid steel. Discuss all the transformation with the rate of cooling. 8

- (b) Why continuous cooling of plain carbon steel does not show bainite in its microstructure? 6
6. (a) What effect does a change in heating or cooling rate have upon the transformation temperature in steel? 6
- (b) Calculate the thickness of micro-constituents present in pearlite if density of ferrite and cementite is 7.76 gm/cc and 7.66 gm/cc respectively. 4
- (c) A steel contains 40% ferrite and 60% pearlite at room temperature. Determine the amount of total ferrite and cementite present in the alloy. 4
7. (a) What are the various types of annealing? Where are they used? 6
- (b) What is the major difference in the purpose of annealing and normalizing? 4
- (c) "Hardening of steel is always followed by tempering." Is it true or false? If true, give reasons. 4
8. (a) What are the different types of composite materials available? Give their suitable examples with applications. 6

- (b) What are the most important rules for designing composite parts? 4
- (c) Write the applications of cemented carbide composite. 4
9. Distinguish the following : 14
- (a) Plain carbon steel and Alloy steel
- (b) White cast iron and Malleable cast iron
- (c) Grey cast iron and Spheroidal grey iron
- (d) Eutectics and Eutectoids
