Code : 021305

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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) austeniting

(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) Temperating 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

(Turn Over)

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

(Continued)

(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) Euterics and Eutectoids

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