GIET UNIVERSITY, GUNUPUR – 765022
B. Tech (Third Semester – Regular) Examinations, December – 2020
BPCME 3040 – Material Science
(Mechanical Engineering)

Time: 2 hrs   Maximum: 50 Marks

The figures in the right hand margin indicate marks.

PART – A: (Multiple Choice Questions)   **(1 x 10 = 10 Marks)**

Q.1. Answer *ALL* questions

a. The reaction in which two solid phases react to form a new solid phase is called

  (i) Eutectoid   (ii) Peritectoid

  (iii) Eutectic   (iv) Peritectic

b. The atomic packing factor for BCC is

  (i) 0.74   (ii) 0.52

  (iii) 0.68   (iv) 0.46

c. A point imperfection in an ionic crystal in which a cation vacancy is associated with an anion vacancy is called

  (i) Schottky imperfection   (ii) Frenkel imperfection

  (iii) Burgers vector   (iv) Screw dislocations

d. In Annealing, cooling is mainly done in which of the following medium?

  (i) Water   (ii) Furnace

  (iii) Air   (iv) Oil

e. Which among the following is an optical fiber fabrication technique?

  (i) Injection molding   (ii) Modified chemical vapor deposition process

  (iii) Vacuum bagging   (iv) Filament winding

f. If a sample of a plain-carbon steel in the austenitic condition is rapidly cooled to room temperature by quenching it in water, its structure will be changed from austenite to

  (i) Martensite   (ii) Cementite

  (iii) Pearlite   (iv) Bainite

g. A type of primary bond typically observed between atoms with small differences in their electronegativities and mostly between nonmetals is called

  (i) Covalent bonding   (ii) Ionic bonding

  (iii) Metallic bonding   (iv) Secondary bonding

h. Which among the following kind of structure is present in amorphous solids?

  (i) Regular   (ii) Irregular

  (iii) Linear   (iv) Dendritic

i. Which among the following is a thermosetting plastic?

  (i) Polypropylene   (ii) Polyvinyl chloride

  (iii) Phenolics   (iv) Polystyrene

j. Which among the following is represents the Gibbs phase rule for general system?

  (i) P+F=C-1   (ii) P+F=C+1

  (iii) P+F=C-2   (iv) P+F=C+2

PART – B: (Short Answer Questions)   **(2 x 5 = 10 Marks)**

Q.2. Answer *ALL* questions

a. Differentiate unit cell and primitive cell.

b. Discuss the role of matrix in composite materials?

c. Compute the theoretical density of Copper which has an atomic radius of 0.128 nm, FCC crystal structure, and an atomic weight of 63.5 g/mol.

d. What do you nano-material? Give an example.

e. Write an equation for the number of vacancies present in a metal at equilibrium at a particular temperature and define each of the terms. Give the units for each term and use electron volts for the activation energy.

PART – C: (Long Answer Questions)   **(6 x 5 = 30 Marks)**

Answer *ANY FIVE* questions
                                                                                    Marks

3. Find the number of atoms associated in each BCC, FCC and HCP unit cells. Calculate the equilibrium number of vacancies per cubic meter for copper at 100° C. The energy for vacancy formation is 0.9 eV/atom; the atomic weight and density for copper are 63.5 g/mol and 8.45 g/cm^3, respectively. Take Avogadro's number as 6.023×10^{23} atoms/mol. k=8.62×10^{-5} eV/atom.   (6)

4. What is ceramic material? Discuss its structure. Name any four ceramics and write their properties and application.   (6)

5. What is ductile iron? Discuss its structure and application. In which form the graphite is present in the ductile iron?   (6)

6. With suitable diagram discuss different types of crystal systems and determine the atomic packing factor for BCC, FCC and HCP crystal structure.   (6)

7. Define critical cooling rate. What factors influence the critical cooling rate? List the factors that determine the strength of properly hardened steel.   (6)

8. What is age-hardening? What are the basic requirements for an alloy to behave as age-hardening? Mention the steps in the process of age-hardening.   (6)

9. State the Hume-Rothery Rules that are favorable for extensive solid solubility of one element in another?   (6)

10. Draw and explain the cooling curves for a system A-B exhibiting a simple eutectic phase diagram when the composition is (i) 100 % A (ii) a eutectic mixture of composition 50 %. Also, define the term eutectic temperature, eutectic point, eutectic percentage ratio and eutectic mixture.   (6)

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