ME/PE/PWE/AUE/Odd/Sem-3rd/ME-303/2015-16

MAULANA ABUL KALAM AZAD UNIVERSITY OF TECHNOLOGY, WEST BENGAL

ME-303

ENGINEERING MATERIALS

Time Allotted: 3 Hours   Full Marks: 70

The questions are of equal value.
The figures in the margin indicate full marks.
Candidates are required to give their answers in their own words as far as practicable.
All symbols are of usual significance.

GROUP A
(Multiple Choice Type Questions)

1. Answer *all* questions. $10 \times 1 = 10$

(i) Crystal structure of metals is studied by

(A) metallographic technique   (B) x-ray technique
(C) ultrasonic method   (D) electron microscopy

(ii) In the imperfection of crystal structure the displacement distance of the atoms around the dislocation is called

(A) twin   (B) slip
(C) imperfection   (D) exceed order quantity

(iii) Which one of the following is not a strong bond?

(A) Van der Wall's bond   (B) Covalent bond
(C) Metallic bond   (D) Ionic bond

3265   1   Turn Over

CS/B.Tech/ME/PE/PWE/AUE/Odd/Sem-3rd/ME-303/2015-16

(iv) Engineering strain related with True strain as

(A) $\varepsilon_E = \ln(1 + \varepsilon_T)$ (B) $\varepsilon_T = \ln(1 + \varepsilon_E)$
(C) $\varepsilon_E = \ln(1 - \varepsilon_T)$ (D) $\varepsilon_T = \ln(1 + \varepsilon_E)$

(v) The force of attraction between a monovalent cation and monovalent anion is 2.07×10^{-9}N. if the radius of the cation is 0.138 nm, what is the radius of the anion?

(A) 0.258 nm   (B) 1.127 nm
(C) 0.334 nm   (D) 0.187 nm

(vi) If P = applied force, D = diameter of indenter ball and d = diameter of indentation then Brinell hardness number (BHN) can be calculated with

(A) $BHN = \dfrac{2\pi D}{P\left(D - \sqrt{D^2 - d^2}\right)}$ (B) $BHN = \dfrac{P\left(D - \sqrt{D^2 - d^2}\right)}{2\pi D}$

(C) $BHN = \dfrac{\pi\left(D - \sqrt{D^2 - d^2}\right)}{2PDd}$ (D) none of these

(vii) In FCC, volume of one unit cell atom with side 'a' is

(A) a^3 (B) $\dfrac{a^3}{6}$

(C) $\dfrac{a^3 \sqrt{2}}{6}$ (D) none of these

(viii) Grain boundary is

(A) line defect   (B) point defect
(C) surface defect   (D) all of these

(ix) A.P.F. of simple crystal is

(A) 0.54   (B) 0.52
(C) 0.67   (D) 0.62

(x) Cementite is a _____ structure

(A) monohorrmbic   (B) orthorhombic
(C) ceramics   (D) all of these

3265   2

GROUP B
(Short Answer Type Questions)

Answer any *three* questions.   3×5 = 15

Plot the 011, [012], [1$\bar{1}$0], (1$\bar{1}$2) in a cubic unit cell, and plot (1$\bar{1}$01) in a HCP cell.   5

Calculate the fraction of atomic sites that are vacant for copper, at its melting temperature 1084°C. Assume energy or vacancy formation is 0.90 eV/atom.   5

Draw and explain Binary isomorphous system with real type example. Find out degree of freedom at melting temperature of second component with the help of Gibbs' Phase Rule.   3+2

5. (a) What is meant by fracture of a material? Name different kinds of fracture and its sketches.   2+1+2
(b) Define resilience of a material?
(c) Find the grain diameter of an austenitic grain size number 6.

6. (a) Explain A.P.F.
(b) Find out the A.P.F. of B.C.C. structure.   2+3

GROUP C
(Long Answer Type Questions)

Answer any *three* questions.   3×15 = 45

7. (a) Derive the expression for critical radius of a spherical nucleus in a solidification of pure metals.   5
(b) What is carburizing? What are the different case hardening methods that are used in heat treatment process?   5
(c) Distinguished among the following three types of plain carbon steels.   5
(i) Eutectoid (ii) Hypo eutectoid (iii) Hyper eutectoid

8. (a) How do you define strength of a material? Explain it for a low carbon tensile test steel sample with proper stress strain diagram.   1+5
(b) Brass and Tungsten cylindrical samples having same cross-sectional area A = 100 sq. mm, but different lengths, were deformed under 2000 N load. If the initial and final length of Brass sample was 3 mm shorter and 5 mm longer to the initial and final length of Tungsten sample respectively, find the ductility of Tungsten. The modulus of elasticity E(Brass) = 97 GPa and E(Tungsten) = 407 GPa are given.   4
(c) How do crystallization and grain growth affect the different mechanical properties?   5

9. (a) What is hardness? How tensile strength is empirically related with Brinell hardness number.   1+3
(b) Explain fatigue life of a sample with S-N curve. Write the stress ratio and amplitude ratio for fully reserved fatigue condition. What is Endurance limit?   5+1+1
(c) If the diameter of standard WC indenter sphere is 10 mm and diameter of indentation of a C25 steel specimen is 0.39 mm under 15 kg load, find the Brinell hardness number.   4

10.(a) What is Elastomer? Give two examples of elastomer with their application. 1+2
(b) What is thermosetting polymer? Explain polymerization to form thermosetting plastic, with proper chemical reaction.   1+3
(c) If the number-average molecular weight of a sample of PVC blue coloured classroom-chair is 74.25 × 10^3 gram per mol, find degree of polymerization of that chair-sample. We know atomic weights of C, H, and Cl are 12.01, 1.01, and 35.45 g/mol respectively.   3
(d) Describe the Miller Indices.   5

11.(a) What is polymerization? Describe the mechanism of polymerization?   5+2+8
(b) State the difference between thermoplastics and thermo sets materials?
(c) Define the following phases that are present in the Fe-Fe$_3$C phase diagram.
(i) Austenite (ii) Alpha-ferrite (iii) Cementite (iv) Delta-ferrite.