17636

BRAINWARE UNIVERSITY

Term End Examination 2025-2026
Programme – Dip.ME-2024
Course Name – Materials Science and Engineering
Course Code - DME30105
(Semester III)

Full Marks : 60 **Time : 2:30 Hours**

[The figure in the margin indicates full marks. Candidates are required to give their answers in their own words as far as practicable.]

Group-A

(Multiple Choice Type Question) 1 x 15=15

1. *Choose the correct alternative from the following :*

(i) A unit cell has a = 5 Å, b = 8 Å, c = 3 Å, α = 90°, β = 65°, γ = 54°. The space lattice for this unit cell is recalled as

a) orthorhombic
b) monoclinic
c) rhombohedral
d) triclinic

(ii) The unit cell with three lattice parameters is identified as

a) tetragonal
b) orthorhombic
c) monoclinic
d) triclinic

(iii) The number of unit cell in 1 m^3 of FCC nickel (r_{Ni} = 1.243 Å) is calculated as

a) 2.3×10^{28}
b) 4.7×10^{28}
c) 18.9×10^{28}
d) 77.3×10^{28}

(iv) If the radius of an atom in a simple cubic crystal is r, the body diagonal of the unit cell is computed as

a) $r/\sqrt{3}$
b) $2r/\sqrt{3}$
c) $4r/\sqrt{3}$
d) $3r/4$

(v) To cause a slip in a perfect lattice, the maximum shear stress for a crystal structure is G/16. Identify the correct crystal structure

a) Simple cubic
b) Diamond structure
c) FCC
d) BCC

(vi) Time-dependent permanent deformation is recorded as

a) plastic deformation b) elastic deformation
c) creep d) failure

(vii) The ability of a material to resist deformation or deflection under stress is summarized as

a) ductility b) strength
c) toughness d) stiffness

(viii) Choose the material that has non-linear elastic behaviour

a) mild steel b) cast iron
c) aluminium d) rubber

(ix) Identify the property that the Jominy end-quench test is used to determine

a) thermal conductivity b) hardenability
c) yield strength d) modulus of elasticity

(x) On a phase diagram, the line above which an alloy is completely liquid is called the

a) solidus b) liquidus
c) lever d) tie

(xi) The crystal structure of materials is generally examined by

a) necked eye b) optical microscope
c) metallurgical microscope d) X-Ray techniques

(xii) The crystal structure of brass is recognized as

a) FCC b) BCC
c) HCP d) orthorhombic crystalline structure

(xiii) The S-curve is matched with

a) combustion b) cutting tools
c) corrosion d) heat treatment

(xiv) HSLA, in steel, stands for

a) high strength low alloy b) high strength low alkanity
c) high stiffness low alkanity d) high stiffness low alloy

(xv) A steel designated by 50Cr1V20 has carbon, chromium and vanadium content (in %)

a) 0.5, 1, and 0.2 respectively b) 0.05, 0.1, and 0.2 respectively
c) 0.05, 0.10, and 0.2 respectively d) none of these

Group-B

(Short Answer Type Questions) 3 x 5=15

2. Define primitive and non-primitive unit cell. (3)
3. Determine the composition in atoms per unit of an alloy consisting of 90% by weight of Ag and 10% by weight of Cu. (3)
4. Explain the Gibb's phase rule. (3)
5. Define Malleability. (3)
6. Illustrate the effect of Hall-Petch influence in the mechanical properties of materials. (3)

OR

If the atomic radius of aluminium is 0.143 nm, estimate the volume of its unit cell. [Crystal structure of aluminium = Face-Centered Cubic (FCC)] (3)

Group-C

(Long Answer Type Questions) 5 x 6=30

7. Draw Fe-Fe_3C phase diagram and label the phase fields. Illustrate in brief the different invariant reactions that take place in this system. (5)

8. Show that the difference in void fraction between Face-Centered Cubic (FCC) and Body-Centered Cubic (BCC) crystal structures is approximately 6%. (5)
9. The variation of percentage elongation with gauge length has been found empirically to follow relationship (5)

$$X = b + c\frac{\sqrt{A}}{L_0}$$

Where b and c are constants. The following data were obtained for a steel sample of diameter 28 mm.

L_0	100 mm	250 mm
X	30.6	25.7

Estimate constants b and c.

10. State the effect of the following elements in steel: (a) Nickel (b) Vanadium. (5)
11. Distinguish between Destructive and Non-destructive testing. (5)
12. Explain the construction of TTT diagram according to the first principle. Why it is called S-curve? (5)

OR

Explain why martensite is hard? What is the crystal structure of martensite? (5)

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