

ENGINEERING MATERIALS
(MEC2203)

Time Allotted : 2½ hrs

Full Marks : 60

Figures out of the right margin indicate full marks.

*Candidates are required to answer Group A and
any 4 (four) from Group B to E, taking one from each group.*

Candidates are required to give answer in their own words as far as practicable.

Group – A

1. Answer any twelve:

12 × 1 = 12

Choose the correct alternative for the following

- (i) The atomic diameter of an FCC crystal (lattice parameter “a”) is
 - (a) $a\sqrt{2}/2$
 - (b) $a\sqrt{2}/4$
 - (c) $a\sqrt{3}/4$
 - (d) $a/2$.
- (ii) Cross-slip occurs in
 - (a) edge dislocation
 - (b) screw dislocation
 - (c) both edge and screw dislocation
 - (d) none of the above.
- (iii) Atomic packing factor of a face centered cube is equal to
 - (a) 0.64
 - (b) 0.54
 - (c) 0.74
 - (d) 0.84.
- (iv) Gibbs phase rule for gases is (symbols are as per convention)
 - (a) $F+P = C+2$
 - (b) $F+C = P+2$
 - (c) $F+P = C+1$
 - (d) $F+1 = C+P$.
- (v) Eutectoid steel has C % of
 - (a) 0.25
 - (b) 0.54
 - (c) 0.76
 - (d) 1.20.
- (vi) Primary objective of annealing is to
 - (a) increase toughness and yield point
 - (b) reduce ductility and resilience
 - (c) remove foreign impurities and improve surface finish
 - (d) increase ductility and machinability.
- (vii) Major components of bronze are
 - (a) copper and zinc
 - (b) copper and tin
 - (c) copper and lead
 - (d) zinc and tin

- (viii) An increase in the percentage of carbon in steel results into decrease in its
 (a) hardness (b) ductility
 (c) ultimate strength (d) corrosion resistance.
- (ix) Which of the following is a property of ceramics?
 (a) Low strength (b) Low melting point
 (c) Resistant to corrosion (d) Bad insulation
- (x) Polystyrene is an example of
 (a) An addition polymer (b) A condensation polymer
 (c) An elastomer (d) A monomer.

Fill in the blanks with the correct word

- (xi) Two types of solid materials are crystalline and _____.
- (xii) In edge dislocation burgers vector is _____ to dislocation line.
- (xiii) Equilibrium cooling of eutectoid mixture of iron-carbon gives the microstructure called _____.
- (xiv) The temperature above which material loses magnetic property is called _____.
- (xv) The property by which a material can sustain impact load is called _____.

Group - B

2. (a) Describe crystalline and amorphous structure. Write their effect on melting point and anisotropy of a material? [[CO1, CO2] (Understand/LOCQ)]
- (b) Explain bonding between metallic elements in metals and its effect on the properties of metals. [[CO1, CO2] (Understand/LOCQ)]
- 6 + 6 = 12**
3. (a) Explain with reason, the effect of grain size on yield strength and ductility of a metal. [[CO1, CO2] (Analyse/IOCQ)]
- (b) Define Burger vector? Show with sketch, Burger vector, dislocation line and slip plane in edge and screw dislocations. [[CO2] (Understand/LOCQ)]
- 6 + 6 = 12**

Group - C

4. (a) Draw iron-carbon phase diagram showing phases at different temperature and carbon percentage. [[CO3] (Understand/LOCQ)]
- (b) Explain with microstructure the transformation that occurs in a plain carbon steel with 1.5% of carbon during equilibrium cooling from the liquid state. [[CO3] (Analyze/IOCQ)]
- 6 + 6 = 12**
5. (a) Draw the phase diagram for the binary isomorphous alloy of Cu and Ni showing the regions of (i) liquid phase (ii) α -solid phase (iii) α -solid + liquid phase. The melting temperatures for pure Cu and Ni are 1085°C and 1453°C respectively. [[CO3] (Apply/IOCQ)]

- (b) Explain Full Annealing and Normalising processes with their effect on structure and property of steel.

[[CO4] (Understand/LOCQ)]

6 + 6 = 12

Group - D

6. (a) Write down the compositions, properties and applications of different plain carbon steel. [[CO5] (Understand/LOCQ)]
- (b) A mild steel rod of 14 mm diameter was tested for tensile strength, with a gauge length of 50 mm. Following were the observations:
Final length = 68 mm
Final diameter = 9 mm
Yield load = 44 kN
Ultimate load = 65 kN
Calculate (i) Yield stress, (ii) Ultimate tensile stress, (iii) Percentage of elongation. [[CO5] (Analyse/IOCQ)]
- 6 + 6 = 12**
7. (a) Why is alloying done? What are the effects of tungsten, chromium, tungsten and nickel alloying elements in steel? [[CO5] (Understand/LOCQ)]
- (b) Define Young's modulus and Poisson's ratio. The Young's modulus and Poisson's ratio of a material are 210 GN/m² and 0.3 respectively. Determine the shear modulus of the material. [[CO5] (Apply/IOCQ)]
- 6 + (4 + 2) = 12**

Group - E

8. (a) Distinguish between thermoplastics & thermosetting plastics using any three of their characteristics. [[CO6] (Understand/LOCQ)]
- (b) Describe in brief the properties and the importance of ceramic in Engineering Applications. [[CO6] (Understand/LOCQ)]
- 6 + 6 = 12**
9. (a) Explain injection moulding method of polymer processing with neat sketch. [[CO6] (Understand/LOCQ)]
- (b) What is composite? What are the characteristics of composite? Give any two example of composite materials. [[CO6] (Understand/LOCQ)]
- 6 + (2 + 3 + 1) = 12**

Cognition Level	LOCQ	IOCQ	HOCQ
Percentage distribution	68.75	31.25	0

