ENGINEERING MATERIALS
(MECH 3103)

Time Allotted : 3 hrs **Full Marks : 70**

Figures out of the right margin indicate full marks.

Candidates are required to answer Group A and any 5 (five) from Group B to E, taking at least one from each group.

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

Group – A
(Multiple Choice Type Questions)

1. Choose the correct alternative for the following: **10 × 1 = 10**

(i) What is the atomic packing factor of BCC structure?
(a) 0.54 (b) 0.68 (c) 0.74 (d) 0.96.

(ii) Which of the following is a point defect in crystals?
(a) Edge dislocation (b) Interstitials
(c) Grain boundaries (d) Cracks.

(iii) The invariant reaction involving, austenite phase decomposing into two different solid phases, ferrite and cementite on cooling is known as _____
(a) Eutectoid point (b) Eutectic point
(c) Peritectic point (d) Peritectoid point.

(iv) Deformation that occurs due to stress over a period of time is known as _____
(a) Wear resistance (b) Fatigue (c) Creep (d) Fracture.

(v) In normalizing, cooling is done in which of the following medium?
(a) Air (b) Water (c) Oil (d) Furnace.

(vi) The ability of a material to be formed by hammering or rolling is known as _____
(a) Malleability (b) Ductility (c) Hardness (d) Brittleness.

(vii) Mild steel can be converted into high carbons steel by which of the following heat treatment process?
(a) Annealing (b) Normalizing (c) Case hardening (d) Nitriding.

(viii) Which of the following carbides are used for cutting tools?
(a) Silicon carbide (b) Tungsten carbide
(c) Vanadium carbide (d) Chromium carbide.

(ix) The process of heat softening, moulding and cooling to rigidness can be repeated for which plastics?
(a) Thermoplastics (b) Thermosetting polymers
(c) Both (a) and (b) (d) Neither (a) nor (b).

(x) Porcelain is a type of _____ ceramic.
(a) whiteware (b) stone (c) abrasive (d) cement

Group – B

2. (a) What is a Van der Waals bond? What are the different types of Van der Waals bonding? What is its effect on property of a material? [(CO1)(Understand/LOCQ)]
(b) Aluminum has fcc crystal structure. The theoretical density of Aluminum is 2700 kg/cubic meter. Its atomic weight is 26.98 gm. Calculate the lattice parameter and atomic radius. [(CO1)(Analyze/IOCQ)]

(2 + 1 + 3) + 6 = 12

3. (a) What are the differences between crystalline, polycrystalline and amorphous materials? [(CO1)(Understand/LOCQ)]
(b) How metallic atoms are tied to each other in solid state in metals? Also, discuss the effect of such bond on the properties of metals. [(CO1)(Understand/LOCQ)]

6 + (3 + 3) = 12

Group - C

4. (a) Draw iron carbon phase diagram. Show all the phases, temperatures and composition properly. [(CO3)(Understand/LOCQ)]
(b) Discuss the transformation that occurs during equilibrium cooling from liquid state of steel with 1.5% of carbon. [(CO3)(Analyze/IOCQ)]

(3 + 3) + 6 = 12

5. (a) Write down the carbon % present in low carbon steel, medium carbon steel, high carbon steel and cast iron. Explain how Cast Iron differs from steel in respect to microstructure. What is Austenitic Stainless steel? [(CO3)(Understand/LOCQ)]
(b) Name three different Cu-Alloys mentioning their compositions and uses. [(CO4)(Understand/LOCQ)]

(3 + 2 + 1) + 6 = 12

Group – D

6. (a) Following observations were made during a tensile test of a mild steel specimen with 40 mm diameter and 200 mm length:
Elongation of length with 40 kN load (within proportional limit) is 0.0304 mm
Yield load = 161 kN
Maximum load = 242 kN
Gauge length of fracture = 249 mm.
Determine (i) young's modulus of elasticity (ii) Yield point stress (iii) ultimate tensile stress (iv) percentage of elongation. [(CO4)(Analyze/IOCQ)]
(b) Discuss the stress strain curve achieved of a mild steel specimen under tensile test. [(CO4)(Understand/LOCQ)]

6 + 6 = 12

7. (a) Discuss the difference in process, microstructure obtained and properties of steel after annealing and normalising process? [(CO5)(Understand/LOCQ)]
   (b) Discuss about any two types of annealing process used in an industry. [(CO5)(Understand/LOCQ)]
6 + 6 = 12

Group - E

8. (a) Differenentiate between thermoplastic and thermosetting polymer with their three major characteristics. [(CO6)(Understand/LOCQ)]
   (b) Discuss the properties and applications of any two types of ceramic. [(CO6)(Understand/LOCQ)]
6 + 6 = 12

9. (a) What is a composite? Identify various functions that a matrix phase performs in a composite material. [(CO6) (Understand/LOCQ)]
   (b) Explain dry corrosion with chemical reaction. [(CO6) (Understand/LOCQ)]
(2 + 4) + 6 = 12

Cognition Level	LOCQ	IOCQ	HOCQ
Percentage distribution	81.25	18.75	0

Course Outcome (CO):

After the completion of the course students will be able to

CO1 Classify different materials like metals, polymers, ceramics, composites and advanced materials and analyze different crystal structure of materials

CO2 Identify different types of defects in the material structure and construct the phase diagram of a multi-phase system of alloy.

CO3 Analyze the Iron –Iron Carbide equilibrium diagram and discuss the composition, properties and applications of ferrous and nonferrous alloy.

CO4 Explain mechanical, thermal, electrical and magnetic properties of material and implement the concept in mechanical components design.

CO5 Explain different heat treatment processes for ferrous material.

CO6 Discuss the properties, applications and making processes of different polymers, ceramics, composites and nanomaterials.

*LOCQ: Lower Order Cognitive Question; IOCQ: Intermediate Order Cognitive Question; HOCQ: Higher Order Cognitive Question.