

**MATERIAL SCIENCE AND TECHNOLOGY
(AEIE 2111)**

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) Pick the composite from the list
(a) Wood (b) Steel (c) Nylon (d) Mica.
- (ii) Coordination number in simple cubic crystal structure
(a) 2 (b) 4 (c) 6 (d) 8.
- (iii) Which one of the following is **NOT** a strong bond?
(a) van der Waals bond (b) Covalent bond
(c) Metallic bond (d) Ionic bond.
- (iv) Figure-out the odd point in the following
(a) Proportional limit (b) Elastic limit
(c) Yield point (d) Fracture point.
- (v) Engineering stress-strain curve and True stress-strain curve are equal up to
(a) Proportional limit (b) Elastic limit
(c) Yield point (d) Tensile strength point.
- (vi) Above the following line, liquid phase exist for all compositions in a phase diagram
(a) Tie-line (b) Solvus
(c) Solidus (d) Liquidus.
- (vii) Fracture stress (σ_f) is proportional to
(a) crack length (b) $1/\text{crack length}$
(c) $(\text{crack length})^{1/2}$ (d) $(\text{crack length})^{-1/2}$.
- (viii) Al-alloys for engine/automobile parts are reinforced to increase their
(a) Strength (b) Wear resistance
(c) Elastic modulus (d) Density.
- (ix) Main form of ceramic degradation is
(a) Corrosion (b) Weathering
(c) Dissolution (d) Swelling.

- (x) One of the characteristic properties of polymer material _____.
(a) High temperature stability (b) High mechanical strength
(c) High elongation (d) Low hardness

Group- B

2. (a) Compare among diamagnetic, paramagnetic and ferromagnetic materials with specific examples of each type. [(CO1)(Remember/LOCQ)]
(b) Define thermal expansion and co-efficient of thermal expansion. [(CO1)(Understand/LOCQ)]
(c) List the examples of future materials with their applications. [(CO1)(Remember/LOCQ)]
(3 + 3) + 2 + (2 + 2) = 12
3. (a) Compare refraction, reflection, absorption & transmission phenomena. [(CO1)(Analyse/IOCQ)]
(b) Establish the relationship between current density and average drift velocity. [(CO1)(Analyse/IOCQ)]
(c) Explain atomic bonding in solids. [(CO1)(Remember/LOCQ)]
4 + 3 + 5 = 12

Group - C

4. (a) Evaluate the relation between (i) true stress & engineering stress and (ii) natural strain & engineering strain. [(CO2)(Evaluate/HOCQ)]
(b) Differentiate between slip and twining. [(CO2)(Analyse/IOCQ)]
(c) Differentiate between substitutional atoms and interstitial atoms. [(CO2)(Analyse/IOCQ)]
4 + 4 + 4 = 12
5. (a) Briefly recognise the factors that influence diffusion. [(CO2)(Analyse/IOCQ)]
(b) Compare steady-state and non-steady-state diffusion processes. [(CO2)(Understand/LOCQ)]
(c) Discuss the effect of atomic vibration on crystalline solids. [(CO2)(Evaluate/HOCQ)]
4 + 4 + 4 = 12

Group - D

6. (a) Compare between ductile and brittle fracture based on fracture parameters. [(CO4)(Analyse/IOCQ)]
(b) Explain the stages of brittle fracture. [(CO4)(Analyse/IOCQ)]
6 + 6 = 12
7. (a) Sketch unary phase diagram of water. Explain the steps to find equilibrium concentration of phases and equilibrium relative amount of phases. [(CO3)(Analyse/IOCQ)]

- (b) Comment on the usefulness of phase diagram.
- [[CO3](Analyse/IOCQ)]
- (4 + 4) + 4 = 12

Group - E

8. (a) Briefly explain the processing techniques of polymer and the products available from each processing technique.
- [[CO5](Analyse/IOCQ)]
- (b) Calculate the volume ratio of aluminium and boron in Al-B composite which can have the Young's modulus equal to that of iron. The Young's modulus of Al,Fe and B are 71, 210, 440 GN/m² respectively.
- [[CO6](Analyse/IOCQ)]
- (c) Classify ceramics based on their compositions.
- [[CO5](Understand/LOCQ)]
- 6 + 4 + 2 = 12
9. (a) How steels are classified based on carbon content? Categorize stainless steels based on constituents of the microstructure.
- [[CO5](Understand/LOCQ)],[[CO5](Analyse/IOCQ)]
- (b) Evaluate the life cycle analysis in engineering product design.
- [[CO6](Evaluate/HOCQ)]
- (3 + 3) + 6 = 12

Cognition Level	LOCQ	IOCQ	HOCQ
Percentage distribution	27	58	15

Course Outcome (CO):

After the completion of the course students will be able to

1. List the properties and describe the structure of engineering materials.
2. Analyze defects in materials and their effect on engineering properties as well as limit their use in service.
3. Use phase diagrams to predict microstructures and also to understand precipitation hardening.
4. Determine the role of fracture mechanism on material life and performance.
5. Explain the processing of engineering materials.
6. Choose suitable material in product manufacturing and system design considering engineering, economic, environmental and societal aspect.

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

