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398, Ramkrishnapur Road, Barasat
Kolkata, West Bengal-700125



BRAINWARE UNIVERSITY

Term End Examination 2025-2026
Programme – B.Tech.(CSE)-AIR-2024
Course Name – Material Science
Course Code - BTR40109
(Semester IV)

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) Identify the discipline that investigates the relationship between internal structure and properties of materials.
 - a) Materials Engineering
 - b) Solid Mechanics
 - c) Materials Science
 - d) Manufacturing Science
- (ii) Relate the evolution of civilization to advancements in materials usage.
 - a) Artistic expression
 - b) Scientific laws
 - c) Tool and technology development
 - d) Political systems
- (iii) Identify the bonding type involving electron transfer between atoms.
 - a) Covalent
 - b) Metallic
 - c) van der Waals
 - d) Ionic
- (iv) Identify the term used for the allowed range of electron energies in a solid
 - a) Forbidden band
 - b) Energy band
 - c) Core band
 - d) Atomic level
- (v) Recall the statistical distribution obeyed by electrons in quantum free electron theory
 - a) Maxwell-Boltzmann
 - b) Bose-Einstein
 - c) Fermi-Dirac
 - d) Classical statistics
- (vi) Identify the application of X-ray diffraction based on Bragg's law
 - a) Density measurement
 - b) Crystal structure determination
 - c) Defect elimination
 - d) Heat treatment
- (vii) Identify the ceramic known for transformation toughening.
 - a) Silica
 - b) Zirconia
 - c) Clay
 - d) Feldspar
- (viii) Recognize the charge carrier present in p-type semiconductors.
 - a) Proton
 - b) Hole

- c) Neutron
(ix) Recognize the SI unit for thermal conductivity.
a) J/kgK
c) °C
(x) Select the material acting as a good heat conductor.
a) Wood
c) Copper
(xi) Select materials suitable for fuse wires.
a) High melting point
c) High strength
(xii) Identify the ratio of conductivity to heat capacity.
a) Diffusivity
c) Retentivity
(xiii) Identify materials used as thermal insulators.
a) Copper
c) Glass
(xiv) Select an insulating material.
a) Copper
c) Rubber
(xv) Recognize property absorbing energy before fracture.
a) Elasticity
c) Plasticity
- d) Ion
b) W/mK
d) W
b) Plastic
d) Glass
b) Low melting point
d) High toughness
b) Expansion
d) Resistivity
b) Aluminium
d) Silver
b) Aluminium
d) Iron
b) Toughness
d) Ductility

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Group-B

(Short Answer Type Questions)

3 x 5=15

2. State the significance of allowed energy bands and forbidden energy gaps in solids. (3)
3. Calculate the mobility of electrons in a metal if conductivity is $6.8 \times 10^7 \Omega^{-1} \text{m}^{-1}$ and electron concentration is $5.8 \times 10^{28} \text{m}^{-3}$. (3)
4. Illustrate the significance of the Processing–Structure–Properties–Performance paradigm in material selection. (3)
5. Identify the role of metallic bonding in determining electrical conductivity. (3)
6. Analyze the significance of Burger's vector in line defects. (3)

OR

- Analyze the relationship between defects and strengthening mechanisms in materials. (3)

Group-C

(Long Answer Type Questions)

5 x 6=30

7. Explain the concept of drift velocity and derive the macroscopic form of Ohm's law. (5)
8. Analyze the impact of service environment on material performance using historical engineering failures. (5)
9. Explain the concept of atomic packing fraction and compare its significance in SC, BCC, and FCC structures. (5)
10. Derive the expression for interplanar spacing in a cubic crystal using Miller indices. (5)
11. Describe elasticity and plasticity and relate them to material deformation behaviour. (5)
12. Explain Bragg's law and interpret the physical meaning of Bragg angle and order of reflection. (5)

OR

Analyze the selection of conductor materials for reliable electrical circuits considering resistance, corrosion, and electromigration.

(5)

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