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MPHE-025

M. SC. (PHYSICS)

(MSCPH)

Term-End Examination

June, 2026

MPHE-025 : MATERIALS SCIENCE

Time : 2 Hours

Maximum Marks : 50

Note : (i) *Attempt any **five** questions.*

(ii) *You can use calculator.*

(iii) *Symbols have their usual meaning.*

(iv) *Values of physical constants are
given at the end.*

1. (a) Explain the classification of solid materials based on their atomic structure with examples. 5

- (b) Explain with appropriate diagram, how 2^- roto-inversion operation is equivalent to $\frac{1}{m}$ symmetry operation. 5
2. (a) What are solid solutions ? Write the Hume-Rothery rules governing the substitutional solid solutions. 5
- (b) Calculate the equilibrium concentration of vacancies in a copper crystal at 900 K temperature. Melting point of copper is 1083°C and the enthalpy of vacancy formation in copper is 120 kJ mol^{-1} . 5
3. What is Powder Processing ? Describe the steps involved in metal powder processing.

2+8

4. (a) Explain the Czochralski (CZ) method of semiconductor crystal growth. 5
- (b) What is meant by Epitaxial growth ?
Explain the method of Molecular Beam Epitaxy (MBE) deposition. 1+4
5. (a) Based on the diffusion mechanisms involved explain why carbon atom diffusion is faster than nickel atom diffusion in iron lattice. 5
- (b) What are Time-Temperature Transformation (TTT) plots ? Why are they also known as isothermal transformation diagram ? Explain their significance in understanding the phase transformation process. 2+1+2

6. (a) What is meant by 'Thermal Shock' experienced by the materials ? How can it be reduced ? State the expression for Thermal Shock Resistance (TRS) explaining all the terms involved. 2+1+2
- (b) In which case microhardness tests are carried out ? Explain the method of Knoop's hardness test. 2+3
7. (a) Describe any *five* forms of corrosion observed in materials. 5
- (b) What are shape memory materials ? Explain with the help of a diagram the phase transition hysteresis observed in case of NiTi alloy giving rise to shape memory phenomenon. 2+3

8. (a) What is Graphene ? Describe the bonding in graphene. State any *four* applications of graphene. 1+2+2
- (b) Describe the construction and working of organic thin film transistor. 5

Physical Constants :

$$k_B = 1.38 \times 10^{-23} \text{ JK}^{-1}$$

$$h = 6.62 \times 10^{-34} \text{ J-s}$$

$$N_A = 6.023 \times 10^{26} \text{ kmol}^{-1}$$

$$R = 8.3 \text{ JK}^{-1} \text{ mol}^{-1}$$

$$e = 1.6 \times 10^{-19} \text{ C}$$

$$\epsilon_0 = 8.85 \times 10^{-12} \text{ C}^2 \text{ kg}^{-1} \text{ m}^{-3} \text{ s}^2$$

$$m_e = 9.1 \times 10^{-31} \text{ kg}$$

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