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MPHE-025

M. SC. (PHYSICS) (MSCPH)

Term-End Examination

June, 2025

MPHE-025 : MATERIALS SCIENCE

Time : 2 Hours

Maximum Marks : 50

Note : Answer any *five* questions. You can use calculator. Symbols have their usual meanings. Values of physical constants are given at the end.

1. Common types of engineering materials are metals, ceramics, polymers and composites. Compare these *four* classes on the basis of their composition and any *two* properties. State *one* application of each type. 10

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2. (a) Explain with appropriate diagram, how many identical points are created by a $\bar{3}$ roto-inversion operation. Among 3-fold rotation and $\bar{3}$ roto-inversion operation, which one has higher order ? Why ? 5
- (b) Describe *one* possible way of accommodating the added alloying elements into a pure metal lattice for the following : 5
- (i) Limited solubility
- (ii) Good solubility
3. (a) Explain with the help of diagram the float zone method of crystal growth. State its advantage over the Czochralski (Cz) method. 5
- (b) Describe in brief the steps involved in the sol-gel synthesis method. 5

4. (a) With a schematic diagram, explain the working of e^- beam deposition system. Under what conditions e^- beam deposition method is preferred ? 5
- (b) Explain the different types of point defects observed in solid structures. 5
5. (a) Explain with the help of a diagram, what is a tie line in a phase diagram. Explain the Lever rule with the help of tie line. 5
- (b) Explain the Avrami and Johnson-Mehl models of computing phase transformation rates based on their assumptions and growth mechanisms. 5

6. (a) Define corrosion in case of metals.
Discuss any *four* main factors affecting corrosion process. 5
- (b) Describe the method of performing Vicker's hardness test. 5
7. (a) Describe the different absorption mechanisms when light interacts with the material. 5
- (b) Differentiate between the Colossal Magnetic Resistance (CMR) and Giant Magnetic Resistance (GMR) on the basis of material characteristics, mechanism and resistance change. Give *one* application of each. 5
8. (a) What are Fullerenes ? Describe any *two* applications of fullerenes. 5

- (b) What is organic electronics ? List any *two* advantages of organic electronic devices over the inorganic semiconductor devices. 5

Physical Constants :

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

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

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

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

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

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

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

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