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# 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

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 charge. 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 :**

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

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

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

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

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

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

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

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