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Unique Paper Code : 2223010014
Name of the Paper : Physics of Materials (DSE Paper)
Name of the Course : B.Sc. Hons.– (Physics)_NEP: UGCF-2022
Semester : V - Semester
Duration : 2 hours
Maximum Marks : 60 Marks

Instructions for Candidates

1. Attempt a total of four questions, including Question No. 1, which is compulsory.
2. Write your roll number on the top immediately on receipt of this question paper.

Q1. Attempt any five

(3 × 5=15)

- (a) What is meant by the density of electronic states in a physical system?
- (b) What are the main factors that influence the mobility of charge carriers in a semiconductor?
- (c) Distinguish between hard and soft magnetic materials.
- (d) Determine the dielectric constant if a capacitor with plate area 0.5m^2 , plate separation 1mm, and charge 10^{-6}C is charged to 50V.
- (e) What is meant by grain growth during sintering?
- (f) Describe the role of substrate temperature in thin film growth.

Q2. (a) Explain the working principle of piezoelectric transducers. Discuss how they are utilized in micropositioners and actuators, highlighting their advantages and limitations? (7)

(b) A pyroelectric sensor of surface area 1cm^2 and thickness 1 mm has a pyroelectric coefficient $1.5 \times 10^{-8}\text{C/m}^2\text{K}$. Calculate the charge generated when the temperature changes by 30 K.

(5)

(c) Explain Fermi Level in semiconductors.

(3)

Q3. (a) Compare thermoplastic and thermosetting polymers in terms of structure, synthesis, and recyclability with reference to examples such as PVC and epoxy resins.

(8)

(b) Discuss the characteristics and molecular arrangement of the nematic and smectic phases of liquid crystals. How do they differ?

(7)

Q4. (a) Describe the molecular architecture of fullerenes, with an emphasis on C_{60} . Explain how the specific arrangement of carbon atoms contributes to the molecule's exceptional stability and distinctive physical and chemical properties?

(7)

(b) Describe the process of Molecular Beam Epitaxy (MBE) with the help of a neat diagram. How do ultra-high vacuum conditions and beam flux control influence the quality of the epitaxial layers?

(8)

Q5. (a) Explain the chemical structure and curing process of epoxy resin. How do cross-linking reactions influence its thermal and mechanical properties?

(8)

(b) Explain the structure and unique properties of graphene. With the help of a neat diagram, describe its energy band structure and discuss how it differs from that of conventional semiconductors.

(7)