A–0441

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MSCPH-552

Master of Science Physics (MSCPH)

Material Science

Examination, June 2025

Time : 2:00 Hrs. Max. Marks : 70

Note* :–** This paper is of Seventy (70) marks divided into Two (02) Sections 'A' and 'B'. Attempt the questions contained in these Sections according to the detailed instructions given therein. ***Candidates should limit their answers to the questions on the given answer sheet. No additional (B) answer sheet will be issued.

Section–A

Long Answer Type Questions 2×19=38

***Note* :–** Section 'A' contains Five (05) Long-answer type questions of Nineteen (19) marks each. Learners are required to answer any *two* (02) questions only.

1. Explain the basic concept of nano-materials and discuss the unique properties they exhibit at the nano-scale. How do these properties differ from those of bulk materials, and why are they important for various technological applications ?

2. What do you mean by single crystal growth ? Discuss the different techniques used for single crystal growth. What are the advantages and limitations of each technique ?

3. Discuss the history of ceramics and their evolution from traditional ceramics to advanced ceramics. Discuss the methods for the preparation of ceramics ?

4. Distinguish between Nuclear Magnetic Resonance (NMR) and Electron Spin Resonance (ESR) spectroscopies. Discuss the principles, the types of species analyzed, and their applications in material characterization.

5. Explain the principles and working mechanisms of Differential Thermal Analysis (DTA), Thermo Gravimetric Analysis (TGA), and Differential Scanning Calorimetry (DSC). Discuss their key differences in terms of the type of information they provide about the thermal properties of materials.

Section–B

Short Answer Type Questions 4×8=32

***Note* :–** Section 'B' contains Eight (08) Short-answer type questions of Eight (08) marks each. Learners are required to answer any *four* (04) questions only.

1. Explain the Fourier transform spectroscopy. What information does we get from it ?

2. What do you understand by Quantum dots ? Explain the quantum confinement effect in quantum dots.

3. Compare the techniques of X-ray diffraction, electron diffraction, and neutron diffraction, highlighting their principles, advantages, limitations, and applications.

4. What is the main principle behind the chemical vapour deposition (CVD) process ? List any two types of CVD techniques.

5. What is the working principle of a Scanning Electron Microscope (SEM) ?

6. Explain the importance of polymerization in the synthesis of polymers.

7. Define the terms used in ceramics, such as abrasives, refractories, and brittle fracture.

8. What are smart materials, and how are they utilized ?

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