

M.Sc. S.Y. (Physics) (NEP Pattern) Semester-IV  
**04MSCPH3.4 - Major Elective-4 Paper-III :**  
**Material Synthesis and Characterization**

P. Pages : 2

Time : Three Hours



**GUG/S/25/16380**

Max. Marks : 80

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**Either:**

1. a) Explain the concept of crystalline structure in materials. Discuss unit cells, space lattices, and the significance of X-ray diffraction in determining crystal structures. **8**
- b) Discuss the various crystal growth techniques and their applications in material science. **8**

**OR**

- e) What are imperfections in crystalline solids? Describe various types of defects and their effects on material properties. **8**
- f) Discuss the Hall effect in semiconductors and its significance in determining material properties **8**

**Either:**

2. a) What are smart materials? Explain the properties and applications of ferroelectric, piezoelectric, and optoelectric materials. **8**
- b) Describe the working principles of lasers and optical fibers. How are these technologies utilized in modern physics applications? **8**

**OR**

- e) What are nanomaterials? Discuss the role of biomaterials, superalloys, and Shape memory alloys in advanced technology. **8**
- f) Define biocompatibility. Explain the degradation mechanisms of biomaterials and their importance in medical applications. **8**

**Either:**

3. a) Discuss various synthesis techniques for nanoparticles, including the sol-gel method and combustion synthesis. **8**
- b) Explain the electronic and optical properties of metal nanoparticles. How does functionalization affect these properties? **8**

**OR**

- e) What are quantum dots? Describe their synthesis, characterization techniques, and applications in optoelectronics. **8**
- f) Explain different characterization techniques for nanomaterials, such as Optical Spectroscopy and Electron Microscopy. **8**

**Either:**

4. a) Define and explain the concepts of free volume and viscosity in materials. How do these properties affect material performance? **8**
- b) Discuss mechanical properties such as tensile testing and stress-strain behavior for different types of materials. **8**

**OR**

- e) Explain the mechanisms of electrical conduction in semiconductors and conducting materials. How do dielectric relaxation and semiconducting behavior influence applications? **8**
- f) Describe the principles and applications of spectroscopy techniques such as UV, ESR, Raman, NMR, and IR spectroscopy. **8**
5. Attempt all of the followings.
- a) Explain the concept of semiconductors. Derive expressions for carrier concentration in intrinsic and extrinsic semiconductors. **4**
- b) Discuss the different types of polymers used in biomaterials, such as hydrogels, bioceramics and bioelastomers. **4**
- c) Explain in short about Atomic Force Microscopy and its applications. **4**
- d) Explain the importance of thermal properties in materials. **4**

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