



K25P 1144

Reg. No. :

Name :

**IV Semester M.Sc. Degree (C.B.S.S. – Supple./Imp.) Examination, April 2025
(2021 and 2022 Admissions)**

PHYSICS

PHY4E11 : Nanoscience and Technology

Time : 3 Hours

Max. Marks : 60

SECTION – A

Answer both questions (either **a** or **b**) :

1. a) Briefly explain X-ray diffraction mechanism for determining the crystalline structure. Discuss how it is used to estimate nanoparticle sizes and compare this method with the dynamic light scattering for size estimation.

OR

- b) Discuss various modelling approaches employed in studying nanoparticles. Explore the differences in optical absorption phenomena exhibited by semiconducting nanoparticles and their bulk counterparts.
2. a) Analyze the electrical properties of Carbon Nanotubes (CNTs). Evaluate the advantages of utilizing CNTs in various applications, including computing devices, fuel cells and catalysis.

OR

- b) With proper diagrams, explain the characteristics of an electron trapped in (a) onedimensional infinite square potential well and (b) curved potential well. **(2×12=24)**

SECTION – B

Answer **any four** (1 mark for Part **a**, 3 marks for Part **b** and 5 marks for Part **c**).

3. a) What is a microscope ?
b) List different types of scanning microscopes and provide a brief explanation.
c) Explain the working principles of a scanning electron microscope.

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4. a) Define nanoparticles.
b) Why are electronic magic numbers important in metal nanoclusters ?
c) Compare the crystal structure of metal nanoclusters with their bulk structures.
 5. a) What are the allotropic forms of carbon ?
b) Draw the Unit cell of C₆₀ molecule and explain its structure.
c) Explain the synthesis of carbon nanotubes by laser evaporation method.
 6. a) What are disordered nanostructures ?
b) Explain the compaction and consolidation method for synthesising disordered nanostructures.
c) Derive the expression for the conductance across a thin insulating layer sandwiched by two similar metals.
 7. a) What are nanomagnets ?
b) Provide a brief overview of nanocarbon ferromagnets.
c) Describe the nanostructuring of bulk magnetic materials to design magnetization curve.
 8. a) What is the density of states ?
b) Sketch the density of states for quantum dots, quantum wires, quantum wells and bulk materials.
c) Explain how the density of states affects the specific heat of solids and the susceptibility of magnetic materials. (4×9=36)
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