

- (c) How is Hydrothermal Synthesis used to create one-dimensional nanostructures like nanowires? 5, 5, 5
6. (a) Why surface area/volume ratio is very large for nano particles compared to bulk materials? Highlight the effect of surface area increase on mechanical and optical properties.
- (b) What is stabilizer molecules used in nanoparticles synthesis? Give two examples.
- (c) Explain the Basic principle of optical methods and electron microscopy, Explain how XRD analysis is important in nanomaterial characterization. 5, 5, 5

[This question paper contains 4 printed pages]

Your Roll No. :**Sl. No. of Q. Paper** : **2947** **I**

Unique Paper Code : 2173512002

Name of the Paper : NANOSCALE MATERIALS AND THEIR APPLICATIONS-DSE

Name of the Course : **B.Sc.(Prog.)**

Semester : IV

Time : 2 Hours **Maximum Marks : 60****Instructions for Candidates :**

- (a) Write your Roll No. on the top immediately on receipt of this question paper.
- (b) Attempt any Four questions.
- (c) All questions carry equal marks

1. (a) Fill in the blanks:

- (i) In a _____ quantum structure, all three dimensions are in the nanoscale range.
- (ii) The surface area to volume ratio _____ as the particle size decreases.

- (iii) _____ is a common bottom-up technique involving a liquid colloidal suspension.
 - (iv) Carbon Nanotubes (CNTs) are often viewed as rolled-up sheets of _____.
 - (v) The process of breaking down bulk material into nano-sized particles is called the _____ approach.
- (b) Explain the concept of Quantum Confinement and how it distinguishes a quantum dot from a quantum well.
- (c) Discuss how the Surface-to-Volume Ratio affects the chemical reactivity of nanomaterials compared to bulk materials. 5, 5, 5
- 2.** (a) Describe the Sol-Gel synthesis method. What are its primary advantages for producing high-purity nanomaterials?
- (b) What is Chemical Vapor Deposition (CVD)? Explain its role in the growth of carbon nanofibers.
- (c) What do you mean by band theory? Describe the differences between conductors, semiconductors, and insulators. 5, 5, 5

- 3.** (a) Define Fullerenes. Discuss the structure and unique properties of the C₆₀ (Buckyball) molecule.
- (b) What is Pulsed Laser Deposition (PLD)? Detail its application in the fabrication of thin films.
- (c) Explain the role of Nanoreactors in controlling the size and shape of nanoparticles during synthesis. 5, 5, 5
- 4.** (a) Describe the step-by-step procedure of a standard photolithography process, starting from substrate cleaning to the final etching or lift-off.
- (b) How do the optical properties of gold nanoparticles change as their size is reduced?
- (c) Write a short note on the application of nanomaterials as Photocatalysts for environmental cleaning. 5, 5, 5
- 5.** (a) Discuss the various applications of Quantum Dots in the field of medical imaging and display technology.
- (b) Describe the Top-Down vs. Bottom-Up approaches to nanotechnology, giving one example of a technique for each.