This question paper contains 4 printed pages.]

3409 *Your Roll No. .....*

M.Tech. / II Sem. **A**

NANOSCIENCE AND NANOTECHNOLOGY

Paper NSNT-204

Synthesis and Characterization of Nanomaterials

Time : 3 Hours *Maximum Marks : 38*

(Write your Roll No. on the top immediately on receipt of this question paper.)

*Section A is **compulsory**. In section B attempt **all** questions. From sections C and D attempt any **two** questions.*

Section A (Compulsory)

1. (a) Show mathematically that the surface-to-volume ratio of a nanoparticle is much higher than that of the bulk particle of the identical material. 2

(b) "bottom-up technique is more convenient for nano-fabrication." - Explain. 2

(c) What are the different processes that control the subsequent growth of nuclei during the nanoparticle synthesis? Discuss any one of them in terms of growth of uniform sized particles. 2+1

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2. (a) Describe briefly the synthesis of gold nanoplate and nanoparticle using bacteria Rhodopsedomonas capsulata & fungus R. Oryzae Mycelia, also illustrate the plausible mechanism for the formation of gold nanoparticles? 2

(b) What are the potential applications of gold nanoparticles? 2

3. (a) What is the difference between UV-vis and FT-IR spectroscopy? How can one make the samples for FT IR for solid and liquid sample? 2

(b) What difference one can see in the spectrum if NaCl is used instead of KBr? 1

4. Describe the steps to follow with schematics for metallization of features of sizes 50×50 nm^2 over a Si substrate using e-beam lithography technique. 3

Section B (Attempt all the question)

5. (a) How do you synthesize Ag nanoparticles using photochemical reaction (UV illumination process) in an aqueous solution containing acetone, isopropanol and silver perchlorate as reactants and PVA as a stabilizer? Write down the photochemical reactions. 1+2

Or

(b) How do you synthesize Pt and Pd nanoparticles separately using reduction process? Write the chemical reactions occur during the process. 3

6. (a) "Template-assisted synthesis is a very efficient tool to grow highly ordered nano-wires/rods".- Explain. 3

Or

(b) Why electrodeposition process is needed to grow nanowires/rods through the alumina nano-pores? 3

7. (a) Describe briefly the deposition of some oxide based nanocrystalline thin film via Sol-Gel Dip-Coating technique. 3

Or

(b) What are the basic chemical reactions involved in CVD process? Give example in each case. 3

Section C (Attempt any two question)

8. What is TMV? What are the advantages of using TMV as a template for the formation of nanostructure? Also illustrate the synthesis of inorganic-organic nanocomposite (CdS, PbS, Silica, Iron oxide) using TMV? 3

9. What are magnetosomes and which type of microorganism is responsible for the formation of magnetosomes? How can this be synthesized following a chemical approach, briefly describe the chemistry? 3

10. (a) What is green synthesis? Describe the various biological ingredients for synthesis of nanomaterials? 1.5

(b) Write short notes on: Diatoms and Actinomycete. 1.5

Section D (Attempt any two question)

11. Discuss in detail about atomic force microscope (AFM) addressing. Instrumentation, parameters measured, Imaging modes. 3

12. What is an electron microscope and how is it superior to optical microscope? Name different types of electron microscopes and how do TEM differ from SEM? 3

13. Write short note on :

(a) Advantages and disadvantages of Scanning probe microscopy. 1.5

(b) Advantages and disadvantages of AFM over SEM. 1.5