G-4/438/21

Roll No. .....

M.Sc. IV Semester Examination, 2021

PHYSICS

Paper II

(Physics of Nanomaterials and Devices)

Time : 3 Hours] [Max. Marks : 80

Note : *All questions are compulsory. Question Paper comprises of 3 sections. Section A is objective type/multiple choice questions with no internal choice. Section B is short answer type with internal choice. Section C is long answer type with internal choice.*

SECTION A **1 × 8 = 8**

(Objective Type Questions)

Choose the correct answer :

1. ..... are used to determine the shape or the surfaces of an equilibrium crystal.

2. Blue shift in photoluminescence emission peaks is attributed to the ..... effect.

3. Resolution limit of X-ray lithography is ..... .

4. VLS or SLS growth processes are used for the synthesis of ..... .

5. Broadening of the X-ray diffraction peaks that

increases with sin θ is caused by ....., where θ is the diffraction angle.

6. The vibrational frequencies provide the information about ..... in then anomaterials FTIR spectroscopy.

7. Plasmon waveguides are optical devices based on ..... effect observed in noble metal nanoparticles.

8. The unsual properties of gold atom are attributed to ..... that stabilizes $6s^2$ electron pair.

SECTION B **6×4=24**

(Short Answer Type Questions)

Note : Attempt all questions from each unit with internal choice.

Unit-I

1. Explain quantum confinement effect and hence discuss the discrete electronic configuration and enlarged band gap of nanomaterials.

Or

Discuss size dependence of ferroelectricity in nanomaterials.

Unit-II

2. Explain how is FIB lithography used for producing electronic devices with submicrometer dimension.

Or

Compare Top Down and Bottom up approaches to synthesize zero dimensional nano-materials.

Unit-III

3. Explain the role of surfactants in reduction of surface or interface energy.

Or

What are zeolites ? Explain various categories, synthesis techniques and applications of zeolites.

Unit-IV

4. Explain the excellent catalytic properties of gold nanoparticles.

Or

Explain the mechanism used by biological molecules to recognize and bind to other molecules with extremely high sensitivity and specificity.

SECTION C **12×4=48**

(Long Answer Type Questions)

Note : Attempt all questions.

Unit-I

1. Explain the electrical conduction mechanism in nano-materials due to the quantized conduction including ballistic conduction and Comlomb charging and tunneling.

Or

Explain the total interaction between two particles, which are electrostatically stabilized. Hence discuss the process of particle size control through the stabilization process.

Unit-II

2. What is Lithography ? Explain the process, schematic representations, various modifications and applications of photolithography.

Or

Describe the Sol-Gel process for synthesizing oxide semiconducting quantum dots. Hence explain various characteristic properties of quantum dots.

Unit-III

3. Describe various techniques used under electron microscopy in detail and compare their pros and cons.

Or

Give a detailed account of synthesis, characteristic properties and applications of Carbon Fullerenes.

Unit-IV

4. Give the working principle, construction and applications of Plasmon waveguides. Hence explain the process through which photonic crystals control the propogation of photons.

Or

Describe the construction, working and applications of various Quantum Well Devices.

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