D 11698 (Pages : 2) Name..

Reg. No...................................

THIRD SEMESTER M.Sc. DEGREE (REGULAR/SUPPLEMENTARY) EXAMINATION, NOVEMBER 2021

(CBCSS)

Physics

PHY 3E 07—INTRODUCTION TO NANOSCIENCE TECHNOLOGY

(2020 Admission onwards)

Time : Three Hours   Maximum : 30 Weightage

General Instructions

1. *In cases where choices are provided, students can attend **all** questions in each section.*

2. *The minimum number of questions to be attended from the Section/Part shall remain the same.*

3. *The instruction if any, to attend a minimum number of questions from each sub section/sub part/sub division may be ignored.*

4. *There will be an overall ceiling for each Section/Part that is equivalent to the maximum weightage of the Section/Part.*

Section A

8 Short questions, each answerable within 7.5 minutes
*Answer **all** questions. Each question carries weightage 1.*

1. Discuss about the lotus effect in nanotechnology.

2. What are the unique features in nanoscale when compared to bulk materials ?

3. What is meant by "locked moment magnetism" ?

4. How does fluctuation induced changes in structure of nanoparticles result in the formation of liquid like droplet of atoms ?

5. Write a note on the reactivity of nanoparticles.

6. What is meant by the density of quantum states ?

7. How can we classify a quantum device based on the relation between its dimensionality and de-Broglie wavelength ?

8. What are the effects of size of a nanomaterial on its mechanical properties ?

(8 × 1 = 8 weightage)

Turn over

Section B

4 Essay questions, each answerable within 30 minutes
Answer any **two** *questions. Each question carries weightage 5.*

9. Discuss any three bottom up methods for the synthesis of nanomaterials.

10. Discuss about any *two* methods used for the synthesis of solid disordered nanostructures.

11. Explain briefly the quantum confinement in semiconductors. Hence explain the concepts of (i) Potential step ; (ii) Potential barrier ; and (iii) Quantum well.

12. What are Excitons ? How are they classified based on the formation mechanism ?

(2 × 5 = 10 weightage)

Section C

7 Problem questions, each answerable within 15 minutes
Answer any **four** *questions, Each question carries weightage 3.*

13. Describe the nanoimprint lithographic (NIL) technique with the help of a neat schematic diagram.

14. Discuss briefly about any *one* method to study the electronic structure of nanoparticles.

15. Describe basic principles of electrospinning and its applications in the production of nanofibers.

16. Consider a spherical gold nanoparticle of radium 4nm. Calculate the total number of gold atoms available inside the nanoparticles. Given that gold has a fcc lattice with lattice parameter 0.408nm.

17. Compare the density of states of 0D, 1D, 2D and 3D nanostructures.

18. Describe the quantum mechanical tunneling effect.

19. Explain how the physical properties of the materials significantly depend on their size when reduced to nanodimension.

(4 × 3 = 12 weightage)