D 31207 **(Pages : 2)** **Name.....**

Reg. No.....

THIRD SEMESTER M.Sc. DEGREE (REGULAR/SUPPLEMENTARY) EXAMINATION, NOVEMBER 2022

(CBCSS)

Physics

PHY 3E 07—INTRODUCTION TO NANOSCIENCE TECHNOLOGY

(2020 Admission onwards)

Time : Three Hours Maximum : 30 Weightage

Section A

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

1. Classify the nanomaterials on the basis of their dimension. Give some examples.
2. Describe the nanoimprint lithographic (NIL) technique.
3. Discuss about the lotus effect in nanotechnology
4. What is meant by quantum size effect ?
5. What is meant by "locked moment magnetism" ?
6. How the yield strength of a conventional grain-sized material is related to the grain size ?
7. What is a quantum well ? How is the physical width of a quantum well related to its effective width?
8. What are Wannier-Mott excitons ?

(8 × 1 = 8 weightage)

Section B

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

9. Discuss in detail any two vapor phase deposition techniques used in the bottom up approach for the synthesis of nanomaterials.
10. Explain in detail the mechanical and electrical properties of bulk nanostructured materials.

Turn over

11. Derive the expression for density of states of a 3D material. Hence compare it with that of 1D and 2D models.

12. Explain how the physical properties like :

    (i) Melting point ;

    (ii) Magnetic property ; and

    (iii) Mechanical property of the materials significantly depend on their size when reduced to nanodimension.

(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 Langmuir-Blodgett (LB) Film Formation method.

14. Describe the sol-gel process for the synthesis of nanostructures with the help of a neat schematic diagram.

15. Describe the Jellium nanoclusters model.

16. Describe the 'chill block melt spinning' method of nanostructured material production.

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

18. Consider a spherical gold nanoparticle of radium 2 nm. Calculate the total number of gold atoms available inside the nanoparticles. Given that gold has a fcc lattice with lattice parameter 0.407 nm.

19. What are Biexcitons ? Illustrate the diamond structure for the biexciton transition scheme.

(4 × 3 = 12 weightage)