Reg. No. : ....

Name : ....

Sixth Semester B.Sc. Degree Examination, April 2023

First Degree Programme Under CBCSS

Physics

Elective Course

PY 1661.4 : NANOSCIENCE AND TECHNOLOGY

(2018 Admission Onwards)

Time : 3 Hours　　　　　　　　　　　　　　　　　　　Max. Marks : 80

SECTION – A

Answer **all** questions. Answer should not exceed **two** sentences. Each question carries **1** mark.

1. Write any two examples of particles in the nanoregime.

2. What are zero dimensional nanostructures?

3. Explain fermi energy.

4. Define thermoelectric emission.

5. Why band structure is not existing in the semi- conductor nanocrystals?

6. Why quantum confinement is not occurring in bulk materials?

7. Explain bottom up approach.

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8.   Write Bragg's relation with explanation of terms used?

9.   What are Buckminster fullerenes?

10. Write any two applications of nanotechnology in medicine.

(10 × 1 = 10 Marks)

SECTION – B

Answer any **eight** questions in a paragraph. Each question carries **2** marks.

11. Explain the properties of one dimensional nano structures. Give any two examples of one-dimensional nanostructures.

12. What do you mean by the term "density of states"?

13. Write the postulates of free electron model.

14. How doping affects, the band structure of semiconductors?

15. What is an infinite potential well?

16. Explain the change in optical properties of a nanosystem due to size effects?

17. Explain the ball milling process for the synthesis of nanostructures.

18. Explain Sol-Gel method.

19. Explain the X-ray diffraction method for the analysis of nanostructures?

20. Write a note on SPM techniques.

21. Explain a molecular machine.

22. What is the principle of an STM?

(8 × 2 = 16 Marks)

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SECTION – C

Answer any **six** questions in a sentence or two, Each question carries **4** marks.

Fundamental data which can be used to solve the numerical problems are given below

Charge on electron $e = 1.6 \times 10^{-19} C$

Boltzmann constant $k_B = 1.38 \times 10^{-23} JK^{-1}$, $m_e = 9.1 \times 10^{-31} Kg$

23. A metallic cube of 10 cm in side is subdivided into cubes of 10 nm lengths. Calculate change in surface area to volume in this system?

24. The Fermi energy of a metal which obeys free electron model is 3.2 eV. Calculates its Fermi velocity and Fermi temperature.

25. Explain the conduction mechanism in 2D structures.

26. Explain the formation, of excitons in semiconductor nanocrystals?

27. Starting from the Schrodinger equation derive the expression for energy of electrons trapped in an infinite potential well.

28. Write a note on sputtering.

29. Explain the principle and working of Atomic force microscope?

30. Compare the properties of the allotropes carbon useful in Nanotechnology.

31. Explain the working of SEM. What are its uses?

(6 × 4 = 24 Marks)

SECTION – D

Answer any **two** questions. **Each** question carries **15** marks.

32. With help of suitable examples compare the properties of 0D, 1D, 2D and 3D nanostructures.

33. With the help of neat diagrams write notes on Chemical Vapour Deposition and Pulsed.

34. What is electron microscopy? Write a note on the principle, experimental setup.

35. Write a detailed note on the principle and construction of a single electron transistor.

(2 × 15 = 30 Marks)