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Reg. No. : .....

Name : .....

Sixth Semester B.Sc. Degree Examination, March 2021

First Degree Programme under CBCSS

Physics

Elective Course

PY 1661.4 : NANOSCIENCE AND TECHNOLOGY

(2018 Admission - Regular)

Time : 3 Hours

Max. Marks : 80

PART - A

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

1. What are nanodiamonds?
2. Explain the phenomenon of ball milling.
3. What are BN nanotubes?
4. What do you mean by sputtering?
5. What are quantum dots?
6. Why are excitonic effects more important in nanostructures than in bulk materials?
7. Mention any two applications of STM.

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8. What do you mean by epitaxy?
9. Mention the three CVD process according to the physical characteristics of vapour.
10. Mention the four stages of PLD process.

(10 × 1 = 10 Marks)

### PART – B

Answer **any eight** questions. Answer should not exceed one small paragraph. Each question carries **2** marks.

11. Differentiate between Top-Down and Bottom-up techniques.
12. What do you mean by lithographic process and what are its limitations?
13. What are Fullerenes?
14. Explain the term molecular machine.
15. Write note on e-beam evaporation.
16. Explain the energy band structure of metals, semiconductors and insulators.
17. Briefly explain about the Fermi Dirac statistics.
18. What are the interactions monitored in STM and AFM?
19. Explain about plasma arc discharge.
20. Write note on the 0D, 1D, 2D and 3D nanomaterials.
21. State and explain the any two CVD process according to source of energy.
22. What are the limitations of Transmission electron microscopy?
23. What is Electrodeposition process?

24. What are the potential applications of nanotechnology?
25. Explain the Poole-Frenkel effect.
26. How is nanotechnology being used in medicine today?

**(8 × 2 = 16 Marks)**

### PART – C

Answer **any six** questions. Each question carries **4** marks.

27. Write note on the Debye Scherrer equation and the different broadening observed in XRD.
28. With neat diagram explain the Molecular beam epitaxy.
29. Derive the AC electrical conductivity of a metal according to Drude model.
30. What do you mean by density of states? Draw the density states of states 3D, 2D, 1D and 0D structure with the corresponding degrees of freedom.
31. Differentiate between Mott-Wannier exciton and Frenkel excitons.
32. Explain briefly any two size effects in smaller systems.
33. Write a short note on quantum confinement effect in nanomaterials.
34. Explain the two non lithographic techniques with examples.
35. Explain briefly the thermal evaporation.
36. With neat diagram explain the working principle and laser beam deflection in AFM.
37. Explain briefly about the Scanning electron microscope with a neat schematic diagram.
38. Explain the basic working principle of an STM.

**(6 × 4 = 24 Marks)**

PART - D

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

39. Describe briefly about the working of a single electron transistor with neat figure.
40. Derive the expression for the wave function and energy of an electron trapped in a nanodot and in a nanosheet.
41. Explain with the neat diagram the Pulsed Laser Deposition technique.
42. Explain the field enhanced thermionic emission and derive the expressions for the net current density.
43. Explain about the sol-gel technique , the sol-gel chemistry and its advantages.
44. Explain briefly about the Transmission electron microscope with a neat schematic diagram.

(2 × 15 = 30 Marks)