

## **QUESTION BANK**

### **III Year B.Sc., Nanophysics (Major Elective)**

1. What are nanomaterials?
2. What is the size range of nanomaterials?
3. Define a nanoparticle.
4. Define Specific surface area.
5. Write about the significance of specific surface area of nanomaterials.
6. Compare the specific surface area of cubic nanoparticles of side 50nm and 2nm.
7. Compare the specific surface area of spherical nanoparticles of size 80nm and 4nm.
8. What is morphology of a nanoparticle?
9. Mention some effects of size reduction of nanoparticles(NPs)?
10. Briefly explain effect of size on melting point of NPs.
11. Write briefly on the effect of change of size on mechanical properties of NPs.
12. How does size change affect the optical properties of NPs?
13. What are the effects of size reduction on magnetic properties of NPs?
14. Mention some chemical properties that change with change of size of NPs.
15. Write briefly on the effect of change of size on the band gap of Nanomaterials.
16. What are the forces between Na and Cl ions?
17. What force binds atoms of Argon?
18. What is the force binding a metal atom to a metal atom?
19. What is a NP grain?
20. Define grain boundary of a NP.
21. Write briefly on Van der Waal forces.
22. What is electro static force (Coulombian force) between NPs?
23. Write about the pore structure of NPs.
24. What is a nanopore, mesopore-illustrate.
25. What is the physical significance of pore structure of NPs?

26. Write briefly on the magnetic features of NPs.
27. Briefly explain super paramagnetism.
28. Write about transport mechanism of NPs.
29. Explain how resistivity varies for NPs.
30. What is meant by Quantum confinement of a NP-explain.
31. Explain 0D,1D,2D and 3D nanomaterials.
32. Give examples for the different Dimensional structures.
33. Explain the terms Quantum dots, Quantum wells.
34. Explain DOS of quantum structures of different nanomaterials?
35. Explain superlattice of nanomaterials.
36. What is meant by band offset?
37. What is a Quantum dot laser?
38. What is meant by top-down approach in NP synthesis?
39. Explain Bottom-Up synthesis of NPs.
40. Briefly explain what is Sol-Gel method.
41. Explain Ball-milling for nano synthesis.
42. Explain PVD method.
43. What is CVD method ?
44. Explain PLD method.
45. Explain CBD method.
46. Explain the principle of XRD analysis of NPs.
47. Write a brief note on Debye-Scherrer formula for size determination of NPs.
48. How is SEM used for nanomaterial characterisation?
49. Explain ED(A)X.
50. Explain use of TEM for NP-characterisation.
51. Explain the principle of FTIR.
52. What properties can be analysed by FTIR studies?

53. Explain UV-Vis studies on NPs.
54. Explain briefly the principle of nano-drug delivery.
55. What are polymeric nanoparticles in drug delivery .
56. Explain controlled release of drug.
57. Explain briefly the principle of nanomagnetic data storage.
58. Explain the principle of magneto-optics.
59. What is optic recording?
60. Explain the advantages of nanosensing.
61. Explain the principle of physical, chemical and bio sensing by nanomaterials.

### **Long Answer Questions**

1. Explain in detail with examples nanomaterials of different sizes and shapes.
2. Explain with suitable examples specific surface area of Nanoparticles and their special applications.
3. Write a note on the morphology of NPs and how physical and chemical characteristics depend on them.
4. Explain in detail how melting point and optical properties of nanomaterials depend on the size of NPs.
5. Write in detail the special magnetic properties of nanomaterials with special reference to Superparamagnetism.
6. Explain in detail why band gap of nanomaterials increases with size reduction.
7. Write on the impact of size on catalysis, reaction rate and chemical binding and sensing of NPs.
8. Emissions and absorption of wavelengths of NPs are size and shape dependant-explain this with CdSe NP as example.
9. Explain ionic, covalent, metallic and weak bonding applicable to nanostructures.
10. Explain Van der Waal and electrostatic forces and their significance in nanostructures and layers.
11. Write in detail Van der Waals force and its importance in agglomeration of NPs.
12. Write in detail what is an electrostatic double layer.
13. Explain in detail surface interaction of nanolayers and their importance in stabilization of nano Particles.
14. Write a note on nanopore structures and their importance and applications.
15. Discuss the density of states in nanomaterials of 0D, 1D, 2D and electron motion in them.
16. Compare the quantum confinement and resulting structures like Quantum dots, quantum wells and their physical significance.

17. Write on the special features of quantum dot lasers.
18. Explain in detail the Sol-Gel processes to prepare NPs of different types like emulsion, aerogel, powder.
20. Discuss in detail different types of ball-milling and their advantages.
21. Explain in detail PVD and CVD methods of nano synthesis of films, coatings and their relative merits.
22. Explain in detail molecular beam epitaxy (MBE) in nanomaterial synthesis.
23. Explain in detail how XRD analysis is important in nanomaterial characterisation.
24. Explain Scherrer powder method in nanoparticle size analysis with a suitable XRD diagram.
25. Explain in detail size and surface, morphological analysis of nanostructures using SEM.
26. Explain with a neat diagram TEM setup and its use in analysing nanostructures.
27. Explain UV and FTIR analysis of NPs and their significance.
28. Explain nano drug delivery system with reference to pore and other special structures.
29. Discuss in detail application of nanomagnetic materials in data storage.
30. Discuss the advantages and basic principles of nanosensors.
31. Explain physisorption, chemisorptions, adhesion, adsorption principles as employed in nano sensing systems.
32. Discuss in detail application of nanosensor systems.