

Roll No.

E-756

**M. Sc. (Third Semester)
EXAMINATION, Dec.-Jan., 2020-21**

PHYSICS

Paper Fourth (C)

(Physics of Nanomaterials—I)

Time : Three Hours]

[Maximum Marks : 80

Note : Attempt all Sections as directed.

Section—A

1 each

(Objective/Multiple Choice Questions)

Note : Attempt all questions.

Choose the correct answer :

1. Nanomaterials exhibit peculiar characteristics because of :

- (a) improved device performance
- (b) chemical composition
- (c) quantum confinement effect
- (d) None of the above

P. T. O.

2. If all the three dimensions are in nanometer range, the structure is referred to :
 - (a) quantum dot
 - (b) quantum wire
 - (c) quantum well
 - (d) bulk

3. In a quantum wire, the electrons are confined to move in :
 - (a) 3 dimensions
 - (b) 2 dimensions
 - (c) 1 dimension
 - (d) 0 dimension

4. The melting point of nanomaterials is usually than their bulk counterpart.
 - (a) less
 - (b) more
 - (c) same
 - (d) may be less or more

5. C_{60} is a molecule made of 60 carbon atoms forming a :
 - (a) sheet of regularly placed atoms
 - (b) sheet of irregularly placed atoms
 - (c) spherical cage like structure
 - (d) cubic structure

6. In multiwalled carbon nanotubes, the distance between the walls is of the order of :
- (a) 3.34 nm
 - (b) 0.334 mm
 - (c) 0.334 μm
 - (d) 3.34 mm
7. Carbon nanotube can be synthesized by :
- (a) electric arc deposition
 - (b) mechanical milling
 - (c) thermal evaporation
 - (d) precipitation
8. Lithography is a technique for obtaining :
- (a) nanoparticles
 - (b) thin layers of materials
 - (c) nanotubes
 - (d) pre-designed patterns on a substrate
9. The bottom-up approach for synthesis of nanomaterials involves :
- (a) milling the material
 - (b) removing material layer by layer
 - (c) adding materials molecule by molecule
 - (d) None of the above

10. By electrochemical deposition, smaller particles are obtained by :

- (a) pulsed deposition
- (b) low current
- (c) low precursor concentration
- (d) high voltage

11. Spray pyrolysis is a :

- (a) bottom-up technique
- (b) top-down technique
- (c) Both of these
- (d) None of the above

12. Sol-gel technique cannot be used to obtain :

- (a) nanopowder
- (b) nanorods
- (c) nanofilms
- (d) heterojunctions

13. For XRD, the wavelength use is of the order of :

- (a) metre
- (b) cm
- (c) μm
- (d) nm

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14. For nanocrystals, the XRD peaks are :
- (a) narrow
 - (b) broad
 - (c) of same width
 - (d) absent
15. EDAX is used to obtain in the sample.
- (a) crystal structure
 - (b) size of crystallites
 - (c) distance between the planes
 - (d) ratio of elements present
16. In X-ray, photoelectron spectroscopy, one measures the :
- (a) kinetic energy of ejected electrons
 - (b) binding energy of electrons
 - (c) energy of incident photons
 - (d) energy levels in the material
17. Scanning tunneling microscopy is used only for :
- (a) conducting surfaces
 - (b) insulating surfaces
 - (c) both conducting and insulating surfaces
 - (d) None of the above

P. T. O.

18. In SEM, the image is obtained by the electrons :
- (a) passing through the sample
 - (b) Scattering from the sample
 - (c) Absorbed by the sample
 - (d) None of the above
19. For UV-Vis spectra, the source should be :
- (a) monochromatic
 - (b) polychromatic
 - (c) white light source having all wavelengths
 - (d) any light source
20. Luminescence spectra of nanocrystals are usually shifted towards :
- (a) lower wavelength
 - (b) higher wavelength
 - (c) not shifted
 - (d) None of the above

Section—B

2 each

(Very Short Answer Type Questions)

Note : Attempt all questions.

1. What do you mean by bulk nanostructured materials ?
2. Why properties of nanomaterials differ from that of bulk ?
3. Give the nature of carbon bonds.

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4. What is microemulsion ?
5. What type of nanomaterial can be produced by e-beam evaporation ?
6. What are diamond envil cells ?
7. What is meant by deep level transient spectroscopy ?
8. Give difference between SEM and field emission SEM.

Section—C

3 each

(Short Answer Type Questions)

Note : Attempt all questions.

1. Discuss various types of nanostructured materials.
2. Describe magnetic clusters.
3. Give structure and properties of C₆₀.
4. Explain electronic properties of carbon nanotube.
5. Explain chemical precipitation technique to obtain nanomaterials.
6. Describe differential thermal analysis method.
7. Explain nano-indentation.
8. Describe Fourier Transform Infrared Radiation (FTIR) spectroscopy.

Section—D

5 each

(Long Answer Type Questions)

Note : Attempt any *four* questions.

1. Discuss theoretical modeling of nanoparticles giving geometric and electronic structure.

P. T. O.

2. What are carbon nanotubes ? Describe various types of carbon nanotubes explaining their structure.
3. Explain top-down and bottom-up approaches for obtaining nanoparticles. Describe ball milling technique.
4. Explain X-ray diffraction technique for characterization of nanoparticles. How can nanocrystal size be determined by this method ?
5. Describe Auger electron spectroscopy. What information does it give about the nanomaterial ?
6. Describe atomic force microscopy and give its advantages and disadvantages.
7. Discuss how luminescence technique is used to investigate nanomaterials. Which type of luminescence is not beneficial ?