

C 80037

(Pages : 3)

Name.....

Reg. No.....

**SIXTH SEMESTER B.Sc. DEGREE EXAMINATION, MARCH/APRIL 2015**

(U.G.-CCSS)

Physics—Elective Course

PH 6B 20 (E 01)—NANO SCIENCE AND TECHNOLOGY

Time : Three Hours

Maximum : 30 Weightage

**Section I**

*Answer all questions.*

*Each question carries ¼ weightage.*

1. Identify a common analytical tool used for the characterization of materials :
  - (a) Atomic force spectroscopy.
  - (b) NMR.
  - (c) ESR.
  - (d) Raman spectroscopy.
2. The smallest object that the eye can resolve is about :
  - (a) 4000 Å .
  - (b) 7000 Å .
  - (c) Between 4000Å and 7000Å .
  - (d) 0.07 mm.
3. The size of a quantum dot is :
  - (a) 100 nm.
  - (b) 1 – 5 nm.
  - (c) 4000 Å .
  - (d) 7000 Å .
4. In a bulk semiconductor a bound electron-hole pair is called :
  - (a) Phonon.
  - (b) Photon.
  - (c) Exciton.
  - (d) Cluster.
5. Nano particles of Ge and Si undergo fragmentation where subjected to :
  - (a) LASER.
  - (b) MASER.
  - (c) Forward bias.
  - (d) Reverse bias.
6. Silicon has a crystal structure like that of :
  - (a) Copper.
  - (b) Gold.
  - (c) Diamond.
  - (d) None of the above.
7. The Drude model explains the transport properties of :
  - (a) Electrons.
  - (b) Protons.
  - (c) Photons.
  - (d) Excitons.

Turn over

8. In semi conductors there exists :
- Drift current.
  - Diffusion current.
  - Drift current and diffusion current.
  - None of there.
9. A quasi particle composed of an electron along with its accompanying polarizatioin field is called \_\_\_\_\_.
10. Frenkel excitons have a binding energy of the order of \_\_\_\_\_.
- 1 meV.
  - 1 keV.
  - 1 eV.
  - 0.001 eV.
11. The manufacturing of integrated circuits is an example of the \_\_\_\_\_ process.
12. The  $e$  beam evaporation technique is based on the heat produced by \_\_\_\_\_ bombardment on the material to be deposited.

(12 × ¼ = 3 weightage)

### Section II

*Answer all questions.*

*Each question carries 1 weightage.*

- What are nano materials ?
- What are the characteristic properties of objects in the nano scale ?
- What are magnetic clusters ?
- What is thermionic emission ?
- What is the principle in a scanning probe technique ?
- What made the discovery of fullerenes possible ?
- What is magnetoresistance ? When do Carbon nano tubes display magnetoresistive effects ?
- Give the principle of pulsed laser deposition.
- Give *two* applications of Carbon nano tubes.

(9 × 1 = 9 weightage)

### Section III

*Answer any five questions.*

*Each question carries 2 weightage.*

- Are there nano objects around you ? What are the likely impacts of nano technology ?
- Draw the schematic diagram of the splitting of energy levels of isolated atoms to energy bands due to coupling between atoms. Explain the schematic diagram.

24. Explain the variable range Hopping conduction model.
25. Show that the thermal time constant decreases in smaller systems.
26. Distinguish between Lithographic process and Non-lithographic process.
27. Explain the basic principle of electron microscopy.
28. Give *two* applications of nano materials in the medical field.

(5 × 2 = 10 weightage)

#### Section IV

*Answer any two questions.*

*Each question carries 4 weightage.*

29. Using the Fermi Dirac statistics. Derive an expression for the fermi energy. What is the significance of the Fermi energy at absolute zero ?
30. Derive an expression for the wave function of a confined particle in 1 D in an infinite potential well. Draw the corresponding energy distribution.
31. Explain what is meant by electron tunnelling ? Describe the working of a Scanning Tunnelling Microscope (STM) using a block diagram.

(2 × 4 = 8 weightage)

C 60121

(Pages : 4)

Name.....

Reg. No.....

**SIXTH SEMESTER B.Sc. DEGREE EXAMINATION, MARCH 2014**

(UG-CCSS)

Physics (Elective)

PH 6B 20 (E01)—NANO SCIENCE AND TECHNOLOGY

Time : Three Hours

Maximum : 30 Weightage

**Section A**

*(Objective Type Questions)*

*Answer all twelve questions.*

Choose the correct answer from the following :

1. \_\_\_\_\_ is a Donor atom.

(a) P.

(b) Al.

(c) In.

(d) Ga.

2. Carbon with 60 molecules is known as :

(a) Graphene.

(b) Diamond.

(c) Super carbon.

(d) Buckminster Fullerene.

3. How many Hydrogen atoms could fit in ananometer ?

(a) 100.

(b) 10.

(c) 1.

(d) 5.

4. How small is nanometre ?

(a)  $10^{-9}$ .

(b)  $10^{-12}$ .

(c)  $10^{-15}$ .

(d)  $10^9$ .

5. Which of the following method was used by IBM to image and position individual atoms ?

(a) AFM.

(b) MFM.

(c) STM.

(d) TEM.

Turn over

6. Who is known as the father of f Nanotechnology ?
- (a) Richard E. Smalley. (b) Richard Feynman.  
(c) K Eric Drexler. (d) Galileo.
7. The term *density of states* refers to \_\_\_\_\_.
- (a) The number of Electrons in a given interval of energy.  
(b) The number of energy levels in a given interval of energy.  
(c) The number of Holes in a given interval of energy.  
(d) None of these.
8. Expand the acronym SPM.
9. \_\_\_\_\_ is a three dimensional Nanostructure.
- (a) Carbon nanotube. (b) Graphene.  
(c) Quantum Dot. (d) Buckyball.
10. \_\_\_\_\_ is equation to find the structural Magic number of an FCC Nanoparticle.
- (a)  $N = 1/3 [10n^3 + 15n^2 + 11n + 3]$ .  
(b)  $N = 1/3 [n^3 - n^2 + n - 1]$ .  
(c)  $N = 1/3 [10n^3 - 15n^2 + 11n - 3]$ .  
(d)  $N = 1/3 [10n^3 - 15n^2 - 11n - 3]$ .
11. \_\_\_\_\_ is a direct band semiconductor.
- (a) Si. (b) Ge.  
(c) GaP. (d) GaAs.
12. Frenkel excitons is seen in \_\_\_\_\_.
- (a) Tightly bound excitons found in Semiconductors.  
(b) Tightly bound excitons, usually found in solid inert gases.  
(c) Weakly bound excitons, found in semiconductors.  
(d) Weakly bound excitons, found in solid inert gases.

(12 ×  $\frac{1}{4}$  = 3 weightage)

**Section B**

*(Short Answer Type Questions)*

*Answer all **nine** questions.*

13. Write any two uses of Nanotechnology in Computer.
14. Draw the energy vs. wave vector diagram for a indirect band gap.
15. Write Bragg's law and give the expression to find the inter-planar distance  $d$ .
16. Explain Field enhanced thermionic emission (Schottky effect).
17. Write any *two* methods to measure the particle size of a nano crystal.
18. Define work function and explain the Bulk to Nano-transition.
19. What do you mean by Coulombic Explosion ?
20. Briefly explain Fermi Energy and Fermi Surface.
21. What is meant by shallow and deep traps ?

(9 × 1 = 9 weightage)

**Section C**

*(Short Essay Type Questions)*

*Answer any **five** questions from seven.*

22. Write a short note on Plasma arc discharge.
23. Distinguish between Top down and Bottom up techniques.
24. Briefly explain Ball-milling process.
25. Write a short note on Nano-wire and any one use for it.
26. Briefly explain Pulsed Laser deposition.
27. What are the advantages of Quantum Dot ?
28. Explain the Non-Lithographic process to synthesize nano material.

(5 × 2 = 10 weightage)

**Turn over**

**Section D***(Essay Questions)**Answer any two questions from three.*

29. Briefly explain the synthesis of nanoparticles by using Chemical Vaporization Technique.
30. Explain the working of a Scanning Tunneling Microscope. Give its important applications.
31. Briefly explain the synthesis and applications of Carbon Nano-tubes.

(2 × 4 = 8 weightage)

C 40407

(Pages : 3)

Name.....

Reg. No.....

SIXTH SEMESTER B.Sc. DEGREE EXAMINATION, MARCH 2013

Physics

PH 6B 20 (E1)—NANO SCIENCE AND TECHNOLOGY—Elective

Time : Three Hours

Maximum : 30 Weightage

Section A (Objective Type Questions)

Answer all twelve questions.

1. What is a Buckyball ?
  - (a) Carbon molecule with 60 atoms.
  - (b) Carbon molecule with 70 atoms.
  - (c) Plastic explosive nanoparticle.
  - (d) Nickel molecule with 60 atoms.
2. The prefix "nano" comes from a —
  - (a) French word meaning billion.
  - (b) Greek word meaning dwarf.
  - (c) Spanish word meaning particle.
  - (d) Latin word meaning invisible.
3. There is plenty of room at the bottom. Who said this ?
  - (a) Richard Feynman.
  - (b) Norio Taniguchi.
  - (c) Eric Drexler.
  - (d) Sumio Iijima.
4. Expand the acronym MFM.
5. — is a zero dimensional Nanostructure.
  - (a) Carbon nanotube.
  - (b) Quantum Dot.
  - (c) Buckyball.
  - (d) Graphene.
6. — is a structural Magic number of an FCC Nanoparticle.
  - (a) 2.
  - (b) 20.
  - (c) 13.
  - (d) 60.
7. Moore's Law is an empirical trend in the microelectronics industry for the number of circuits per chip to double roughly in — months.
  - (a) 6 months.
  - (b) 30 months.
  - (c) 24 months.
  - (d) 18 months.
8. — is an acceptor.
  - (a) In.
  - (b) As.
  - (c) P.
  - (d) Si.
9. — is an indirect band Semiconductor.
  - (a) GaSb.
  - (b) GaAs.
  - (c) Si.
  - (d) InP.

Turn over

10. Nano-transistor is a transistor with a size less than ———.
- (a) 100 femtometer. (b) 100 nanometer.  
(c) 100 picometer. (d) 100 atometer.
11. The term *density of states* refers to ———.
- (a) the number of particles with same energy.  
(b) the number of Electrons in a given interval of energy.  
(c) the number of Holes in a given interval of energy.  
(d) the number of energy levels in a given interval of energy.
12. Mott-Wunniier exciton is seen in ———.
- (a) Tightly bound excitons found in Semiconductors.  
(b) Tightly bound excitons, usually found in solid inert gases.  
(c) Weakly bound excitons, found in semiconductors.  
(d) Weakly bound excitons, found in solid inert gases.

(12 × ¼ = 3 weightage)

### Section B (Short Answer Type Questions)

*Answer all nine questions.*

13. Write short note on hopping conduction.  
14. Briefly describe the electro deposition technique.  
15. Define effective mass with its expression.  
16. Explain thermal evaporation.  
17. Write any two important structures of nano crystals.  
18. What is the advantage of nano-magnetism in storage capacity ?  
19. What do you mean by Frenkel effect ?  
20. Write a short note on quantum confinement.  
21. Briefly explain polaron conduction.

(9 × 1 = 9 weightage)

### Section C (Short Essay Type Questions)

*Answer any five questions.*

22. What do you mean by nanostructures and briefly explain any one technique for its synthesis ?  
23. Write the Schrödinger equation for trapped particle in 3D.  
24. Briefly explain carbon nano-tubes.  
25. What do you mean by quantum dot ? Give an example for it.  
26. Briefly explain Pulsed Laser deposition.  
27. What is bottom up nanotechnology ?  
28. Explain the role of nanotechnology for the treatment of cancer.

(5 × 2 = 10 weightage)

**Section D (Essay Questions)**

*Answer any two questions.*

29. With examples briefly explain zero, one, two and three dimensional nanostructures.
30. Explain the different applications and uses of Nanotechnology.
31. Briefly explain the working of an SPM.

(2 × 4 = 8 weightage)