Seat No. : _____

AN-105

August-2021

B.Sc., Sem.-V

305 : Physics
(Nanoscience & Nanotechnology)

Time : 2 Hours] **[Max. Marks : 50**

Instructions : (1) **All** questions in Section-**I** carry equal marks.
(2) Attempt any **three** question in Section-**I**.
(3) Question **9** in Section-**II** is **compulsory**.

SECTION-I

1. (A) What are excitons ? Explain how the two different type of excitons can result in nanocrystalline materials. How the exciton plays an important role in size dependent characteristics of semiconductor nanoparticles ? **7**

   (B) Discuss the different quantum size effects resulting in semiconducting nano particles. **7**

2. (A) What is the luminescence in the semiconducting nanomaterials ? Name the different principles involved in the luminescence property of material and describe the electroluminescence in detail. **7**

   (B) Discuss the structural properties of nanomaterials by considering the illustrations of ZnS and CdSe nanoparticles. **7**

3. (A) Give the limitation of Mie theory of scattering. Explain the Drude model for free electron gas and discuss the phenomenon of Surface Plasmon Resonance (SPR). **7**

   (B) Show a chart representing different methods for the synthesis of nanomaterials. What are top-down and bottom-up approaches for the synthesis of nanomaterials ? Classify the different syntheses methods listed in above shown chart into top-down and bottom-up approaches. **7**

4. (A) What is a Chemical Vapour Deposition (CVD) method ? Explain the concept of a basic CVD method to synthesize the nanomaterials. Describe the different type of reactors used in the method. Give their merits and demerits. **7**

(B) In context to chemical method for the synthesis of nanomaterials, answer the following questions : **7**

(i) What are sols and gels ?

(ii) What is the sol-gel method ?

(iii) Write the importance and advantages of sol-gel method.

(iv) Show the sol-gel options to synthesize aerogels and ceramic fibers with a neat schematic diagram.

5. (A) What are colloids ? Give the illustrations of different colloids. Describe a method to synthesize ZnS nanoparticles through the colloidal route. **7**

(B) Using a neat sketch showing different folding axis on a graphene-sheet of carbon nano tube and describe the terms chiral vector, chiral tube, diameter and angle of folding for carbon nano tube. Derive the equations for diameter and folding angle of carbon nanotube. **7**

6. (A) Discuss the analogy between electron and optical microscopy. With the help of a neat sketch, discuss the interaction of high energy electrons with a solid sample producing different electromagnetic radiations. **7**

(B) Using a neat sketch, explain the construction and working of transmission electron microscope (TEM). What are the importance of bright and dark field imaging modes in TEM ? **7**

7. (A) In context to nano technological applications : **7**

(i) Describe the role of titania (TiO_2) nano particles in automobile.

(ii) How can the nanotechnology fulfill the power requirements in satellite and spaceship ?

(B) For the nano technological applications : **7**

(i) What is the use of aerogels in space and defense ?

(ii) How is the spintronics useful in the development of nanotechnology ?

8. (A) Name the different characterization methods based on diffraction phenomenon. Derive Scherrer equation to determine the size of nano particles using X-ray diffraction. What would be the broadening of diffraction peak caused by ZnS nano particle of 15 nm size when the monochromatic X-rays of 1.542 Å wavelength are scattered at the Bragg angle of 14.5° ? **7**

(B) Explain the concepts of atomic scattering factor and crystal structure factor. **7**

The unit cell of sodium chloride (NaC*l*) having F. C. C. structure has four Na^+ and four Cl^- ions located at (0, 0, 0), (0, 1/2, 1/2), (1/2, 1/2, 0), (1/2, 0, 1/2) and (1/2, 0, 0), (0, 1/2, 0), (0, 0, 1/2), (1/2, 1/2, 1/2) respectively. If the atomic scattering factor for Na^+ and Cl^- ions are f_1 and f_2 respectively, then using the structure factor formula determine the intensity of X-rays scattered from [0 1 0] plane of the NaC*l* crystal.

SECTION-II

9. Attempt any **Eight** : **8**

(1) Which type of microscope is integrated with the small pyramidal shaped nano indenter for hardness measurement of nano particles ?

(2) The young modulus of magnesium crystalline materials is observed to be 4100 N/mm^2 and 3900 N/mm^2. If the size of particles in the material are 12 nm and lμm for nano crystalline and polycrystalline material, what do you predict about young modulus for each ?

(3) What is the relation between the frequency of plasma band (ω_s) and that of plasmon (ω_p) at metal-vacuum interface ?

(4) On which luminescence principle does the Cathode Ray Oscilloscope (C.R.O.) work ?

(5) The magnetic materials having antiparallel spin but smaller magnitude in their alternate neighbour atoms are called _____ materials.

(6) _____ is a thin film made of three layers: magnetically soft, magnetically hard and an alloy.

(7) Which of the following methods is the chemical method to synthesize nano materials ?

(a) Colloids

(b) Chemical Vapour Deposition Method

(c) Melt-mixing

(d) Ion-implantation

(8) Why is the vacuum required in a chamber for the Physical Vapour Deposition (PVD) method ?

(9) When will the growth rate be maximum on the substrate surface in the Langmuir-Hinshelwood mechanism for the film growth ?

(10) Which is the type of electrical conductivity arm chair type CNT possess ?

(11) A chiral vector in carbon nano tube is represented as $R = 3\bar{x} + 3\bar{y}$. If distance between 1.1 Å, what is the diameter of such carbon nano tube ?

(12) In laser ablation method, a laser beam of _____ radiation is preferred.

(13) Which of the following is the characterization technique used to investigate the morphology of synthesized nano solids ?

(a) Microscopy

(b) Spectroscopy

(c) Diffraction

(d) Magnetic measurement

(14) What will be the wavelength of an electron beam excited with 60 KV electrical potential ?

(15) The X-rays scattered by the atoms of different planes in the same directions reinforce to give _____.

(16) Which are the nano particles used in the synthesis of self-cleaning window glass materials ?

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AN-105

August-2021

B.Sc., Sem.-V

305 : Physics
(Object Oriented Programming C++)

Time : 2 Hours] **[Max. Marks : 50**

SECTION-I

Attempt any **Three** :

1. (A) Write the applications of Object Oriented Programming C++. **7**

   (B) Write the all Primitive data types of C++. **7**

2. (A) Write a program to input data and display with class and objects. **7**

   (B) Write a program to evaluate the following equation/series : **7**

   $\sin(x)=x - x^3/3!+x^5/5! - x^7/7!+.....$

3. (A) Write a note on multiple constructors. **7**

   (B) Write a C++ program to add amount data in rupees and paise format. **7**

4. (A) Write a note on function overloading. **7**

   (B) Write a C++ program to calculate sum of first 10 two digits natural numbers. **7**

5. (A) Write the rules of overloading operators. **7**

   (B) Explain the Exception Handling with keywords : *throw*, *catch*, *try*. **7**

6. (A) Write the importance of deconstructors. **7**

   (B) Write a program to add distance data in kilometers and meters format. **7**

7. (A) Explain the mode with open( ). **7**

(B) Write a program for Arithmetic Operator (+) Overloading to add time in hours and minutes. **7**

8. (A) Explain the private member function with suitable example. **7**

(B) Write a C++ program to display string in triangle "PHYSICS". **7**

SECTION-II

9. Attempt any **Four :** (Each carried **2** marks) **8**

(1) Single line remark statement represent by _____ characters.

(2) _____ identifier is used for character value.

(3) Default extension of C++ program is _____.

(4) _____ operator is called scope resolution operator.

(5) *cout* object from _____ header file.

(6) _____ header file is used for standard input output.

(7) Member functions defined inside a class are _____ by default.

(8) sqrt( ) from _____ header file.

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