Seat No. : _____

MF-106

March-2018

B.Sc., Sem.-V

SE-305 : Physics + Electronics
(Nanoscience & Nanotechnology)

Time : 3 Hours] **[Max. Marks : 70**

Instructions : (1) **All** questions are compulsory and carry equal marks.
(2) The symbols have their usual meanings.

1. (a) What do you mean by the hardness of solid materials ? Give the different scales to measure the hardness of materials. Explain how can the nano indentors be used to determine the mechanical properties of nano materials. **7**

OR

What is luminescence in the semiconducting materials ? Name the different principles involved in the luminescent property of materials and describe the electroluminescence principle in detail.

(b) How can the size dependent properties of semiconducting nano particles be realized ? Discuss the optical properties of semiconducting nano particles. **7**

OR

What are magnetic multilayers ? Describe the magnetoresistive behaviour of magnetic multilayers.

2. (a) Show a chart representing different methods for the synthesis of nanomaterials. Describe high energy ball milling method to synthesize nanomaterials with the help of a neat schematic diagram. **7**

OR

What are colloids ? Give the illustrations of different colloids. Describe a method to synthesize ZnS nanoparticles through the colloidal route.

(b) Give the advantages of chemical methods used for the synthesis of nano materials. With the La-Mer diagram, describe the growth of nanoparticles through different stages. How can the Ostwlad ripening and aggregation result during the growth ? **7**

OR

What is a chemical vapour deposition (CVD) method ? Explain the concept of basic CVD method to synthesize nanomaterials. Describe the different type of reactors used in this method. Give their advantages and disadvantages.

3. (a) Show the different folding axis on a graphene sheet which can result different type of carbon nano tubes (CNTs). Compare the different type of carbon nano tubes. State their important properties. **7**

OR

What is an electric discharge technique used in the synthesis of carbon nano tubes ? With the help of a neat schematic diagram for the experimental set up, describe the synthesis of carbon nano tubes based on it.

(b) Explain how a nanotechnology plays an important role in the field of 'Energy'. **7**

OR

Describe the importance of nanotechnology in space and defense.

4. (a) What is meant for the characterization of nano materials ? Describe the different type of characterization methods and their importance in characterizing materials in detail. **8**

OR

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

(b) Discuss the X-ray diffraction from different type of material samples. **6**

OR

The unit cell of sodium chloride (NaCl) 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, show that the intensity of X-rays scattered from [1 0 0] plane of the NaCl crystal is zero.

5. Answer the following questions in short : **14**

(1) What is a quantum dot ?

(2) Which type of excitons may result in a semi-conductor nanoparticles ?

(3) On which luminescence principle does the light emitting diode (LED) work ?

(4) What is meant by a term coulomb staircase ?

(5) What are ferrimagnetic materials ?

(6) Name any two devices based on spintronics.

(7) What is the difference between aerogels and zeolites ?

(8) What are field emitter scanning electron microscopes (FESEMs) ?

(9) What do you mean by the diffraction techniques SAXS and SANS ?

(10) What is the chiral vector in carbon nano tubes (CNTs) ?

(11) What is Elay-Riedel mechanism for the growth of nanomaterials ?

(12) What is a graphene ?

(13) Which type of the electric behaviour a pure C_{60} fullerene exhibits ?

(14) The wavelengths of X-rays emitted by Mo(Kα) and Cu(Kα) radiations are 0.7173 Å and 1.542 Å respectively. Why is the X-rays from Mo(Kα) radiations having more atomic scattering factor than those from Cu(Kα) radiations when incident on a graphene layer at the same incident angle θ ?