

Name of the Department : Physics  
Name of the course : B.Sc. Hons-CBCS \_DSE  
Unique Paper Code : 32227612  
Name of Paper : Nanomaterials and Applications  
Name of Course : B.Sc. (Hons.) Physics  
Semester : VI  
Question Paper Set number : Set C

**Total Time: 3 Hours**

**Maximum Marks: 75**

**Instructions for Candidates:**

- (a) Attempt any **Four** questions in **all**.
- (b) **All** questions carry equal marks

1. How is a Cu  $k\alpha$  radiation produced in a X-ray diffractometer? On what factors does intensity of peaks in an X-ray diffractogram of a nanomaterial depends? Electrons are accelerated to 300 volts and are reflected from a crystal. The first reflection occurs when glancing angle is  $60^\circ$ . Determine the interplanar spacing. **(5+8+5.75)**
  
2. What is Quantum confinement effect? What types of structures are produced when Quantum confinement is observed in 1, 2 and 3 dimensions, provide diagrams? Consider a particle of mass  $10^{-30}$  kg trapped in an infinitely deep potential well of width 0.5 nm. Find the value of the (a) wave number k in the ground state (b) How many states are there having value of k between  $10 \text{ nm}^{-1}$  and  $100 \text{ nm}^{-1}$  (c) What is the density of states at  $E = 3\text{eV}$ ? **(3+6+3+3+3.75)**
  
3. What do you understand by vacuum deposition? Describe working of thermal evaporation using suitable diagram. What is the significance of vapor pressure of material being deposited? Find number density of particles if mean free path is 1 centimeter and effective cross sectional area is  $2 \times 2 \text{ mm}^2$ . **(5+5+4+4.75)**
  
4. Differentiate between the direct and indirect semiconductors with suitable diagrams. What is the difference between optical band gap and electronic band gap? Discuss radiative and non-radiative transitions and their role in devices like p-n Junction diode and LEDs? **(6+6+6.75)**

5. Explain the phenomenon of electron transport via thermionic emission using any device structure. What is the difference between tunneling and hopping mechanism of electron transport? **(12+6.75)**
  
6. Discuss the structure of a thin film based Solar cell and explain its working? Draw the IV characteristics of a Solar cell under different intensity of illumination. How is data written and read using magnetic memory devices? **(7+4+7.75)**