B.Sc. 5th Semester (Honours) Examination, 2019 (CBCS)

Subject : Physics

(Nano Materials and Applications)

Paper : DSE-2(1)

Time: 2 Hours **Full Marks: 40**

The figures in the margin indicate full marks.

Candidates are required to give their answers in their own words as far as practicable.

1. Answer *any five* of the following questions : 2×5=10

(a) Why nanomaterials are so important than their bulk counterpart?

(b) What is the principle of CVD? What is CVD used for?

(c) What are primary differences between SEM and TEM?

(d) How does nanosize influence the band gap of a semiconductor?

(e) What is Photoluminescence?

(f) What is tunneling conduction in nanoparticles?

(g) What is a quantum dot? Why it is called so?

(h) What is CNT? What are the current applications of CNT?

2. Answer *any two* of the following questions : 5×2=10

(a) Describe the Sol-Gel process of nanomaterial synthesis with necessary steps of chemical reactions. 3+2=5

(b) State Scherrer formula explaining the used symbols. Calculate the crystallite size of a nanomaterial from its XRD pattern with FWHM $= 0{\cdot}8°$, $\lambda = 0{\cdot}154\ mm$ and $\theta = 30°$. 2+3=5

(c) What are dielectrics? A solid dielectric has electronic polarizability of $10^{-40}\ Fm^2$. If the internal electric field be a Lorentz field, what is the dielectric constant of the material? Given density of material $= 3 \times 10^{28}\ atoms/m^3$. 2+3=5

(d) Draw the schematic diagram depicting the working principle of any one of the following:

(i) Scanning Tunneling Microscope

(ii) Atomic Force Microscope 5

3. Answer *any two* of the following questions: 10×2=20

(a) (i) Explain the importance of size and shape dependence of material properties at the nanoscale.

(ii) Distinguish between direct band gap and indirect band gap semiconducting materials. 8+2=10

(b) Describe in detail about the principle and process of X-ray diffraction technique with neat sketch. Explain the application of XRD technique for nanomaterial characterization. 6+4=10

(c) What are top down and bottom up approaches of nanomaterial synthesis? Describe the ball milling process of nanomaterial synthesis with its merits and demerits. 2+6+2=10

(d) (i) What are surface defects? Briefly describe different types of surface defects in a nano crystal.

(ii) How thin films are used in solar cell devices? (1+4)+5=10
