B.Sc. 6th Semester (Honours) Examination, 2020-21

PHYSICS

Course ID: 62417 **Course Code: SH/PHS/604/DSE-4**

Course Title: Nano Materials and Applications (DSE T7)

Time: 1 Hour 15 Minutes **Full Marks: 25**

The figures in the margin indicate full marks.
Candidates are required to give their answers in their own words as far as practicable.

Section-I

1. Answer any ***five*** questions: 1×5=5

a) Why reactivity of a material increases when we decrease its particle size?

b) Calculate the exciton Bohr radius of GaAs if the effective mass of electron is $0.067m_e$, effective mass of hole is $0.45m_e$ and relative permittivity is 12.4 in GaAs.

c) How band gap of semiconductor materials changes with temperature?

d) Why excitons are called quasi-particle?

e) Write the name of a microscope where the quantum mechanical tunnelling is used.

f) What are the disadvantages of ball milling method of nanomaterial synthesis?

g) Write two advantages of Sol-Gel synthesis method.

h) Mention two applications of nanoscience and nanotechnology in the field of agriculture.

Section-II

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

(a) What is quantum confinement in connection to the nanomaterials? Obtain the condition of quantum confinement of a particle along a particular direction. What do you mean by Density of States? [1+3+1]

(b) What is 'Lithography'? Explain how photolithography technique is used to fabricate different nanostructures. [1+4]

(c) How structural purity of a nanomaterial can be studied using X-ray diffraction data? Explain the principle of estimating particle size from X-ray diffraction data. [2+3]

(d) What is a single electron transistor? Explain the structure of a single electron transistor with suitable diagram. [1+4]

P.T.O.

Section-III

3. Answer any ***one*** question**:** 10×1=10

(a) What is the blue shift in nanoparticle luminescence? Why does a semiconductor quantum dot possess tunable fluorescent emission? What do you mean band edge fluorescent emission and red shifted defect fluorescent emission of semiconductor nanoparticles? Why do the core-shell composite nanomterials possess better optical properties compared to the individual nanomaterials? [2+2+(2+2)+2]

(b) What are the effects of reduction of particle size of a conducting material on its electrical conductivity? How do the crystal imperfection and surface scattering affect the electrical conductivity of a material when the particle size reduces to nano-range? What is ballistic conduction? Compare diffusive conduction with ballistic conduction. [2+2+3+3]

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