B.Sc. 6th Semester (Honours) Examination 2020

PHYSICS

(Nanomaterials and applications)

Paper: 604/DSE-4/T-7

Course ID: 62417

Time: 1 Hour **Full Marks: 12**

The figures in the margin indicate full marks.
Students should write the answers in their own words as much as practicable.
Answer all the questions.

Section I

1. Answer any ***two (02)*** questions: 1X2=2

a) What is the dimension of nano-regime?

b) What is Fermi level?

c) Mention two applications of nanotechnology.

d) What is thermionic emission?

e) The band gap of a direct band gap semiconductor is 4.2 eV. What will be the frequency of the band to band luminescence radiation coming out of it?

f) What do you mean by quasi-particles?

Section II

2. Answer any ***one (01)*** question: 4X1=4

(a) How does the density of states (DOS) change with the degree of confinement in low dimensional materials? N numbers of spherical nanoparticles, each of radius r, are merged into a single spherical nanoparticle of radius R. How does the surface to volume ratio change due to this conversion? 3+1

(b) What do you mean by the top-down and bottom-up approaches of nanomaterial synthesis? Give examples of each case. Compare the two approaches. 1+1+2

(c) Why optical microscope is not suitable for characterization of nanomaterials? Mention the differences between resolution and magnification. 1+3

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Section III

3. Answer any ***one (01)*** question: 6X1=6

(a) What is the effect of quantum confinement on the energy levels of semiconducting quantum dots? Explain their optical properties on the basis of quantum confinement. Write and explain the Brus equation expressing the band gap energy of a semiconductor quantum dot. 2+1+3

(b) Explain the Coulomb blockade effect. What conditions must be satisfied for this effect to be observed? 3+3

(c) Why quantum dots are identified as attractive candidates to be applied for LED devices? Describe the basic structure of quantum dot LED with suitable diagram. 1+(3+2)
