

U.G. 6th Semester Examination-2021

PHYSICS

[HONOURS]

Discipline Specific Elective (DSE)

Course Code : PHY-H-DSE-T-03

(Nano Materials and Applications)

Full Marks : 40

Time : 2½ Hours

The figures in the right-hand margin indicate marks.

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

1. Answer any **five** questions : 2×5=10
- i) What is thermionic emission?
 - ii) What do you mean by quasi-particles?
 - iii) What is the dimension of Nano-regime?
 - iv) What is surface plasmon resonance?
 - v) What is exciton? How does it differ from polaron?
 - vi) Distinguish between localized states and delocalized states.
 - vii) Bulk gold is yellow but nanogold is never yellow—why is it so?
 - viii) What is the principle behind X-ray crystallography?

2. Answer any **two** questions: 5×2=10
- i) 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+2
 - ii) 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+(1+1)+1
 - iii) Why quantum dots are identified as attractive candidates to be applied for LED devices? Describe the basic structure of quantum dot LED with a suitable diagram. 2+3
 - iv) What do you mean by topological defects? Distinguish between deep level and shallow level defects. 2+3
3. Answer any **two** questions: 10×2=20
- i) Write detailed note on (a) High energy Ball milling method (b) Chemical vapor deposition. 5+5
 - ii) Explain the role of excitons in direct and indirect bandgap semiconductor nanocrystals.

Why direct bandgap material is preferred over indirect one for optical devices? What is the binding energy of exciton? 4+4+2

iii) Indicate some of the major commercial applications of Nano Electromechanical Systems. Describe briefly the advantages of carbon nanotube (CNT) FET in comparison to MOSFET. 5+5

iv) a) Why are optical microscopes not suitable for resolving objects at atomic level?

b) What do you mean by Van der Waals interaction? In which ways is it different from Coulomb interaction? Explain briefly its role in the measurements by atomic force Microscopy.

2+(2+2+4)
