

2022
B.A./B.Sc.
Fifth Semester
DISCIPLINE SPECIFIC ELECTIVE – 2
PHYSICS
Course Code: PHD 5.21 (B)
(Nanomaterials & Applications)

Total Mark: 70
Time: 3 hours

Pass Mark: 28

Answer five questions, taking one from each unit.

UNIT-I

1. Derive an expression for the density of energy states and carrier concentration in 2-dimensional, 1-dimensional, and 0-dimensional solid material. Write a note on quantum dots. 10+4=14
2. Show that the solution of Schrodinger's equation for a particle in an infinite potential well leads to the concept of quantization of energy. Find the probability that a particle trapped in a box L wide can be found between 0.45 L and 0.55 L for the ground state and first excited state. 10+4=14

UNIT-II

3. Explain sol-gel synthesis for producing nanomaterials? Explain with the help of a neat sketch. What are the differences between physical vapour deposition and chemical vapour deposition? 10+4=14
4. Discuss X-ray diffraction characterization techniques for nanomaterials with a neat diagram. Calculate the glancing angle on the cube whose Miller indices (110) of a rock salt $a = 2.84 \text{ \AA}$ corresponding to second order maxima of 0.710 \AA . What are the differences between SEM & TEM? 8+2+4=14

UNIT-III

5. Discuss the impact of SnO_2 based coupling on photocatalytic self-cleaning properties. Distinguish between direct and indirect semiconductor. 10+4=14
6. Write a note on optical properties of electronic transitions for bulk semiconductor materials and a quantum structure. What are optical absorption? What are Frenkel excitons and Wannier-Mott excitons? 8+2+4=14

UNIT-IV

7. Discuss in detail about quantum size effect. Write a short note on quantum transport. 10+4=14
8. What are the different types of point defects? How are point defects formed? Calculate the energy required for the formation of vacancy. Find out an expression for the number of vacancies at a given temperature. 2+2+8+2=14

UNIT-V

9. Explain carbon nanotubes. What are the types of carbon nanotubes? Discuss the properties of carbon nanotubes. 4+2+8=14
10. Write a short note on the following: 7×2=14
- (a) Solar cell
 - (b) Nano electromechanical systems (NEMS)