



VIT AP

VIT AP AMARAVATI

Introduction to Nanotechnology [PHY2005 - 074]

Marks: 50

Duration: 90 mins.

SECTION I

Answer all the questions.

- 1) A particle is represented (at time $t=0$) by the wave function represented below (10)
- $$\Psi(x, 0) = \begin{cases} A(a^2 - x^2) & \text{if } -a \leq x \leq +a \\ 0 & \text{Otherwise} \end{cases}$$
- (a) Determine the normalization constant A.
(b) Based on your knowledge on nanomaterials discuss whether the shape and size have greater effect on optical properties of nanoparticles or not?
- 2) (a) According to you what could be the possible reason for the boiling point of ethane to be more than that of methane. (b) Can a non-polar molecule have polar covalent bonds? Justify your answer with appropriate examples. (10)
- 3) (a) Name the type of semiconductor that has equal electron and hole concentration. State the effect of temperature on conductivity of a semiconductor. Also mention the reason for a transparent body to be an insulator? (10)
(b) Estimate the de Broglie wavelength of a neutron moving at one five- hundredth of the speed of light? Given the neutron mass= 1.67493×10^{-27} Kg.
- 4) (a) Illustrate with suitable example why does the energy gap of a quantum dot vary with its dimensions? Also discuss what is the future of quantum dots (QDs) for biological applications? (b) Illustrate how does the density of states function change with different dimensional nanomaterials. (10)
- 5) A particle in an infinitely deep square well has a wave function as given below for $0 \leq x \leq L$ and zero otherwise. (10)
- $$\psi(x) = \sqrt{\frac{2}{L}} \sin\left(\frac{2\pi x}{L}\right)$$
- (a) Determine the expectation value of x .
(b) Determine the probability of finding the particle near $L/2$, by calculating the probability that the particle lies in the range $0.490L \leq x \leq 0.510L$.

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