

Exam.Code:1029

Sub. Code: 7853

1128

M. Tech. (Material Science and Technology)

First Semester

MST-103: Physics of Nano-Materials

Time allowed: 3 Hours

Max. Marks: 50

NOTE: Attempt five questions in all, including Question No. 1 which is compulsory and selecting two questions from each Unit.

x-x-x

I. Attempt the following briefly:-

- Explain the meaning of the terms (i) Fermi surface (ii) Brillouin zone.
- Is it possible to observe a Compton Effect with visible light? Why?
- Mention the applications of nano-wires.
- How nano materials can improve the mechanical properties of the bulk materials.
- Distinguish between Fermions and Bosons. (5x2)

UNIT - I

- II. a) Show that the de Broglie wavelength of a particle, of charge  $e$ , rest mass  $m_0$ , moving at relativistic speeds is given as a function of the accelerating potential  $V$  as

$$\lambda = \frac{h}{(2m_0eV)^{1/2} \left(1 + \frac{eV}{2m_0c^2}\right)^{-1/2}}$$

- b) Use the Schrodinger equation to obtain the expressions for the reflection and transmission coefficients of a particle of mass  $m$  and energy  $E$ , approaching a potential step of height  $V_0$  for the case of  $E < V_0$ . (5,5)

- III. a) Separate the Schrodinger equation for a time-independent potential, into a time-independent Schrodinger equation and an equation for the time dependence of the wave function.

- b) Compare the probability for three bosons to be in a particular quantum state with the probability for three classical particles to be in the same state.

(5,5)

P.T.O.

(2)

- IV. a) Obtain an expression for the thermodynamic probability of a system obeying M-B statistics and hence evaluate the M-B distribution function.
- b) Compare the quantum confinement and resulting structures like Quantum dots, quantum wells and their physical significance. (5,5)

UNIT - II

- V. a) Discuss the concept of effective mass of an electron in a metal. Give its physical significance.
- b) Explain in detail the Sol-Gel method to prepare nanomaterials of different types like Aerogel and Xerogel. (5,5)
- VI. a) Explain with examples to show that magnetic nanomaterials show a variety of unusual magnetic behavior when compared to bulk materials.
- b) Write a note on the morphology of nanoparticles and how physical and chemical characteristics depend on them. (5,5)
- VII. a) Write a short note on application of nanomaterials on the basis of their optical properties.
- b) Discuss the density of states in 0-D, 1-D and 2-D nanomaterials. (5,5)

x-x-x