

Exam. Code: 0905

Sub. Code: 6645

1128

**B.E. (Bio-Technology) First Semester
APH-103: Quantum and Statistical Physics
(Common with IT and CSE)**

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 Part.

x-x-x

I. Attempt any five of the following:-

- a) What is paradoxical about twin paradox?
- b) Why pair production cannot occur in free space?
- c) Why gravitational red shift is not apparent for most of the stars?
- d) What are the angles between L and the z axis for $l = 1$? For $l = 2$?
- e) Why is it not possible for Stern-Gerlach-experiment to be performed in a uniform magnetic field?
- f) Distinguish between macrostate and microstate of a statistical system.
- g) Under what condition do B-E and F-D statistics yield Classical statistics?
(5x2)

UNIT - I

- II.
 - a) What was the aim and conclusion of Michelson-Morely experiment?
 - b) According to the postulates of Einstein theory, laws of physics are same in all inertial frame. What about non-inertial frames? Why they can't be same in non-inertial frame?
 - c) What were the limitations of Galilean transformations? Obtain Lorentz transformation laws for position and time coordinates. Why we consider $y=y'$ and $z=z'$?
(2,3,5)
- III.
 - a) How are continuous and characteristic X-rays produced? How can you control the intensity and penetrating power of the X-rays?
 - b) Work function of nickel is 5.01 eV. Will violet light of wavelength 400nm cause the photoelectric effect in nickel?
 - c) Cite an experiment which proved de Broglie's hypothesis.
(3,3,4)

P.T.O.

(2)

- IV. a) What is the Born's interpretation of quantum mechanical wave function? What are the essential requirements for an acceptable (well-behaved) wave function?
- b) Using operator mechanics find commutator $[\hat{x}, \hat{p}_x^2]$.
- c) Qualitatively show that Heisenberg's Uncertainty principle is natural consequence of wave nature of particle. (4,4,2)

UNIT - II

- V. a) A particle having energy E faces a step potential barrier of height V_0 at $X=0$. Show that even if $E < V_0$, the particle has finite probability to tunnel into the region $X > 0$.

- b) Prove that average value of r for a 1s electron in hydrogen atom is $\frac{3}{2} a_0$. a_0 is Bohr

radius and wave function for 1s electron is $\psi = \frac{e^{-r/a_0}}{\sqrt{\pi a_0^3}}$

- VI. a) How is the Pauli exclusion principle a consequence of antisymmetric wave function?

- b) Show that Rayleigh-Jeans law failed but Planck's radiation law successfully explained the observed radiation spectrum of a blackbody. (5,5)

- VII. a) Discuss the phenomenon of thermionic emission in metals. Obtain Richardson-Dushman equation.

- b) Show that the most probable speed of an ideal gas molecule is $\sqrt{\frac{2kt}{m}}$. (6,4)