

1019
B.E., Third Semester
APH-203: Quantum and Statistical Physics
(Common with ECE, IT, EEE and ECE)

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 parts (2 x 5=10)

- (a) Why no Compton effect is observed when an photon gets scattered from K shell electron of Uranium atom.
- (b) Heisenberg's uncertainty principle is a natural consequence of wave nature of associated with moving microscopic particle.
- (c) Give two distinguishing features between three kinds of statistics obeyed by different physical systems.
- (d) What are the postulates of special theory of relativity.
- (e) What are time like events. Do they obey principle of causality.
- (f) What is correspondence principle and give its significance in quantum physics.
- (g) Why a particle can't be at rest in the infinitely deep one dimensional potential well.

PART A

- II (a) Derive Lorentz transformation for position and time coordinates using basic postulates of special theory of relativity. (6)
- (b) Using Lorentz transformation, obtain the relation for length contraction. (4)
- III (a) What is relativistic Doppler effect in light. Derive the expression for change in frequency of light in case of longitudinal Doppler effect. (5)
- (b) Show that $(E/c)^2 - p^2$ is invariant under Lorentz transformations. (5)
- IV (a) Discuss Max Born's interpretation of wavefunction associated with a moving particle. (6)
- (b) Using Heisenberg uncertainty principle, show that the electron can never be constituent of the nucleus. (4)

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PART B

- V (a) A particle of mass m and kinetic energy E is incident on a one dimensional potential step of height V_0 , such that $E < V_0$. Solve Schrodinger's equation for this particle and list the observations. How do these observations differ from the expectations of classical mechanics (7)
- (b) Prove the identity that $[x^2, p_x] = 2i\hbar x$ (3)
- VI. (a) Give an account on quantum theory of hydrogen atom. (7)
- (b) Write a brief note on Zeeman effect. (3)
- VII What is thermionic emission? Using appropriate formalism of statistical physics, derive the expression for Richardson Dushman equation. (1)

x-x-x