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Register Number
Name of the Candidate:

M.Sc. DEGREE EXAMINATION, May 2015

(PHYSICS)

(SECOND YEAR)

210: WAVE MECHANICS AND QUANTUM MECHANICS

Time: Three hours | Maximum: 100 marks

SECTION-A **(5×4=20)**

Answer any FIVE questions

1. State and explain Heisenberg's uncertainty r elation.
2. Show that the expectation value of the square of an observable is always positive.
3. Write the Fermi's Golden Rule related to transition probability and interpret the meaning of the rule.
4. Explain the fundamental concept of WKB approximation.
5. What is meant by "Hermitian operator"? Write its properties and physical significance.
6. What do you understand by the terms differential cross section and total cross section in Quantum theory of scattering?
7. Write briefly the contribution of p-wave scattering to the total cross section.
8. Distinguish between "Laplacian operator" and 'De Alembertian operator".

SECTION-B **(5×16=80)**

Answer any FIVE questions

9. a) State and prove Ehrenfest Theorem. (10)
   b) Obtain the current density carried by a plane wave $A.e^{ikx}$ is one dimension and verify that it satisfies the equation of continuity in one dimension. (6)
10. Solve the Schrödinger's wave equation for a particle moving in a one dimensional square well potential of finite depth and finite width and obtain its energy eigen values.
11. What are Einstein's co-efficients? Obtain Einstein's transition probabilities by a quantum mechanical perturbation treatment.
12. Explain the principles of variation al method in perturbation theory. Use it calculate of the Van der Waal's interaction between two hydrogen atoms in their ground state.
13. Explain the characteristics of raising and lowering operators. Solve the quantum mechanical problem of one dimensional Harmonic oscillator using ladder operator method.

14. Discuss the method of Born's approximation for scattering by screened columns potential field: discuss the conditions of validity.

15. Discuss the theory of partial wave analysis. Show that for a beam of low energy particles scattered by a rigid sphere, the scattering is isotropic. Find out the expression for scattering cross section.

16. Derive the Dirac's equation for an electron moving in an electrostatic field and show that the spin of the electron is a natural consequence of Dirac's mathematical formulation.

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