URUMU DHANALAKSHMI COLLEGE

TIRUCHIRAPPALLI – 620 019

Model Exam / I M.Sc., Physics / Quantum Mechanics / 75 Marks / 3 Hours / April 2020

Part – A

Answer the all the questions   10 x 2 = 20

1. Define Hermitian operator and also mention any two properties.
2. How do you represent a state vector and its conjucate in Dirac's notation?
3. Explain "Norm" and "Basis" in Hilbert's Space.
4. Write and explain the zero point energy of a linear harmonic oscillator.
5. What is meant by perturbation and harmonic perturbation?
6. What is tunnel effect?
7. Write the validity of born approximation.
8. List the commutation rules for angular momentum.
9. What is hole?
10. Give any two properties of Dirac matrices.

Part – B

Answer the all the questions   5 x 5 = 25

11. a. Explain in the physical significance of wave functions.   (or)
    b. State Heisenberg's uncertainty principle. Derive a mathematical proof of the position momentum uncertainty relation.
12. a. Discuss the problem of a particle in a box.   (or)
    b. Solve the wave equation of rigid rotator and obtain its energy levels.
13. a. Develop the first order perturbation theory for non degenerate case.   (or)
    b. Discuss the time dependent perturbation and arrive at Fermi's golden rule.
14. a. Using Green function method, deduce integral equation for scattering.   (or)
    b. Obtain the Eigen values Eigen functions of L^2 and L_2.
15. a. Derive the Klein-Gorden equation for a free particle.   (or)
    b. Write a note on negative energy states.

Part – C

Answer any Three of the questions   3 x 10 = 30

16. Compare Schrodinger, Heiscenberg and interaction picture.
17. Obtain Schrodinger equation of hydrogen atom in radial and polar form.
18. State and Explain Stark effect.

19. Derive and expression for scattering amplitude using born approximation.
20. Show that how the spin orbit interaction comes out automatically Dirac's equation.

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