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M.Sc. DEGREE (C.S.S.) EXAMINATION, NOVEMBER 2018

Third Semester

Faculty of Science

Branch II : Physics (A)–Pure Physics

PH 3C 09—QUANTUM MECHANICS–II

(2012 Admission onwards)

Time : Three Hours   Maximum Weight : 30

Part A

Answer any **six** *questions.*
Each question carries 1 *weight.*

1. Bring out the time evolution in interaction picture.

2. What is harmonic perturbation ? Explain.

3. What are the features of electric dipole approximation ? Explain.

4. Explain the criteria for Born approximation.

5. Explain resonance scattering.

6. Write and explain KG equations.

7. What are gamma matrices ?

8. Briefly explain the plane wave solutions for free particles at rest.

9. State the conservation laws for classical field theory.

10. What is meant by canonical quantisation of Dirac field ?

$(6 \times 1 = 6)$

Part B

Answer any **four** *questions.*
Each question carries 2 *weight.*

11. Calculate the electric dipole transition probability from atom placed in a radiation field.

12. Apply the perturbation theory to evaluate first order energy shift in the ground state of the linear harmonic oscillator by small perturbing potential C x^4 in the Hamiltonian.

Turn over

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13. Obtain the formula for expanding a plane wave in terms of partial waves.

14. Show that the orbital angular momentum is not conserved in Dirac theory.

15. Obtain the Dirac equation in covariant form.

16. Discuss the Hamiltonian density of Dirac field.

$(4 \times 2 = 8)$

Part C

Answer **all** *questions.*
Each question carries 4 *weight.*

17. (a) Discuss the first order time dependent perturbation theory and derive the Fermi golden rule for the transition rate from a given initial state to final state continuum.

Or

(b) Discuss the sudden and adiabatic approximation in detail.

18. (a) Bring out the expression for scattering cross section in the Born approximation.

Or

(b) Show that the method of partial wave analysis is used in the theory of scattering indicating merits and limitations.

19. (a) Determine the current, charge density and continuity equation associated with Dirac equation and KG equation.

Or

(b) Set up Dirac equation for an electron in an em field and obtain an expression for electron spin magnetic moment.

20. (a) Discuss the Hamiltonian formulation in field theory.

Or

(b) Discuss the canonical quantization of Dirac field.

$(4 \times 4 = 16)$