LOYOLA COLLEGE (AUTONOMOUS), CHENNAI – 600 034

M.Sc. DEGREE EXAMINATION – **PHYSICS**

THIRD SEMESTER – NOVEMBER 2016

PH 3808 - RELATIVITY AND QUANTUM MECHANICS

Date: 01-11-2016   Dept. No. _____   Max. : 100 Marks
Time: 09:00-12:00

PART A

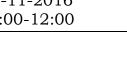Answer **ALL** questions: **10 x 2 = 20 marks**

1. State the relation between relativistic energy and relativistic momentum.

2. If a particle of kinetic energy is one-fourth of its rest energy, what is its speed?

3. Explain the salient features of Minkowski's space time diagram.

4. Establish that the relativistic energy is non-zero even when the object is stationary.

5. What are partial waves?

6. Explain Ramseur-Townsend effect.

7. What do you understand by a selection rule?

8. Distinguish between stimulated emission and spontaneous emission.

9. What is the limitation of Klein-Gordon equation?

10. The dimensions of Dirac's matrices have to be even. Why?

PART B

Answer any **FOUR** questions: **4 x 7.5 = 30 marks**

11. a. Explain in detail the" the invariant interval" of two events in special theory of relativity.

    b. If a particle of kinetic energy is twice of its rest mass energy, what is its velocity? **5 + 2.5**

12. If a point charge q is at rest at the origin in system S_0. What is the electric field of this same charge in system S, which moves to the right at speed v_0 relative to S_0.

13. Outline the Green's function method of obtaining a formal solution of a Schrodinger wave equation in scattering theory.

14. What are Einstein's coefficients? Outline the way in which absorption and emission of radiation is explained in quantum mechanics?

15. Explain how Klein-Gordon equation leads to positive and negative probability density states.

PART C

Answer any **FOUR** questions: **4 x 12.5 = 50 marks**

16. Explain Compton's scattering and find an expression for the change in wavelength of the scattered X-ray beam. (b) Discuss the work-energy theorem in relativity.

17. Establish the covariant forms of (i) Lorentz force and (ii) the homogeneous Maxwell's equation.   **6 + 6.5**

18. Discuss the Born-approximation method of scattering theory and obtain an expression for the scattering amplitude.

19. Discuss time-dependent perturbation theory with reference to sinusoidal perturbation and obtain expression for transition probability.

20. Starting from the basic energy equation derive the *Dirac's relativistic equation* for a free particle

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