LOYOLA COLLEGE (AUTONOMOUS), CHENNAI – 600 034

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

THIRD SEMESTER – NOVEMBER 2017

PH 3808 - RELATIVITY AND QUANTUM MECHANICS

Date: 02-11-2017 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. State the equation of continuity in electromagnetism in terms of the 4-current.
4. How does charge density transform under Lorentz transformation?
5. Define differential scattering cross-section.
6. What are partial waves?
7. Write a short note on Rabi frequency.
8. Explain the principle of Lasers.
9. What is a hole, with reference to a free Dirac particle?
10. What is the limitation of Klein-Gordon equation?

PART B

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

11. (a) Explain the salient features of Minkowski's space time diagram. (b) A pion at rest decays into a muon and a neutrino. Find the energy of the outgoing muon, in terms of the two masses m_{π} and m_{μ} (assume m_{ν} = 0) 3 + 4.5
12. 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 speed? 5 + 2.5
13. Outline the Green's function method of obtaining a formal solution of a Schrodinger wave equation in scattering theory.
14. Develop the time dependent perturbation theory up to second order.
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. (a) 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. Obtain the transformation equations among the components of electric and magnetic fields of the special theory of relativity.
18. Discuss the Born-approximation method of scattering theory and obtain an expression for the scattering amplitude.
19. Discuss the interaction of an atom with the radiation field and obtain an expression for probability in terms of energy density of the radiation field.
20. Starting from the basic energy equation derive the *Dirac's relativistic equation* for a free particle

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