



LOYOLA COLLEGE (AUTONOMOUS), CHENNAI – 600 034

M.Sc. DEGREE EXAMINATION – PHYSICS

THIRD SEMESTER – APRIL 2014

PH 3811/3808 - RELATIVITY AND QUANTUM MECHANICS

Date : 05/04/2014

Dept. No.

Max. : 100 Marks

Time : 01:00-04:00

PART A

Answer **ALL** the questions (10 × 2 = 20)

1. Define interval between two events in relativistic mechanics. What is a “space- like” events?
2. Obtain the relation between proper velocity and ordinary velocity.
3. How does charge density transform under Lorentz transformation?
4. Define differential scattering cross-section.
5. Distinguish between Born approximation and the partial wave analysis of the scattering theory.
6. What do you understand by a selection rule?
7. What is meant by first and second order perturbations?
8. What is ‘dipole approximation’ in radiation theory?
9. Write the Dirac’s Hamiltonian and explain the significance of each term.
10. What is a hole, with reference to a free Dirac particle?

PART – B

Answer any **FOUR** questions (4 × 7.5 = 30)

- 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 $m_\nu=0$)
(3 + 4.5)
12. Establish that the relativistic energy is non-zero even when the object is stationary.

13. Discuss the kinematics of scattering process to obtain a formal expression for scattering amplitude.
14. Discuss the time-dependent perturbation theory to obtain an expression for the amplitude of first order transition.
15. Explain how Klein-Gordon equation leads to positive and negative probability density.

PART - C

Answer any **FOUR** questions

(4 × 12.5 = 50)

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. Define the electromagnetic field strength tensors and establish the covariant formulation of Maxwell's equations.
18. Discuss the Born-approximation method of scattering theory and obtain an expression for the scattering amplitude.
19. Discuss the time dependent perturbation theory with reference to harmonic perturbation and obtain an expression for the transition probability per unit time.
20. Obtain the plane wave solutions of the Dirac's relativistic wave equation of a free particle.
