 LOYOLA COLLEGE (AUTONOMOUS), CHENNAI – 600 034

**M.Sc.** DEGREE EXAMINATION - **PHYSICS**

THIRD SEMESTER – NOVEMBER 2012

# PH 3811/3808 - RELATIVITY AND QUANTUM MECHANICS

Date : 03/11/2012 Dept. No. Max. : 100 Marks

Time : 9:00 - 12:00

**PART – A**

Answer **ALL** questions: (10x2=20)

1. Obtain the relation between proper velocity and ordinary velocity.
2. If a particle of kinetic energy one-fourth 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. What do you understand by a selection rule?
8. What is meant by first and second order perturbation?
9. What is a hole, with reference to a free Dirac particle?
10. The dimensions of Dirac’s matrices have to be even. Why?

**PART – B**

Answer any **FOUR** questions: (4x7.5=30)

1. (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)
2. 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**
3. Outline the Green’s function method of obtaining a formal solution of a Schrodinger wave equation in scattering theory.
4. Develop the time dependent perturbation theory up to second order.
5. Explain how Klein-Gordon equation leads to positive and negative probability density.

**PART – C**

Answer any **FOUR** questions: (4x12.5=50)

1. (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.
2. Obtain the transformation equations among the components of electric and magnetic fields of the special theory of relativity.
3. Discuss the Born-approximation method of scattering theory and obtain an expression for the scattering amplitude.
4. 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.
5. Obtain the plane wave solutions of the Dirac’s relativistic wave equation of a free particle.

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