 LOYOLA COLLEGE (AUTONOMOUS), CHENNAI – 600 034

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

FOURTH SEMESTER – **NOVEMBER 2012**

# PH 4959 - PARTICLE PHYSICS

Date : 06/11/2012 Dept. No. Max. : 100 Marks

Time : 1:00 - 4:00

**PART - A**

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

1. Why is the physics of light quark systems almost independent of the quark masses ?

2. Why was the concept of colour introduced in the Standard Model ?

3. What is meant by second quantization?

4. Define the helicity operator . What is its use ?

5. What is the need for renormalization in the formulation of the Standard Model ?

6. How was the weak interaction discerned ? Why was it considered weak ?

7. What is a neutral current ?

8. What is the lower limit for the mass of the Higgs boson ?

9. What are Noether currents ?

10. What are colour singlets ?

**PART - B**

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

11. Explain the spectrum of baryon states on the basis of a simple shell model of three confined quarks.

12. Obtain the time-time component of the energy-momentum tensor in the case of the Klein-Gordon Lagrangian density.

13. Show that the law of conservation of particles arises as a consequence of global U(1) symmetry.

14. Discuss the interaction of the muon neutrino with electrons.

15. Explain what is meant by asymptotic freedom ?

**PART - C**

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

16. (a) Obtain the Klein-Gordon equation using a suitable Lorentz invariant Lagrangian density.

(b) Obtain an expression for the field energy of a complex scalar field satisfying the K-G equation and interpret it.

17. (a) Show that the Dirac particle has intrinsic spin h/4π.

(b) Express the total energy and total momentum of the Dirac field in terms of the wave amplitudes.

18. (a) Discuss the decay of the charged pi meson illustrating the left-handedness of the lepton fields and lepton universality.

(b) Discuss the important role played by the analysis of muon decays in establishing the Standard Model.

19. (a) Construct a gauge-invariant and Lorentz-invariant expression for the dynamical part of the Langragian density for the electron and the electron neutrino.

(b) Discuss the coupling of the lepton fields to the W gauge fields.

20. Using a local SU(3) gauge theory, obtain the total strong interaction Lagrangian density.

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