

LOYOLA COLLEGE (AUTONOMOUS), CHENNAI – 600 034

M.Sc. DEGREE EXAMINATION – PHYSICS

FOURTH SEMESTER – APRIL 2010

PH 4959 - PARTICLE PHYSICS

Date & Time: 22/04/2010 / 9:00 - 12:00 Dept. No.

Max. : 100 Marks

PART A (20 MARKS)

ANSWER ALL QUESTIONS. EACH QUESTION CARRIES 2 MARKS.

1. State two properties of the known quarks.
2. How can one conclude that the d quark is heavier than the u quark ?
3. What are spinors ?
4. What is meant by charge conjugation ?
5. What is lepton universality ?
6. Are neutral current decays observed in atomic systems ? Why ?
7. Estimate the coupling constant between the electron field and the Higgs field .
8. Give the equation which expresses the conservation of electron lepton number.
9. What is meant by saying that the gluon fields are confining on a length scale greater than 1 Fermi ?
10. What is asymptotic freedom ?

PART B (30 MARKS)

ANSWER ANY FOUR QUESTIONS. EACH QUESTION CARRIES 7.5 MARKS.

11. Discuss the solution of the K-G equation and its relevance to the Standard Model.
12. Show that the electromagnetic field appears as a consequence of the invariance of the Lagrangian of quantum electrodynamics under a local symmetry transformation.
13. Discuss Higg's mechanism of introducing mass into a theory.
14. Discuss the coupling of the lepton fields to the Z gauge field.
15. Discuss the quark-anti quark interaction at short distances.

PART C (50 MARKS)

ANSWER ANY FOUR QUESTIONS. EACH QUESTION CARRIES 12.5 MARKS.

16. (a) Discuss the discovery of the heavier quarks.
(b) Find the Lagrangian density which describes massive particles having intrinsic spin 1.
17. (a) Establish the Lorentz invariance of the Dirac equation.
(b) Obtain the Lagrangian of quantum electrodynamics.
18. (a) Construct a Lagrangian density which is invariant under a local SU(2) transformation as well as a local U(1) transformation.
(b) Obtain an expression for the total dynamical contribution to the Lagrangian density associated with the gauge fields B and W.
19. Explain the construction of the Lagrangian density for the electro-weak interaction of the quarks.
20. Explain why colour symmetry is not readily apparent in the particles, baryons and mesons formed from quarks by the strong interaction .
