8. (a) Show that pion decay, muon decay and pair production conserve the lepton numbers L_e and L_μ. **10**

(b) Discuss the Quarks model of Hadrons. **10**

No. of Printed Pages : 04 **Roll No. .....**

DD-282

M. Sc. EXAMINATION, Dec. 2017

(Fourth Semester)

(Re-appear Only)

PHYSICS

PHY-604-B

Advance Quantum Mechanics and Elements of Particle Physics

Time : 3 *Hours*] [*Maximum Marks :* 100

Before answering the question-paper candidates should ensure that they have been supplied to correct and complete question-paper. No complaint, in this regard, will be entertained after the examination.

Note : Attempt *Five* questions in all, selecting at least *one* question from each Unit. All questions carry equal marks.

Unit I

1. (a) Set up the Dirac relativistic equation for a free particle. **10**

(b) Show that $(\alpha.A)(\alpha.B) = (A.B) + i\sigma.(A \times B)$, where A and B commute with α and σ is the Pauli spin matrices. **10**

2. (a) Obtain the Dirac position probability density and probability current density, and establish the relation between both. **10**

(b) Describe the bahaviour of Dirac particle (electron) in electromagnetic field. **10**

Unit II

3. Why the quantization of Schrödinger wave equation referred to as second quantization of field ? Show that the non-relativistic field can be quantized using either Bose-Einstein statistics or Fermi-Dirac statistics. **20**

4. Write the process of canonical quantization. Describe the Hamiltonian formalism of a classical field. **20**

Unit III

5. How the S-matrix connect the initial state of a scattering system with its possible final state. Derive an expression for Klein-Gorden field equation. **20**

6. How the theoretical treatment differs for free fields and coupled fields ? Discuss the Feynman rules and sketch the Feynman diagrams for the following scattering processes : **20**

(a) Electron Scattering by a potential.

(b) Photon Scattering by an electron.

(c) Compton Scattering by electrons.

Unit IV

7. Write a note on different fundamental interactions between the elementary particles. Also list the particles exchanged during such interactions. Explain that how these interactions are playing key role in our Universe. **20**