

(i) Printed Pages : 4

Roll No. ....

(ii) Questions : 9

Sub. Code :

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Exam. Code :

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M.Sc. Physics 3<sup>rd</sup> Semester

(2125)

PARTICLE PHYSICS-I

Paper : PHY-8032

Time Allowed : Three Hours]

[Maximum Marks : 60

Note :— Attempt FIVE questions in all, selecting ONE question each from units I to IV. Unit-V is compulsory to attempt.

UNIT-I

1. (a) What are strange particles? Explain the concept of strangeness and the principle of associated production. Also discuss Gellmann-Nishijima formula. 5
- (b) Distinguish between the strong, weak and electromagnetic interactions on the basis of cross section, decay times and ranges. Give example of each type of interaction. 4
- (c) Show that according to Yukawa theory, the range of a field is given by the Compton wavelength of associated quantum. 3

2. (a) Explain and draw various electromagnetic processes using Feynman diagrams. 5
- (b) What are antiparticles? Explain Dirac theory of antiparticles. 4
- (c) Explain why the decay  $\Sigma^0 \rightarrow \Lambda^0 + \gamma$  is observed but not  $\Sigma \rightarrow P + \pi^-$  or  $\Sigma^0 \rightarrow n + \pi^0$ . 3

### UNIT-II

3. (a) Describe various iso-spin states of two-nucleon system and Pion-Nucleon system and their total wave function. 4
- (b) What is CPT Theorem? Give its two important consequences. 4
- (c) At a given centre of mass energy, what is the ratio of cross-section for:  
 $p + p \rightarrow d + \pi^+$  and  $p + n \rightarrow d + \pi^0$  4
4. (a) What is charge conjugation operator? Obtain the Eigen state of charge conjugation operator. 4
- (b) Explain G-parity and determine its value for a system of n-pions. 4
- (c) What do you mean by time reversal invariance? What is the effect of time reversal invariance and parity on:
- (i) Magnetic field
  - (ii) Electric field
  - (iii) Spin
  - (iv) Electric dipole moment
  - (v) Magnetic dipole moment? 4

### UNIT-III

5. (a) What is Breit-Wigner formula? Explain its application for the scattering of two elementary particles. 5
- (b) Explain  $\tau$ - $\theta$  puzzle. 4
- (c) Explain the introduction of color quantum number for quarks. 3
6. (a) What are Dalitz plots? Explain these by taking the example of three dissimilar particles. 5
- (b) Write a note on baryon decuplet using quark model. 4
- (c) Define Mandelstam variables. 3

### UNIT-IV

7. (a) Give the classifications of weak interactions. What are Fermi and Gamow-Teller transitions? Explain Fermi theory of nuclear  $\beta$ -decay. Also find the value of Fermi constant  $G$ . 7
- (b) Describe  $K^0$  and  $K^{0-}$  mixing via intermediate pion state leading to  $2\pi$  or  $3\pi$  states with  $CP = \pm 1$ . 5
8. (a) Why is CP violated in weak interaction? Discuss the Experimental Determination of CP-Violation in  $K^0$  system. 7
- (b) Define Helicity. Explain the determination of Helicity of Neutrino. 5

## UNIT-V

9. (a) Why do we require high energies to study the elementary particles?
- (b) What is the difference between QED and QCD?
- (c) Write a short note on neutrino and its source.
- (d) Explain why Gluons are bi-coloured.
- (e) What are pseudo scalar and vector mesons? Give example in each case.
- (f) What are quarks? Explain its Flavour. 2×6=12