2022
M. Sc. (Physics) Third Semester
PHY-8032: Particle Physics - I

Time allowed: 3 Hours

Max. Marks: 60

NOTE: *Attempt five questions in all, including Question No. IX (Unit-V) which is compulsory and selecting one question each from Unit I-IV.*

x-x-x

UNIT – I

I. a) Show that natural system of units, energy and momentum can be expressed in terms of times

b) Explain Yukava Theory of quantum exchange.

c) Write the quark constant, Baryon numbers, charge spin and strangeness for the following:-

$$\pi^+, K^-, P, n, \Omega^-, \pi^0, \Sigma^-, \Xi^0$$

(3x4)

II. a) Write a short notes on neutrino and its source. How many types of neutrino exist in nature? What is the spin of neutrino? Do neutrino have a mass?

b) Explain Dirac theory of antiparticles.

c) What are Fermions? How will you differentiate between Leptons and Baryons? (3x4)

UNIT – II

III. a) Describe various iso-spin states of two-nucleon system and the total wave functions.

b) At a given centre of mass energy, what is the ratio of cross section for
$P + P \rightarrow d + \pi^+$ and $p + n \rightarrow d + \pi^0$

c) What is G-parity? Determine G-parity for a system of n-pions. (5,4,3)

IV. a) What is iso-spin? How its concept was introduced? Write down the iso-spin for pion-nucleon system.

b) Describe parity and pion-parity.

c) Explain CPT invariance and its consequences. (5,4,3)

P.T.O.

UNIT – III

V. a) In Lorentz invariant phase-space, obtain the expression for the final state factor for n-final state particle and (n - 1) independent 3-momenta.

b) Discuss τ- θ puzzule.

c) Explain the introduction of colour quantum numbers. (5.4.3)

VI. a) Describe in details Briet-Wingner Resonance formula.

b) What are Dalitz plots? Explain K-3π decay.

c) Define Mandelstam variables and show that how the sum of these variables is equal to the sum of the square of masses of the particles involved in a collision. (5.4.3)

UNIT – IV

VII. a) Why CP is violated in weak interactions? Discuss experimental determination of CP-Violation in K^0-system.

b) Explain the determination of helicity of neutrino. (7.5)

VIII. a) Discuss Fermi theory of nuclear β-decay.

b) Describe the parity violation in β-decay with experimental evidence. (6.6)

UNIT – V

IX. Answer the following:-

a) Give three examples each for weak interactions with DS = 0 and |DS = 1.

b) Which reaction is more probable:-

i) $K^0 \rightarrow \pi^+ \pi$

ii) $K^- \rightarrow \pi^- \pi^0$. Explain.

c) Explain OZI rule with examples.

d) What are four types of fundamental interactions? Give their magnitudes, strength, range and carriers.

e) What are Pseudo-scalar and vector particles? Give one example in each case.

f) Show that Deutron is iso-singlet. (6x2)

x-x-x