Total No. of Questions : 11

M.Sc. (Physics) (Sem.-3) PARTICLE PHYSICS Subject Code : MSPH-533-18 M.Code : 76752 Date of Examination : 02-01-23

Time: 3 Hrs.

Max. Marks : 70

Total No. of Pages : 02

INSTRUCTIONS TO CANDIDATES :

- 1. SECTION-A is COMPULSORY consisting of TEN questions carrying TWO marks each.
- 2. SECTION-B contains SEVEN questions carrying FIVE marks each and students have to attempt any SIX questions.
- 3. SECTION-C contains THREE questions carrying TEN marks each and students have to attempt any TWO questions.

SECTION-A

1. Write briefly :

- a) What is permutation symmetry? Give examples.
- b) Explain the standard model of elementary particles.
- c) What are self conjugate particles.
- d) Explain briefly the helicity of neutrino and anti-neutrino.
- e) Calculate the charge for η meson and Σ baryons using the Gell-man Nishijima formula. State all the associated quantum numbers.
- f) Explain the concept of time reversal.
- g) State the interaction Hamiltonian responsible for the beta decay.
- h) Draw the Feynmann diagram for pair production and $e^+ e^-$ scattering.
- i) Explain the term hadron fragmentation.
- j) π° decays in the following manner : $\pi^{0} \rightarrow \gamma + \gamma$. What is the energy of each γ ray if the π° is at rest when it decays? Given that mass of pion is 135MeV.

SECTION-B

2. Classify various types of fundamental interactions among elementary particles.

3. What are the Mandelstam variables? Give their physical significance. Also, show that

$$s+t+u = \sum_{i}^{4} m_i^2$$

where m_i is the mass of particle *i*.

- 4. State and prove the Breit-Wigner resonance, formula. Comment on the maximum cross-section for Δ^{++} resonance.
- 5. What is parity. Prove the following statement for the fermions:

$$\Psi(r) = \stackrel{\wedge}{P} \Psi(-r) = \gamma^0 \Psi(-r)$$

Also, comment on the intrinsic parity of fermion and anti-fermion.

- 6. Calculate the spin for neutral and charged pion using the symmetry principles.
- 7. What do you understand by the quark model. Discuss briefly the successes of quark model.
- 8. Discuss the Reines Cowan experiment to demonstrate the interaction of antineutrino in Inverse beta decay. Also, comment on the mean free path of antineutrino in water.

SECTION-C

- 9. Describe using table the particle content of the standard model of particle physics. Show how particles can be classified into fermions and bosons, and indicate that some particles exist in generations.
- 10. What is Isospin? Calculate, the relative cross-section for the following three processes at a fixed energy:

$$\pi^+ p \to \pi^+ p,$$

 $\pi^- p \to \pi^- p,$
 $\pi^- p \to \pi^0 n,$

Highlight the physical significance of your results.

11. Explain the phenomena of Kaon mixing, Oscillation, Regeneration, and CP violation in neutral meson system. Also, give the experimental evidence for the same.

NOTE : Disclosure of Identity by writing Mobile No. or Making of passing request on any page of Answer Sheet will lead to UMC against the Student.