

Roll No.....

Total No. of Printed Pages: 1

Total No. of Questions: [11]

M.Sc. (Physics) (Semester – 4th)

PARTICLE PHYSICS

Subject Code: MPHYS1419

Paper ID: [18220716]

Time: 03 Hours

Maximum Marks: 60

Instruction for candidates:

1. Section A is compulsory. It carries 16 marks. It consists of 4 questions of 4 marks each.
2. Section B consist of 4 questions of 8 marks each. The student has to attempt any 3 questions out of it.
3. Section C consist of 3 questions of 10 marks each. The student has to attempt any 2 questions.

Section – A

(4 marks each)

- Q1. Write the valence quark constituents of the Σ^0 , Δ^{++} , π^+ and Λ^0 .
- Q2. a. Which conservation law prohibits the strong decay of $\Sigma^+ \rightarrow p + \eta^0$?
b. What is the value of the isospin quantum number for pions? Also list their respective values of third component of isospin quantum number.
- Q3. Highlighting the key points of Cabibbo's theory, define Cabibbo's angle.
- Q4. Write a short note highlighting the elementary ideas of CP and CPT invariance.

Section – B

(8 marks each)

- Q5. Give the brief account of the discovery of electron and muon neutrinos by providing the brief overview of the experimental setup used.
- Q6. What is spontaneous symmetry breaking (SSB)? Explain the phenomenon of SSB of (i) global symmetry and (ii) local symmetry.
- Q7. Discuss the four fermion theory of weak interactions.
- Q8. Show the existence of a zero mass particle in any field theory where global continuous symmetry is broken.

Section – C

(10 marks each)

- Q9. Name the force carriers for the weak interactions. List the different categories in which the weak interactions are classified. Also give at-least one example of each. Also list the key features of weak interactions.
- Q10. Define an $SU(3)$ group and show that the matrices form the fundamental representation of $SU(3)$ group. Also show that the diagonal generators of $SU(3)$ group obey the commutation relations.
- Q11. With the help detailed calculations which of the following reactions are allowed or forbidden? Also name the typical interactions in case of allowed reactions.
- a. $\pi^0 + n \rightarrow \pi^0 + K^+$
 - b. $\pi^+ + n \rightarrow K^0 + K^+$
 - c. $\pi^0 + n \rightarrow \overline{K}^0 + \Sigma^0$
 - d. $K^0 \rightarrow \pi^+ + \pi^-$

e. $\Xi^- \rightarrow \Lambda^0 + \pi^-$