A–0442

Total Pages : 3 **Roll No. .....**

MSCPH-558

Master of Science Physics (MSCPH)

Particle Physics

Examination, June 2025

Time : 2:00 Hrs. Max. Marks : 70

Note* :–** This paper is of Seventy (70) marks divided into Two (02) Sections 'A' and 'B'. Attempt the questions contained in these Sections according to the detailed instructions given therein. ***Candidates should limit their answers to the questions on the given answer sheet. No additional (B) answer sheet will be issued.

Section–A

Long Answer Type Questions 2×19=38

***Note* :–** Section 'A' contains Five (05) Long-answer type questions of Nineteen (19) marks each. Learners are required to answer any *two* (02) questions only.

1. Define isospin, strangeness, and hypercharge. Derive the Gell-Mann-Nishijima relation and explain its application in classifying particles.

2. Explain the basics of the quark model. Discuss the role of colored quarks and gluons in quantum chromodynamics.

3. Explain the concept of unitary symmetries. Describe the fundamental representation of SU(2) and SU(3) and their applications in particle physics.

4. Explain the Young Tableaux method and its application in determining the dimensionality of representations of SU(N).

5. Describe the basic principles of particle detection and explain the working mechanisms, advantages, and limitations of Proportional Counter and Geiger-Muller Counter.

Section–B

Short Answer Type Questions 4×8=32

***Note* :–** Section 'B' contains Eight (08) Short-answer type questions of Eight (08) marks each. Learners are required to answer any *four* (04) questions only.

1. Explain parity, time reversal, and charge conjugation symmetries. How do they relate to the fundamental interactions ?
2. What are fundamental interactions ? Describe their relative strengths and ranges.
3. Explain CP violation in mesons and discuss its implications for fundamental symmetries.
4. What is Yukawa's hypothesis ? Describe the role of mesons, particularly pions, in the strong interaction.
5. Discuss CPT invariance and its importance as a fundamental principle in quantum field theory.
6. What is the fundamental representation of SU(2) ? Explain its weight diagram and applications in particle physics.
7. Explain the Gell-Mann-Okubo mass formula and its significance in predicting particle masses.
8. What is the nuclear emulsion technique ? Explain its working principle and significance in tracking particle interactions.

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