D 150364 (**Pages : 2**) **Name.....**

Reg. No.....

THIRD SEMESTER M.Sc. (CBCSS) REGULAR/SUPPLEMENTARY EXAMINATION, NOVEMBER 2026

Physics

PHY 3C 10—NUCLEAR AND PARTICLE PHYSICS

(2019 Admission onwards)

Time : Three Hours Maximum : 30 Weightage

Answer the questions as per the instructions given in each section.

Section A

Answer **all** *questions.*

Each question carries 1 *weightage.*

1. What is meant by the tensor component of the nuclear force ?
2. What are allowed transitions in beta decay ?
3. Give the physical significance of spin-orbit coupling in nuclei.
4. Define a fissile nucleus with one example.
5. What is the basic principle of operation of an ionization chamber ?
6. Define the dead time of a G-M counter.
7. What is meant by the strangeness quantum number ?
8. State the CPT theorem.

(8 × 1 = 8 weightage)

Section B

Answer any **two** *questions.*

Each question carries 5 *weightage.*

9. Describe nucleon-nucleon scattering. Include scattering lengths, phase shifts, cross sections, and effective-range theory.
10. Describe alpha decay using Gamow's tunneling theory and the Geiger-Nuttall law. Also discuss the evidence for the quantum mechanical nature of alpha emission.

Turn over

11. Discuss the liquid-drop model of the nucleus. Derive the semi-empirical mass formula and explain how the model accounts for nuclear fission.

12. Explain quark theory, including quark flavours, colour, confinement, experimental evidence, and the development of the quark model.

(2 × 5 = 10 weightage)

Section C

Answer any **four** *questions.*
Each question carries 3 *weightage.*

13. The deuteron binding energy is 2.224 MeV. Calculate the mass defect in atomic mass units. (Use: 1 amu = 931.5 MeV)

14. Give an account of multipole radiation in gamma decay.

15. Discuss the main features of the collective model of nuclear vibrations.

16. If a nucleus has a non-zero quadrupole moment, state what this implies about the shape of the nucleus and justify your answer.

17. Discuss the characteristics and applications of Si(Li) and Ge(Li) detectors.

18. Explain the phenomenon of CP violation with an example.

19. Discuss Yukawa's theory of the strong interaction and the role of the pion.

(4 × 3 = 12 weightage)