K25P 2908

Reg. No. : .....

Name : .....

III Semester M.Sc. Degree (C.B.C.S.S. – O.B.E. – Reg./Supple./Imp.) Examination, October 2025
(2023 Admission Onwards)
PHYSICS/PHYSICS WITH COMPUTATIONAL AND NANO SCIENCE SPECIALISATION
MSPHY03C15/MSPHN03C15 : Nuclear and Particle Physics

Time : 3 Hours Max. Marks : 60

SECTION – A

Answer **any five** questions. **Each** question carries **three** marks.

1. Give a brief account of any two ways to evaluate the radius of a nucleus.
2. Comment on the spin and parity of a deuteron.
3. What is the importance of spin-orbit interaction in the origin of magic numbers in nuclei ?
4. Briefly explain the characteristics of fission.
5. 'Quarks are confined within the hadrons' – Explain the statement.
6. Discuss the CP violation in a weak decay. **(5×3=15)**

SECTION – B

Answer **any three** questions. **Each** question carries **six** marks.

7. State Fermi's theory of β – decay in brief. Explain the meaning of allowed and forbidden β transitions and list the selection rules for angular momentum and parity for an allowed (Fermi and Gamow – Teller) transition.

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8. Estimate the binding energy of $^{63}_{29}Cu$ using the semi-empirical mass formula. Coefficients: $a_v = 15.6$, $a_s = 17.2$, $a_c = 0.72$, $a_a = 23.0$ MeV. Pairing $\delta \approx 0$.

9. Explain why nuclei with "magic numbers" of nucleons exhibit higher stability. Give at least two experimental evidences that support the nuclear shell model.

10. Classify the following processes as strong, electromagnetic or forbidden :
    a) $\pi^- + p \rightarrow \Lambda^0 + K^0$ b) $\pi^- + p \rightarrow n + \pi^0$.

11. Estimate the energy released when one gram of ^{235}U undergoes fission (200 MeV per fission). **(3×6=18)**

SECTION – C

Answer **any three** questions. **Each** question carries **nine** marks.

12. a) Explain the salient features of the Liquid Drop Model of the nucleus. **6**
    b) State the limitations of the Liquid Drop Model. **3**

13. a) Discuss the ground state properties of the deuteron. **6**
    b) What does the positive quadrupole moment of the deuteron indicate about its shape ? **3**

14. a) Discuss the different types of nuclear reactions with suitable examples. **6**
    b) Distinguish between direct and compound nuclear reactions. **3**

15. a) How are elementary particles classified according to the fundamental interactions they take part in ? **6**
    b) Distinguish between leptons and hadrons with examples. **3**

16. a) Describe Gamow's theory of alpha decay. **6**
    b) What are the experimental tests of Fermi theory ? **3**

(3×9=27)

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