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K24P 3147

Reg. No. : .....

Name : .....

III Semester M.Sc. Degree (C.B.C.S.S. – OBE – Regular) Examination, October 2024
(2023 Admission)
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. What is meant by strangeness ?
2. Distinguish between the Fermi and the Gamow-Teller transition in β decay.
3. Outline the salient principles of the collective model of nuclear structure.
4. State and explain CPT theorem.
5. Discuss scattering length and its importance.
6. What are delayed and prompt neutrons in thermal fission ? **(5×3=15)**

SECTION – B

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

7. Use the semi-empirical mass formula to show that nuclear mass for a given A constitute a parabola. Also plot parabolas in odd-A and even-A nucleus.
8. Estimate the ground state spin and parity : $^{127}_{53}I$, $^{87}_{38}Sr$, $^{29}_{14}Si$, $^{39}_{19}K_{20}$.
9. List all the selection rules of γ decay. Use the rules to find the most intense γ ray for the following γ transitions : $d_{5/2} \rightarrow s_{1/2}$.

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10. Apply the conservation laws to identify the particle labeled x in the following reactions, which proceed by means of the strong interactions :
    a) $p + \bar{p} \rightarrow K^- + x + \pi^0 + \pi^+$
    b) $K^- + p \rightarrow \Omega^- + K^+ + x$
11. Estimate the number of partial waves which will be important in nuclear collisions occurring between 9 MeV neutrons and ^{125}Sn nucleus. Assume that the interaction radius is given by, $R = 1.2 \times A^{1/3}$ fm, where A is the mass number of the target. **(3×6=18)**

SECTION – C

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

12. a) Explain how shell model accounts for the experimentally observed properties like spin, parity, magnetic moment and quadrupole moment of nuclei. 6
    b) Give the empirical evidence which suggests that the nuclear force is short ranged. 3
13. a) Discuss the ground state of Deuteron problem. 6
    b) Explain the relevance of tensor force in explaining the ground state properties of Deuteron. 3
14. a) Give a detailed account of the Fermi theory of beta decay. 6
    b) Differentiate between allowed and forbidden β transitions. 3
15. a) Explain quark model and how it accounts for various properties of hadrons. 6
    b) Discuss the connection between symmetries and conservation laws. 3
16. a) Explain the working principle of a fission reactor with natural Uranium as fuel. 6
    b) Describe about Fissile materials and Fertile materials with examples. 3

(3×9=27)
