A–888

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PHY–551

M.Sc. PHYSICS (MSCPHY)

(Nuclear Physics and Analytical Techniques)

2nd Year Examination, 2024 (June)

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. State and explain Fermi theory of β- decay. Discuss how it explains the important features of β- spectrum. Also explain the selection rules of β- emission.

2. What are the elementary particles and how they are classified into different categories ? Explain various conservation laws obeyed by the particles.

3. Assuming a square well type of nuclear potential, give a simple theory for the deuteron problem and establish the relationship between the depth and width of the well and deuteron binding energy.

4. Explain the term nuclear cross section. Derive an expression for the number of particles emerging out of a slab of finite thickness.

5. Explain the basic properties of neutrons. How these neutrons can be classified as slow, fast and intermediate neutrons. Derive four factor formula and also discuss its importance.

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. Write a note on the energies and selection rules for alpha particle emission.

2. Explain the term multipolarity in gamma transition.

3. Using the semi-empirical binding energy equation calculate the binding energy for the mirror nuclei K^{39} and Ca^{39}.

4. Define the terms Bohr magneton and nuclear magneton. Also explain the magnetic dipole moment and electric quadrupole moment exhibited by the nucleus.

5. Calculate the average binding energy per nucleon for $^{64}_{28}Ni$ having mass 63.9280 u. (Given that m_p = 1.007825 u and m_n = 1.0086665 u).

6. Discuss Yukawa's meson exchange theory of the nuclear force.

7. Discuss how the shell model of the nucleus accounts for the shell structure of the magic number values for neutron and proton numbers.

8. Define Q-value of a nuclear reaction. Obtain an expression for the Q-value in terms of the kinetic energies of incident and product particles and masses of various particles and nuclei.

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