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PHY-551

Nuclear Physics and Analytical Techniques

M.Sc. Physics (MSCPHY)

2nd Year Examination, 2023 (June)

Time : 2 Hours] **[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 answer to the questions on the given answer sheet. No additional (B) answer sheet will be issued.

SECTION–A
(Long Answer Type Questions)

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.

(2×19=38)

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. Explain liquid drop model and obtain the Bethe-Weizsacker formula and explain the alpha decay with the help of semi-empirical formula.

4. 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.

5. Discuss the compound nucleus theory of nuclear reaction. Obtain an expression for the Breit-Weigner formula.

SECTION–B

(Short Answer Type Questions)

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. (4×8=32)

1. State and explain Geiger-Nuttal law. How the range and energy of the α-particle and half life period are related to it.

2. Discuss the postulates of Pauli's neutrino hypothesis.

3. Explain about the fundamental interactions existing in nature.

4. Discuss Bohr and Wheeler theory of nuclear fission.

5. Explain the theory of Compton Effect.

6. Calculate the binding energies of the following isobars and their binding energies per nucleon.

(Given $^{64}_{28}Ni$ = 63.9280 u, $^{64}_{28}Cu$ = 63.9298 u

M_N = 1.00008665 u, M_N = 1.00007825 u)

7. Calculate the atomic number of the most stable nucleus for a given mass number based on the liquid drop model. Hence explain which one is the most stable nucleus out of $^{6}_{2}He$, $^{6}_{4}Be$ and $^{6}_{3}Li$ nuclei.

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