K–888

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PHY–551

M.Sc. Physics IInd Year Examination
Dec., 2023

NUCLEAR PHYSICS AND ANALYTICAL TECHNIQUES

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 there in. ***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. What is Gamow's theory of alpha decay ? Explain the main features of alpha particle emission process. Write down the limitations of this theory.

2. What do you understand by radiation detectors ? Discuss various types of semiconductor junction type detectors with their construction and working.

3. Explain the basic difference between the liquid drop model and shell model of the nucleus. Explain how the shell model of the nucleus accounts for the shell structure for the magic number values for neutron and proton numbers.

4. Explain the Compound nucleus theory proposed by Neil's Bohr. Also obtain Breit-Wigner formula.

5. Write a short note on any *two* of the following :

   (i) Pair Production

   (ii) Compton Effect

   (iii) Nuclear statistics and Parity

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 down the postulates of Pauli's neutrino hypothesis.
2. Explain about the fundamental interactions existing in nature.
3. The binding energy of $_{10}Ne^{20}$ is 160.64 MeV. Find the atomic mass. (Given mass of proton = 1.007825u and mass of neutron = 1.008665u).
4. Define the terms Bohr magneton and nuclear magneton. Also explain the magnetic dipole moment and electric quadrupole moment exhibited by the nucleus.
5. Explain the concept of tensor force. Prove the statement that a tensor force is capable of explaining the deuteron quadrupole moment.
6. Using the semi-empirical binding energy equation calculate the binding energy for the mirror nuclei K^{39} and Ca^{39}.
7. 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.
8. Discuss Bohr and Wheeler theory of nuclear fission.

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