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MPHY-602

Nuclear Physics

M.Sc. Physics (MSCPHY)

3rd Semester Examination, 2023 (June)

Time : 2 Hours] **[Max. Marks : 35**

Note : This paper is of Thirty Five (35) 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 Nine and Half (9½) marks each. Learners are required to answer any Two (02) questions only. (2×9½=19)

1. Describe nuclear shell model and its predictions. Give the experimental evidence for the shell model.

2. Define the nuclear reaction and Q equation? Find out the solution of Q equation. Calculate the Q value of reaction $^{14}N_7$ (α, p) $^{17}O_8$ which occurred in Rutherford's α range in nitrogen experiment.

3. Explain binding energy of nucleus and effect of different terms of binding energy formula on binding energy. Describe the binding energy per nucleon and the stability of the nucleon on the basis of binding energy curve.

4. Discuss in detail the theory of deuteron based on the square well potential model.

5. Define the nature of nuclear force. Discuss Exchange forces and meson theory of nuclear forces.

SECTION–B

(Short Answer Type Questions)

Note : Section 'B' contains Eight (08) short answer type questions of Four (04) marks each. Learners are required to answer any Four (04) questions only. (4×4=16)

1. Write the short notes on following :

(a) Magnetic dipole moment and Electric quadruple Moment of nucleus.

(b) four-factor formula.

2. Discuss the main conclusions of Liquid drop model.

3. What do you mean by magic number? How does it play the role for stability of nucleus?

4. Explain the theory of nuclear fission with example in brief.

5. Prove that the cross-section is equal to $4\pi R^2$ for low energy hard sphere scattering, where R is the radius of the potential well.

6. Calculate the values of E_{th}, E_{max}, of the product neutrons, for the following endoergic reaction, which is used for lithium analysis and for neutron production,

$$^{7}Li_{3} + p \rightarrow {}^{7}Be_{4} + n - 1.643 \text{ MeV}$$

7. Explain one method to determine the size of the nucleus in brief.

8. Calculate the kinetic energy of protons to probe the size of $^{40}Ca_{20}$, where rest mass of proton = 938 MeV.
