C153

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MPHY-602

Nuclear Physics

M.Sc. Physics (MSCPHY-20)

3rd Semester Examination, 2022 (June)

Time : 2 Hours] **Max. Marks : 40**

Note : This paper is of Forty (40) marks divided into two (02) Sections A and B. Attempt the questions contained in these sections according to the detailed instructions given therein.

SECTION–A

(Long Answer Type Questions)

Note : Section 'A' contains Five (05) long answer type questions of Ten (10) marks each. Learners are required to answer any Two (02) questions only.

(2×10=20)

1. Define the terms binding energy and binding energy per nucleon. Draw a graph showing the variation between the average binding energy per nucleon and mass number. Using this graph explain the stability of the nucleon.

2. On account of the properties of deuteron, discuss in detail the theory of deuteron based on the square well potential model.

3. Give an account of assumptions of the Liquid drop model. Also obtain an expression for the total binding energy of a nucleus based on this model.

4. Give a brief account of single particle shell model which predicts the magic numbers. Assuming the shell model to be correct, what should be the spin and parity of ground state of $^{15}_{7}N$ and $^{41}_{20}N$.

5. Discuss the compound nucleus theory of nuclear reactions.

SECTION–B

(Short Answer Type Questions)

Note : Section 'B' contains Eight (08) short answer type questions of Five (05) marks each. Learners are required to answer any Four (04) questions only. (4×5=20)

1. Define electric quadrupole moment and discuss its importance.

2. Calculate the average binding energy per nucleon for $_{28}Ni^{64}$ having mass 63.9280u. Given that Z = 28, A = 64, m_p = 1.007825u and m_n = 1.008665u.

3. Discuss about the Yukawa's meson exchange theory of nuclear forces.

4. Calculate the atomic number of the most stable state for a given mass number based on liquid drop model. Explain why $^{6}_{3}Li$ is more stable than $^{6}_{4}Be$.

5. Compute the Q-value of the reaction $B^{9}_{e}.(d, n)B^{10}$.

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

7. Discuss Bohr and Wheeler theory of nuclear fission.

8. What is a neutron ? How do you classify the neutrons as fast and slow neutrons on the basis on their energy range ?
