

Exam. Code : 103206

Subject Code : 1404

B.A./B.Sc. Semester—VI

NUCLEAR PHYSICS

Paper—Physics—A

Time Allowed—3 Hours] [Maximum Marks—35

Note : Section A is compulsory. Attempt **ONE** question each from Sections B, C, D and E. All questions carry equal marks.

SECTION—A

1. (a) What is packing fraction ?
- (b) What are the reasons for assigning spin to the electron ?
- (c) What do you mean by even and odd parity of a nucleus ?
- (d) What are the important features of β -ray spectra and what is end point energy ?
- (e) Explain the relation between statistics and mass number.
- (f) Write down the similarities between a nucleus and a liquid drop.
- (g) Define internal conversion and electron capture.

SECTION—B

2. (a) Explain the different causes for the failure of proton-electron hypothesis of nuclear constitution.
- (b) Using the semi-empirical mass formula, find the most stable isobar for a nucleus having odd A .
3. (a) Discuss the following :
- (i) Nuclear electrical quadrupole moment
- (ii) Non-existence of electrons in nucleus.
- (b) Explain the nuclear force's responsibility for holding the nucleus together. Discuss the nature of these forces.

SECTION—C

4. (a) Explain with the help of the Gamow's theory how α -particles with energies less than the height of the potential barrier are emitted from a radioactive nucleus.
- (b) What are the selection rules obeyed in β -decay ?
5. (a) Give the elementary theory of β -decay. Explain how this is accounted for the existence of neutrino.
- (b) A sample of RaE (At. Wt. 210) containing 4.0 mgm shows β -activity and radiates energy at the rate of 1 watt. Find the average energy of β -particles emitted assuming the half life of the sample to be of 5 days.

SECTION—D

6. (a) Describe kinematics of nuclear reaction, obtain the expression of its Q-value and explain its significance.
- (b) Explain different types of nuclear reactions with examples.
7. (a) Explain the term nuclear reaction cross-section and differential cross-section. Derive an expression for nuclear reaction cross-section.
- (b) The cross-section of Cd^{113} for capturing thermal neutrons is $2 \times 10^4 \text{b}$, the mean atomic mass of natural Cd is 112 amu and its density is $8.648 \times 10^3 \text{ kg/m}^3$. What fraction of an incidental beam of thermal neutrons is absorbed by a Cd sheet of 0.1 mm thickness ?

SECTION—E

8. (a) What are basic features of Shell model of nucleus and how it accounts for the existence of magic number ? Discuss schematic energy level diagram.
- (b) Why stable nuclei have more neutrons than protons ?
9. (a) Write down the limitation of Shell model.
- (b) Write down the experimental evidences of magic number.
- (c) Using shell model predict the ground state angular momenta and parities of ${}_{13}\text{Al}^{27}$ and ${}_{16}\text{S}^{33}$.