

Exam. Code : 103206

Subject Code : 1407

B.A./B.Sc. Semester—VI

PHYSICS

Paper—A

(Nuclear Physics)

Time Allowed— [3 Hours] [Maximum Marks—35]

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

SECTION—A

1. (a) What is the significance of existence of quadrupole moment of nucleus ?
- (b) Explain the role of exchange forces in nuclear structure.
- (c) Why an α radioactive emitter emits α -particle and not the proton directly ?
- (d) Describe all the three β -decay processes.
- (e) What are the pickup and stripping reactions ?
- (f) Write down the inadequacies of liquid drop model.
- (g) What are Bohr's assumptions of compound nucleus theory ?

SECTION—B

2. (a) What do you mean by mass defect and B.E. of nucleus ? Discuss the B.E. curve and use the curve to explain the instability of intermediate nuclei.
- (b) Calculate the distance of closest approach of α -particle to the copper nucleus ($Z = 29$), when α -particle of 5 MeV energy are scattered back by a thin sheet of copper.
3. (a) What is the nuclear angular momentum and nuclear magnetic dipole moment ? How is the nuclear magnetic moment determined experimentally ?
- (b) Calculate atomic number of the most stable nucleus for a given mass number A .

SECTION—C

4. (a) Explain the Gamow's theory of the α -decay. How is Geiger-Nuttal law obtained from it ?
- (b) Show that ${}^{236}\text{Pu}_{94}$ is unstable against α -decay. Given $M_{\text{Pu}} = 236.0460 \text{ u}$, $M_{\text{U}} = 232.03717 \text{ u}$ and $M_{\alpha} = 4.00260 \text{ u}$.
5. (a) Give the Fermi's theory of β -decay. Discuss the selection rules for allowed transitions and what are the forbidden transitions.
- (b) Find the maximum height of the potential barrier for α -penetration through U^{238} nucleus. The radius of residual nucleus is $9.3 \times 10^{-13} \text{ cm}$.

SECTION—D

6. (a) Describe the kinematics of nuclear reaction.
(b) Discuss the nuclear reactions induced by the protons.
7. (a) Explain the difference between compound nucleus and direct reaction mechanism.
(b) Write two nuclear reactions of historical importance.
(c) Explain Q value of reaction and its relation to threshold energy of a particle.

SECTION—E

8. Describe the Shell model of nucleus. How does it explain the angular momenta, magnetic momenta and quadrupole moments of nuclei?
9. Derive the Weizsacker semi-empirical mass formula giving arguments for each term. Write down the significant conclusion drawn from this formula.