K21P 1010

Reg. No. : .....

Name : .....

III Semester M.Sc. Degree (CBSS – Reg./Suppl./Imp.) Examination, October 2021
(2018 Admission Onwards)
PHYSICS
PHY 3C12 : Nuclear and Particle Physics

Time : 3 Hours Max. Marks : 60

SECTION – A

Answer both questions (either **a** or **b**) :

1. a) Derive an expression for the differential scattering cross section of electrons by a finite size nucleus. How this method enables us to determine the scattering length ?

OR

b) Explain the Shell model of nucleus. Write a note on magnetic dipole moment on the basis of shell model.

2. a) Explain the Bohr and Wheeler theory of nuclear fission. Deduce the expression for the critical energy for fission and show that the nucleus would be stable against spontaneous fission if $\frac{z^2}{A}$ is smaller than 50.

OR

b) What is parity in particle physics ? Where it is violated ? Give its experimental details. **(2×12=24)**

SECTION – B

Answer **any four**. (**1** mark for part (**a**), **3** marks for part (**b**), **5** marks for part (**c**))

3. a) What are the basic similarities between a liquid drop and an atomic nucleus ?

b) Write down the Semi empirical mass formula and explain each term.

P.T.O.

c) Using the semi empirical mass formula, show that the atomic number of most stable isobar for a nucleus having odd A is $Z = \frac{A}{2 + 0.015A^{2/3}}$. (Given $a_3 = 0.58$ MeV, $a_4 = 19.3$ MeV.)

4. a) What are the salient characteristics of the nuclear forces ?

   b) Briefly outline Yukawa's theory of nuclear forces.

   c) Show that for a square well of depth V_0 and range b, the scattering length a for a spinless neutron is given by the relation $K \cot Kb = (b - a)^{-1}$, where $K = (M V_0)^{1/2}/\hbar$.

5. a) Define the internal conversion Phenomenon.

   b) Explain the significance of internal conversion coefficient.

   c) Determine the product nuclei and Q values in the following reactions : ${}_{13}Al^{27}$ (d, α) and ${}_{12}Mg^{25}$ (α, d). Masses of ${}_{13}Al^{27}$, ${}_{12}Mg^{25}$, d, and α are 26.9901, 24.9936, 2.0147 and 4.0039 amu respectively.

6. a) Define Q value for beta decay.

   b) Find the energy released during beta decay.

   c) Explain the Fermi Theory of beta decay.

7. a) What are the four basic forces ?

   b) Write the important conservation laws obeyed in particle interactions.

   c) Which of the following reactions are possible ?

      i) $\pi^+ + n^\circ \rightarrow \Lambda^\circ + K^+$

      ii) $\pi^+ + n^\circ \rightarrow K^\circ + K^+$

      iii) $\pi^+ + n^\circ \rightarrow \pi^+ + P$

8. a) What are Quarks ?

   b) Outline the basic properties of quarks.

   c) Find the quark content of the following particles

      n, p, π^-, π^0, π^+.

(4×9=36)