GSQ/D-20   1061
PHYSICS
Paper X
Nuclear Physics

Time : Three Hours]   [Maximum Marks : 40

Note : Attempt *Five* questions in all, selecting *one* question from each Unit. Q. No. **1** is compulsory. Use of scientific calculator is allowed.

(Compulsory Question)

1. (a) What do you mean by quadrupole moment of the nucleus ?   **2**

   (b) Define mass attenuation coefficient.   **2**

   (c) What are the limitations of cyclotron ?   **2**

   (d) Name the conservation laws of nuclear reaction. **2**

Unit I

2. (a) Describe the structure of nucleus. Explain, why electrons cannot be constituents of nucleus ?   **5**

(b) A nucleus with A = 235 splits into two fragments whose mass numbers are in the ratio of 3:2. Find the radii of the two fragments. Also find the separation between the fragments at the moment of splitting. **3**

3. (a) Explain the construction and working of Bain Bridge and Jordan double focussing mass spectrograph. What are its main advantages ? **6**

(b) Calculate the average binding energy per nucleon for $_{28}^{64}\text{Ni}$ having mass 63.9280 amu. Given m_p = 1.007825 amu and m_n = 1.008665 amu. **2**

Unit II

4. (a) Discuss the theory of α-disintegration with the help of quantum mechanical tunneling. **6**

(b) Compare the radiation loss with the ionisation loss for 2 MeV β-particles in lead. Calculate the β-energy for which these losses are equal in lead. Atomic number of lead is 82. **2**

5. Discuss in brief the three processes of interaction of γ-photon with matter by which radiation loses energy while passing through matter. **8**

Unit III

6. (a) Describe a tandem accelerator. Give its merits. **6**

(b) A uniform magnetic field of 2 Wb/N^2 is used in a cyclotron to accelerate the protons. The radius of the cylotron is 0.64 m. Calculate, how rapidly the electric field between the dees should be reversed ?

2

(Mass of proton = 1.67×10^{-27} kg; Charge of proton = 1.6×10^{-19} C)

7. (a) What is a scientillation counter ? Give its construction and working. **6**

(b) A GM counter wire collects 10^8 electrons per discharge. When the counting rate is 500 counts/min, what will be the average current in the circuit ? **2**

Unit IV

8. Define Q-value of a reaction. Derive an expression for Q-value in case of two body system. **8**

9. (a) Explain the terms nuclear fission and fusion. Give example of each. **4**

(b) Discuss the principle, construction and working of nuclear fission reactor. **4**