

Time: 3 hrs.

M. M.: 100

N.B.:

1. All questions are **compulsory**.
2. **Figures** to the **right** indicate **full** marks.
3. Draw **neat** diagrams wherever **necessary**.
4. Symbols have usual meaning unless otherwise stated.
5. Use of **non-programmable** calculator is allowed.

**Constants: Planck's constant ( $h$ ) =  $6.64 \times 10^{-34}$  J-s;**

**Mass of an electron ( $m_e$ ) =  $9.10 \times 10^{-31}$  Kg = 0.00055 amu**

**Charge on electron ( $e$ ) =  $1.60 \times 10^{-19}$  C**

**Speed of light ( $c$ ) =  $3 \times 10^8$  m/s**

**1 eV =  $1.60 \times 10^{-19}$  J**

Q1.

Attempt any two

- (i) (a) Explain how a magnetic spectrograph can be used to determine the velocity of alpha particles? **10**  
b) Write a short note on Geiger Nuttal law and discuss its significance.
- (ii) Explain the origin of short range  $\alpha$ -particles using the decay scheme. **10**
- (iii) What is Pauli's neutrino hypothesis? Also explain continuous  $\beta$  - particle spectrum. **10**
- (iv) Derive the energy conditions under which different types of beta decay can take place. **10**

Q2

Attempt any two

- (i) What is gamma decay? Explain the selection rules for gamma decay. Also discuss Gamma ray spectra. **10**
- (ii) Discuss Mossbauer effect with experimental setup. State the applications of Mossbauer effect. **10**
- (iii) From the Bohr-Wheeler theory obtain the stability limit against spontaneous fission. **10**
- (iv) Obtain Weizsacker's Semi-Empirical mass formula. Draw a neat diagram indicating the variation of contribution of different energy terms to the binding energy per nucleon with respect to mass number A. **10**

Q3

Attempt any two

- (i) Explain Nuclear Chain Reaction. What are the various factors on which it depends? **10**
- (ii) What is Nuclear Reactor? Explain its various features. **10**
- (iii) Describe the construction and working of Betatron. **10**
- (iv) Discuss in detail the principle, construction and working of Cyclotron. **10**

**Q4**

Attempt any two

- (i) Summarize the important experimental properties of the deuteron. **10**
- (ii) State conservation laws for the various properties of elementary particles. **10**

Which of the following reactions can occur by conservation laws of elementary particles? If not, state the conservation principles violated by them.

- a)  $\Lambda^0 \rightarrow p + \pi^-$   
 b)  $\pi^+ + p \rightarrow \pi^+ + p + \pi^- + \pi^0$   
 c)  $\gamma + n \rightarrow p + \pi^-$

- (iii) (a) Write note on electrons, positrons and their anti particles. **10**  
 (b) Explain Yukawa potential.
- (iv) Explain qualitatively the Quark model. **10**

**Q5.**

Attempt any four

- (i)  $\text{Ra}^{226}$  decays by  $\alpha$  – emission to  $\text{Rn}^{222}$ . The alpha disintegration energy is 4.863 MeV. Calculate the kinetic energy of the alpha particle. **05**
- (ii) What is meant by electron capture? **05**
- (iii) Explain the phenomenon of internal conversion. **05**
- (iv) Write short note on shell model of nucleus. **05**
- (v) Calculate the amount of energy available if 10gm of  ${}_{92}\text{U}^{235}$  is completely fissioned. Given: Energy per fission = 200 MeV, and Avogadro's number =  $6.022 \times 10^{23}$  per gm-mole. **05**
- (vi) Protons are accelerated in a 100cm cyclotron. The oscillator frequency is 10 Megacycle. Calculate the magnetic field needed for the protons. Also calculate the energy required for acceleration of ions.  
 Given:  $e = 1.6 \times 10^{-19}$  C, Mass of proton  $m = 1.67 \times 10^{-27}$  kg. **05**
- (vii) On the basis of the meson theory, estimate the mass of the exchanged particle if the 'range' of the potential is  $10^{-15}$  m? **05**
- (viii) Show that lepton number and baryon number is conserved in case of neutron to ( $\beta^-$ ) decay. **05**