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 x 10^{-34} J-s;
Mass of an electron (m_e) = 9.10 x 10^{-31}Kg = 0.00055 amu
Charge on electron (e) = 1.60 x 10^{-19} C
Speed of light (c) = 3 x 10^{8} m/s
1 eV = 1.60 x 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 α-particles using the decay scheme. **10**

(iii) What is Pauli's neutrino hypothesis? Also explain continuous β - 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) Ra^{226} decays by α – emission to 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 $_{92}U^{235}$ is completely fissioned. Given: Energy per fission = 200 MeV, and Avogadro's number = 6.022×10^{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. **05**

Given: e = 1.6×10^{-19} C, Mass of proton m = 1.67×10^{-27} kg.

(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 (β^-) decay. **05**