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   **10**
         velocity of alpha particles?
         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   **10**
         β - particle spectrum.

   (iv) Derive the energy conditions under which different types of beta decay   **10**
         can take place.

Q2 Attempt any **two**

   (i)   What is gamma decay? Explain the selection rules for gamma decay.   **10**
         Also discuss Gamma ray spectra.

   (ii) Discuss Mossbauer effect with experimental setup. State the   **10**
         applications of Mossbauer effect.

   (iii) From the Bohr-Wheeler theory obtain the stability limit against   **10**
         spontaneous fission.

   (iv) Obtain Weizsacker's Semi-Empirical mass formula. Draw a neat   **10**
         diagram indicating the variation of contribution of different energy
         terms to the binding energy per nucleon with respect to mass number
         A.

Q3 Attempt any **two**

   (i)   Explain Nuclear Chain Reaction. What are the various factors on   **10**
         which it depends?

   (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**

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Q4   Attempt any **two**

(i)   Summarize the important experimental properties of the deuteron.   **10**

(ii)   State conservation laws for the various properties of elementary   **10**
particles.

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   **05**
is 4.863 MeV. Calculate the kinetic energy of the alpha particle.

(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   **05**
completely fissioned. Given: Energy per fission = 200 MeV, and
Avogadro's number = 6.022×10^{23} per gm-mole.

(vi)   Protons are accelerated in a 100cm cyclotron. The oscillator frequency   **05**
is 10 Megacycle. Calculate the magnetic field needed for the protons.
Also calculate the energy required for acceleration of ions.
Given: e = 1.6 x 10^{-19} C, Mass of proton m =1.67 x 10^{-27} kg.

(vii)   On the basis of the meson theory, estimate the mass of the exchanged   **05**
particle if the 'range' of the potential is 10^{-15} m?

(viii)   Show that lepton number and baryon number is conserved in case of   **05**
neutron to (β^-) decay.

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