

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) = 6.64×10^{-34} J-s;

Mass of an electron (m_e) = 9.10×10^{-31} Kg = 0.00055 amu

Charge on electron (e) = 1.60×10^{-19} C

Speed of light (c) = 3×10^8 m/s

1 eV = 1.60×10^{-19} J

Q1. Attempt any two

- (i) Discuss Gamow's theory of α -decay? 10
- (ii) (A) Explain how the velocity of α -particles is determined using magnetic spectrograph? 10
(B) Write note on short range alpha particles.
- (iii) Describe the detection of neutrino using Cowan and Reines experiment. 10
- (iv) Explain three different types of β -decay. Derive the energetic for K-capture process. 10

Q2 Attempt any two

- (i) Obtain expression for binding energy of a nucleus based on liquid drop model. 10
- (ii) What is γ ray spectra? Explain the selection rules in case of γ -decay. Also discuss the phenomenon of internal conversion. 10
- (iii) What are mass parabolas? For odd A nuclei, derive expression for the charge and mass of the most stable isobar. 10
- (iv) Describe Mossbauer effect using its experimental set up. 10

Q3 Attempt any two

- (i) What is natural fusion? Explain energy productions in stars using carbon cycle. 10
- (ii) Explain the Nuclear cycle in a thermal nuclear reactor and show how it leads to the Four factor formula. How does this formula get modified if the reactor fuel contains only U^{235} and no U^{238} ? 10
- (iii) Explain construction and working of Van de Graff generator in detail with the help of schematic diagram. 10
- (iv) Describe the construction and working of Betatron. 10

- Q4** Attempt any two
- (i) Summarize the important experimental properties of the deuteron. 10
- (ii) Explain meson theory of nuclear Force. Using Heisenberg's uncertainty principle, estimate the mass of meson. 10
- (iii) What are elementary particles? Give the basis of their classification. 10
- (iv) (a) State conservation laws for various properties of elementary particles. 10
 (b) Give the basic properties of neutrinos and antineutrinos.
- Q5.** Attempt any four
- (i) Explain what is Specific ionization and Stopping power. 05
- (ii) Explain continuous β -particle spectra. 05
- (iii) Write a note on nuclear isomerism. 05
- (iv) What are mirror nuclei? For the mirror nuclei, ${}^{15}_7\text{N}$ and ${}^{15}_8\text{O}$, calculate Coulomb coefficient. 05
 Given: $M({}^{15}_7\text{N}) = 15.000108 \text{ amu}$, $M({}^{15}_8\text{O}) = 15.00307 \text{ amu}$,
 $m_n = 1.008665 \text{ amu}$, $m_p = 1.007825$
- (v) If the fission process starts with the 3000 neutrons and the multiplication factor $k = 1.05$, calculate the number of neutrons present in the tenth generation. 05
- (vi) The radius of dees in the cyclotron is 35 cm and magnetic field is 3000 Gauss. What would be the velocity and energy of protons? 05
 Given: $m_p = 1.67 \times 10^{-27} \text{ Kg}$, $q = 1.6 \times 10^{-19} \text{ C}$.
- (vii) Write a short note on photon. 05
- (viii) Explain qualitatively the Quark model. 05
