

2025

M.Sc. 3rd Semester Examination

PHYSICS

Paper : PHS - 305

(Nuclear Physics-I)

Full Marks : 25

Time : One Hour

*The figures in the margin indicate full marks.
Candidates are required to give their answers
in their own words as far as practicable.*

Group - A

Answer any *two* questions : $2 \times 2 = 4$

1. What was the role of oscillating radio-frequency field in Rabi's experiment of nuclear magnetic moment?
2. The quadrupole moment of ${}_{64}\text{Gd}^{155}$ nucleus is 130 fm^2 . Show that this nucleus is almost spherical.
3. In a mass spectrometer, a single positive charged ion is accelerated through a potential difference 1 kV. It then travels through a uniform magnetic field for which $B = 1 \text{ k Gauss}$ and is detected into a circular path of radius 18.2 cm. Calculate the mass of the ion in unit of u .
4. What are allowed and forbidden β -transitions?

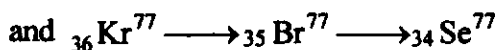
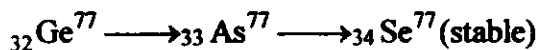
P.T.O.

(2)

Group - B

Answer any *two* questions : 4×2=8

5. (i) Graphically show the transitions of the following Odd A (77) isobaric nuclei with parabolic presentation :



- (ii) Evaluate the maximum energy shift that can be observed for a body whose quadrupole moment is Q . 2+2
6. (i) Write about the fine structure of α -spectrum and its importance.
- (ii) What do you mean by the Hindrance factor for α -decay? 3+1
7. Discuss the postulates of Pauli's neutrino hypothesis in β -decay. 4
8. (i) "Nuclei for which β^+ -decay is energetically possible may also undergo electron-capture, but the reverse is not true" — justify your answer.
- (ii) State the multipole characters of γ -radiation emitted in the following transition with given spin-parity values : $3/2^- \rightarrow 5/2^+$ 2+2

(3)

Group - C

Answer any *one* question : 8×1=8

9. (i) Calculate the frequency of hitting the potential wall for ^{238}U ($Z = 92$) nucleus by an alpha-particle. Given, the velocity of alpha particle is in the order of 10^7 m.s^{-1} and its energy 4.25 MeV.
- (ii) An α -particle of energy 6 MeV traverses in Al material of relative stopping power 1700, calculate the thickness of Al that is equivalent in stopping power to 1 m air.
- (iii) A nucleus with initial spin and parity 3^- decays to a final state with 1^+ . What are the possible multipolarities of the emitted gamma ray? Is a pure transition possible? Justify your answer using the gamma decay selection rules. 3+2+3
10. (i) What are Fermi-Kurie plots? Discuss their importance.
- (ii) Explain how the recoil-free emission and absorption of gamma rays occur. 2+6

Internal Assessment : 5 marks
