

**Assignment – 5**  
**Course Instructor: Prof. Rajeev Gupta**  
**M.Sc. Chemistry (Semester – IV)**  
**Paper: 4104 Section: B (Nuclear & Radiation Chemistry)**

**Time: 1 Hour**

**Attempt any Five questions. All questions carry equal marks.**

Q1. What are the Nordheim's rules for predicting the spin and parities of the nuclei? Explain with the following nuclei (a)  $^{55}\text{Mn}_{25}$  and (b)  $^{64}\text{Cu}_{29}$ .

Q2. What do you understand by the "binding energy per nucleon"? How does this information help in understanding the "nuclear fission" and "nuclear fusion" reactions?

Q3. Calculate the number of  $^{60}\text{Co}$  atoms produced when a 60 mg piece of  $^{59}\text{Co}$  metal foil is exposed for 10 minutes to a flux of  $6 \times 10^{15}$  thermal neutrons/cm<sup>2</sup>sec. The cross-section for the  $^{59}\text{Co} (n, \gamma) ^{60}\text{Co}$  nuclear reaction is 0.36 barn.

Q4. How does Ghoshal's experiment help in understanding the "compound nucleus theory"? Explain with a suitable example.

Q5. Discuss the working principles and difference of a breeder reactor with a converter reactor. Discuss the fissile and fertile material in each case.

Q6. Discuss the necessary conditions (with suitable example) for the positron emission and electron capture.

**Values of some of the physical constants:**

$$\begin{aligned} N &= 6.022 \times 10^{23} \\ 1/4\pi\epsilon_0 &= 9 \times 10^9 \\ 1 \text{ amu} &= 931.5016 \text{ MeV} \\ h &= 6.626 \times 10^{-34} \text{ Js} \\ m_e &= 9.1 \times 10^{-31} \text{ kg} \\ c &= 3.0 \times 10^8 \text{ m/s} \\ e &= 1.6 \times 10^{-19} \text{ C} \\ 1\text{eV} &= 1.6 \times 10^{-19} \text{ J} \\ k &= 1.3805 \times 10^{-23} \text{ J deg}^{-1} \\ R_0 &= 1.5 \times 10^{-15} \text{ m} \end{aligned}$$