

**Elective Paper III (Group A)**  
**Nuclear and Radiochemistry**

**60 Hrs.**  
**8Hrs**

**I**  
Nuclear stability, binding energy, n-p ratio, Meson theory of nuclear forces, Structure of the nucleus, Liquid drop model, Nuclear shell model, Magic numbers, Radioactive decay and Radioactive series, The basic principles of Geiger Muller counter and proportional counter.

**II**  
Energetics of nuclear reactions based on conservation of angular momentum, coulombic repulsion, potential barrier, particles escalation through electrostatic Van de Graaff generator, multiple stage linear accelerators, Cyclotrons, frequency modulated cyclotrons and synchrocyclotrons

**III**  
Cross Section, Resonance and tunnelling, Types of nuclear reactions, Nuclear reactions induced by neutrons, protons, deuterons, alpha particles,  $\gamma$ - photons and accelerated heavy charged ions, Discovery of Nuclear Fission reactions, fission yield, delayed neutrons, Explanation of Nuclear Fission reaction based on liquid drop theory, critical size, critical energy, role of multiplication factor, basic principle of design of Atom Bomb.

**IV**  
Principal of design of Nuclear Reactors, Classification of nuclear reactors, Oak-Ridge Graphite Reactor, Uranium – Heavy Water Reactor, Breeder Reactor, composition, functioning and utility of these reactors, Nuclear Reactors in India, Preliminary concept of Nuclear Waste management.

**V**  
Nuclear Fusion reactions, Weizäcker and Bethe cycle, Stellar energy, Basic principles of design of Wet and Dry Hydrogen bombs and Cobalt bomb, Spallation reactions.

**VI**  
Szilard-Chalmers separation process, Hot atom Chemistry, separation of Neptunium and Plutonium from  ${}_{92}\text{U}^{238}$  and their nuclear reactions. Synthesis of important radioisotopes viz  ${}^3_1\text{H}$ ,  ${}^{14}_6\text{C}$ ,  ${}^{22}_{11}\text{Na}$ ,  ${}^{32}_{15}\text{P}$ ,  ${}^{35}_{16}\text{S}$ ,  ${}^{131}_{53}\text{I}$ ,  ${}^{99\text{m}}_{43}\text{Tc}$ . Their applications in predicting reaction mechanism, determination of age of rocks and minerals in agriculture, industries and uses of coordination compounds of  $\text{Tc}^{99\text{m}}$  as imaging agents for the diagnosis of Alzheimer's diseases, disease related to liver, kidney, throat, bones in Nuclear medicine. Preliminary concept of damage to DNA from nuclear radiations.

**Books/Reading Material suggested**

1. Nuclear and Radiochemistry, G. Friedlander and J.W. Kennedy, John Wiley & Sons.
2. Essentials of Nuclear chemistry, H.J. Arnikar New Age International.
3. Advance in Inorganic Chemistry and Radiochemistry series
4. Coordination Compounds in Nuclear Medicine, Chemical Reviews 93 (1993)1137.