

FCYC 908	Nuclear Chemistry	(3-1-0)	4 Credits
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Module I

[12 Lectures]

General Aspects of Nuclear Chemistry: Discovery- Types of decay-Decay kinetics: Decay constant, half-life period, mean life Parent daughter decay-growth relationships-Secular and transient equilibrium-Units of radioactivity- Alpha, beta and gamma decay: Theory of decay, energies and properties-Artificial radioactivity- Detectors: Ionization chamber, electron pulse counters, scintillation detectors, semiconductor, detectors, thermo luminescence detectors and neutron detectors. Bethe notation-Types of nuclear reactions: The compound nucleus theory- Reaction cross section- Transmutation reactions, elastic and inelastic scattering, spallation, fragmentation, stripping and pick-up, fission, fusion, photonuclear reactions, Thermonuclear reactions.

Module II

[10 Lectures]

Nuclear Disintegration and Reactors: The fission energy – Reproduction factor - Classification of reactors- Based on Moderators, Coolant, Phase of Fuel and Generation -Principle of Thermal nuclear Reactors: The four factor formula - Reactor power – Critical size of a thermal reactor – Excess reactivity and control - Breeder reactor - Reprocessing of spent fuels - Nuclear waste management – Safety culture – Active and passive safety, containment building, nuclear criticality safety, ionizing radiation protection – enforcement agencies.

Module III

[14 Lectures]

Radiation chemistry – Passage of radiation through matter – Units for measuring radiation absorption – Radiation dosimetry – Radiolysis of water – Free radicals in Water Radiolysis – Chemical dosimetry: Radiolysis of Fricke Dosimeter Solution.

Application of radioisotopes: probing by isotopes, reactions involved in the preparation of radioisotopes, The Szilard-Chalmer's Reaction – Radiochemical principles in the use of Tracers – Applications of radioisotopes as tracers- Chemical investigations, analytical applications, agricultural and industrial applications -Neutron Activation Analysis – Carbon and Rock Dating – Use of nuclear reactions- Radioisotopes as source of electricity – Nuclear medicines.

Essential Readings

1. Essentials of Nuclear Chemistry, Arnikaar, H. J., New Age International Publishers Ltd., New Delhi, 4th Edn., 1995.
2. Nuclear and Radiochemistry, K. H. Lieser, Wiley-VCH, 2nd revised Edn, 2001.
3. Radiochemistry and Nuclear Chemistry, G. Choppin, J. O Liljenzin and J. Rydberg. Butterworth-Heinemann, Oxford, 3rd Edn., 2002.
4. Modern Nuclear Chemistry, Walter D. Loveland, David J. Morrissey, Wiley, 2nd Edn. 2006.