NUCLEAR RADIATION DETECTORS, DATA AQCUISITION AND ANALYSIS MODULE – I

Introduction: Principle of detection of photons, charged particles and neutrons. (Interaction of light and heavy charged particles with matter, photoelectric, Compton and pair production)

Gas counters: Ionisation chambers, Proportional counters, Neutron detectors and G.M. counters.

Scintillation detectors: Organic and inorganic Scintillators – theory, characteristics and detection efficiency. BGO detectors – advantages of BGO over Scintillation detectors.

Solid State Detectors: Silicon Surface Barrier detectors, E - ΔE detection for charged particles, Si (Li) detectors for X-rays and electrons, HPGe detectors for photon detection. Energy resolution, efficiency and timing considerations. Introduction to Cluster and Clove detectors.

MODULE II DATA ACQUISITION AND ANALYSIS

Pulse Processing and shaping: - Preamplifiers - Voltage, Current and Charge sensitive types. Resistive and Optical feedback. Main amplifiers- pulse shaping, pole-zero compensation, base line restoration and pile up rejection.

Pulse height analysis: Single Channel analyser – integral and differential modes of operation. Simple spectrometer assembly.

Multi-channel analyser: A/D converters (Wilkinson and Flash types). D/A converters (R-2R ladder type). Principle of operation and performance indices. Multi-channel analyser in PHA and MCS modes.

Assignment:

Coincidence measurements: Slow - fast coincidence arrangement for measurement of coincidence between radiation. Prompt and chance coincidences. Experimental arrangement for energy and time coincidence measurements. Compton suppression spectrometer (Ge (Li) detectors with anti-Compton BGO shield).

Counting Statistics: Statistical errors and their propagation in experimental measurements, χ^2 - test.

Text and Reference Books:

1. Nuclear Radiation Detectors S. S. Kapoor and V. S. Ramamurthy.
2. Radiation Detection and Measurement G. F. Knoll.
3. Techniques for Nuclear and Particle Physics experiments William R. Leo.