

Nuclear Instrumentation [NI]

B.E. Sem. VIII [INST]

(Elective – II)

EVALUATION SYSTEM

	Time	Marks
Theory Exam	3 Hrs.	100
Practical & Oral Exam	–	–
Oral Exam	–	25
Term Work	–	25

SYLLABUS

1. Radioactivity

General Properties of Nucleus, Radioactivity, Nature of Nuclear Radiation's, Characteristic properties of radioactive radiation's, Properties of Alpha, Beta, and Gamma rays, Natural and artificial radio-activity. Radioactivity Laws, Half life period, radioactive series, Isotopes and Isobars, Various effects- photoelectric, Compton scattering and pair production, stopping power and range of charged nuclear particles.

2. Radiation detectors

Techniques for weak signal detection, Detectors for Alpha, beta and gamma rays, Detector classification – Ionization chamber, Regions of multiplicative operation, Proportional counter, Geiger Muller counter-volt ampere characteristics, Designing features, Scintillation detectors (Photomultiplier tube- types, dark currents, scintillators, pulse resolving power), efficiency of detection, SNR improvement, Solid state detectors (Lithium ion drifted - Si-Li, Ge-Li, Diffused junction, surface barrier)

3. Electronics and Counting systems

Pre-amp., main amplifiers, Discriminators, Scalars and count rate meters, Pulse shaping, pulse stretchers, Coincidence circuits, photon counting system block diagram, factors influencing resolution of gamma energy spectrum, Energy resolution in radiation detectors, single and multichannel analyzers (MCA), pulse height analyzers (PHA).

4. Application in Medicines

Gamma camera- design, block diagram, medical usage. Radiation uptake studies- block diagram and design features. Nuclear Instrumentation for health care, Radiation Personnel Health Monitors like neutron monitors, Gamma Monitors, Tritium monitors, Iodine monitors and PARA (particulate activity radiation alarms).

5. Applications in Industry

Basic Nuclear Instrumentation system- block diagram, Nuclear Instrumentation for laboratory. Personal monitors like Thermo Luminescence Detectors (TLD), Dosimeters, Tele-detectors, which are used to assess the radiation exposure to the radiation plant workers. Nuclear Instrumentation for power reactor. Nuclear Instrumentation for Toxic fluid tank level measurement, Underground Piping Leak detection, weighing, thickness gauges, water content measurement etc. Agriculture applications like food irradiation.

Reference Books :

1. Radiation Detection & Measurement (*G. F. Knoll*) 2nd edition, John Wiley & Sons, 1998.
2. Nuclear Electronics (*P.W.NICHOLSON*) John Wiley, 1998.
3. Nuclear Radiation Detectors (*S. S. Kapoor & V. S. Ramamurthy*) Wiley Eastern Limited, 1986.
4. Engineering Physics (*Gaur & Gupta*) Danpat Rai & Sons, 2001.
5. Nuclear Physics (*Irvin Kaplan*) Narosa, 1987.
6. Engineering Physics (*M.N.Avdhamule & P.G.Kshirsagar*) S.Chand & Co., 2001.
7. Introduction to Experimental Nuclear Physics (*R. M. Singru*) Wiley Eastern Pvt. Ltd., 1974.
8. Hand Book of Nuclear Medical Instruments, TMH Publishing New Delhi, 1974.

