

**Mangalore University**  
**Medical Physics Division**

**Semester II:** *Open Elective for the students of other departments*

**MPE 455: Industrial Application of Radiation and Radioisotopes**

(Teaching hours: Each Unit – 12 h)

**Unit I: Basic Radiation Physics**

Atomic and nuclear structure – Rutherford's and Bohr's atomic models, nucleus and its constituents, isotopes, isobars and isomers. Electromagnetic radiation – Ionising and non-ionising radiations. Radioactivity – Radioactive decay, decay constant, half-life, biological half-life, types of ionising radiations (alpha, beta, X-ray and gamma radiations) and radioisotopes. Radiation sources – Natural and artificial radioactive sources.

**Unit II: Radiation Measurements, Quantities, Units and Protection**

Basic principles of radiation detection - GM detectors, scintillation detectors, semiconductor detectors, solid state nuclear track detectors (SSNTD) and thermo luminescent dosimeters (TLD). Radiation quantities and units – Activity, radiation exposure, absorbed dose, equivalent dose and effective dose. Linear energy transfer (LET). **Radiation protection** - Objectives of radiation protection, committees and regulatory bodies concerned with risk estimates and radiation protection, occupational exposure, as low as reasonably achievable (ALARA), protection of the embryo/fetus, Exposure of members of the public (non-occupational).

**Unit III: Industrial Applications**

Non-Destructive Testing: automobile industry - thickness of metal sheets, pipeline corrosion; aircraft industry - checking flaws in jet engines; mineral analysis. Sealed source applications: industrial radiography, gauging applications - density, moisture, level, thickness monitoring gauges. Radio tracer techniques: Leak and block detection, flow rate and mixing measurements. Gamma Radiation Processing Plants: sterilization of medical products, irradiation of food materials, treatment of sewage, etc. **Enhancing Material Quality:** hardening plastics by cross linking, heat resistant wire and cables by irradiation, radiation vulcanisation of natural rubber for better quality. **Electrostatic control applications.** **Oil and Gas Exploration:** nuclear well logging, porosity and lithography studies; contour mapping to test wells and mine bores. Smoke detectors. Neutron activation analysis – landmine detection. Particle accelerators. Nuclear reactors.

**Reference Books:**

1. Hall Eric J. Radiobiology for the radiologist, Lippincott Williams & Wikins, Philadelphia, 1994.

2. Eisenbud M. Environmental Radioactivity, Academic Press Inc. (London) Ltd., 24-28 Oval Road, London NW1 7DX, 1987.
3. Bushong, Stewart C. Radiological Science for technologists – physics, biology and protection, Mosby, St. Louis, 1997.
4. Edward L. Alphen, “Radiation Biophysics” Academic Press, Second Edition.

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