



MANGALORE UNIVERSITY

MSc Medical Physics

MPE 455: Industrial Application of Radiation and Radioisotopes

Teaching hours: Each Unit – 12 h

Objective:

To acquaint the students with basic knowledge of nuclear/radiation physics, measurements, radiation protection and safety, also to familiarize with industrial applications of radiations, radioisotopes and radiation technology.

Outcomes:

- Students will have knowledge of basic nuclear/radiation physics.
- They learn about radiation measurements, quantities and units.
- Familiar with protection from harmful effects of radiation and know about different kinds of personnel monitoring systems.
- Acquire knowledge on nucleonic gauges used in industries and household applications.
- Students will learn about sealed sources applications of in industries and familiar with radiography and its applications.
- They will also gain the knowledge about application of radiation and radioisotopes in oil and gas exploration.

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:

- Hall Eric J. Radiobiology for the radiologist, Lippincott Williams & Wikins, Philadelphia, 1994.
- Eisenbud M. Environmental Radioactivity, Academic Press Inc. (London) Ltd., 24-28 Oval Road, London NW1 7DX, 1987.
- Bushong, Stewart C. Radiological Science for technologists – physics, biology and protection, Mosby, St. Louis, 1997.
- Edward L. Alphen, –Radiation Biophysics| Academic Press, Second Edition.

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