



**MANGALORE UNIVERSITY**  
**MSc Medical Physics**

**Semester – II: Theory**

**MPH 451: Radiation Detection and Measurement**

**Teaching hours: Each Unit – 12 h**

To acquaint the students about the radiation sources, detectors, radiation counting systems, radiation measuring systems and various kinds of radiation instruments used for diagnosis, therapy and radiation safety.

**Outcomes:**

- Students will be familiar with different kinds of radiation sources including radioisotopes with specific applications in diagnosis and therapy.
- Learn about radiation and radioisotope detection, counting, recording and analysis of the data.
- Acquaint with different kinds of radiation counters and measuring instruments.
- They will also learn about various kinds of personnel monitoring and safety instruments, their operation and use.

**Unit I: Radiation Sources**

Radiation sources - Natural and artificial radioactive sources - Large scale production of isotopes - Reactor produced isotopes - Cyclotron produced isotopes - Fission products - Telecobalt and Brachy Cesium sources – Gold seeds - Tantalum wire -  $^{125}\text{I}$  Sources - Beta ray applicators - Thermal and fast neutron sources - Preparation of tracers and labelled compounds - Preparation of radio colloids.

**Unit II: Radiation Detection**

Principles of Radiation detection and measurement - Basic principles of radiation detection - Counting systems for alpha and beta radiation – Gas Filled detectors, Ionisation chambers - Theory and design - Construction of condenser type chambers and thimble chambers - Gas multiplication - Proportional and GM Counters, Detector efficiency

and minimum detectability, Background correction, Geometry correction for counting, Dead time and recovery time - beta spectrometer.

### **Unit III: Radiation Counters**

Scintillation detectors, Characteristics of organic and inorganic scintillators, liquid scintillators, liquid scintillation counting system, quench correction, solid scintillators, NaI(Tl) detector, RIA counters, Semiconductor detector, HPGe detector, Gamma ray spectrometers - single and multi-channel analyzers, Pulse height spectroscopy, Neutron Detectors - Nuclear track emulsions for fast neutrons - Solid State Nuclear track detectors (SSNTD) - New Developments.

### **Unit IV: Radiation Measuring Instruments**

Dosimeters based on condenser chambers - Pocket chambers - Dosimeters based on current measurement - Different types of electrometers - MOSFET, Vibrating condenser and Varactor bridge types - Secondary standard therapy level dosimeters - Farmer Dosimeters – Radiation field analyser (RFA) - Radioisotope calibrator - Multipurpose dosimeter - Water phantom dosimetry systems - Brachytherapy dosimeters - Thermoluminescent dosimeter readers for medical applications - Calibration and maintenance of dosimeters.

### **Unit V: Radiation Instruments**

Instruments for personnel monitoring – TLD, OSLD badge readers - PM film densitometers - Glass dosimeter readers - Digital pocket dosimeters using solid state devices and GM counters - Teletector- Industrial gamma radiography survey meter - Gamma area (Zone) alarm monitors - Contamination monitors for alpha, beta and gamma radiation - Hand and Foot monitors - Laundry and Portal Monitors - Scintillation monitors for X and gamma radiations - Neutron Monitors, Tissue equivalent survey meters - Flux meter and dose equivalent monitors - Pocket neutron monitors – Tele-dose systems. Instruments

for counting and spectrometry - Portable counting systems for alpha and beta radiation - Gamma ray spectrometers - Multichannel Analyser - Liquid scintillation counting system - RIA counters  
– Whole body counters - Air Monitors for radioactive particulates and gases. Details of commercially available instruments and systems.

**Reference Books:**

1. Nicholas Tsoufanidis Measurement and Detection of Radiation, second edition
2. W.E. Burcham& M. Jobes – Nuclear and Particle Physics – Longman (1995)
3. G.F.Knoll, Radiation detection and measurements
4. Thermoluminescence Dosimetry, Mcknlly, A.F., Bristol, Adam Hilger (Medical Physics Handbook 5)
5. W.J.Meredith and J.B.Massey –Fundamental Physics of Radiology| John Wright and sons, UK, 1989.
6. J.R.Greening –Fundamentals of Radiation Dosimetry|, Medical Physics Hand Book Series No.6 Adam Hilger Ltd., Bristol 1981.
7. Practical Applications of Radioactivity and Nuclear Radiations, G.C.Lowental and P.L.Airey, Cambridge Universiyt Press, U.K., 2001

