



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}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 Tsoulfanidis 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, Mcknlay, 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 University Press, U.K., 2001

