



MANGALORE UNIVERSITY

MSc Medical Physics

MPH 552: Radiation Protection, Standards and Safety

Teaching hours: Each Unit – 12 h

Objective:

To familiarise the students with radiation doses, risks, limits and basic concepts of radiation protection. To familiarise the students with the various radiation sources, principles of monitoring and safety aspects in medical use of radiations, also about radioactive waste, its treatment and disposal. To teach the students about radioisotope transportation, safety aspects involved in it, radiation emergencies, legal framework and legislation to be practiced in radiation protection.

Outcome:

- Students will learn about natural and artificial radioactivity and radiation doses due to them. Also know the basic concepts of safety and protection and about ALARA principle.
- They will come to know about principles involved in radiation monitoring and protection.
- They will understand the safety aspects involved in medical uses of radioisotopes and radiations.
- They will know about radiation waste, its safe handling and disposal.
- Students will be learning transportation of radioisotopes, radiation emergencies involved in handling them, legal framework to be practiced while handling them and also about legislation governing the handling of radiation and radioisotopes.

Unit I: Radiation Protection Standards

Radiation dose to individuals from natural radioactivity in the environment and man-made sources. Basic concepts of radiation protection standards – Historical background – ICRP recommendations – Basic of Radiation Risk and Dose Limits - The system of Radiological Protection – Justification of Practice, Optimisation of protection and individual dose limits – AERB directives on dose limit - concepts of collective dose – Potential exposures, dose and dose constraints – system of protection for intervention – categories of exposures – occupational, public and medical exposures – ALARA principle, factors governing internal exposure – Safe handling of radioactive materials, Radionuclide concentrations in air and water – ALI, DAC and contamination levels.

Unit II: Principles of Monitoring and Protection

Evaluation of external radiation hazards – Effects of distance, time and shielding – shielding calculations – Personnel and area monitoring – Internal radiation hazards – Radio toxicity of different radionuclides and the classification of laboratories – control of contamination –

Bioassay and air monitoring – Chemical protection – Radiation accidents – disaster monitoring.

Unit III: Safety in the Medical uses of Radiation

LNT hypothesis - Radiation shielding Inverse Square Law of radiation, Half Value Layers, TVL, Linear Attenuation Coefficient, Mass Attenuation Coefficient – General considerations – Design of diagnostic, deep therapy, telegamma and accelerator installations, brachytherapy facilities and medical radioisotope laboratories. Evaluation of radiation hazards in medical diagnostic, therapeutic installations – Radiation monitoring procedures – Protective measures to reduce radiation exposure to staff and patients – Radiation hazards in brachytherapy and teletherapy departments and radioisotope laboratories – Particle accelerators Protective equipment – Handling of patients – Waste disposal facilities – Radiation safety during source transfer operations - Special safety features in accelerators, reactors.

Unit IV: Radioactive Waste Disposal

Radioactive Wastes: sources of radioactive wastes – classification of waste – Treatment techniques for solid, liquid and gaseous effluents – permissible limits for disposal of waste – Sampling techniques for air, water and solids – Geological hydrological and metrological parameters – Ecological considerations.

Disposal of radioactive wastes: General methods of disposal – Management of radioactive waste in medical, industrial, agricultural and research establishments.

Unit V: Radioisotopes – transportation, legal framework and Emergencies

Transport of Radioisotopes: Transportation of radioactive substances – Historical background – General packing requirements – Transport documents – Labeling and marking of packages – Regulations applicable for different modes of transport – Transport by post – Transport emergencies – Special requirements for transport of large radioactive sources and fissile materials – Exemptions from regulations – Shipment approval – Shipment under exclusive use – Transport under special arrangement – Consignor's and carrier's responsibilities.

Legislation: Physical protection of sources – Safety and security of sources during storage, use, transport and disposal – security provisions: administrative and technical – security

threat and graded approach in security provision. National legislation – Regulatory framework – Atomic Energy Act – Atomic Energy (Radiation Protection) Rules – Applicable Safety Codes, Standards, Guides and Manuals – Regulatory Control – Licensing, Inspection and Enforcement – Responsibilities of Employers, Licensees, Radiological Safety Officers (RSO) and Radiation workers – National inventories of radiation sources – Import, Export procedures.

Radiation Emergencies and their Medical Management: Radiation accidents and emergencies in the use of radiation sources and equipment in industry and medicine – Radiographic cameras and teletherapy units – Loading and unloading of sources – Loss of radiation sources and their tracing – Typical accident cases. Radiation injuries, their treatment and medical management – case histories.

Reference Books:

1. Herman Cember. Introduction to Health Physics
2. Atomic Energy Act 1962
3. AERB Radiation Protection Rules 2004
4. ICRP 1990 Recommendation
5. ICRP 2007 Recommendation
6. IAEA Basic safety standards 115, 1997
7. Shapiro T. radiation Protection
8. Mckenzie. Radiation Protection in radiotherapy
9. Mawson C.A. management of Radioactive wastes.
10. Practical Applications of Radioactivity and Nuclear Radiations, G.C.Lowental and P.L.Airey, Cambridge University Press, U.K., 2001
11. S.P.Yaremonenko, –Radiobiology of Humans and Animals, MIR Publishers, Moscow, 1988.
12. R.F. Mold –Radiation Protection in Hospitals, Adam Hilger Ltd. Bristol, 1985.
13. A.Martin and S.A.Harbisor, An Introduction to Radiation Protection, John Wiley & Sons, Inc. New York, 1981.
14. NCRP, ICRP, ICRU, IAEA, AERB Publications.

-----*****-----