w.e.f. July, 2021

PH-9204

RADIATION PHYSICS

L	T	P	C
4	1	0	5

Course outcomes

The objective of the course on Radiation Physics is to provide an introduction to the students to understand,

CO1: The aspects of radioactive sources (alpha, beta, gamma and neutron sources). The detailed description of the nuclear accelerators (linear and Circular accelerators) and the description of synchrotron radiations.

CO2: The interaction, scattering and processes of energy losses of charged particles, and the photons in the matter.

CO3: The interaction of neutron with matter. Description of neutron diffusion and moderation in multiplying and non-multiplying media.

CO4: The aspects of various nuclear detectors used for the detection of charged particle, photons and the neutrons.

CO5: The description of the radiation effects in condensed system, radiolysis of water and the aspects of the dosimetry.

CO6: The importance of modern application of radiations; radiotherapy, radiation image techniques etc.

CO/PO Mapping

S-strong, M-medium and W-weak indicate the strength of correlation

COs	Programme outcomes (POs)											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	S	S	S	S	W	W	W	M	S	S	S	S
CO2	S	S	S	M	S	W	M	W	M	W		W
CO3	S	M	S	W	W	S	S	S	S	M	S	S
CO4	S	S	W	M	M	M	M	M	M	S	W	W
CO5	M	W	S	W	S	M	S			W	M	M
CO6	S	S	W	W	M	W	W	W	W	S	S	S

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UNIT-I

Sources of Radiation: Cosmic rays, Radioactive sources, Accelerators; Brief study of principle of operation & characteristics of radiations of Cockroft Walton, Vande Graff, Cyclotron, Electron Linac, Electron Synchrotron, Synchrotron radiation: Polarization, coherence and emittance. Neutron Source: Reactors, Neutrons from charged particle and photon induced reactions. Radiation Protection: Units and special parameters, background levels, radiation carcinogenic.

10Hrs

Interaction of Charged particle with matter: Definition of range, types of charged particle interaction, energy transfer in elastic collisions, Bethe formula, scattering of heavy and light charged particles, Radiation loss: corrections for Born approximations and Bremsstrahlung.

10Hrs

Interaction of Photons: Attenuation coefficients, classical scattering from single electrons, coherent scattering, Compton scattering: The Klein–Nishina cross section (No derivation), Atomic electrons: Effect of electron binding, electron recoil energy, electron momentum distributions from Compton profiles. Photoelectric absorption, characteristic X-rays, Auger electrons, pair production.

10hrs

UNIT-II

Interaction with Neutrons: Neutron interactions, Definition of flux, current density, collision dynamics, distribution of energy and angle of scatter, Mean scatter angle and energy loss in single collision, extension to multiple collision, neutron diffusion and moderation: Diffusion equation and its solutions; non-multiplying and multiplying media, Neutron slowing down and thermalization. **8hrs**

Nuclear detectors: Gas detectors, Scintillation detector, semiconductor detectors. Analysis of the spectrum measured with NaI(Tl) and Semiconductor detectors. **8Hrs**

Dosimetry and Microdosimetry: Dosimetric Principles, Quantities and units, Relationships between various Dosimetric quantities, Dosimetry, Calorimetry, standardization for low and medium energy X-rays, high energy photons, electrons, chemical dosimeters, TLD, solid state and film dosimeters. Experimental determinations of micro-dosimetric spectra. **5Hrs**

Radiation effects: Stochastic and Non Stochastic effects, Radiation effects in condensed systems, radiolysis of water. Brief discussion of Radiotherapy using Photons, electrons and heavy particle. **5Hrs**

Brief introduction to radiation imaging techniques: Diagnostic radiology, Tomography, Magnetic Resonance Imaging, Nuclear Medicine (Qualitative). **4Hrs**

Total: 60Hrs

BOOKS:

1. A primer in Applied Radiation Physics, F.A. Smith, World Scientific
2. Radiation Oncology Physics: E.B. Podgorsak, Technical Editor; A handbook for teachers and students: International Atomic Energy agency
3. Radiation Detection and Measurement, G.F. Knoll, John Wiley

C/BOS 7/7/2021

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