Course Code	Course Name	Credits
26PH107	RADIATION SCIENCE	04

Course Objectives

- To familiarize students with basic of radiation.
- Understand the basic physics of radiation detectors.
- Understand the distinctions between the units of radiation quantity, exposure and dose.

Learning Outcomes

Upon successful completion of this course it is intended that a student will be able to:

- Understand the various radiation behaviours.
- Understand the circuits to detect radiation
- Understand how radiation is measured using different instruments.

Unit 1 - Interaction Of Radiation With Matter (13 Hrs.)

Passage of heavy charged particles through matter : Energy loss by collision, maximum energy loss in a single collision, range energy relation, Bragg curve, Specific ionization, mean excitation energies, Bethe-Bloch formula collision stopping power, radiation stopping power. Interaction of neutrons: Neutron sources, General properties, energy classification, elastic and inelastic scattering, nuclear reaction, neutron activation and induced activity, radioisotope production, Nuclear fission.

Unit 2 – Radiation Detectors (13 Hrs.)

Characteristics of organic and inorganic scintillation counters, Resolving time, Semiconductor devices - physics of semiconductors, diffused junction, surface barrier and ion-implanted detectors, Examples, Semiconductor spectrometer, Analysis of pulse height of spectra, superheated drop detectors. Neutron detectors: BF3 counters, fission chambers, activation methods, Neutron time of flight method.

Unit 3 - Measurement Of Radiation Exposure And Dose (13 Hrs.)

Particle flux and fluence, energy flux and fluence, cross section, linear and mass absorption coefficient, stopping power and LET. Exposures and its measurement, absorbed dose and its relation to exposure. Electronic equilibrium, Bragg-Gray principle and air wall chamber, Kerma, Kerma rate constant. Biological effectiveness, Equivalent dose, effective dose, Committed equivalent dose, Ambient and directional equivalent dose. Tissue equivalence.

Unit 4 – Internal And External Dosimetry (11 Hrs.)

Biological half-life, effective half-life, selectivity of organs, beta particle dosimetry. Calculation of integral dose due to internal deposition, specific effective energy, annual limit on intake, derived air concentration.

Unit 5 - Dosimeters (10 Hrs.)

Primary and secondary dosimeters. Pocket dosimeters, films, TLDs. Chemical and calorimetric devices.

Reference Books:

1. Knoll G F, „Radiation Detection and Measurements“ (Wiley, New York, 1989)
2. Kapoor S S and Ramamurthy V S, „Nuclear Radiation Detectors“ (Wiley Eastern Ltd., New Delhi, 1986)
3. Herman Cember, „Introduction to Health Physics“ (Pergamon Press, 1983)
4. Attix F H et al, „Radiation Dosimetry“, Vol. I, II and III (Academic Press, NY, 1968)

Websites and eLearning Sources:

1. https://youtu.be/JeUKVJgW89c?si=MXT8ee9QaKMno9fA
2. https://youtu.be/w5L-NnZHoQo?si=RY91omwQ3jMvetc1
3. https://youtu.be/WBQVLGfvKqs?si=aTcPdW2iNXogtxzD

COs and Bloom's Taxonomy Mapping – 26PH107		
Course Outcomes	**On successful completion of this course, students will be able to**	**BTL**
CO1	Recall and explain the interaction of heavy charged particles with matter, including concepts such as energy loss by collision, range-energy relation, and specific ionization.	K1, K2
CO2	Apply the principles of radiation detection, including the characteristics of scintillation counters and semiconductor detectors, to analyze different detection methods and their applications.	K3
CO3	Analyze and evaluate various techniques for measuring radiation exposure and dose, including the Bragg-Gray principle, electronic equilibrium, and the concept of kerma.	K4
CO4	Critically evaluate internal and external dosimetry methods, including the use of dosimeters and the calculations related to biological half-life and effective dose.	K5
CO5	Design and conduct independent research projects related to radiation physics, formulating hypotheses, and proposing innovative solutions for radiation measurement and safety.	K6

BTL (Bloom's Taxonomy Level) - K1 – Remembering, K2 – Understanding, K3- Applying, K4 – Analyse, K5- Evaluate and K6 - Create

Relationship Matrix – 26PH107													
Course Outcomes	**Programme Outcomes (POs)**						**Programme Specific Outcomes (PSOs)**						**Mean Score of Cos**
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PSO1**	**PSO2**	**PSO3**	**PSO4**	**PSO5**	**PSO6**	
CO1	3	2	1	1	1	1	3	2	1	2	2	1	1.67
CO2	2	2	3	2	1	1	2	2	3	1	1	1	1.75
CO3	2	3	2	3	2	1	1	2	2	3	2	1	2.08
CO4	1	2	2	3	3	2	1	1	2	2	3	2	2.08
CO5	1	1	2	3	3	3	1	1	2	2	3	3	2.08
												Total	1.93

Mean Score: 3- High, 2- Medium/Moderate, 1-Low