PHY-444 Medical Physics

Credit Hours: 3-0

Prerequisite: None

Course Description:

This course provides an in-depth theoretical foundation in medical physics tailored for undergraduate physics students. It explores the application of fundamental physics principles to medical imaging, radiation therapy, and nuclear medicine. Students will study the physics underlying diagnostic modalities such as X-ray, computed tomography (CT), magnetic resonance imaging (MRI), and ultrasound, as well as the mechanisms of radiation interaction with biological tissue. The course also covers radiation dosimetry, biological effects of radiation, and safety standards essential for medical applications. Designed to equip students with critical theoretical knowledge, the course prepares them for advanced studies or careers in medical physics, healthcare technology, and related fields.

Course Objectives:

By the end of the course, students will be able to:

- Understand the physical principles behind major medical imaging modalities (X-ray, CT, MRI, Ultrasound).
- Explain the fundamental interactions between radiation and biological tissue.
- Describe the principles of radiation therapy and dosimetry.
- Analyze safety standards and radiation protection protocols.
- Develop a conceptual understanding of instrumentation used in medical diagnostics and treatment.

Text Book:

- Introduction to Physics in Modern Medicine – Suzanne Amador Kane (SAK)

Reference Books:

- Medical Physics – Martin Hollins
- The Physics of Radiology – Harold Elford Johns and John R. Cunningham
- Physics in Nuclear Medicine" – Simon R. Cherry, James A. Sorenson, Michael E. Phelps

Week	Section	Topics
1.	Chapter 1 (SAK)	Introduction to Medical Physics: Scope, History, and Applications
2.	Chapter 2 (SAK)	Physics of the Human Body: Basic Anatomy & Physiology from a Physics View
3.	Chapter 3 (SAK)	Interaction of Radiation with Matter (Photons, Electrons, Neutrons)
4.	Chapter 4 (SAK)	X-ray Production, X-ray Tubes, and Image Formation
5.	Chapter 5 (SAK)	Diagnostic Radiology: Film-Screen and Digital Systems
6.	Chapter 6 (SAK)	Computed Tomography (CT): Principles, Detectors, Image Reconstruction
7.	Chapter 7 (SAK)	Magnetic Resonance Imaging (MRI): Physics, Relaxation, Contrast Mechanisms
8.	Chapter 8 (SAK)	Ultrasound Imaging: Wave Propagation, Transducers, Doppler Effect
	Midterm	
9.	Chapter 9 (SAK)	Radiation Therapy: Linear Accelerators, Brachytherapy
10.	Chapter 10 (SAK)	Radiation Dosimetry: Concepts, Units, Measurement Techniques
11.	Chapter 11 (SAK)	Biological Effects of Radiation: Deterministic & Stochastic Effects
12.	Chapter 12 (SAK)	Radiation Protection & Safety Standards (ICRP, ALARA, Shielding)
13.	Chapter 13 (SAK)	Medical Physics in Oncology and Diagnostic Departments
14.	Chapter 14 (SAK)	Review and Advanced Topics (e.g., AI in Medical Imaging, Future Trends)
15.	Chapter 15	

	(SAK)
16.	
17.	**End Semester Exam**