BMPC3001 BIOMEDICAL IMAGING (3-0-0)

Course Objectives: This course aims to equip students with foundational knowledge of biomedical imaging principles, techniques, and systems including X-ray, ultrasound, CT, radionuclide, MRI, and gamma camera. It emphasizes understanding their production, applications, advantages, and safety in medical diagnostics, fostering skills for analyzing and evaluating imaging technologies in healthcare.

Module-I: (12 Hrs)
Introduction to basic concepts of medical imaging
X-Ray Machines: Basis of Diagnostic Radiology, Nature of X-rays, Properties of X-rays, Units of X-radiation,Production of X-rays : stationary anode tube & rotating anode tube.X-Ray Machine: High Voltage Generation, High frequency Generator, High Tension Cable, Collimators & Grids, Exposure Time Systems, and Automatic Control. Visualization of X-rays & Digital Radiography: X-ray Films, X-ray Image Intensifier Television System, Dental X-ray machines, portable &mobile X-ray units, Digital Radiography, Flat Panel detector for Digital Radiography.

Module-II: (10 Hrs)
Ultrasonic Imaging System: Physics of Ultrasonic waves, generation & detection of ultrasound, basic pulse-echo apparatus, brief description of different modes of scans like A-scan, M-mode, Bscan with its applications in medicine.

Module-III: (10 Hrs)
Computed Tomography Machine (CT): (10 hours) Basic Principle of CT, System components: scanning system, Detector, Processing system, Viewing system, storing & documentation, Gantry geometry, Patient dose in CT Scan & Advantages of CT Scanning.

Module-IV: (08 Hrs)
Radionuclide imaging: fundamentals of radioactivity, radionuclide generators and detectors, radionuclide imaging methods: Scintigraphy, SPECT, PET, Introduction to recent developments like Infrared Imaging, Ophthalmic Imaging.

Module-V: (08 Hrs)
MRI Machine & Gamma Camera: Principles of NMR Imaging System, Basic NMR Components – Block Diagram Description, Advantages of NMR Imaging, The Gamma Camera – Block Diagram Description.

Course Outcome:
CO1: Recall the fundamental principles, properties, and components of X-ray machines and digital radiography systems used in medical imaging.
CO2: Explain the physics of ultrasonic waves, generation methods, and applications of different scan modes in ultrasonic imaging for medical diagnostics.
CO3: Demonstrate the use of computed tomography (CT) components and principles to interpret scanning processes, patient dosing, and imaging advantages in clinical scenarios.
CO4: Differentiate between radionuclide imaging techniques such as Scintigraphy, SPECT, and PET, analyzing their fundamentals, detectors, and recent developments like infrared imaging.
CO5: Assess the principles, block diagrams, and advantages of MRI and gamma camera systems, evaluating their effectiveness and limitations in advanced biomedical imaging applications.

Books

- Introduction to Environmental Engineering and Science by Gilbert Masters, Prentice Hall, New Jersey.
- Introduction to Environmental Engineering by P. Aarne Vesilind, Susan M. Morgan, Thompson /Brooks/Cole; Second Edition 2008.
- Peavy, H.s, Rowe, D.R, Tchobanoglous, G. Environmental Engineering, Mc-Graw -Hill International Editions, New York 1985.
- MetCalf and Eddy. Wastewater Engineering, Treatment, Disposal and Reuse, Tata McGraw-Hill, New Delhi