

MEDICAL IMAGING TECHNIQUES

Course code: 18ML7IEMIT

Credits: 03

L: P: T: S: 3: 0: 0: 0

CIE Marks: 50

Exam Hours: 3 Hrs

SEE Marks: 50

Total Hours: 40

Course Objectives:

1. To learn the physics of image formation in medical imaging
2. To know how to assess image quality in different medical imaging systems using signals and systems concepts
3. To know the instrumentation used in medical imaging

Course Outcomes:

At the end of the course, student will be able to:

CO1	Have knowledge on basic physical principles behind major medical imaging techniques
CO2	Knowledge on the image formation, image quality, and imaging hardware for different imaging modalities
CO3	Understand sub system components involved in each modality
CO4	Analyse production of signal generation in different imaging modalities
CO5	Evaluate the importance of modern medical imaging by block diagram approach to recent developments in imaging modalities
CO6	Develop a basic familiarity with all the modern medical imaging techniques employed in modern hospitals

Mapping of Course outcomes to Program outcomes:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	-	2	-	-	-	1	-	-	-	2
CO2	3	3	2	2	-	-	-	1	1	1	1	1
CO3	3	2	2	2	-	-	-	-	1	1	-	1
CO4	3	3	2	1	-	-	-	-	1	1	-	-
CO5	3	1	3	2	-	-	-	-	1	1	-	-
CO6	3	1	2	2	-	-	-	1	1	1	-	1

Unit	Course Content	Hours	CO's
1	X-RAY MACHINES AND DIGITAL RADIOGRAPHY: Basics of diagnostic radiology, nature of X-Rays, production of X-Rays, X-Ray machine, visualization of X-Rays, dental X-Ray machines, Portable and mobile X-Ray units, Digital radiography, Fluoroscopy, Angiography, Mammography and Xeroradiography, Image subtraction.	07	CO1
2	COMPUTED TOMOGRAPHY: Computed tomography, system components, gantry geometry, system electronics, patient dose in CT scanners, Recent developments – Digital radiography, Digital subtraction angiography (DSA), 3D reconstruction, Dynamic Spatial Reconstructor (DSR). RADIONUCLIDE IMAGING: Radio-isotopes in medical diagnosis, physics of radioactivity, radiation detector, pulse height analyser, uptake monitoring equipment, emission computed tomography, Single – Photon Emission Computed Tomography (SPECT), Positron Computed Tomography (PET) scanner	09	CO2 CO6
3	MAGNETIC RESONANCE IMAGING SYSTEM: Basics of Magnetic Resonance Imaging - Fundamentals of nuclear magnetic resonance, Introduction to MRI sub systems, Imaging Methods- Introduction, slice selection, frequency encoding, phase encoding, Spin-Echo imaging- Gradient echo imaging, Blood flow imaging, Characteristics of MRI images- Spatial resolution, image contrast. Biological effects of magnetic fields- Static magnetic fields, Radio-frequency fields, Gradient magnetic fields, Imaging safety, Functional MRI.	09	CO3 CO6
4	ULTRASONIC IMAGING SYSTEMS: Diagnostic ultrasound, physics of ultrasonic waves, medical ultrasound, basic pulse echo apparatus, imaging modes, modern ultrasound imaging systems, portable ultrasound systems, biological effects of ultrasound, Biological effects of ultrasound	08	CO4
5	THERMAL IMAGING SYSTEMS: Medical thermography, physics of thermography, infrared detectors, thermographic equipment, quantitative medical thermography, pyroelectric vidicon based thermographic camera, thermal camera based on IR array sensor	07	CO5

SELF-STUDY COMPONENT:

UNIT 1: Digital radiography

UNIT 2: Recent developments in CT

UNIT 3: Functional MRI

UNIT 4: Modern hand held and low cost ultrasound systems

UNIT 5: Applications of medical thermal imaging

Note:

1. Questions for CIE and SEE not to be set from self-study component.
2. Assignment Questions should be from self-study component only.

TEXT BOOKS:

1. R. S. Khandpur, "Handbook of Biomedical Instrumentation", 3rd Edition, Tata McGraw Hill, 2014
2. K. Kirk Shung, Michael Smith, Benjamin M.W. Tsui, "Principles of medical imaging", Academic Press, 1st edition, 2012

REFERENCE BOOKS:

1. Jerrold T. Bushberg, John M. Boone, "The essential physics of medical imaging", Lippincott Williams & Wilkins, 3rd edition, 2011
2. Nadine Barrie Smith, Andrew Webb, "Introduction to medical imaging: Physics, Engineering and clinical applications", Cambridge University Press, 1st edition, 2010
3. M. A. Flower (Editor), "Webb's Physics of medical imaging, Second Edition", CRC Press, Taylor & Francis Group, ISBN: 978-0-7503-0573-0, 2nd edition, 2016