GANPAT UNIVERSITY

FACULTY OF ENGINEERING & TECHNOLOGY

Programme	Bachelor of Technology	Branch/Spec.	Biomedical Engineering
Semester	V	Version	1.0.0.0
Effective from Academic Year	2024-25	Effective for the batch Admitted in	July 2022
Course Code	2BM5107	Course Name	Ultrasonic Imaging and Radiology

Teaching scheme						Examination scheme (Marks)			
(Per week)	Lecture(DT)		Practical(Lab.)		Total		CE	SEE	Total
	L	TU	P	TW					
Credit	3	-	1	-	4	Theory	40	60	100
Hours	3	-	2	-	5	Practical	30	20	50

Pre-requisites

Basic knowledge of medical transducers and Engineering Physics.

Course Outcomes

On successful completion of the course, the students will be able to:

CO1	**Understand** the fundamental of X-ray and Ultrasound.
CO2	**Analyze** the generation, detection and machine components of X-ray and Ultrasound modalities.
CO3	**Learn** the X-ray and Ultrasound interaction with tissues, related controlling parameters and safety.
CO4	**Apply** X-ray and Ultrasound imaging modes for different imaging applications.

Theory syllabus

Unit	Content	Hrs.
1	INTRODUCTION TO THE OVERVIEW AND IMPORTANCE OF THE COURSE	1
2	FUNDAMENTALS OF X-RAY Ionization principle, Units of Radiation, Electromagnetic Radiation, properties of X-ray, X-ray Beam Quality controlling factors & Quantity controlling factors, X-ray potential hazards, Dose limits for patients and workers.	4
3	X-RAY MACHINE COMPONENTS X-ray tube Internal structure: Cathode- filament, focusing cup, Stationary and rotating Anode with their functions, target material, Dual focus tube, Types of X-Ray tubes. Filters: inherent and added filters, Grids, X-ray film, Intensifying Screens. Block diagram of X-ray Machine.	8
4	GENERATION AND DETECTION OF X-RAYS X-ray production i.e. electron target interaction K-characteristics and Bremsstrahlung, Interactions between X-rays and Matter: Photon scattering – elastic and Compton scattering, Photon disappearance - photo electric, pair production process and photonuclear reactions and their significance in radiology, DEXA.	5
5	DIGITAL RADIOGRAPHY Digital Radiography - discrete digital detectors, storage phosphor and film Scanning**,** Fluoroscopy, Digital Subtraction Angiography**, Mammography:** Basic principles and working**.**	8
6	INTRODUCTION OF ULTRASONIC SYSTEM Fundamentals of Acoustic Propagation: Acoustic impedance, Reflection and Refraction, Attenuation, Scattering, absorption of ultrasonic energy.	5
7	GENERATION OF ULTRASOUND BEAM AND ITS CHARACTERISTICS Doppler effect, Ultrasonic Transducers, Huygens principle, Beam profile for continuous and pulsed ultrasound waves, Axial and lateral resolution, Focusing, Transducer arrays.	5
8	ULTRASOUND IMAGING	9

	Types of Ultrasonic probes, **Ultrasonic imaging modes:** A-Mode: Echo-ophthalmoscope and Echoencephalograph, B-Mode, M-Mode: Echocardiography, Color Doppler flow imaging, Duplex Imaging, Biological effects and safety.	
Practical content		
Term Work and Practical shall be based on the above syllabus.		
Text Books:		
1	Radiologic Science for Technologists by Stewart C. Bushong Pub.: Mosby	
2	Principles of Medical Imaging by K. Kirk Shung, Michael B. Smith, Benjamin Tsui Pub.: Academic Press	
Reference Books:		
1	Handbook of Bio-Medical Instrumentation by R. S. Khandpur Pub.: Tata McGraw Hill	
2	Fundamentals of Medical Imaging by Paul Suetens Pub.: Cambridge University Press	
3	Introduction to Biomedical Equipment Technology by Carr & Brown Pub.: Pearson Education	
ICT/MOOCs Reference:		
1	https://nptel.ac.in/courses/108105091/	
2	http://www.gfresidency.com/resources/Basic+Ultrasound.pdf	
3	https://www.askiitians.com/iit-jee-dual-nature-of-matter-and-x-rays/x-rays/	

Mapping of CO with PO and PSO:

	PO 1	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PSO 1**	**PSO 2**	**PSO 3**
CO1	3	0	0	0	1	0	1	1	0	0	0	1	1	0	0
CO2	2	1	1	1	1	1	1	1	0	0	0	1	3	1	1
CO3	2	1	1	1	0	2	0	1	0	0	0	1	0	1	1
CO4	3	2	2	1	2	2	1	2	1	2	0	1	2	3	2