

<b>Module Name (Bio Medical Engineering)</b>	<b>Total Hours</b>
<b>Maintenance of Medical Imaging Equipment</b>	<b>35</b>

Unit No.	Learning Outcomes	Topic	Sub-Topic	Lecture Hrs	Activity	Activity Hrs			
<b>Unit 1: Prerequisites (7 Hrs)</b>	a. Should be able to understand the fundamentals of electrical circuits	Basics Of Electricity and EM Spectrum	<ul style="list-style-type: none"> <li>▪ Principle of Electromagnetic Induction</li> <li>▪ Principle of Transformer action and Types</li> <li>▪ Capacitor Charging and Discharging</li> <li>▪ Diode, Rectifier, Filtering Basics</li> </ul>	1	<ul style="list-style-type: none"> <li>▪ Principle of Transformer action and Types</li> <li>▪ Capacitor Charging and Discharging</li> <li>▪ Diode Characteristics</li> <li>▪ Bridge rectifier</li> <li>▪ Filters</li> </ul>	3			
	b. Should be able to understand the fundamentals of electromagnetic energy radiations and their applications electronics								
	c. Able to understand the atomic structure and valence bands theory.			Atomic Structure		<ul style="list-style-type: none"> <li>▪ Energy Bands</li> <li>▪ Concepts of Valence Electrons and Energy Transfer</li> </ul>	0.5		0
	d. Should be able to measure basic electrical and electronic parameters			Relay, Contactors and Switches		<ul style="list-style-type: none"> <li>▪ Types and Operation</li> </ul>	0.5	<ul style="list-style-type: none"> <li>▪ Testing of Relay, Contactor and Switches</li> </ul>	1
		Basics of Measurement	<ul style="list-style-type: none"> <li>▪ Voltage, Current, Continuity</li> </ul>	0	<ul style="list-style-type: none"> <li>▪ Measurement of Basic Electrical Parameters (V,I,R etc.)</li> </ul>	1			
<b>Unit 2: Basics of X-Ray (3Hrs)</b>	a. Should be able to understand various properties of X-rays	X-Ray Properties and X-Ray Generation	<ul style="list-style-type: none"> <li>▪ White Radiation and Characteristic Radiation</li> </ul>	0.5	Video tutorials related to X-Ray tubes and X-Ray Parameters	1			
	b. Should be able to compare various types of X-ray tubes	Types of X-Ray Tube	<ul style="list-style-type: none"> <li>▪ Stationary Anode and Rotating Anode tubes</li> </ul>	0.5					
	c. Specify and design various tube ratings for X-ray machine	X-Ray Quantity	<ul style="list-style-type: none"> <li>▪ Tube Potential</li> <li>▪ Filtration</li> <li>▪ Waveform</li> </ul>	0.5					
		X-Ray Quality	<ul style="list-style-type: none"> <li>▪ Tube Current (mA)</li> <li>▪ Exposure Time (S)</li> <li>▪ Tube Potential (KVp)</li> <li>▪ Filament Current</li> <li>▪ Distance (FSD)</li> <li>▪ Exposure Time</li> </ul>	0.5					

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<b>Unit 3: X-Ray Equipment (7Hrs)</b>	a. Understand the working of basic X-ray machine along with its circuits. b. Gain knowledge regarding the construction and design of various X-ray machine accessories	Block Diagram of X-Ray Machine	<ul style="list-style-type: none"> <li>▪ High Tension Circuits/HV</li> <li>▪ Low Tension Circuits/ LV</li> <li>▪ Timing Circuits</li> <li>▪ Meters: Millimeter, Voltmeters</li> <li>▪ Selection of mAS, KV Range</li> <li>▪ Power Supply</li> </ul>	1	<ul style="list-style-type: none"> <li>▪ Industrial Visit and Hands on Session for understanding operation of X-Ray Machine.</li> </ul>	5
		X-Ray Accessories	<ul style="list-style-type: none"> <li>▪ X-Ray Visualization               <ul style="list-style-type: none"> <li>✓ X-Ray Films</li> <li>✓ Film Cassettes</li> <li>✓ Image Intensifier</li> <li>✓ IITV</li> <li>✓ Fluorescent Screen</li> </ul> </li> <li>▪ Grid</li> <li>▪ Collimators</li> <li>▪ Filters</li> <li>▪ Image Acquisition Detectors</li> </ul>	1		
<b>Unit 4: Radiological Safety and Hazards (7Hrs)</b>	a. Understand the fundamentals of radiological safety aspects. b. Learning of various standards and regulations used for X-ray safety. c. Should be able to design monitoring rooms for X-ray	X-Ray Safety Standards and Regulations	<ul style="list-style-type: none"> <li>▪ Protective Gear               <ul style="list-style-type: none"> <li>✓ X-Ray Lead Apron</li> <li>✓ Glass Wear</li> <li>✓ TLD Badge</li> <li>✓ Gloves</li> <li>✓ Safety Shoes</li> <li>✓ Lead Sheets</li> <li>✓ Thyroid Shield</li> <li>✓ Gonads Shield</li> <li>✓ Lead Glass Window</li> <li>✓ Door</li> </ul> </li> <li>▪ Precautions</li> <li>▪ Radiation Safety Standards and Regulations               <ul style="list-style-type: none"> <li>✓ Types of Radiation</li> <li>✓ Shielding</li> <li>✓ Radiation Leakage Levels and RPS</li> <li>✓ Radiation Detection and Measurement</li> </ul> </li> <li>▪ Hazards of X-Ray</li> <li>▪ Biological Effects of Radiation</li> </ul>	3	<ul style="list-style-type: none"> <li>▪ Hospital Visit for understanding the procedural and safety aspects of X-Ray systems.</li> <li>▪ Demonstration of patient care methods and design of X-Ray rooms.</li> <li>▪ Demonstration of X-ray Film processing</li> </ul>	4

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			<ul style="list-style-type: none"> <li>▪ Radiation Protection               <ul style="list-style-type: none"> <li>✓ Patient Dose in X-Ray Procedure</li> <li>✓ Occupational Dose</li> <li>✓ Time, Distance and Shielding</li> </ul> </li> <li>▪ Design of X-Ray Room</li> <li>▪ Patient Care Methods</li> </ul>			
<b>Unit 5: X-Ray Installation and Maintenance (7Hrs)</b>	a. Should be to install and perform maintenance and QA checks for radiological equipment	X-Ray Installation	<ul style="list-style-type: none"> <li>▪ General Principles of Planning of X-Ray Installations</li> <li>▪ Preparation of facility Plan</li> <li>▪ Consideration of Room Layout</li> <li>▪ Determination of parameters governing Shielding requirements</li> </ul>	1	<ul style="list-style-type: none"> <li>▪ Demonstration of basic preparation for installation of X-ray machine</li> <li>▪ Demonstration of X-ray room layout and equipment placement</li> </ul>	1
		Quality Assurance Test	<ul style="list-style-type: none"> <li>▪ Mechanical tests</li> <li>▪ Tests for High Frequency generators</li> <li>▪ Radiation Dose test (CTDI measurement)</li> <li>▪ Image Quality Parameters</li> <li>▪ Calibration</li> <li>▪ QA Kit</li> </ul>	0.5	<ul style="list-style-type: none"> <li>▪ Calibration and QA checking of X-ray Machine</li> </ul>	0.5
		<b>Maintenance</b>	<ul style="list-style-type: none"> <li>▪ Types of Maintenance</li> <li>▪ Routine maintenance               <ul style="list-style-type: none"> <li>✓ Maintenance survey for an X-ray room</li> <li>✓ X-ray generator maintenance</li> <li>✓ Collimator maintenance</li> <li>✓ Bucky table &amp; vertical Bucky maintenance</li> <li>✓ Fluoroscopy table and TV Maintenance</li> </ul> </li> <li>▪ Fault diagnosis and repair modules               <ul style="list-style-type: none"> <li>✓ Common procedures for fault diagnosis and repairs</li> <li>✓ X-ray generator repairs</li> <li>✓ Mobile or portable-generator repairs</li> </ul> </li> <li>▪ Automatic film processor, routine maintenance</li> </ul>	1	<ul style="list-style-type: none"> <li>▪ Demonstration of various maintenance methodologies for X-ray machine.</li> <li>▪ Identification and demonstration of different faults and their troubleshooting methods</li> </ul>	3
<b>Unit 6: Advanced</b>	a. Should be able to understand latest imaging modalities and	Other imaging techniques	<ul style="list-style-type: none"> <li>▪ Digital X-Ray</li> <li>▪ Fluoroscopy</li> </ul>	2	<ul style="list-style-type: none"> <li>▪ Video tutorials for advanced medical imaging techniques</li> </ul>	2

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<b>Medical Imaging Techniques (4 Hrs)</b>	their applications.		<ul style="list-style-type: none"> <li>▪ Mammography</li> <li>▪ Densitometer: Bone Density Measurement</li> <li>▪ Computed Tomography</li> <li>▪ Magnetic Resonance imaging</li> <li>▪ Ultrasonography</li> <li>▪ PET, SPECT</li> </ul>		<ul style="list-style-type: none"> <li>▪ Hospital Visit for demonstration of advanced imaging techniques.</li> </ul>	
<b>TOTAL : 35 Hrs</b>				<b>13.5 (TH)</b>		<b>21.5 (PR)</b>