

*Faculty of Medicine*

*Bachelor of Science in Medical Radiology and  
Imaging Technology (B.Sc. MRIT)*

*Semester – V*

*Cross Sectional Anatomy and Physiology*

<b>Course Title</b>	<b>Cross Sectional Anatomy and Physiology</b>	
<b>Course Code</b>	MRIT24	
<b>Course Credit</b>	Lecture: 03	
	Practical + Clinical Training: 02	
	Total: 05	
<b>Course Objectives</b>		
<ul style="list-style-type: none"> <li>• Radiology has been developing dramatically during the past few years. With enhancements in magnetic resonance imaging (MRI) and computed tomography (CT), the role of the radiologic technologist has also been changing.</li> <li>• Skills in cross-sectional anatomy are important to help the technologist in MRI and CT to identify the anatomy being imaged and to communicate effectively with the radiologist and physicians.</li> </ul>		
<b>#</b>	<b>Detailed Syllabus</b>	

Section I		Sessions
1	Identify cross-sectional anatomy in the sagittal, coronal and axial planes on CT and MR images.	10
2	Describe anatomical structural relationships.	9
3	Recognize normal anatomy and build a personal resource system for future study.	9
4	Locate and identify pertinent cerebral, upper thorax, mid-thorax, and abdominal anatomy.	10
5	On CT and MR images, identify anatomical structures of the body and of the head.	9
6	Distinguish between arterial and venous anatomy of the entire body's vascular system.	9
Section II		
Classify the various sections of anatomical regions and their associated parts. The students will be given a thorough understanding of:		
7	1. Introduction to Sectional Anatomy & Terminology- Sectional planes, Anatomical relationships/terminology	4
	2. Anatomy of the upper thorax- Surface anatomy relationships, Bony structures and muscles, Blood vessels.	5
	3. Divisions of the mid-thorax, heart and great vessels- Lungs, heart and great vessels, Esophagus	5
	4. CT/MRI Images of the Thorax - Normal and pathologic	3
	5. Anatomy of the Abdomen- Major organs and their accessories, Abdominal blood vessels	6
	6. CT/MR Images of Abdomen - Normal and pathologic	4
	7. Anatomy of the Pelvis- Bony structures and associated muscles, Digestive and urinary systems	6
	8. Reproductive Organs	3
	9. CT/MR Images of the Male/Female Pelvis- Normal and pathologic	5

10.	Neuro Anatomy- Scan planes	3
11.	Brain - Cerebral hemispheres, Sinuses, Ventricles, Brainstem and associated parts, Arterial/venous systems, Basal ganglia, Cranial nerves	6
12.	Spine- Vertebra and disc, Spinal cord and meninges	3
13.	Neck- Arterial/venous systems, Muscles, Glands and pharynx	3

#### **Instruction Method**

1. Teaching and training sessions will be carried out through active learning. Active participation and contribution in group discussion and seminars are mandatory for students
2. Lectures to be conducted with the help of black board and/or audio-visual aids that includes multi-media projector, OHP, etc.
3. Assignments based on course content will be given to the students at the end of each unit/topic and will be evaluated at regular interval
4. The course includes a laboratory where the students have an opportunity to build and appreciation for the concepts being taught in lectures.

#### **Text Books**

- Text Book of Radiology for Residents & Technicians – 4th Edition – Satish K. Bhargava CBS publishers & Distributor (p) ltd.
- Step by Step CT; Step by Step MRI and MRI made Easy for beginners – Govind B. Chavhan – Jaypee brothers and Medical Publishers (p) Ltd, New Delhi
- CT & MRI protocol – Satish K. Bhargava, CBS publishers.

*Physics of Advanced Imaging Technology*

<i>Course Title</i>	<i>Physics of Advanced Imaging Technology</i>	
<i>Course Code</i>	<i>MRIT25</i>	
<i>Course Credit</i>	<i>Lecture: 03</i>	
	<i>Practical + Clinical Training: 03</i>	
	<i>Total: 06</i>	
<b>Course Objectives</b>		
<ul style="list-style-type: none"> <li>Describe the positioning factors and anatomical structures visualized as they relate to the performance</li> </ul>		
<b>#</b>	<b>Detailed Syllabus</b>	<b>Sessions</b>
<b>Section I</b>		
1	<b>Basic Computed Tomography:</b> <ul style="list-style-type: none"> <li>Basic principles of CT</li> <li>Generations of CT</li> <li>CT instrumentation</li> <li>Image formation in CT</li> <li>CT image reconstruction</li> <li>Hounsfield unit</li> <li>CT image quality</li> <li>CT image display</li> </ul>	15
2	<b>Advanced computed tomography:</b> <ul style="list-style-type: none"> <li>Helical CT scan:</li> <li>Slip ring technology</li> <li>Advantages</li> <li>Multi detector array helical CT</li> </ul>	20

	<ul style="list-style-type: none"> <li>• Cone –beam geometry</li> <li>• Reconstruction of helical CT images</li> <li>• Ct artifact</li> <li>• Ct angiography</li> <li>• Ct fluoroscopy</li> <li>• Hrct</li> <li>• Post processing techniques: mpr, mip, min ip, 3d</li> <li>• Rendering: ssd and vr</li> <li>• Ct dose</li> <li>• Patient preparation</li> <li>• Imaging techniques and protocols for various parts of body</li> <li>• Ct contrast enhanced protocols –CT angiography – (aortogram, selective angiogram head, neck and peripheral) image documentation and filing</li> <li>• Maintenance of equipment and accessories</li> </ul>	
3	<p><b>Advanced technique &amp; instrumentation of MRI:</b></p> <ul style="list-style-type: none"> <li>• Basic Principles:</li> <li>• Spin – precession – relaxation time</li> <li>• Pulse cycle</li> <li>• T1 weighted image</li> <li>• T2 weighted image</li> <li>• Proton density image</li> <li>• Pulse sequence:</li> <li>• Spin echo pulse sequence –</li> <li>• Turbo spin echo pulse sequence –</li> <li>• Gradient echo sequence –</li> <li>• Turbo gradient echo pulse sequence –</li> <li>• Inversion recovery sequence –</li> <li>• STIR sequence</li> <li>• SPIR sequence</li> </ul>	42

	<ul style="list-style-type: none"> <li>• FLAIR sequence</li> <li>• Echo planar imaging</li> <li>• Advanced pulse sequences</li> <li>• MR Instrumentation:</li> <li>• Types of magnets –</li> <li>• RF transmitter –</li> <li>• RF receiver –</li> <li>• Gradient coils–</li> <li>• Shim coils –</li> <li>• RF shielding –computers.</li> <li>• Image formation:</li> <li>• 2D Fourier transformation method –</li> <li>• K-space representation –</li> <li>• 3D Fourier imaging –MIP.</li> <li>• MR contrast media –</li> <li>• MR angiography –TOF &amp; PCA –</li> <li>• MR Spectroscopy –</li> <li>• Functional MRI</li> </ul>	
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Section II		
4	<ul style="list-style-type: none"> <li>• Ultrasonography</li> <li>• Basic Acoustics</li> <li>• Ultrasound terminologies:               <ul style="list-style-type: none"> <li>○ Acoustic pressure</li> </ul> </li> </ul>	30

	<ul style="list-style-type: none"> <li>○ Power</li> <li>○ Intensity</li> <li>○ Impedance</li> <li>○ Speed</li> <li>○ Frequency</li> <li>• dB notation:</li> <li>• Relative acoustic pressure and relative acoustic intensity</li> <li>• Interaction of US with matter: <ul style="list-style-type: none"> <li>○ Reflection</li> <li>○ Transmission</li> <li>○ Scattering</li> <li>○ Refraction and absorption</li> <li>○ Attenuation and attenuation coefficients</li> <li>○ US machine controls</li> <li>○ US focusing</li> </ul> </li> <li>• Production of ultrasound: <ul style="list-style-type: none"> <li>○ Piezoelectricity</li> </ul> </li> <li>• Medical ultrasound transducer: <ul style="list-style-type: none"> <li>○ Principle</li> <li>○ Construction and working</li> <li>○ Characteristics of US beam</li> </ul> </li> </ul>	
5	Localization of foreign bodies. Various techniques	17
6	<ul style="list-style-type: none"> <li>• Ultrasound display modes: A, B, M</li> <li>• Real-time ultrasound:</li> <li>• Line density and frame rate</li> <li>• Real-time ultrasound transducers:</li> <li>• Mechanical and electronic arrays</li> <li>• Ultrasound artifacts</li> <li>• Ultrasound recording devices, and Distance, area &amp; volume measurements.</li> </ul>	30



- *Techniques for imaging different anatomic areas*
- *Ultrasound artifacts*
- *Biological effects and safety*
- *Doppler Ultrasound*
- *Patient preparation for Doppler*
- *Doppler artifacts*
- *vascular sonography*

### **Instruction Method**

1. *Teaching and training sessions will be carried out through active learning. Active participation and contribution in group discussion and seminars are mandatory for students*
2. *Lectures to be conducted with the help of black board and/or audio-visual aids that includes multi-media projector, OHP, etc.*
3. *Assignments based on course content will be given to the students at the end of each unit/topic and will be evaluated at regular interval*
4. *The course includes a laboratory where the students have an opportunity to build and appreciation for the concepts being taught in lectures.*
5. *Instruction method will be integrated with clinical training, bedside / class room teaching and tutorials as necessary.*

### **Text Books**

- *Clark's Handbook for Radiographers – Charles Sloane, Ken Holmes & Craig Anderson, Hodder Educations, UK*
- *Diagnostic Radiography – A concise practical Manual – Glenda J. Bryan (4th edn), Churchill Livingstone.*

*Radiographic Techniques in Advanced Imaging Technology*

<b>Course Title</b>	<i>Radiographic Techniques in Advanced Imaging Technology</i>	
<b>Course Code</b>	<i>MRIT26</i>	
<b>Course Credit</b>	<i>Lecture: 03</i>	
	<i>Practical + Clinical Training: 03</i>	
	<i>Total: 06</i>	
<b>Course Objectives</b>		
<ul style="list-style-type: none"> <li>• <i>The Modalities Imaging Techniques will aim to develop an understanding of the historical evolution of these imaging methods, as well as indicate how medical imaging is likely to develop over the next few years.</i></li> <li>• <i>Student learn about the role of teamwork and communication in patient safety</i></li> </ul>		
<b>#</b>	<b>Detailed Syllabus</b>	<b>Sessions</b>
<b>SECTION I</b>		

1.	<p><i>Ultrasonography/ Doppler studies:</i></p> <ul style="list-style-type: none"> <li>• <i>Techniques of sonography</i></li> <li>• <i>Selection</i></li> <li>• <i>Preparations</i></li> <li>• <i>Instructions and positioning of patient for TAS, TVS, TRUS, neck USG and extremities</i></li> <li>• <i>Patient care and maintenance protocols clinical applications display methods</i></li> <li>• <i>Quality image reproducible extend</i></li> <li>• <i>Biopsy procedures, assurance to patients</i></li> </ul>	25
2.	<p><i>CT scan studies acquisition/ protocols /techniques:</i></p> <ul style="list-style-type: none"> <li>• <i>CT of head and neck – thorax – abdomen – pelvis – musculo skeletal</i></li> <li>• <i>system – spine – PNS</i></li> <li>• <i>Anatomy</i></li> <li>• <i>Clinical indications and contraindications</i></li> <li>• <i>Patient preparation</i></li> <li>• <i>Technique</i></li> <li>• <i>Contrast media: types, dose, injection technique</i></li> <li>• <i>Timing</i></li> <li>• <i>Sequence</i></li> <li>• <i>Image display</i></li> <li>• <i>Patient care</i></li> <li>• <i>Utilization of available techniques &amp; image processing facilities to guide the clinician</i></li> <li>• <i>CT anatomy and pathology of different organ systems</i></li> </ul>	52

## SECTION II

### MRI Scanners :

3	1. Methods of MRI imaging methods – Head and Neck ,Thorax, Abdomen, Musculoskeletal System imaging	6
	2. Clinical indications and contraindications	3
	3. Types of common sequences effects of sequence on imaging	3
	4. Protocols for various studies	3
	5. Slice section	4
	6. Patient preparation	3
	7. Positioning of the patient	5
	8. Patient care	3
	9. Calibration	3
	10. Paramagnetic agents and dose	5
	11. Additional techniques and recent advances in MRI	6
	12. Image acquisition	5
	13. Modification of procedures in an unconscious or un co-operative patient	6
	14. Plain studies	3
	15. Contrast studies	3
	16. Special procedures	4
	17. Reconstructions	3
	18. 3D images	3
	19. MRS blood flow imaging, diffusion/perfusion scans	3
	20. Strength and limitations of MRI- role of radiographer	3

### Instruction Method

- Teaching and training sessions will be carried out through active learning. Active participation and contribution in group discussion and seminars are mandatory for students
- Lectures to be conducted with the help of black board and/or audio-visual aids that includes multi-media projector, OHP, etc.
- Assignments based on course content will be given to the students at the end of each unit/topic and will be evaluated at regular interval

4. The course includes a laboratory where the students have an opportunity to build and appreciation for the concepts being taught in lectures.
5. Instruction method will be integrated with clinical training, bedside / class room teaching and tutorials as necessary.

#### **Text Books**

- Text book of radiology for residents & technicians – 4th edition, Satish K. Bhargave Radiological patient care – Jensen Chesney.
- Atlas of dental and maxillofacial radiological imaging – Brownie
- Care of patient in diagnostic Radiography – Chesney & Chesney.
- Practical Nursing and First Aid – Ross and Wilson.

*Regulatory Requirements in Diagnostic Radiology & Imaging, Act and rules, regulations for JCI, NABH, NABHR.*

<i>Course Title</i>	<i>Regulatory Requirements in Diagnostic Radiology &amp; Imaging, Act and rules, regulations for JCI, NABH, NABHR.</i>	
<i>Course Code</i>	<i>MRIT27</i>	
<i>Course Credit</i>	<i>Lecture: 03</i>	
	<i>Practical + Clinical Training: 03</i>	
	<i>Total: 06</i>	
<i>Course Objectives</i>		
<ul style="list-style-type: none"> <li>• <i>Optimum image quality of radiological procedures with minimum possible dose to the patient(s) Describe the Quality &amp; Patient Safety gap</i></li> <li>• <i>Identify quality improvement methods</i></li> <li>• <i>Identify some Joint Commission National Patient Safety goals</i></li> </ul>		
<i>#</i>	<i>Detailed Syllabus</i>	<i>Sessions</i>
	<i>Section I</i>	

## Regulatory Bodies & regulatory Requirements:

1	International Commission on Radiation Protection (ICRP) / National Regularity body (AERB - Atomic Energy Regulatory Board)	10
2	Responsibilities	7
3	Organization	7
4	Safety Standard	8
5	Codes and Guides	7
6	Responsibilities of licenses	7
7	Registrants & employers and Enforcement of Regulatory requirements	8
8	Role of Radiographer in Planning, QA & Radiation Protection:	8
9	Role of technologist in radiology department	8
10	Personnel and area monitoring	7
<b>SECTION II</b>		
11	Setting up of a new X-Ray unit, staff requirement,	6
12	AERB specifications for site planning and mandatory guidelines	6
13	Planning of X-ray rooms, dark rooms	5
14	Inspection of X-Ray installations	6
15	Registration of X-Ray equipment installation	6
16	Certification	5
17	Evaluation of workload versus radiation factors	6
18	Occupational exposure and protection Tools/devices.	6
19	ICRP, NRPB, NCRP and WHO guidelines for radiation protection,	7
20	pregnancy and radiation protection.	6
21	NABH guidelines	6
22	AERB guidelines	6
23	PNDT Act and guideline	6

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1. Teaching and training sessions will be carried out through active learning. Active

participation and contribution in group discussion and seminars are mandatory for students

2. Lectures to be conducted with the help of black board and/or audio-visual aids that includes multi-media projector, OHP, etc.
3. Problem based and/or case-based assignments based on course content will be given to the students at the end of each unit/topic and will be evaluated at regular interval.
4. The course includes a laboratory where the students have an opportunity to build and appreciation for the concepts being taught in lectures.
5. Instruction method will be integrated with clinical training, bedside / class room teaching and tutorials as necessary.

#### Text Books

- Text Book of Radiological Safety – K. Thaylan (2010) Jaypee Brothers and medical Publishers, New Delhi.
- Quality Assurance Workbook for Radiographers & Radiologic Technologists, Radiologic science for technologist – 9th edition (2008) Stewart Carlyle Bushong, Mosby Elsevier, UK.
- Quality Control in Diagnostic Imaging J.E.Gray