

*Faculty of Medicine*

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

*Semester – IV*

*Physics of Newer Imaging Modalities*

<b>Course Title</b>	<b>Physics of Newer Imaging Modalities</b>	
<b>Course Code</b>	MRIT20	
<b>Course Credit</b>	Lecture: 3	
	Practical + Clinical Training: 3	
	Total: 6	
<b>Course Objectives</b>		
<ul style="list-style-type: none"> <li>• The aim of this course is to enable students to develop a basic familiarity with all the major medical imaging techniques employed in modern hospitals, including x-ray imaging, computed tomography, magnetic resonance imaging, ultrasound, nuclear isotope imaging, and electroencephalography.</li> <li>• Each technique will be introduced in the context of the underlying clinical requirements. Students need to learn what physical principles are involved, and what properties of tissues the corresponding medical images show.</li> </ul>		
<b>#</b>	<b>Detailed Syllabus</b>	

<b>Section I</b>		<b>Sessions</b>
1	<i>Computed Tomography its principle, various generations and advancements</i>	20
2	<i>Magnetic Resonance Imaging- its principle, advancements and applications.</i>	20
3	<i>Ultrasonography, Color Doppler- its principle, advancements and applications.</i>	18
4	<i>Digital Radiography and Digital subtraction angiography equipment- principle, advancements and applications.</i>	14
<b>Section II</b>		
5	<i>Fusion Imaging including PET-CT, PET- MRI.</i>	20
6	<i>Digital Mammography, DEXA equipment- principle, advancements and applications.</i>	16
7	<i>Tele radiology HIS, RIS and PACS</i>	16
8	<i>Image processing in digital radiography systems: Post processing techniques in console using CR, DR and flat panel fluoroscopy systems</i>	20

### **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.*

## Clinical Radiography Positioning Part 2

<b>Course Title</b>	<b>Clinical Radiography Positioning Part 2</b>	
<b>Course Code</b>	MRIT21	
<b>Course Credit</b>	Lecture: 3	
	Practical + Clinical Training: 3	
	Total: 6	
<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	Radiography technique comprising of the complete	08
2	Radiography of Skull and Radiography of cranial bones; including special techniques for sella turcica, orbits, opticforamina, superior orbital fissure and inferior orbital fissure etc.	08
3	Facial bones; Paranasal sinuses, Temporal bone and Mastoids.	08
4	Dental Radiography: <ul style="list-style-type: none"> <li>Radiography of teeth—intra oral, extra oral and occlusal view.</li> </ul>	08
5	Abdomen: <ul style="list-style-type: none"> <li>Preparation of patient. General abdominal radiography and positioning for fluid and air levels.</li> <li>Plain film examination.</li> <li>Radiography of female abdomen to look for pregnancy.</li> <li>Radiography in case of acute abdomen.</li> </ul>	10

6	<p><i>Microradiography:</i></p> <ul style="list-style-type: none"> <li>• <i>Principle, advantage, technique and applications.</i></li> </ul>	12
7	<i>Stereography - Procedure - presentation, for viewing, stereoscopes, stereometry.</i>	10
8	<i>High KV techniques principle and its applications.</i>	08

**Section II**

9	<i>Soft tissue Radiography including Mammography - its techniques, equipment, advancements and applications.</i>	08
10	<i>Localization of foreign bodies. Various techniques</i>	08
11	<i>Ward /mobile radiography - electrical supply, radiation protection, equipment and instructions to be followed for portable/ward radiography.</i>	08
12	<i>Operation theatre techniques: General precautions, Asepsis in techniques - Checking of mains supply and functions of equipment, selection of exposure factors, explosion risk, radiation protection and rapid processing techniques.</i>	08
13	<i>Trauma radiography/Emergency radiography</i>	08
14	<i>Neonatal and Pediatric Radiography</i>	08
15	<i>Tomography and Tomosynthesis</i>	08
16	<i>Dual energy X-ray absorptiometry</i>	08
1	<i>Forensic Radiography</i>	08

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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.

**Newer Modalities Imaging Techniques including patient care**

<b>Course Title</b>	<b>Newer Modalities Imaging Techniques including patient care</b>
<b>Course Code</b>	MRIT22
<b>Course Credit</b>	Lecture: 3
	Practical + Clinical Training: 3
	Total: 6

**Course Objectives**

- 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.
- Student learn about the role of teamwork and communication in patient safety

#	Detailed Syllabus	Sessions
<b>SECTION I</b>		
1.	<p><b>Interventional Radiography:</b>  <u>Basic angiography and DSA:</u></p> <ul style="list-style-type: none"> <li>a) History, technique, patient care</li> <li>b) Percutaneous catheterisation, catheterization sites, Asepsis</li> <li>c) Guidewire, catheters, pressure injectors, accessories</li> <li>d) Use of digital subtraction- single plane and bi-plane</li> </ul> <p>All forms of diagnostic procedures including angiography, angioplasty, biliary examination, renal evaluation and drainage procedure.</p>	12
2.	<p><b>Central Nervous System:</b></p> <ul style="list-style-type: none"> <li>a) Myelography</li> <li>b) Cerebral studies</li> <li>c) Ventriculography</li> </ul>	10
3.	<p><b>Arthrography:</b></p> <ul style="list-style-type: none"> <li>• Shoulder, Hip, Knee, Elbow</li> </ul>	08
4.	<p><b>Angiography:</b></p> <ul style="list-style-type: none"> <li>a) Carotid Angiography (4 Vessel angiography)</li> <li>b) Thoracic and Arch Aortography</li> <li>c) Selective studies: Renal, SMA, Coeliac axis</li> <li>d) Vertebral angiography</li> <li>e) Femoral arteriography</li> <li>f) Angiocardiography</li> </ul>	10



5.	<b>Venography:</b> a) <i>Peripheral venography</i> b) <i>Cerebral venography</i> c) <i>Inferior and superior venocavography</i> d) <i>Relevant visceral phlebography</i>	12
6	<b>Cardiac catheterization procedures:</b> <ul style="list-style-type: none"> <li>• <i>PTCA, BMV, CAG, Pacemaker, Electrophysiology,</i></li> </ul>	10
7	<b>Microbiology:</b> 1) <i>Introduction and morphology - Introduction of microbiology, Classification of microorganisms, size, shape and structure of bacteria. Use of microscope in the study of bacteria.</i> 2) <i>Growth and nutrition -nutrition, culture media, types of medium with example and uses of culture media in diagnostic bacteriology, antimicrobial sensitivity test</i> 3) <i>Sterilization and disinfection - principles and use of equipments of sterilization namely hot air oven, autoclave and serum inspissator, pasteurization, anti-septic and disinfectants.</i> 4) <i>Introduction to immunology, bacteriology, parasitology, mycology</i>	10
<b>SECTION II</b>		
<b>Patient care in Medical Imaging Department</b>		
	<b>1. Hospital procedure:</b> <ul style="list-style-type: none"> <li>• <i>Hospital staffing and organization</i></li> <li>• <i>Records relating to patients and departmental statistics</i></li> <li>• <i>Professional attitude of the technologist to patients and other members of the staff</i></li> <li>• <i>Medico- legal aspects</i></li> <li>• <i>Accidents in the departments, appointments, organization</i></li> <li>• <i>Minimizing waiting time</i></li> </ul>	10

	<ul style="list-style-type: none"> <li>• <i>Out-patient and follow-up clinics</i></li> <li>• <i>Stock-taking and stock keeping.</i></li> </ul>	
	<p><b>2. Care of the patient:</b></p> <ul style="list-style-type: none"> <li>• <i>FIRST contact with patients in the department</i></li> <li>• <i>Management of chair and stretcher patients and aids for this, management of the unconscious patient</i></li> <li>• <i>Elementary hygiene</i></li> <li>• <i>Personal cleanliness</i></li> <li>• <i>Hygiene in relation to patients (for example clean linen and receptacles, nursing care)</i></li> <li>• <i>Temperature pulse and respiration</i></li> <li>• <i>Essential care of the patient who has a tracheostomy</i></li> <li>• <i>Essential care of the patient who has a colostomy</i></li> <li>• <i>Bedpans and urinals</i></li> <li>• <i>Simple application of a sterile dressing.</i></li> </ul>	10
	<p><b>3. First aid:</b></p> <ul style="list-style-type: none"> <li>• <i>Aims and objectives of first aid</i></li> <li>• <i>Wounds and bleeding, dressing and bandages</i></li> <li>• <i>Pressure and splints, supports etc. Shock</i></li> <li>• <i>Insensibility – asphyxia – convulsions</i></li> <li>• <i>Resuscitation, use of suction apparatus, drug reactions</i></li> <li>• <i>Prophylactic measures</i></li> <li>• <i>Administration of oxygen</i></li> <li>• <i>Electric shock – Burns – Scalds – Hemorrhage – Pressure</i></li> </ul>	12

	<p><i>points - Compression band</i></p> <ul style="list-style-type: none"> <li>• <i>Fractures - splints, bandaging</i></li> <li>• <i>Dressing, foreign bodies</i></li> <li>• <i>Poisons</i></li> </ul>	
	<p><b>4. Infection:</b></p> <ul style="list-style-type: none"> <li>• <i>Bacteria, their nature and appearance</i></li> <li>• <i>Spread of infections</i></li> <li>• <i>Auto-infection or cross-infection</i></li> <li>• <i>The inflammatory process</i></li> <li>• <i>Local tissue reaction, general body reaction</i></li> <li>• <i>Ulceration - asepsis and antisepsis</i></li> <li>• <i>Universal precautions, hospital acquired infections- HIV, Hepatitis B, C, and MRSA etc.</i></li> </ul>	12
	<p><b>5. Principles of asepsis:</b></p> <ul style="list-style-type: none"> <li>• <i>Sterilization - methods of sterilization</i></li> <li>• <i>Use of central sterile supply department</i></li> <li>• <i>Care of identification of instruments, surgical dressings in common use, including filamented swabs, elementary operating theatre procedure</i></li> <li>• <i>Setting of trays and trolleys in the radio imaging department (for study by radio imaging students only)</i></li> </ul>	10
	<p><b>6. Departmental procedures:</b></p> <ul style="list-style-type: none"> <li>• <i>Department staffing and organisations</i></li> <li>• <i>Records relating to patients and departmental statistics</i></li> <li>• <i>Professional attitudes of the technologist to patients and other members of the staff, medico-legal aspects accidents in the department</i></li> <li>• <i>Appointments - Organizations - Minimizing waiting time - Out-Patient and follow-up clinics</i></li> <li>• <i>Stock taking and stock keeping.</i></li> </ul>	10

**7. Drugs in the department:**

- Storage - Classification
- Labelling and checking, regulations regarding dangerous and other drugs
- Units of measurement, special drugs, anti-depressive, anti-hypertensive etc.

08

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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.

*Quality Control in Radiology and Radiation Safety*

<i>Course Title</i>	<i>Quality Control in Radiology and Radiation Safety</i>	
<i>Course Code</i>	<i>MRIT23</i>	
<i>Course Credit</i>	<i>Lecture: 3</i>	
	<i>Practical + Clinical Training: 2</i>	
	<i>Total: 5</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>		
<i>Quality Control in Radiology</i>		
<i>1</i>	<i>Objectives of quality Control:</i> <ul style="list-style-type: none"> <li>• <i>Improve the quality of imaging thereby increasing the</i></li> </ul>	<i>06</i>

	<p><i>diagnostic value</i></p> <ul style="list-style-type: none"> <li>• <i>To reduce the radiation exposure</i></li> <li>• <i>Reduction of film wastage and repeat examination</i></li> <li>• <i>To maintain the various diagnostic and imaging units at their optimal performance.</i></li> </ul>	
2	<p><b>Quality assurance activities:</b></p> <ul style="list-style-type: none"> <li>• <i>Equipment selection phase</i></li> <li>• <i>Equipment installation and acceptance phase</i></li> <li>• <i>Operational phase</i></li> <li>• <i>Preventive maintenance</i></li> </ul>	06
3	<p><b>Quality assurance programme at the radiological faculty level:</b></p> <ul style="list-style-type: none"> <li>• <i>Responsibility – Purchase – Specifications – Acceptance</i></li> <li>• <i>Routine testing – Evaluation of results of routine testing</i></li> <li>• <i>Quality assurance practical exercise in the X ray generator and tube – Image receptors from processing</i></li> <li>• <i>Radiographic equipment – Fluoroscopic equipment</i></li> <li>• <i>Mammographic equipment</i></li> <li>• <i>Conventional tomography – Computed tomography</i></li> <li>• <i>Film processing, manual and automatic</i></li> <li>• <i>Consideration for storage of film and chemicals – Faults tracing</i></li> <li>• <i>Accuracy of imaging- image distortion for digital imaging devices – LASER printer calibration</i></li> </ul>	10
4	<p><b>Quality assurance programme tests:</b></p> <ul style="list-style-type: none"> <li>• <i>General principles and preventive maintenance for routine, daily, weekly, monthly, quarterly, annually machine calibration.</i></li> <li>• <i>Basic concepts of quality assurance – LASER printer – Light beam alignment – X-ray out-put and beam</i></li> </ul>	10

	<p>quality check</p> <ul style="list-style-type: none"> <li>• kv_p check - Focal spot size and angle measurement - Timer check - mA_s test - Grid alignment test</li> <li>• High and low contrast resolutions</li> <li>• Mechanical and electrical checks</li> <li>• Cassette leak check - Proper screen-film contact test</li> <li>• Safe light test - Radiation proof test</li> <li>• Field alignment test for fluoroscopic device - Resolution test</li> <li>• Phantom measurements - CT, US and MRI.</li> </ul>	
5	<p><b>Quality assurance of film and image recording devices:</b></p> <ul style="list-style-type: none"> <li>• Sensitometry - Characteristic curve</li> <li>• Film latitude - Film contrast - Film Speed Resolution</li> <li>• Distortion</li> <li>• Artifacts of films and image recording</li> <li>• Monitor calibration.</li> <li>• SMPTE pattern</li> </ul>	08
6	<p><b>Maintenance and care of equipment:</b></p> <ul style="list-style-type: none"> <li>• Safe operation of equipment</li> <li>• Routine cleaning of equipment and instruments</li> <li>• Cassette, screen maintenance</li> <li>• Maintenance of automatic processor and manual processing units</li> <li>• Routine maintenance of equipments</li> <li>• Record keeping and log book maintenance</li> <li>• Reject analysis and objectives of reject analysis programme.</li> </ul>	08
7	<p><b>Care and maintenance of diagnostic equipment:</b></p> <ul style="list-style-type: none"> <li>• General principles and preventive maintenance for routine - daily, Weekly, monthly, quarterly, annually:</li> </ul>	08

*care in use, special care of mobile equipment.*

**SECTION II**

**Radiation safety in diagnostic Radiology**

1

**Radiation Quantities and Units:**

- Radiation- Radioactivity- Sources of radiation – natural radioactive sources – Cosmic rays terrestrial radiation – man made radiation sources.
- Units of radiation – Quality factor – Flux- Fluence- Kerma- Exposure Absorbed dose- Equivalent Dose- Weighting Factors-Effective Dose – Occupational Exposure Limits – Dose limits to public.

08

2

**Biological Effects of radiation:**

- Ionization, excitation and free radical formation, hydrolysis of water, action of radiation on cell – Chromosomal aberration and its application for the biological dosimetry Effects of whole body and acute irradiation, dose fractionation, effects of ionizing radiation on each of major organ system including fetus – Somatic effects and hereditary effects – stochastic and deterministic effects Acute exposure and chronic exposure – LD50 – factors affecting radio sensitivity.
- Biological effects of non-ionizing radiation like ultrasound, lasers, IR, UV and magnetic fields.

12



3	<p><b>Radiation detection and Measurements:</b></p> <ul style="list-style-type: none"> <li>• Ionization of gases- Fluorescence and Phosphorescence - Effects on photographic emulsion.</li> <li>• Ionization Chambers – proportional counters- G.M counters scintillation detectors – liquid semiconductor detectors – Gamma ray spectrometer.</li> <li>• Measuring systems – free air ionization chamber – thimble ion chamber – condenser chamber – Secondary standard dosimeters – film dosimeter – chemical dosimeter Thermoluminescent Dosimeter.</li> <li>• Pocket dosimeter-Radiation survey meter- wide range survey meter -zone monitor-contamination monitor – their principle function and uses.</li> <li>• Advantages &amp; disadvantages of various detectors &amp; its appropriateness of different detectors for different type of radiation measurement.</li> <li>• Dose and Dosimetry, CT Dose Index (CTDI, etc.), Multiple Scan Average Dose (MSAD), Dose Length Product (DLP), Dose Profile, Effective Dose, Phantom Measurement Methods, Dose for Different Application Protocols, Technique Optimization.</li> <li>• Dose area product in fluoroscopy and angiography systems, AGD in mammography.</li> </ul>	16
4	<p><b>Radiation protection:</b></p> <ul style="list-style-type: none"> <li>• Radiation protection of self and patient- Principles of radiation protection, time – distance and shielding, shielding – calculation and radiation survey – ALARA – personnel dosimeters (TLD and film batches) – occupational exposure.</li> </ul>	10
5	<p><b>Radiation Hazard evaluation and control:</b></p>	10

- Philosophy of Radiation protection, effects of time, Distance & Shielding.
- Calculation of Work load, weekly calculated dose to radiation worker & General public Good work practice in Diagnostic Radiology.
- Planning consideration for radiology, including Use factor, occupancy factors, and different shielding material.

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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