



## Subject: Modern Radiological Imaging - Equipment and Physics

Subject Code: MMRIT04

### RATIONALE

Modern radiological Imaging Equipment and Physics provides the students knowledge about the modern x-ray equipment and working principle. Modern imaging techniques – including X-rays, ultrasound, CT scans and MRI – can show structures inside your body in great detail. Radiologic Physics is the study of medical imaging components, technology, and parameters in an effort to produce optimal imaging results. The goal with studying radiologic physics is to ensure you get clear images while ensuring the patient is safe from radiation.

### COURSE OUTCOMES

*At the end of the course students will be able to...*

**CO001:** Describe the special radiological equipments

**CO002:** Describe the digital and computed radiography

**CO003:** Describe PACS, RIS and HIS

Teaching Scheme (In Hours)			Total Credits (L+T+P)	Examination Scheme				
L	T	P		Theory Marks		Practical Marks		Total Marks
3	1	4	6	CIE 30	ESE 70	CIE 30	ESE 70	200

CIE, Continuous Internal Evaluation; ESE, End Semester Evaluation; L, lecture; T, Tutorial; P, Practical

### TUTORIAL ASSIGNMENTS

Tutorials should be planned to enhance learning. The faculty shall decide suitable assignments minimum one per unit based on the curriculum.

### THEORY COMPONENTS

The following topics/subtopics should be taught and assessed in order to attain the identified competency.

Unit	Topic and contents	Hours	Marks
1.	Modern x-ray tube: its principle, physics & equipment	5	5
2.	Digital Radiography: its principle, physics & equipment. Flat panel digital fluoroscopy and radiography system, Direct and indirect digital radiography and fluoroscopy systems. Digital radiography and Computed radiography its advantages, disadvantages and applications. Digital Portable and mobile x-ray units	5	5

3.	Dual energy x-ray absorptionometry (DEXA) scan: its principle, physics & equipment	5	5
4.	Computed radiography: its principle, physics & equipment.	5	5
5.	Mammography and Tomosynthesis: its principle, physics & equipment	5	5
6.	Modern dental equipments. Cone beam dental CT	5	5
7.	Bone mineral density test: its principle, physics & equipment	5	5
8.	Picture archiving and communication system (PACS), RIS, HIS and Teleradiology	5	5
9.	Computed Tomography	7	5
10.	Magnetic Resonance Imaging	5	5
11.	Ultrasound Imaging	5	5
12.	Hybrid Imaging	5	5
13.	Smart Simulator/virtual imaging	5	5
14.	Artificial Intelligence in Modern Radiological Imaging	5	5
<b>Total</b>		<b>72</b>	<b>70</b>

### SUGGESTED PRACTICALS/DEMONSTRATION

Sr. No		Hours
1.	Modern x-ray tube: its principle, physics & equipment	5
2.	Digital Radiography	5
3.	Dual energy x-ray absorptionometry (DEXA) scan: its principle, physics & equipment	2
4.	Computed radiography	3
5.	Mammography and Tomosynthesis: its principle, physics & equipment	5
6.	Modern dental equipments. Cone beam dental CT	3
7.	Bone mineral density test: its principle, physics & equipment	2

Sr. No		Hours
8.	Picture archiving and communication system (PACS), RIS, HIS and Teleradiology	5
9.	Computed Tomography	5
10.	Magnetic Resonance Imaging	5
11.	Ultrasound Imaging	5
12.	Hybrid Imaging	5
13.	Smart Simulator/virtual imaging AI Imaging	4
Total		54

### Evaluation System

#### Continuous Internal Evaluation (CIE)

Sl. No.	Component	Marks	Weightage	IA marks
1.	Sessional test(s)			
	Two Written tests Same pattern as Summative test Average of two to be considered Absence without prior permission to be marked as 0	50		
	<b>Total</b>	<b>50</b>	<b>0.3</b>	<b>15</b>
2.	Continuous assessment			
	Seminars/Case presentations/ Logbook/ Case records/Record book/assignment			
	<b>Total</b>	<b>50</b>	<b>0.3</b>	<b>15</b>
	<b>Total CIE marks</b>			<b>30</b>

#### End Semester Evaluation (ESE)

## Written Paper

Type of question	No. of questions	Marks per question	Total
Long Essay	2	15	30
Short Essay	8	5	40
			70
Duration (minutes)			150

### End Semester Evaluation (ESE)

There shall be practical examination for 70 marks in the subject.  
Distribution of marks for university examination practical exams:

ESE		CIE		Grand total
Practical	Viva		Sub Total	
50	20	30	100	100

### SUGGESTED LEARNING RESOURCES

S.No.	Title of Book	Author	Publication
1	Textbook of Radiology: Physics	Amol Sasane, Hariqbal Singh, Roshan Lodha	Jaypee Brothers Medical Publishers
2	The Physics Of Radiology And Imaging	THAYALAN K	Jaypee Brothers Medical Publishers
3	Christensen's Physics of Diagnostic Radiology	Thomas S. Curry (Author), James E. Dowdey (Author), Robert E. Murry (Author)	Lea &Febiger,U.S
4	Textbook Of Radiology For Residents And Technicians	BHARGAVA S. K	CBS; publishers
5	Ultrasound physics and technology	Vivien gibbs, davidcole, Antonio sassano	Churchill Livingstone;
6	Manual of Diagnostic Ultrasound	Philip E. S. Palmer (Author)	World Health Organization
7	Physics and Technical Aspects Diagnostic Ultrasound	DINESH K BAGHEL (Author)	AITBS PUBLISHERS

### Subject: Contrast Media and Interventional Radiology

**Subject Code: MMRIT05**

## **RATIONALE**

Interventional radiology (IR) helps student MRIT to gain about the basics diagnostics and interventional procedures and to learn procedures in modalities like digital radiography CT and MRI and nuclear medicine and to increase the level of understandings and knowledge required to meet current radiologic procedures and to understand the physical principles of radiography and basic radiography positioning to perform the procedures. It is a medical specialty that performs various minimally-invasive procedures using medical imaging guidance, such as x-ray fluoroscopy, computed tomography, magnetic resonance imaging, or ultrasound. IR performs both diagnostic and therapeutic procedures through very small incisions or body orifices

## **COURSE OUTCOMES**

At the end of the course students will be able to...

CO1: Know the basic principle and physics of interventional equipment.

CO2: Know the management and positioning of patients while performing interventional radiological procedure.

CO3: Have knowledge about the indications, contraindications, contrast media, radiation dose, exposure timing and radiation safety measures for the different interventional radiological procedure.

CO4: Understand the patient preparation needed before any interventional radiological procedures.

CO5: Have knowledge about the post procedural care and safety.

Teaching Scheme (In Hours)			Total Credits (L+T+P)	Examination Scheme				
L	T	P		Theory Marks		Practical Marks		Total Marks
			C	CIE	ESE	CIE	ESE	
2	1	4	5	30	70	30	70	200

CIE, Continuous Internal Evaluation; ESE, End Semester Evaluation; L, lecture; T, Tutorial; P, Practical

## **TUTORIAL ASSIGNMENTS**

Tutorials should be planned to enhance learning. The faculty shall decide suitable assignments minimum one per unit based on the curriculum.

## THEORY COMPONENTS

The following topics/subtopics should be taught and assessed in order to attain the identified competency.

Unit	Topic and contents	Hours	Marks
1.	<b>Contrast Media:</b> Positive and Negative, Ionic & Non Ionic, Adverse Reactions to contrast media and patient management.	8	10
2.	Introduction to interventional procedures <b>DSA:</b> principles and types <b>Equipment:</b> Basics of angiographic equipments, single and biplane angiographic equipments, angiographic table, image intensifier, flat panel detectors, recording systems, pulseoximetry, cardiac resuscitation measure-ECG, pressure injector, catheters, needle and other tools, 3D rotational angiography, image processing, patient monitor, CO2 angiography	8	10
3.	<b>Interventional procedures:</b> Catheter- classification, types and applications, Guide wire- classification, types and applications, Pressure Injector and Accessories, Percutaneous catheterization, Digital Subtraction Angiography, Catheterization Sites, Asepsis	8	10
4.	<b>Arteriography:</b> Head and Neck Arteriography, Pulmonary Arteriography, Coronary Arteriography, Ascending Aortography, Trans Lumbar Aortography, Renal Arteriography, Trans Femoral Arteriography <b>Venography:</b> Peripheral Venography- Lower Limb, Upper Limb, Central Venography, Superior Venacavography, Inferior Venacavography, Pelvic Venography	20	20
5.	<b>Safety considerations in angiography room;</b> room design, protective devices, radiation monitoring	5	10
6.	<b>Care and maintenance tests:</b> General care, functional test <b>Quality assurance program:</b> Acceptable limits of variation, corrective action	5	10
<b>Total</b>		<b>54</b>	<b>70</b>

## SUGGESTED PRACTICALS/DEMONSTRATION

Sr. No		Hours
5.	Contrast Media	10
6.	Basics of angiographic equipments	10
7.	Catheter and guide wires	10
8.	Arteriography and venography procedures	20
9.	Safety considerations in angiography room	12
10.	Care and maintenance tests Quality assurance program:	10
	Total	72

### Evaluation System

#### Continuous Internal Evaluation (CIE)

Sl. No.	Component	Marks	Weightage	IA marks
1.	Sessional test(s)			
	Two Written tests Same pattern as Summative test Average of two to be considered Absence without prior permission to be marked as 0	50		
	<b>Total</b>	<b>50</b>	<b>0.3</b>	<b>15</b>
2.	Continuous assessment			
	Seminars/Case presentations/ Logbook/ Case records/Record book/assignment			
	<b>Total</b>	<b>50</b>	<b>0.3</b>	<b>15</b>
	<b>Total CIE marks</b>			<b>30</b>

#### End Semester Evaluation (ESE)

## Written Paper

Type of question	No. of questions	Marks per question	Total
Long Essay	2	15	30
Short Essay	8	5	40
			70
Duration (minutes)			150

## End Semester Evaluation (ESE)

There shall be practical examination for 70 marks in the subject.

Distribution of marks for university examination practical exams:

ESE		CIE		Grand total
Practical	Viva		Sub Total	
50	20	30	100	100

## SUGGESTED LEARNING RESOURCES

S. No.	Title of Book	Author	Publication
1	The practice of interventional radiology	Karim valji	
2	Interventional radiology: a survival guide	EBIR Kessel, David, MB, BS, MA, MRCP, FRCR (Author), FRCR Robertson, Iain, MB, ChB, MRCP	Elsevier Health Sciences
3	Handbook of Interventional Radiologic Procedures	Krishna kandarpa (author), lindsay machan (author), janettedurham (author)	Lippincott Williams and Wilkins
4	Interventional Radiology: A Survival Guide	David Kessel MB BS MA MRCP FRCR EBIR, Iain Robertson MB chb MRCP FRCR	sevier Health Sciences

## Subject: Modern Imaging and Special Radiological Procedures

Subject Code: MMRIT06

### RATIONALE

Contrast & Special Radiological Procedures are diagnostic procedures usually performed by giving contrast through oral or intravenous to diagnose the disease. These imaging procedures are done under the guided of fluoroscopy or c-ram equipment.

### COURSE OUTCOMES

At the end of the course students will be able to...

**CO1:** Prepare management and positioning of patients while performing radiological procedures.

**CO2:** Correlate of indications, contraindications, contrast media, radiation dose, exposure timing and radiation safety measures for different radiological procedures.

**CO3:** Understand the patient preparations needed before any radiological examination.

**CO4:** Generalize knowledge of post procedural care.

**CO5:** Students will be able position the patients for radiological procedures.

**CO6:** Knowledge of image quality in radiological images.

**CO7:** Management of patients in radiology department for various procedures.

**CO8:** Ability to handle emergency situations in radiology department.

**CO9:** Precautions and care required in interventional suits.

Teaching Scheme (In Hours)			Total Credits (L+T+P)	Examination Scheme				
L	T	P		Theory Marks		Practical Marks		Total Marks
L	T	P	C	CIE	ESE	CIE	ESE	
2	1	4	5	30	70	30	70	200

CIE, Continuous Internal Evaluation; ESE, End Semester Evaluation; L, lecture; T, Tutorial; P, Practical

### TUTORIAL ASSIGNMENTS

Tutorials should be planned to enhance learning. The faculty shall decide suitable assignments minimum one per unit based on the curriculum.

### THEORY COMPONENTS

The following topics/subtopics should be taught and assessed in order to attain the identified competency.

Unit	Topic and contents	Hours	Marks
1.	Introduction: General approach to Special Radiographic procedures, Responsibility of Radiology Technologist during radiological procedures, Preparation of patient for different procedures, Room layout in interventional radiology and fluoroscopy.	6	5
2.	Basics and modern Emergency Equipment's in the Radiology Department	4	5
3.	Gastrointestinal Tract: Barium Swallow; Barium Meal - Single and Double Contrast; Barium Meal Follow Through; Small Bowel Enema (Enteroclysis); Barium Enema - Gastrograffin Enema; Loopogram Advanced procedures of Gastrointestinal Tract	10	15
4.	Biliary Tract: Oral & Intravenous Cholecystography; Percutaneous Transhepatic Cholangiography; Percutaneous Transhepatic Biliary Drainage; Endoscopic Retrograde Cholangiopancreatography Advanced procedures of Biliary Tract	10	15
5.	Urinary System: IVU (Intravenous Urography), Retrograde Pyeloureterography (RGU), Micturating Cysto Urethrography, Ascending Urethrography. Advanced procedures of Urinary System	10	15
6.	Reproductive System: HysteroSalpingogram, FTR (Fallopian Tube Recanalization) Advanced procedures of Reproductive System	5	5
7.	Respiratory System: Bronchography, Percutaneous Lung Biopsy Advanced procedures of Respiratory System	5	5
8.	Other procedures in radiology: Arthrography, Sialography, Lymphography, Sinography & Fistulography, Dacryocystography, Embolization & embolic agents Related Advanced procedures.	4	5
<b>Total</b>		<b>54</b>	<b>70</b>

## SUGGESTED PRACTICALS/DEMONSTRATION

Sr. No		Hours
5.	General approach to special radiographic procedures, responsibility of radiology technologist during radiological procedures  Contrast media and their adverse reactions to contrast media and patient management	10
6.	Procedures for gastrointestinal tract including barium studies  Procedures for biliary tract	15
7.	Procedures for urinary system and reproductive system	15
8.	Procedures for central nervous system and respiratory system	15
9.	Other procedures in radiology: Arthrography, Sialography, Lymphography, Sinography & Fistulography, Dacryocystography, Embolization & embolic agents  Related Advanced procedures.	17
	Total	72

### Evaluation System

#### Continuous Internal Evaluation (CIE)

Sl. No.	Component	Marks	Weightage	IA marks
1.	Sessional test(s)			
	Two Written tests Same pattern as Summative test Average of two to be considered Absence without prior permission to be marked as 0	50		
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2.	Continuous assessment			
	Seminars/Case presentations/ Logbook/ Case records/Record book/assignment			
	<b>Total</b>	<b>50</b>	<b>0.3</b>	<b>15</b>
	<b>Total CIE marks</b>			<b>30</b>

#### End Semester Evaluation (ESE)

## Written Paper

Type of question	No. of questions	Marks per question	Total
Long Essay	2	15	30
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			70
Duration (minutes)			150

## End Semester Evaluation (ESE)

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Practical	Viva		Sub Total	
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## SUGGESTED LEARNING RESOURCES

S. No.	Title of Book	Author	Publication
1	Radiographic Imaging (Cbs)I.C.R.P.	Bhushan and Lakkhar	Arya Publications
2	A guide to radiological procedures	Chapman	Elsevier

## MMRIT Radiological Clinical Education- part II (studentship): 16 hrs/week

The course may offer hands-on training or practical sessions, allowing participants to enhance their skills in teaching and research.

