

**Maulana Abul Kalam Azad University of Technology, West Bengal**  
(Formerly West Bengal University of Technology)  
**DRAFT SYLLABUS FOR MASTER OF MEDICAL IMAGING TECHNOLOGY (M.Sc. MIT)**  
(Effective from Academic Session 2023-2024)

**PROGRAMME OVERVIEW**

- This is a professional educational course in Medical Imaging Technology which will fulfil need of trained manpower in the field of health services.
- This medical imaging technology course will ensure & help better patient care & diagnosing the patient in accurate manner & direction to achieve optimum result by the medical professionals.
- To enhance the standard of knowledge and experience of the students in the field of medical imaging technology, for instance, Radiography and to update them with the newer developments taking place in diagnosis using those imaging technologies.
- The students will be aware and conversant with latest sophisticated modern imaging modalities such as USG, CT scan, MRI and PET Scan etc.
- To make the students aware of various radiations safety measures meant for staff members and general public.

**PROGRAMME STRUCTURE:**

Year	Semester	Paper Code	Paper	L	T	P	Credit	Marks
1 <sup>st</sup>	1 <sup>st</sup>	MMIT-101	HUMAN ANATOMY & PHYSIOLOGY-I	3			3	100
1 <sup>st</sup>	1 <sup>st</sup>	MMIT-102	INSTRUMENTATION OF CONVENTIONAL RADIOLOGICAL EQUIPMENTS-I	3			3	100
1 <sup>st</sup>	1 <sup>st</sup>	MMIT-103	RADIOGRAPHIC PROCEDURES-I	3			3	100
1 <sup>st</sup>	1 <sup>st</sup>	MMIT-104	RADIATION PHYSICS-I	3			3	100
1 <sup>st</sup>	1 <sup>st</sup>	MMIT-105	ADVANCED TECHNIQUE & INSTRUMENTATION OF ULTRASOUND-I	3			3	100
1 <sup>st</sup>	1 <sup>st</sup>	MMIT-106	RADIATION PROTECTION AND MANAGEMENT OF RADIOLOGY DEPARTMENT-I	3			3	100
1 <sup>st</sup>	1 <sup>st</sup>	MMIT-191	HUMAN ANATOMY & PHYSIOLOGY-I (PRACTICAL)			4	2	100
1 <sup>st</sup>	1 <sup>st</sup>	MMIT-193	RADIOGRAPHIC PROCEDURES-I (PRACTICAL)			4	2	100
1 <sup>st</sup>	1 <sup>st</sup>	MMIT-195	ADVANCED TECHNIQUE & INSTRUMENTATION OF ULTRASOUND-I (PRACTICAL)			4	2	100
			<b>Total</b>				<b>24</b>	<b>900</b>

Year	Semester	Paper Code	Paper	L	T	P	Credits	Marks
1 <sup>st</sup>	2 <sup>nd</sup>	MMIT-201	HUMAN ANATOMY & PHYSIOLOGY-II	3			3	100
1 <sup>st</sup>	2 <sup>nd</sup>	MMIT-202	INSTRUMENTATION OF CONVENTIONAL RADIOLOGICAL EQUIPMENTS-II	3			3	100
1 <sup>st</sup>	2 <sup>nd</sup>	MMIT-203	RADIOGRAPHIC PROCEDURES-II	3			3	100
1 <sup>st</sup>	2 <sup>nd</sup>	MMIT-204	RADIATION PHYSICS-II	3			3	100
1 <sup>st</sup>	2 <sup>nd</sup>	MMIT-205	ADVANCED TECHNIQUES & INSTRUMENTATION OF ULTRASOUND-II	3			3	100
1 <sup>st</sup>	2 <sup>nd</sup>	MMIT-206	RADIATION PROTECTION AND MANAGEMENT OF RADIOLOGY DEPARTMENT-II	3			3	100
1 <sup>st</sup>	2 <sup>nd</sup>	MMIT-291	HUMAN ANATOMY & PHYSIOLOGY-II (PRACTICAL)			4	2	100
1 <sup>st</sup>	2 <sup>nd</sup>	MMIT-293	RADIOGRAPHIC PROCEDURES-II (PRACTICAL)			4	2	100
1 <sup>st</sup>	2 <sup>nd</sup>	MMIT-295	ADVANCED TECHNIQUES & INSTRUMENTATION OF ULTRASOUND-II (PRACTICAL)			4	2	100
			<b>Total</b>				<b>24</b>	<b>900</b>

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Year	Semester	Paper Code	Paper	L	T	P	Credit	Marks
2 <sup>nd</sup>	3 <sup>rd</sup>	MMIT-301	ADVANCED TECHNIQUES AND INSTRUMENTATION OF CT-I	3	1		4	100
2 <sup>nd</sup>	3 <sup>rd</sup>	MMIT-302	ADVANCED TECHNIQUES AND INSTRUMENTATION OF MRI-I	3	1		4	100
2 <sup>nd</sup>	3 <sup>rd</sup>	MMIT-303	TECHNIQUES AND EQUIPMENTS OF INTERVENTIONAL RADIOLOGY AND NUCLEAR MEDICINE TECHNOLOGY-I	3	1		4	100
2 <sup>nd</sup>	3 <sup>rd</sup>	MMIT-304	CARE OF PATIENT IN DIAGNOSTIC RADIOLOGY AND MANAGEMENT OF HEALTH CARE ORGANIZATION-I	3	1		4	100
2 <sup>nd</sup>	3 <sup>rd</sup>	MMIT-305	BIOSTATISTICS	2			2	100
2 <sup>nd</sup>	3 <sup>rd</sup>	MMIT-391	ADVANCED TECHNIQUES AND INSTRUMENTATION OF CT ( <b>PRACTICAL</b> )			4	2	100
2 <sup>nd</sup>	3 <sup>rd</sup>	MMIT-392	ADVANCED TECHNIQUES AND INSTRUMENTATION OF MRI ( <b>PRACTICAL</b> )			4	2	100
2 <sup>nd</sup>	3 <sup>rd</sup>	MMIT-393	TECHNIQUES AND EQUIPMENTS OF INTERVENTIONAL RADIOLOGY AND NUCLEAR MEDICINE TECHNOLOGY ( <b>PRACTICAL</b> )			4	2	100
			<b>Total</b>				<b>24</b>	<b>800</b>

Year	Semester	Paper Code	Paper	L	T	P	Credit	Marks
2 <sup>nd</sup>	4 <sup>th</sup>	MMIT-401	ADVANCED TECHNIQUES AND INSTRUMENTATION OF CT-II	3			3	100
2 <sup>nd</sup>	4 <sup>th</sup>	MMIT-402	ADVANCED TECHNIQUES AND INSTRUMENTATION OF MRI-II	3			3	100
2 <sup>nd</sup>	4 <sup>th</sup>	MMIT-403	TECHNIQUES AND EQUIPMENTS OF INTERVENTIONAL RADIOLOGY AND NUCLEAR MEDICINE TECHNOLOGY-II	3			3	100
2 <sup>nd</sup>	4 <sup>th</sup>	MMIT-404	CARE OF PATIENT IN DIAGNOSTIC RADIOLOGY AND MANAGEMENT OF HEALTH CARE ORGANIZATION-II	3			3	100
2 <sup>nd</sup>	4 <sup>th</sup>	MMIT-481	PROJECT / THESIS				4	200
2 <sup>nd</sup>	4 <sup>th</sup>	MMIT-482	SEMINAR / PRESENTATION				4	100
2 <sup>nd</sup>	4 <sup>th</sup>	MMIT-483	HOSPITAL TRAINING				4	200
			<b>Total</b>				<b>24</b>	<b>900</b>

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**PROGRAMME EDUCATIONAL OBJECTIVES:**

PEO 1: Established themselves as successful professionals with strong multidisciplinary knowledge and technical competence in the field of Medical Imaging Technology and used the integration of knowledge and competence necessary for success in the profession.

PEO 2: Developed interdisciplinary approach and analytical thinking in designing and solving problems related to radiological and various other imaging process using modern analytical tools & techniques wherever necessary.

PEO 3: Attained the skill for understanding group dynamics with the objective to contribute positively towards collaborative activities and demonstrate the capacity for self-management, organizational management and team work through effective communication.

PEO 4: Pursued a career for lifelong learning with personal and professional growth, superior work ethics and character towards sustainable betterment of the society by engaging in self-learning methodologies.

**SYLLABUS IN DETAIL: SEMESTER I**

**HUMAN ANATOMY & PHYSIOLOGY-I (MMIT-101)**

Gross Anatomy, Radiological and Surface Anatomy of Human Body

Introduction: Anatomy of human body as a whole, structure of cell and tissues of body: epithelial tissue, connective tissue, muscle tissue and nervous tissue

Anatomy of the various systems of body Skeletal system:

Classification of bones- Axial skeleton, Appendicular skeleton, Bones – structure and functions, - formation of bone, growth of skeleton, centers of ossification, fracture and dislocation, disease of bones, and Radiological and Surface Anatomy.

Joints: Classification of joints with example, anatomy of various joints of head and neck, trunk and limbs

Muscular system- Types of muscles, Position and actions of chief muscles of the body

Cardiovascular System: Anatomy of Pericardium and heart, blood vessels, types of blood circulation

Respiratory System: Nasal passages and para nasal sinuses, pharynx and larynx, trachea, bronchi, lungs and pleura

Gastro-intestinal System: Parts of GIT, Oral cavity salivary glands, Esophagus, stomach, small and large intestine, liver, gall bladder, pancreas

Blood – its composition and function- nerve tissue – muscular tissue and types. Abnormalities in tissue – ulceration-sepsis- asepsis and antisepsis – the nature of neoplasm- common tumors–malignant tumors- dissemination of malignancy primary and secondary spread.

Respiratory system- nasal passages and para nasal sinuses, pharynx, and larynx, trachea, bronchus and lungs. The pleura nature and functions of respiration, common terms relating to disease and conditions of this system. Lymphatic system – lymph and tissue fluid – main glands and drainage areas in the lymphatic system – lymphoid tissue and the tonsils.

Reticulo-endothelial system – liver and spleen, bone marrow, life cycle of red and white corpuscles of the blood

Alimentary systems- functions of mouth, tongue, and teeth, salivary glands – pharynx and esophagus, stomach, small

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intestine (jejunum), large intestine (colon), liver and biliary tract, pancreas, functions of the alimentary system – digestion and absorption of food, metabolism, common terms used in connection with abnormalities of this system.

**Reference Books:**

1. William Davis, Understanding Human Anatomy and Physiology, McGraw Hill
2. Chaurasia, A Text Book of Anatomy
3. Ranganathan, T.S., A Text Book of Human Anatomy
4. Fattana, Human Anatomy, (Description and Applied), Saunder's & C P Prism Publishers, Bangalore
5. Ester. M. Grishcimer, Physiology & Anatomy with Practical Considerations, J.P. Lippincott. Philadelphia

**INSTRUMENTATION OF CONVENTIONAL RADIOLOGICAL EQUIPMENTS-I (MMIT-102)**

UNIT 1

- Generation of electrical energy
- Ac/dc
- Poly-phase supply
- Distribution of electrical energy
- Uses of electrical energy
- Current loads and power loss
- Uses of electricity in the hospitals
- Safety rules for radio-diagnosis

UNIT 2

- X ray circuit components
- X-ray generators
- High tension transformers
- Main voltage compensation
- High tension switches
- Stabilizers and UPS

UNIT 3

- Fuses
- Switches
- Earthing
- High tension cables, construction and design
- Rectification
- Types of rectifiers
- X ray circuits
- Filament circuits
- High voltage circuits

UNIT 4

- Tube rating
- Types of generators
- Capacitor discharge generator
- Battery powered generator
- Medium frequency and high frequency generator

Reference Books:

1. X- ray equipment for radiographers- Noreen Chesney and Muriel Chesney

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2. Christensens physics of diagnostic radiology
3. Physics for radiographers- George hay
4. Equipment in diagnostic radiology- E. forster

**RADIOGRAPHIC PROCEDURES-I (MMIT-103)**

**CONVENTIONAL- NON CONTRAST RADIOGRAPHY**

Radiography of upper extremity, lower extremity including pelvis, chest radiography, spine, skull, facial bones, mandible, TMJ, mastoid etc., abdomen, soft tissue radiography, dental, pediatric, foreign body localization.

For all: radiographic and technical considerations, equipment requirement, conditions essential for optimal image quality

Conventional contrast radiography Urinary system imaging (IVU, MCU, RGU)

Revision of anatomy and physiology, clinical indications and contraindications, patient preparation, contrast media used and dosage, physiological process by which urinary tract in outline, film sequence (projection and timing), normal anatomy on films, additional techniques, radiation protection, care of patient during and after examination. Pathological conditions of urinary system: kidneys, ureter, urinary bladder and urethra.

**GASTROINTESTINAL TRACT IMAGING**

(Barium swallows, barium meal upper GI, barium meal follow-through, barium enema, small bowel enema, distal colography, defaecography). Revision of anatomy and physiology, clinical indications and contraindications, contrast media used and dosage, patient preparation, preparation of equipment, control of radiographic and fluoroscopic equipment, film sequence, radiographic projections, radiation protection, patient management after care of care of patient, radiographer's role in the team. Pathological conditions of the GI tract.

Biliary system (PTC, ERCP, T-TUBE CHOLANGIOGRAPHY, PRE- OPERATIVE CHOLANGIOGRAPHY)

Revision of anatomy and physiology, clinical indications and contraindications, patient preparation, contrast media used and dosage, film series, radiation protection, patient care, normal anatomy. Pathological conditions of biliary system.

**SIALOGRAPHY AND SINOGRAPHY**

anatomy, clinical indications and contraindications, patient preparation, contrast media used and dosage, injection procedure, techniques for radiographic projections, radiographic appearances, radiation protection, patient care. Pathological conditions.

**HYSTEOSALPINGOGRAPHY (HSG)**

Revision of anatomy and physiology, clinical indications and contraindications, patient preparation, contrast media used and dosage, film series, radiation protection, patient care.

Normal and pathological conditions.

Procedures which are obsolete or rarely used: an overview

Pyelography- indications and contradictions, contrast used, patient preparation, injection technique, film sequence, projections, patient care

- Pelvimetry
- Oral cholecystography/ intravenous cholangiography
- Dacro-cystography
- Arthrography
- Discography

**Reference Books:-**

1. Clark, Radiographic Positioning and Special Procedure
2. Chapman, Radiological Procedure
3. Krishnamurthy, Medical Radiographic Technique & Darkroom Practice
4. Radiological Procedures- BushanLakhar

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**RADIATION PHYSICS-I (MMIT-104)**

- Radiation
- Types of radiation
- Production of x-rays
- Heel effect
- Line focus principle
- X-ray tube
- Crookes tube
- Gas tube
- Coolidge tube
- Stationary tube
- Rotating anode x-ray tube
- Interaction of x-ray with matter
- Attenuation
- Filters
- Photographic characteristic of x-ray film
- X-ray film
- Intensifying screen
- Cassettes
- Characteristic curve
- Image quality
- Factors affecting image quality
- Film processing
- Automatic film processor
- Darkroom
- Fluoroscopy
- Image intensifier
- Linear energy transfer
- Relative biological effectiveness
- Radioactivity
- Photo stimulable phosphor
- Digital radiography

**ADVANCED TECHNIQUES & INSTRUMENTATION OF ULTRASOUND-I (MMIT-105)**

Basic principle of ultrasound  
Interaction of ultrasound with matter  
Modes of ultrasound  
Transducer  
Types of transducer  
Wave propagation  
Image Recorded In Ultrasound  
Artefacts in Ultrasound  
Clinical Applications Of Ultrasound-

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**RADIATION PROTECTION AND MANAGEMENT OF RADIOLOGY DEPARTMENT-I (MMIT-106)**

**UNIT 1**

Introduction to Radiation protection Need for protection

Aim of radiation protection

Basic radiation units and quantities

- \_ Exposure
- \_ Absorbed dose
- \_ Absorbed dose equivalent
- \_ Quality factor
- \_ Tissue weighting factor.

**UNIT 2**

Limits for Radiation exposure Concept of ALARA (or ALARP) ICRP regulation

Maximum permissible dose Exposure in pregnancy, children

**UNIT 3**

Protection in Diagnostic Radiology Protection for primary radiation Work load

Use factor Occupancy factor

Protection for scatter radiation and leakage radiation X-Ray room design

Structural shielding Protective devices Radiation signage

**References:**

1. Christensen, Physics of Diagnostic radiology
2. Euclid Serum, Radiation Protection
3. ThalayinK., Text book of Radiological Safety
4. James E. M., The Physics for Radiation Protection
5. ICRP manual

**HUMAN ANATOMY & PHYSIOLOGY-I [PRACTICAL] (MMIT-191)**

1. Histology of types of epithelium, Histology of serous, mucous & mixed salivary gland
2. Histology of the 3 types of cartilage, Demo of all bones showing parts, radiographs of normal bones& joints, Histology of compact bone (TS & LS), Demonstration of all muscles of the body, Histology of skeletal (TS & LS), smooth & cardiac muscle
3. Demonstration of heart and vessels in the body, Histology of large artery, medium sized artery & vein, large vein, Microscopic appearance of large artery, medium sized artery & vein, large vein, pericardium, Histology of lymph node, spleen, tonsil & thymus, Normal chest radiograph showing heart shadows, Normal angiograms
4. Demonstration of parts of respiratory system, Normal radiographs of chest, Histology of lung and trachea
5. Demonstration of reflections
6. Demonstration of parts of urinary system, Histology of kidney, ureter, urinary bladder,
7. Demonstration of section of male and female pelvis with organs in situ, Histology of testis, vasdeferens, epididymis, prostate, uterus, fallopian tubes, ovary, Radiographs of pelvis – hystero Salpingogram
8. Demonstration of the glands, Histology of pituitary, thyroid, parathyroid, suprarenal glands
9. Histology of peripheral nerve & optic nerve, Demonstration of all plexuses and nerves in the body, Demonstration of all part of brain, Histology of cerebrum, cerebellum and spinal cord
10. Histology of thin and thick skin, Demonstration and histology of eyeball, Histology of cornea & retina

**Reference Books:**

1. William Davis, Understanding Human Anatomy and Physiology, McGraw Hill
2. Chaursia's, Practical of Human Anatomy

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**RADIOGRAPHIC PROCEDURES-I [PRACTICAL] (MMIT-193)**

1. Radiography in various positions for all the special radiological procedures, using contrast media as per syllabus.
2. Positioning and treatment of various cases patients by using:
  - a) Prescribed filters and wedges
  - b) Protection of various organs

Reference Books:

1. Clark, Radiographic Positioning and Special Procedure
2. Chapman, Radiological Procedure
3. Krishnamurthy, Medical Radiographic Technique & Darkroom Practice

**ADVANCED TECHNIQUES & INSTRUMENTATION OF ULTRASOUND-I [PRACTICAL] (MMIT-195)**

Based on theory

Reference Books:

1. Chapman, Radiological Procedure
2. Bhushan L Lakkar, Radiological Procedure
3. Clark, Radiological Procedure
4. Kartikeyan, Step by Step CT Made Easy
5. Khurana, 3D&4D Ultrasound: A Textbook and Atlas

**SYLLABUS IN DETAIL: SEMESTER II**

**HUMAN ANATOMY & PHYSIOLOGY-II (MMIT-201)**

Urinary System: Kidney, ureter, urinary bladder, and urethra

Reproductive System: Parts of male and female reproductive system, location, functions, mammary gland

Endocrine Glands: Location, structure and functions of pituitary, thyroid, parathyroid, suprarenal and pancreas

Nervous System and sense organs: structure and function of neuron, sub divisions of nervous System: central and autonomic nervous system-parts, structure and functions, ventricles of brain, CSF circulation

Sense Organs: structure and function of the eye, ear, tongue, nose, skin

Surface landmarks and topography of organs on the surface of the body for radiographic positioning.

Urinary tract- - kidney, ureters and bladder, urethra, urinary excretion.

Reproductive system- male genitalia, female genital mammary glands, menstruation pregnancy and lactation, common terms related to abnormalities of this system.

Ductless glands (endocrine system) – anatomical location of pituitary, thyroid, parathyroid, adrenal, thymus, pancreas and gonads – their function, common terms related to this system

Nervous system- main subdivisions, lobes, and ventricles of the brain, spinal cord, meninges and CSF, common terms used in abnormalities of this system.

Organs of senses, structure and function of eye and ear.



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**Reference Books:**

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2. Chaurasia, A Text Book of Anatomy
3. Ranganathan, T.S., A Text Book of Human Anatomy
4. Fattana, Human Anatomy, (Description and Applied), Saunder's & C P Prism Publishers, Bangalore
5. Ester. M. Grishcimer, Physiology & Anatomy with Practical Considerations, J.P. Lippincott. Philadelphia

**INSTRUMENTATION OF CONVENTIONAL RADIOLOGICAL EQUIPMENTS-II (MMIT-202)**

**UNIT 1**

- Circuit breakers
- Primary and secondary switches
- Exposure switching and its application
- Interlocking circuits
- Regulating and safety devices
- Magnetic relay
- Thermal relay switches
  
- Interlock in tube circuit and overload interlocks

**UNIT 2**

- Exposure timers
- Timing systems
- Electronic timer
- Ionization timer
- Photo timer
- Synchronous timer and impulse timer

**UNIT 3**

- Devices improving radiographic quality
- Cone
- Cylinder
- Collimator
- Grid
- Filter

**Reference Books:**

1. X-ray equipments for radiographers- Noreen Chesney and Muriel Chesney
2. Christensens physics of diagnostic radiology
3. Physics for radiographers- George hay
4. Equipments in diagnostic radiology- E. forster

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**RADIOGRAPHIC PROCEDURES-II (MMIT-203)**

**RADIOGRAPHY**

Conventional – non contrast, special situations Pediatric radiography

Special needs of patient and radiographers, equipment considerations, use of dedicated equipment and accessories, technical considerations, the need to modify “adult” techniques, selection of exposure factors , image quality considerations, radiation protection of the patient, special techniques peculiar to children as follows:

- Anorectal malformation- contrast study
- Intersex disorders-contrast study
- Esophageal atresia –pre/post-operative
- Intussusception
- Congenital dislocation of hip
- Scoliosis
- Leg-length measurements
- Assessment of bone age
- Non- accidental injury
- Radiography of babies in incubators

**GERIATRIC RADIOGRAPHY**

Understanding patient profile, possible difficulties during radiography, technical considerations need to carry out standardized projections in unconventional position, equipment and accessories, exposure factor considerations in view of variations in skeletal tissue, special care.

**TRAUMA/ EMERGENCY RADIOGRAPHY**

Limb fractures- fractures of thoracic cage, spine, skull, GIT obstruction, lung collapse, pleural effusion, and pneumothorax. Selection of suitable x-ray equipment, patient position , radiographic projections and sequence for each patient, modification of routine positioning, X Ray tube and film, radiation protection and patient care.

**OPERATION THEATRE RADIOGRAPHY**

Operative cholangiography, orthopedic procedures, pre- operative chest.

Strict observation of asepsis, preparation of radiographer and equipment/ accessories, careful safe use of mobile and fluoroscopic equipment, radiation protection, patient care, protection of theatre staff, rapid availability of radiographic image.

**MAMMOGRAPHY**

Anatomy and physiology of breast, knowledge about the nature of x ray be suitable for breast imaging, equipment suitable for generating such X- radiation, image recording devices, accessories for immobilization and identification, positioning, techniques for various projections, exposure factors, radiation protection, techniques of biopsy procedures, and characteristics of benign and malignant lesions, patient care, and female attendant.

**Reference Books:-**

1. Clark, Radiographic Positioning and Special Procedure
2. Chapman, Radiological Procedure
3. Krishnamurthy, Medical Radiographic Technique & Darkroom Practice
4. Radiological Procedures- BushanLakhar

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**RADIATION PHYSICS-II (MMIT-204)**

Quality Assurance

- Sensitometer
- Densitometer with Software
- Personal Dosimeter
- Radiation Survey Meter
- Beam Alignment Test Tool
- Grid Alignment Test Tool
  
- Focal Spot Test Tool
- Collimator Test Tool
- To check the congruence between the Radiation field and optical field with the help of Collimator Test Tool
- To check the Alignment of the Radiation beam by the using the Beam Alignment Test Tool
- To test the grid by using the Grid alignment Test Tool
- To find out the size of the Focal Spot by using the Focal Spot Test Tool
- To test the consistency of the KVp by using Digital KVp Meter.
- To verify the Inverse Square Law by using Pocket Dosimeter.
- To measure the Radiation output of the X-ray Machine using Dosimeter.
- To check the perpendicularity of the X-ray beam to Image Receptor.
- To check the consistency of the X-ray Films .
- To check the Density of the X-ray Film
- To check the Leakage of Radiation , if any

**ADVANCED TECHNIQUES & INSTRUMENTATION OF ULTRASOUND-II (MMIT-205)**

Indications, Preparation And Scanning Technique

- abdomen
- liver
- gall bladder
- biliary tract
- pancreas
- spleen
- kidneys
- ureter
- bladder

Machine control

Doppler ultrasound

Doppler effects

Clinical applications of Doppler ultrasound

Biological effects of ultrasound

Tissue harmonic imaging

**RADIATION PROTECTION AND MANAGEMENT OF RADIOLOGY DEPARTMENT-I (MMIT-206)**

UNIT 1

Technical protective consideration during Radiography

Evaluation of hazards

Effective communication Immobilization

Beam limiting devices Filtration

Exposure factors Protection in

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- \_ Fluoroscopy
- \_ Mammography,
- \_ Mobile Radiography
- \_ CT SCAN

\_ Angiography room

#### UNIT 2

Radiation measuring instruments Area monitoring

Personnel dosimeters

- \_ Film badge
- \_ Thermo luminescent dosimeter
- \_ Pocket dosimeter.

#### UNIT 3

Biological aspects of Radiological protection Biological effects of radiation

Direct & Indirect actions of radiation

Concept of detriment – Deterministic & stochastic effect of radiation – somatic and genetic effects

Dose relationship

Effects of antenatal exposure

#### References:

1. Christensen, Physics of Diagnostic radiology
2. Euclid Serum, Radiation Protection
3. ThalayinK., Text book of Radiological Safety
4. James E. M., The Physics for Radiation Protection
5. ICRP manual

#### **HUMAN ANATOMY & PHYSIOLOGY-II [PRACTICAL] (MMIT-291)**

Haemoglobinometry

2. White Blood Cell Count 3 Red Blood Count
4. Determination of Blood Groups
5. Leishman's staining and Differential WBC count
6. Determination of packed cell Volume
7. Erythrocyte sedimentation rate [ESR]
8. Calculation of blood indices
9. Determination of Clotting Time, Bleeding Time
10. Blood pressure Recording
11. Auscultation for Heart Sounds
12. Artificial Respiration
13. Determination of vital capacity

#### Reference Books:

1. William Davis, Understanding Human Anatomy and Physiology, McGraw Hill
2. Chaurasia's, Practical of Human Anatomy

#### **RADIOGRAPHIC PROCEDURES-II [PRACTICAL] (MMIT-293)**

1. Radiography in various positions for all the special radiological procedures, using contrast media as per syllabus.
2. Positioning and treatment of various cases patients by using:
  - a) Prescribed filters and wedges
  - b) Protection of various organs

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Reference Books:

1. Clark, Radiographic Positioning and Special Procedure
2. Chapman, Radiological Procedure
3. Krishnamurthy, Medical Radiographic Technique & Darkroom Practice

**ADVANCED TECHNIQUES & INSTRUMENTATION OF ULTRASOUND-II [PRACTICAL] (MMIT-295)**

Based on theory

Reference Books:

1. Chapman, Radiological Procedure
2. Bhushan L Lakkar, Radiological Procedure
3. Clark, Radiological Procedure
4. Kartikeyan, Step by Step CT Made Easy
5. Khurana, 3D&4D Ultrasound: A Textbook and Atlas

**SYLLABUS IN DETAIL: SEMESTER III**

**ADVANCED TECHNIQUES AND INSTRUMENTATION OF CT-I (MMIT-301)**

UNIT-I

Introduction to Computed Tomography and Principle of Computed Tomography  
History, EMI scanner, Advantage and Disadvantages of CT, Basic principle of CT

UNIT-2

Generations of Computed Tomography

1st generation, 2nd generation, 3rd generation, Slip ring technology, 4th generation, Electron beam CT, Dual Source CT, Flat Panel Detector CT

Single and Multi slice Technology

UNIT-3

Instrumentation

CT scanner gantry, Detectors & Data Acquisition System, Generator, Computer and image processing System Image display system, storage, recording and communication system, CT control console, Options and accessories for CT systems

UNIT-4

Image Reconstruction

Basic principle, Reconstruction algorithms, Image reconstruction from projections, Types of data Reconstruction

References:

- 1- Euclid S., Computed Tomography- Physical Principle, Clinical application & quality control
- 2- Stewart C. B., Computed Tomography

**ADVANCED TECHNIQUES AND INSTRUMENTATION OF MRI-I (MMIT-302)**

UNIT-1

Introduction and Basic Principle of Magnetic Resonance Imaging History of MRI, Electricity & Magnetism, Laws of

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magnetism, Atomic structure, Motion within the atom, The Hydrogen nucleus, Precession, Larmor equation, Resonance, MR signal, Free induction decay signal, Relaxation, T1 recovery, T2 decay, Pulse timing & parameters.

UNIT-2

MRI Hardware

Introduction, Permanent magnets, Electromagnets, Super conducting magnets, Fringe fields, Shim coils, Gradient coils, Radio-frequency coils, the pulse control units, Patient transportation system, Operator interface

UNIT-3

Encoding, Data collection & Image formation

Introduction, Gradients, Slice selection, Frequency encoding, Phase encoding, Scan timing, Sampling, data space, k-space, k-space filling and fast Fourier transformation.

UNIT-4

Pulse sequences

Introduction To basic pulse sequences. Spin echo sequences,

Conventional spin echo, Fast spin echo Inversion recovery,

STIR, FLAIR

Proton Density Imaging, Gradient echo pulse sequences

Conventional gradient echo, The steady state, SSFP, Coherent residual transverse magnetization, Incoherent residual transverse magnetization, Ultra- fast imaging, Advanced imaging techniques, EPI

UNIT-5

MRI parameters & Trade offs

Introduction, Signal To Noise Ratio (SNR) & How to increase SNR, Contrast to Noise Ratio (CNR), Spatial resolution & how to increase the spatial resolution, Scan time & how to reduce time, Trade off, Decision making, Volume imaging

References:

1- Stark & Bradley, Fundamentals of MRI

2- Catherine W., MRI in Practice

3- Stewart C B., MRI Physics & Biological Principle

**TECHNIQUES AND EQUIPMENTS OF INTERVENTIONAL RADIOLOGY AND NUCLEAR MEDICINE TECHNOLOGY-I (MMIT-303)**

UNIT-1

Introduction to NMT and Radioactive Transformation

Basic atomic and nuclear physics, History of radioactivity, Units & quantities, Isotopes, Isobars, Isomers, , Radioactivity and half-life, Exponential decay ,specific activity, Modes of Radioactive decay, parent daughter decay.

UNIT -2

Production of Radio nuclides

Reactor produced radionuclide, Reactor principles; Accelerator produced radionuclide, Radionuclide generators.

UNIT-3

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Radio pharmacy &

Handling & Transport of Radio-nuclides

Cold kits, Radio pharmacy used in Nuclear medicine, Radiopharmaceuticals used in various procedures, Safe handling of radioactive materials, Procedures for handling spills

UNIT-4

Equipments of NMT

Gamma camera, PET, SPECT (working principle) Instrumentation

The Anger Camera Basic principle System components

Detector system and electronics Collimators

Image display and recording systems Scanning camera

UNIT-5

In vivo technique

Static and dynamic studies Thyroid imaging

Imaging of bone Respiratory system Urinary system

G.I. system Cardiovascular system Iodine<sup>131</sup> uptake studies

Iodine 131 therapy for thyrotoxicosis and thyroid ablation

References:

- 1- Cope & Constantin, Current Techniques in Interventional Radiology
- 2- Anthony W., Andreas A., Interventional Radiology - A Practical Guide
- 3- Sorenson, Physics in Nuclear medicine
- 4- Powsner, Physics of Nuclear medicine

**CARE OF PATIENT IN DIAGNOSTIC RADIOLOGY (MMIT-304)**

UNIT 1

Introduction to Patient Care

Responsibilities of the Healthcare facility Responsibilities of the Imaging Technologist

UNIT 2

General Patient Care Patient transfer technique Restraint techniques Aspects of patient comfort Specific patient conditions Security of patient property Obtaining vital signs Laying up a sterile trolley IV injection administration

UNIT 3

Infection Control Isolation technique Infection sources Transmission modes Procedures

Psychological considerations Sterilization & sterile techniques.

UNIT 4

Patient Education Communication

Patient communication problems Explanation of examinations Radiation Safety / Protection Interacting with terminally ill patient Informed Consent

References

- 1. Care of Patients in Diagnostic Radiology – Chesney & Chesney
- 2. Care of Patients in Diagnostic Radiology - Gunn

**BIOSTATISTICS (MMIT-305)**

UNIT 1

Introduction

Introduction to Biostatistics & research methodology, types of variables & scales of measurements, measures of central tendency and dispersion, rate, rate, ratio, proportion, incidence & prevalence

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UNIT 2

Sampling

Random & non-random sampling, various methods of sampling-simple random, stratified, systematic, cluster and multistage. Sampling and non-sampling errors & methods of minimizing these errors.

UNIT 3

Basic probability distributions and sampling distributions

Concept of probability distribution. Normal, Poisson and Binomial distributions, parameters and applications. Concept of sampling distributions. Standard error and confidence intervals. Skewness and Kurtosis

UNIT 4

Tests of significance

Basics of testing of hypothesis-Null and alternate hypothesis, type I and type II errors, level of significance

(parametric) and power of the test, p value. Tests of significance –t-test (paired & unpaired), Chi square test and test of proportion, one-way analysis of variance. Repeated measures analysis of variance.

Repeated measures analysis of variance. Tests of significance (nonparametric) – Mann-Whitney u test, Wilcoxon test, Kruskal-Wallis analysis of variance.

Friedmann's analysis of variance.

UNIT 5

Correlation and Regression

Simple correlation-Pearson's and Spearman's; testing the significance of correlation coefficient linear and multiple regression.

UNIT 6

Sample size determination

General concept. Sample size for estimating means and proportion, testing of difference in means and proportions of two groups.

UNIT 7

Study designs

Descriptive epidemiological methods- case series analysis and prevalence studies. Analytical epidemiological

methods- case control and cohort studies. Clinical trials/intervention studies, odds ratio and relative risk, stratified analysis

UNIT 8

Multivariate analysis

Concept of multivariate analysis, introduction to logistic regression and survival analysis

UNIT 9

Reliability and validity evaluation of diagnostic tests

UNIT 10

Format of scientific documents

Structure of research protocol, structure of thesis/ research report, formats of reporting in scientific journals.

Systematic review and meta analysis

Reference Books:

1. Cooper & Schindler, Business Research Methods, Tata McGraw Hill.
2. Saunders Research Methods for Business Students, Pearson Education, 2007.
3. Malhotra Naresh K., Marketing Research, Pearson Education.
4. Fisher, R.A., Statistical Methods for Research Works, Oliver & Boyd, Edinburgh.



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5. Chow, Statistical Design and Analysis of Stability Studies, Marcel Dekker, New York.
6. Finney, D.J., Statistical Methods in Biological Assays, Hafner, New York.
7. Montgomery, D.C., Introduction to Statistical Quality Control, Willy.
8. Lipschutz, Introduction to Probability and Statistics, McGraw-Hill.

**ADVANCED TECHNIQUES AND INSTRUMENTATION OF CT [PRACTICAL] (MMIT-391)**

- 1- Patient preparation, patient positioning, performing all non-contrast and contrast computed tomography procedures.
- 2- Radiation protection and care of patient during procedures including contrast media management.
- 3- Various post processing techniques and evaluation of image quality and clinical findings. 4-Post procedural care of the patient.

**ADVANCED TECHNIQUES AND INSTRUMENTATION OF MRI [PRACTICAL] (MMIT-392)**

- 1- Patient preparation, patient positioning, performing all non-contrast and contrast MRI procedures.
- 2- Planning of different scanning planes, parameters and their tradeoffs & patient monitoring during the procedures.
- 3- Various post processing techniques and evaluation of image quality and clinical findings.
- 4- Post procedural care of the patient.

**TECHNIQUES AND EQUIPMENTS OF INTERVENTIONAL RADIOLOGY AND NUCLEAR MEDICINE TECHNOLOGY [PRACTICAL] (MMIT-393)**

- 1-Patient preparation, positioning for Various Interventional and nuclear medicine procedures.
- 2-Radiation protection for patient, occupational workers and public during Various Interventional and nuclear medicine procedures.
- 3- Basic physics and working principle of Interventional and NMT equipment's.
- 4- Procedure, post processing techniques and evaluation of Image quality and clinical finding. 5-Post procedural care of the patient.

**Interventional Procedures**

Cardiac, Vascular, Nonvascular

References:

1. Cope & Constantin, Current Techniques in Interventional Radiology
2. Anthony W. & Andreas A. Interventional Radiology - A Practical Guide
3. Sorenson, Physics in Nuclear medicine
4. Powsner Physics of Nuclear medicine

**SYLLABUS IN DETAIL: SEMESTER IV**

**ADVANCED TECHNIQUES AND INSTRUMENTATION OF CT-II (MMIT-401)**

UNIT-1

Image Display and Image Quality

Image formation and representation, Image processing, Pixel and voxel, CT number Window level and window width, Qualities, Resolution, Contrast, Sharpness, Noise properties in CT

UNIT-2

CT Artefacts

Classification, Types, Causes, Remedies

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UNIT-3

Diagnostic aspects of CT and post Processing Techniques

CT dose index, DLP

HRCT, Isotropic imaging, Patient management, Patient preparation, positioning, Technologist role, Protocols for whole body imaging

Clinical applications of CT, 2D & 3D imaging, 4D imaging, MPR, SSD, Volume Rendering

Cardiac CT, Pulmonary angiography, peripheral angiography, cerebral angiography, abdomen angiography, renal angiography, HRCT temporal bone

UNIT-4

CT fluoroscopy CT guided biopsy PET CT

CT coronary angiography CT enteroclysis

References:

1- Euclid S., Computed Tomography- Physical Principle, Clinical application & quality control 2- Stewart C. B., Computed Tomography

**ADVANCED TECHNIQUES AND INSTRUMENTATION OF MRI-II (MMIT-402)**

UNIT-1

MRI Artefacts

Introduction, Phase miss-mapping, Aliasing or wrap around, Chemical shift artefact, Chemical misregistration, Truncation artefact/Gibbs phenomenon, Motion of the patient

Magnetic susceptibility artefact, Magic angle artefact, Zipper artefact, shading artefact Cross excitation and cross talk

UNIT-2

MRI contrast agents

Introduction, Uses and methodology, Review of weighting, Mechanism of action, Dipole-dipole interactions, Magnetic susceptibility, Relaxivity

Gadolinium safety, Feridex safety, Current applications of contrast agents

UNIT-3

Flow Phenomena & MRI angiography

Introduction, The mechanisms of flow, Time of flight phenomenon, Entry slice phenomenon, Intravoxel dephasing

Flow phenomena compensation

Gradient moment rephrasing, Pre saturation, Even echo rephrasing, MR Angiography

UNIT-4

Clinical Applications, Scanning Protocols and Safety aspects

Protocols for whole body imaging, The main magnetic field, Gradient magnetic field, Radiofrequency fields, Projectiles, Implants and prostheses, Pacemakers, Medical emergencies, Patient monitoring, Monitors and devices in MRI Claustrophobia, Quenching, Safety tips, Layout planning

UNIT-5

Recent advances in MRI

Newer sequences, MRS, functional MRI, Cardiac MRI, PET MRI

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References:

- 1- Stark & Bradley, Fundamentals of MRI 2- Catherine W., MRI in Practice
- 3- Stewart C B., MRI Physics & Biological Principle

**TECHNIQUES AND EQUIPMENTS OF INTERVENTIONAL RADIOLOGY AND NUCLEAR MEDICINE TECHNOLOGY-II (MMIT-403)**

Interventional Radiology

UNIT-1

Introduction to Interventional Radiology, Contrast media & Emergency Drugs  
Need for interventional procedures, Informed consent, patient care, patient preparation, Patient monitoring, role of technologist in interventional procedure Types of contrast media, method of administration, contraindication, contrast reaction management, emergency crash cart.

UNIT-2

Angiographic Equipments, Catheters & guide wires  
Basics of Angiographic equipments, Single and biplane angiographic equipment, Angiographic Table, Image intensifier, Flat panel detector, electromechanical injectors, Catheters, types of catheters & guidwires, seldinger technique,

UNIT-3

Digital Subtraction Angiography  
Types, Instrumentation,

UNIT-4

Sterile Techniques & Radiation Protection  
Laying up a sterile trolley, sterile techniques, radiation protection for staff and patient , protective devices, monitors .

UNIT-5

Sterile Techniques & Radiation Protection  
Laying up a sterile trolley, sterile techniques, radiation protection for staff and patient, protective devices, monitors .

UNIT-6

Interventional Procedures  
Cardiac, Vascular, Nonvascular, PTC,  
Cardiac catheterization

References:

- 1- Cope & Constantin, Current Techniques in Interventional Radiology 2- Anthony W., Andreas A., Interventional Radiology - A Practical Guide 3- Sorenson, Physics in Nuclear medicine
- 4- Powsner, Physics of Nuclear medicine

**MANAGEMENT OF HEALTH CARE ORGANIZATION (MMIT-404)**

- Hospital structure and organization
- Radiography as a profession- professionalism, projecting professional image, professional and personal qualities (both essential and desirable) of the radiographer

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- Communication and relational skills- development of appropriate communication skills with patients, verbal and non- verbal communication, appearance and behaviour of the radiographer
- Moving and lifting patients- hazards of lifting and manoeuvring patients, rules for correct lifting, transfer from chair or trolley to couch and vice-versa, safety of both lifter and the lifted must be emphasised. Highlight on handling of geriatric, paediatric, and trauma patients
- Communicable diseases (special reference to aids), cross infection and prevention, patient hygiene, personal hygiene, department hygiene, handling of infectious patients in the department, application of asepsis, inflammation and infection process
- Patient vital signs- temperature, pulse, respiration and blood pressure- normal values and methods of taking and recording them
- Medico-legal considerations- radiographers clinical and ethical responsibilities, misconduct and malpractice, handling female patients, practice in pregnancy.
- Radiological contrast media- classification, need for radiological contrast media, methods of administration, dosage, reactions to contrast media, role of the imaging department and the radiographer in management of patient with contrast reaction.
- References
- 1. Care of Patients in Diagnostic Radiology – Chesney & Chesney
- 2. Care of Patients in Diagnostic Radiology – Gunn

### **PROJECT / THESIS (MMIT-481)**

#### Guidelines

Each M.Sc. (MIT) student will carry out research work under the supervision of a faculty member (Guide) with post-M.D./ Ph.D. with teaching experience of three years or more in the subject.

However, a teacher with Ph.D. degree/ M.Sc. Medical Imaging Technology with teaching experience of two years in the subject or related subjects shall be qualified for being taken in as Co-guide.

The Guide will be allotted to each student at the commencement of second year. The student will prepare a Plan of Thesis under the supervision of the Guide and Co-guide and submit it to the university within two months of commencement of second year. The university will convey approval/disapproval of the Plan within one month.

In case the Plan is disapproved, a fresh Plan must be submitted within one month. After approval of the Plan, the student will begin work on the thesis.

The progress of work will be monitored regularly by the Guide/ Co-guide. The thesis not exceeding 100 pages typed on A4 paper on one side only in double spacing is to be submitted to the university through the Guide .

The synopsis shall be submitted by the student within six months of first year. The details of the project /thesis can be carried out in the last six month of second year.

It will be evaluated by a panel of examiners (2 external & 1 internal at least) approved by the Vice- Chancellor.

Note: A student is required to submit three hard copies of the thesis alongwith the soft copy in the prescribed format given by the college.

#### Recommended Textbooks

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1. Euclid S., Computed Tomography- Physical Principle, Clinical application & quality control
2. Stewart C. B., Computed Tomography
3. Stark & Bradley, Fundamentals of MRI
4. Catherine W., MRI in Practice
5. Stewart C B., MRI Physics & Biological Principle
6. Care of Patients in Diagnostic Radiology – Chesney & Chesney
7. Care of Patients in Diagnostic Radiology - Gunn
8. Kartikeyan, Step by Step CT Made Easy

**SEMINAR / PRESENTATION (MMIT-482)**

Students have to give a presentation on the Topic of the Project / Thesis.

**HOSPITAL TRAINING (MMIT-483)**

Students shall be deputed to various imaging modalities of Radiology department wherein they shall undergo practical training of handling patients, collection and processing of investigation (Special procedures of MRI Scan, Nuclear medicine technology, Interventional procedure, etc.) and equipment.

Identification of patient's particulars based on CR number, Lab Number and transfer of samples from collection to different labs.

Each student is required to maintain a logbook of the various posting. Student's performance shall be evaluated by the faculty posted in various sections. The faculty shall submit the assessment records of each student.