# JAMIA HAMDARD

## DEPARTMENT OF PARAMEDICAL SCIENCES

## CBCS ENABLED SYLLABUS
## MSc In Medical Imaging Technology

# SYLLABUS FOR MSC.

## Medical Imaging Technology

### Choice Based Credit System (CBCS)

**Approval Date: _____**

**( __thBOARD OF STUDIES)**


**DEPARTMENT OF PARAMEDICAL SCIENCES**

# JAMIA HAMDARD

**Deemed to be University**
**Accredited in 'A' Grade by NAAC**
**Declared to be designated as Institute of Eminence (IoE) by MHRD, GOI**
**NEW DELHI 110062**
**www.jamiahamdard.edu**

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|---|
| **PROGRAM NAME: MSc in Medical Imaging Technology** |
| **PROGRAM CODE: 559** |
| **ACADEMIC SESSION OF INTRODUCTION OF THE PROGRAMME: (2022-2023)** |
| **SCHOOL NAME: SNSAH** |
| **DEAPRTMENT NAME: DEPARTMENT OF PARAMEDICAL SCIENCES** |

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| **APPROVAL DATE OF THE BOARD OF STUDIES (B.O.S) MEETING FOR THE PRESENT SYLLABUS ___TH _____ 202_ (___TH BOARD OF STUDIES)** |
| **APPROVAL DATE AND NUMBER OF ACADEMIC COUNCIL OF MEETING FOR THE PRESENT SYLLABUS __ AC (_____ 202_)** |

**JAMIA HAMDARD, NEW DELHI - 110062**

**Internal Quality Assurance Cell (IQAC)**

# GUIDELINES FOR PREPARING THE UGC – LEARNING OUTCOMES-BASED CURRICULUM

**JAMIA HAMDARD, NEW DELHI - 110062**

# Internal Quality Assurance Cell (IQAC)

**Template for Programm under on UGC – Learning Outcomes-Based Curriculum Framework**
**SCHOOL OF NURSING AND ALLIED HEALTH SCIENCES**

**Vision Statement (School Level):**
To create an institute of national an international repute in paramedic offering stat of art education entailing the finest skills combined with compassionate patient care.

**Mission Statements (3 to 4) (School Level):**

**MS1:** To provide a quality paramedical education and prepare human and competent global paramedic professionals.

**MS 2:** To provide highest level of quality patient care and can make contribution towards education and research.

**MS 3:** To provide the most advanced and comprehensive course offerings to health sciences students possible by employing the most qualified faculty, utilizing the most advanced technology

## DEPARTMENT OF PARAMEDICAL SCIENCES

**Vision Statement (Department Level):**
Academic excellence in education, research, and healthcare by grooming into highly skilled health professionals and faithful experts fully committed to serve the society.

**Mission Statements (3 to 4) (Department Level):**

**MS1:** : To impart basic, theoretical, practical and professional knowledge of high quality for overall holistic growth of every student

**MS 2:** To develop innovative educational activities and participate in public health reforms through training, research and intervention in the field of allied health sciences

**MS 3:** To strive to upload a future generation with high academic academic standards.

## MSc in MEDICAL IMAGING TECHNOLOGY

## QUALIFICATION DESCRIPTORS (QDs)

**Upon the completion of MSc MIT, students will be able to:**

**QD-1** Effectively manage the patients who are undergoing radiological investigation.

**QD-2** Perform all the radiological investigations prescribed by the residents.

**QD-3**Demonstrate comprehensive knowledge and skill in areas of various modalities (CT,MRI,X-ray,Mammography,Fluoroscopy etc)

**QD-4** Apply the knowledge & skills of radiation protection in its working area.

**QD-5** Know about the medical ethics and professionalism.

**Mapping Qualification Descriptors (QDs) with Mission Statements (MS)**

| | **MS-1** | **MS-2** | **MS-3** |
|---|---|---|---|
| **QD-1** | 2 | 2 | 2 |
| **QD-2** | 1 | 2 | 2 |
| **QD-3** | 2 | 2 | 2 |
| **QD-4** | 2 | 2 | 2 |
| **QD-5** | 3 | 2 | 2 |

Write '3' in the box for 'High-level'mapping, 2 for 'Medium-level'mapping, 1 for 'Low-level'mapping.

# SCHOOL OF NURSING AND ALLIED HEALTH SCIENCES
## MSc in MEDICAL IMAGING TECHNOLOGY

### PROGRAM LEARNING OUTCOMES (PLOs) ( 12)

After completing 2 years of this Course, the postgraduates will exhibit the ability to-

**PLO-1** Express thoughts and ideas effectively required in managing and diagnosis patients.

**PLO-2** Perform X-ray,CT & MRI on its own as a full fleshed radiographers.

**PLO-3** Female graduates are able to manage & perform mammography independently.

**PLO-4** Deliever lectures to graduates as well as post graduates students related to their field.

**PLO-5** Demonstrate the ability to identify ethical issues related to one's work, avoid unethical behaviour such as fabrication, falsification or misrepresentation of data or committing plagiarism, not adhering to intellectual property rights, appreciate environmental and sustainability issues, and adopt objective, unbiased and truthful actions in all aspects of work.

**PLO-6** Demonstrate the ability to acquire knowledge and skills, including 'learning how to learn' that are necessary for participating in learning activities throughout life, through self-paced and self-directed learning aimed at personal development and to meet the changing trades and demands of work place.

**PLO-7** Demonstrate capability for mapping out where one needs to go to "win" as a team or an organization, formulate an inspiring vision, build a team who can help achieve the vision, motivate and inspire team members to engage with that vision, and use management skills to guide the the team to the right destination

## PROGRAM SPECIFIC OUTCOMES (PSOs)

After completing this Course, the students of MMIT should be able to …….

**PSO-1** Perform radiological investigations on its own.

**PSO-2** Apply knowledge of radiation protection and know all harmful effects of radiation.

**PSO-3** Do research in its specific area.

**PSO-4** Provide instructions and handle all type of patients whether sick,geriatrics, peadiatric or obstetrics.

### Mapping of Program Learning Outcomes (PLOs) WithQualification Descriptors (QDs)

| | QD-1 | QD-2 | QD-3 | QD-4 | QD-5 |
|---|---|---|---|---|---|
| PLO-1 | 2 | 2 | 1 | 2 | 2 |
| PLO-2 | 2 | 3 | 3 | 1 | 2 |
| PLO-3 | 2 | 2 | 2 | 3 | 1 |
| PLO-4 | 1 | 2 | 2 | 2 | 2 |
| PLO-5 | 3 | 3 | 2 | 1 | 1 |
| PLO-6 | 2 | 2 | 1 | 1 | 1 |

| | | | | | |
|---|---|---|---|---|---|
| **PLO-8** | **2** | **1** | **1** | **1** | **1** |
| **PSO-1** | **3** | **3** | **3** | **2** | **2** |
| **PSO-2** | **3** | **3** | **3** | **3** | **2** |
| **PSO-3** | **2** | **2** | **2** | **1** | **1** |
| **PSO-4** | **3** | **3** | **3** | **2** | **3** |

Write ‘3’ in the box for ‘High-level’ mapping, 2 for ‘Medium-level’ mapping, 1 for ‘Low-level’ mapping.

# BYELAWS OF PROGRAMME

Beside Theory Classes, students shall be posted to HAHC Hospital or any other specialized hospital for practical training in the laboratories.

## Work record

Every candidate shall attend symposia, Seminars, conference, journal review meetings and lectures during each Year as prescribed by the department. Every candidate shall make a work diary and record his or her participation in the training program, presentations given by the candidate and details of laboratory work conducted by the candidate.

The candidate will also be involved in teaching and Training of under Graduate Courses.

## Dissertation:

**Each candidate pursuing M.Sc. Medical Imaging Technology** has to select a topic under the guidance of a recognized post graduate teacher; prepare and submit a synopsis and carry out dissertation work for one year. The result of such work should be submitted in the form of thesis. Every candidate shall submit to the registrar of the university in the prescribed Performa two hard copies of the synopsis within six months from commencement of the course. The synopsis should be send through proper channel.

The university shall make a committee for review of synopsis and if found suitable shall register the topic for dissertation. No change in dissertation topic or guide shall be made without prior approval by the university.

The dissertation is aimed to train in research methods and techniques. It includes identification of problem, formulation of hypothesis, search and review of literature, resent advances, critical analysis and interpretation of results.

The dissertation should be written under the following headings:

- Introduction
- Aims and Objectives
- Review of literature
- Material and Methods
- Results
- Discussion
- Conclusion
- Summary
- References
- Tables
- Annexure

The text of dissertation should be Minimum of fifty pages and shall not exceed 100 pages excluding references, tables, questionnaires and other annexure. It should be typed neatly typed on one side of A4 sized paper and bound properly. Spiral binding shall not be done. A declaration by the candidate that the work is done by him or her shall be included. The guide, head of the department and head of the institution shall certify the bonafide of the dissertation.

Four hard copies of the dissertation should be submitted to the university through proper channel along with the soft copy two months before the 2nd year examination. It shall be assessed by two examiners appointed by the university, one internal and one external. No marks will be awarded for dissertation. A candidate will be eligible to appear in 2nd year examination after acceptance of the dissertation. In a genuine case, if dissertation is left to be cleared, permission may be granted to sit in 2nd year examination with prior approval of the Vice Chancellor. The certificate of successful completion of course to such be awarded only after submission and acceptance of the thesis.

**Student guide ratio:-5:1.** A recognized guide shall supervise dissertation work of not more than five students per academic years

## Attendance

a) All students must attend every lecture delivered, however, to account for the late joining or other such contingencies, the attendance requirement for appearing in the semester examinations shall be a minimum of 75% of the total taken separately in theory and posting.
b) The course shall be pursued on full time basis. No candidate shall be permitted to work in a hospital or laboratory outside the institution while pursuing the course in Jamia Hamdard, however the Dissertation work can be carried out out side Jamia Hamdard if required after permission through HOD Paramedical Sciences.
c) In order to maintain the attendance record of a course, a roll call will be taken by the teacher in every scheduled lecture.
d) Attendance on account of participation in the prescribed functions of NCC, NSS, Inter-University sports, educational tours/field work assigned by the university to students shall be credited to the aggregate, provided the attendance record, duly counter signed by the officer in-charge, is sent to the Head of Department within two weeks time after the function/activity.
e) The teacher in-charge will consolidate the attendance record for the lectures for each student. The statements of attendance of students shall be displayed on the Department's Notice Board by the teacher concerned at the beginning of the following month and consolidated attendance before the conclusion of each year as given in the University Calendar. A copy of the same shall be sent to the Head of Department for record. Notices displayed on the Notice Board shall be deemed to be a proper notification, and no individual notice shall be sent to students.
f) If a student is found to be continuously absent from the classes without information for a period of 30 days, the teacher in charge shall report it to the Head of Department, who will inform the Registrar through the Dean. Registrar will issue a notice to such student, as to why his/ her admission should not be cancelled. The Registrar will take a decision on cancellation of admission within 30 days of issue of the notice. A copy of the order shall be communicated to the student.
g) A student with less than 75% attendance in the lectures and 80% in lab postings shall be detained from appearing in the annual examination each year. The Dean of Faculty concerned may consider application for the condonation of shortage of attendance up to 5% on account of sickness or any other extra ordinary circumstances, provided the medical certificate duly certified by registered Medical Practitioner, had been submitted within 7 days of the recovery from the illness.
h) A student detained on account of attendance will be re-admitted to the same class in the next academic year on payment of current fees except Enrolment and identity card fees

## Internal Assessment

Internal assessment for 25 markseach in respect of theory and Practical. Papers will be based on written tests, assignments, presentations, viva-voice etc.

- The evaluation shall be done by subject teacher and marks will be notified within 15 days of such test.
- There shall be two written tests in each year. The test will be conducted as per the academic calendar individual faculty member to announce the date for tests or conduct them as per academic calendar.
- Average of the two tests or best of the two tests will be compute for internal assessment.
- The teacher concerned shall maintain records of marks of various components of evaluation for each student.
- The internal assessment marks shall be submitted by head of the Department tothe Registrar at the end of each year.
- A candidate who has to reappear (as an ex-student) in the annual examination of a course will retain the marks of internal assessment.
- A student who will be required to seek re-admission, for whatever reason, will have to appear for internal assessment and tests afresh.

## Setting of Question paper:

- The question paper will be of 75 marks comprising of long Questions, Short notes, along with objective types questions with distribution of marks accordingly. The duration of theory paper will be of three hours.

- The paper setter should set and send question paper to the examination Department in a sealed envelope within a week of receiving letter, No hard or soft copy should be kept by the paper setter to maintain the confidentiality. The whole procedure should be completed by the examination department one week before the commencement of examination with due confidentiality .

## Annual Examinations:

### Eligibility to appear in Annual Examination

A candidate will be eligible to appear in Annual examination if he or she has satisfactory completed the prescribed course and fulfilled the prescribed attendance.

a) The Annual examinations shall be held at the end of each Academic year as notified in the academic calendar. There shall be a supplementary examination after three months of declaration of result of annual examination

b) The duration of each theory paper will be 3 hours.

c) The question papers shall be set by either an external or an internal examiner duly appointed by the Board of Studies and approved by the Vice Chancellor.

d) The papers set by the examiners shall be moderated by a panel of moderators constituted by the Board of Studies at the time of approving the panel of examiners.

e) The minimum pass marks shall be 50 % in each theory and Practical/viva-voce .

## Span Period

A student must complete all the requirements of the course within a period of five years from his/ her admission; otherwise the admission of the candidate will be cancelled and the candidate has to apply afresh for the course.

## Schedule of examination:

The university will conduct one (Annual) examinations in a year .

a) The number of examiners for practical and viva voce shall be two, comprising of

b) one internal and one external examiner appointed by the university.

c) A candidate shall not be admitted to the practical examination for the first time unless he/she produces the class record book certified by the head of the department.

d) A failed candidate needs to reappear in that paper he or she has not cleared.

e) Classification of successful candidate:

f) For each Annual Examination a successful candidate is one who has achieved 50% marks in each Theory and practical separately and has achieved 50% of the total Marks

g) Grading System

h) The grade awarded to a student in any particular course will be based on his/her performance in Sessional and final examinations combined together. The letter grades and their equivalent numerical points are listed below:

| % Of Marks Scored | Grade | Description of Performance |
|---|---|---|
| 80% or more | A+ | Outstanding |
| 75% or more but less than 80% | A | Excellent |
| 70% or more but less than 75% | B+ | Very Good |
| 60% or more but less than 70% | B | Good |
| 50% or more but less than 60% | C | Average |
| less than 50% | F | Fail |
| Absent/ Detained | I | Incomplete |

# YEAR-1

# SCHOOL OF NURSING AND ALLIED HEALTH SCIENCES

## MSc in MEDICAL IMAGING TECHNOLOGY

## MSc in Medical Imaging Technolog (1ST YEAR)

**Course Code: MMIT-101 Title of the Course: Radiographic Procedure & Principal of Radiographic Exposure (Theory)**

**Lecture-90 Credit-4**

## COURSE LEARNING OUTCOMES (CLOs)

After completing this Course, the students should be able to understand the…….

**CLO-1** Idea of administrating contrast media,theoritecial knowledge of the same.

**CLO-2** Knowledge of Fluoroscopy

**CLO-3** Knowledege of different Radiographic procedures & tools and equipment required in procedure.

**CLO-4** Positioning of views required in doing barium and contrast procedures.

**CLO-5** Dealing with patients and increases communication skills.

**Mapping of Course Learning Outcomes (CLOs)with Program Learning Outcomes (PLOs) and Program Specific Outcomes (PSOs)**

| | PLO 1 | PLO 2 | PLO 3 | PLO 4 | PLO 5 | PLO 6 | PLO 7 | PLO 8 | PLO 9 | PLO10 | PSO 1 | PSO 2 | PSO 3 | PSO 4 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CLO 1 | 1 | 1 | 2 | 3 | | 2 | | | 1 | | 1 | 1 | 3 | |
| CLO 2 | | 2 | | | 1 | | | 2 | | | | | 1 | 2 |
| CLO 3 | | | 2 | | 2 | | 1 | 1 | | 3 | | 2 | 2 | 3 |
| CLO 4 | 2 | | | 1 | | 2 | | | 2 | | 2 | 3 | | 1 |
| CLO 5 | | 2 | | | | | 3 | | | | | 1 | 2 | |

'3' in the box for 'High-level' mapping, 2 for 'Medium-level'mapping, 1 for 'Low-level'mapping.

## Detailed Syllabus:

**Unit 1**:Basic review of all Radiographic Techniques & Radiographic procedures (1 hours)

**Unit 2**: Contrast Media- Application, types, safety aspects, administration, administration techniques (2 hours)

**Unit 3**: Digestive System ,Anatomy and physiology, Associated pathology and radiographic appearance,Plain radiography,Barium swallow,Barium meal,Barium meal follow through (6 hours)

**Unit 4**: Genito urinary system,Anatomy and physiology,Associated pathology and radiographic appearance,Plain radiography, Intravenous urogram (IVU), Micturating Cystourethrogram (MCU), Ascending Urethrogram (ASU), Hysterosalpingography (HSG), Fallopian Tube Recanalisation (FTR) (6 hours)

**Unit 5**: Cardio - Respiratory system,Anatomy and physiology,Associated pathology and radiographic appearance,Chest radiography (2 hours)

**Unit 6:** Mammography- Anatomy and physiologyIndications, contraindications and techniques , ICRP guidelines, BIRADS (2 hours)

**Unit 7:** Skull- Related anatomy of facial and cranial bones Associated pathology and radiographic appearance Radiographic projections (2 hours)

**Unit 8:** Vertebral Column- Related anatomyAssociated pathology and radiographic appearanceRadiographic projections (2 hours)

**Unit 9:** Upper limb-Related anatomy
Associated pathology and radiographic appearance Radiographic projections (2 hours)

**Unit 10:** Lower limb- Related anatomy
Associated pathology and radiographic appearance, Radiographic projections (2 hours)

**Unit 11:** Pelvis
Related anatomy of pelvic bones and hip jointAssociated pathology and radiographic appearanceRadiographic projections, Pelvimetry (2 hours)

**UNIT 12**
Hepatobiliary system- Related anatomy, Associated pathology and radiographic appearance, ERCP/ PTBD, T – tube cholangiography (5 hours)

**UNIT 13**
Dental Radiography- Related anatomy
Associated pathology and radiographic appearance, Intraoral, Extraoral and Occlusal views, General precautions, OPG (2 hours)

**UNIT 14**
Other procedures
Sialography , Dacrocystography, Sinography, Fistulography (3 hours)
Related anatomy-Associated pathology and radiographic appearance
Indications, contraindications and technique

**UNIT I5**

X-ray production

Interaction of radiation with matter- Compton effect, photoelectric effect, pair production, coherent scattering.Useful range, Clinical application (3 hours)

**UNIT 16**

The Photographic process, Introduction, Basic review of photographic emulsions, Photographic latent image, Film materials, Spectral sensitivity of film material, Speed and contrast of photographic materials, Intensifying screens and cassettes, Film processing (2 hours)

**UNIT 17**

Sensitometry-Photographic
density OpacityTransmission
Production of Characteristic curve
Features of Characteristic curve
Variation in the characteristic curve with development Comparison of emulsions by their characteristic curve Application of Characteristic curve
Information from the Characteristic curve (4 hours)

**UNIT 18**

Radiographic Image
Radiographic Density
Acceptable range
Factors influences density.
Radiographic Contrast Components
Factors influences contrast
Management of Radiographic Image quality (3 hours)

**UNIT 19**

Resolution
Line spread function & Modulation transfer function
Unsharpness in the Radiographic image and various factors contributing towards Unsharpness
TypesofUnsharpness
Radiographic mottle (2 hours)

**UNIT 20**

Geometry of the radiographic image Magnification / Distortion -Types and factors Micro / Macro radiography (1 hour)

**UNIT 21**

Instrumentation of Processing Equipment
Automatic film processor (AFP)
Maintenance and Quality control tests in AFP Layout and planning of Darkroom
Viewing accessories: viewing boxes
Magnifiers and viewing conditions (2 hours)

**Reference Books:**


1. Radiographic positioning – Clarke's
2. Radiographic positioning – Merriil's
3. Diagnostic Radiography – Glends Bryan
4. Christensen's Physics of Diagnostic radiology
5. Radiographic Imaging – Chesney & Chesney
6. Anatomy & Physiology-Ross and Wilson
7. Normal Radiation Anatomy-Meschan
8. Human anatomy – Chaurasia.
9. Atlas of Human anatomy – Antunez
10. Basic anatomy and Physiology for radiographers – Dean.M.R.E


**Teaching-Learning Strategies in brief**

- In university,delievering knowledge by teachers through the means of lectures followed by the tutorials & workshops to a large number of students.
- Assignments are given on daily basis and discussed weekly.
- One class in a week is typically reserved for the purpose of assignments and doubts discussion.
- Seminars are also conducted in which two way question and answering is open between techers, students & audience.
- Lectures can be taken through different modes like presentation or showing videos to students that might help in grasping the topics.
- Revision of old semester topics is done as per students requirement.
- After completion of 2-3 topics, sessional/Quiz is conducted. It can be viva or a written test.

**Assessment methods and weightages in brief**

1.Two internal assessment are done, each carrying 25 marks. At the end best of two or average of two will be considered.

2.One external assessment should be done carrying 75 marks.

**Course Code: MMIT-102 Title of the Course: INSTRUMENTATION OFCONVENTIONAL X-RAY EQUIPMENTS&INSTRUMENTATION OFSPECIALIZED RADIOLOGYEQUIPMENTS (Theory)**

**Lecture-45 Credit-2**

## COURSE LEARNING OUTCOMES (CLOs)

After completing this Course, the students should be able to …….

**CLO1-** Knowledge of conventional x-ray equipments & fluoroscopic equipments

**CLO2**- Theoritical knowledge of image formation.

**CLO3-**Handling of equipments

**CLO4-**Handling of fluoroscopic units and positioning

**Mapping of Course Learning Outcomes (CLOs)with Program Learning Outcomes (PLOs) and Program Specific Outcomes (PSOs)**

| | PLO 1 | PLO 2 | PLO 3 | PLO 4 | PLO 5 | PLO 6 | PLO 7 | PLO 8 | PLO 9 | PLO1 0 | PSO 1 | PSO 2 | PSO 3 | PSO 4 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CLO 1** | 1 | 1 | 2 | 3 | | 2 | | | 1 | | 1 | 1 | 3 | |
| **CLO 2** | | 2 | | | 1 | | | 2 | | | | | 1 | 2 |
| **CLO 3** | | | 2 | | 2 | | 1 | 1 | | 3 | | 2 | 2 | 3 |
| **CLO 4** | 2 | | | 1 | | 2 | | | 2 | | 2 | 3 | | 1 |
| **CLO 5** | | 2 | | | | | 3 | | | | | 1 | 2 | |

'3' in the box for 'High-level' mapping, 2 for 'Medium-level'mapping, 1 for 'Low-level'mapping.

**Detailed Syllabus-**

**UNIT 1**

Generation of electrical energy AC/DC Polyphase supply Distribution of electrical energy Use of electrical energy loads power loss Uses of electricity in Hospitals Safety rules for Radiographers (1 hour)

**UNIT 2**

**Xray Circuit components** High tension transformers Main Voltage Compensation High tension switches Stabilizers and UPS (1 hour)

**UNIT 3**

Fuses Switches Earthing
High tension cables construction & design. Rectification
Types of Rectifiers X-ray circuits Filament circuits High voltage circuits (2 hours)

**UNIT 4**

Tube rating, Types of Generators, Capacitor discharge generator, Battery Powered generator, Medium frequency & High frequency generator. (2 hours)

**UNIT 5**

Switches ,Circuit breakers, Primary & Secondary switches, Exposure switching and Its application.Interlocking Circuits,Regulating and safety devices
Magnetic relay, Thermal relay switches
Interlockin Tube Circuit and overload interlocks. (2 hours)

**UNIT 6**

Exposure timers Timing systems Electronic timer Ionization timer, Phototimer
Synchronous timer and impulse timer. (1 hour)

**UNIT 7**

Devices improving radiographic quality, Cone, Cylinder, Collimator, Grid, Filter (2 hour)

**UNIT 8**

Portable & Mobile equipments, Mains requirements
Cable connections to wall plugs Portable X-Ray Equipments Mobile X-Ray Equipments
Capacitor Discharge Mobile Equipment, Cordless Mobile Equipments
X-Ray Equipments for the Operating Theatre, Mobile Image Intensifier units (2 hours)

**UNIT 9**

Fluoroscopy Equipments, Construction & Working principlesof Image Intensifier
Viewing the Intensified image Recording the intensified Image Digital fluoroscopy
Panel type image intensifier (2 hours)

**UNIT 10**

Fluoroscopic/Radiographic Tables, General features of fluoroscopic/radiographic table, The serial changer Remote controltable The spot film devices. (1 hours)

**UNIT 11**

Tomographic Equipment, Principles of tomography, Various types of tomographic movement, Equipment for linear tomography (1 hour)

**UNIT 12**

Equipment for Cranial and Dental radiography, The skull table, General Dental X-ray equipment, Pantomography equipment, Equipment for Cranial & skeletal radiography

Equipment for mammography (2 hours)

**UNIT 13**

Care, Maintenance and tests, General care, Functional tests

Quality assurance program Acceptable limits of variation Corrective action (1 hour)

**Teaching-Learning Strategies in brief**

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- One class in a week is typically reserved for the purpose of assignments and doubts discussion.
- Seminars are also conducted in which two way question and answering is open between techers, students & audience.
- Lectures can be taken through different modes like presentation or showing videos to students that might help in grasping the topics.
- Revision of old semester topics is done as per students requirement.
- After completion of 2-3 topics, sessional/Quiz is conducted. It can be viva or a written test.

**Assessment methods and weightages in brief**

1.Two internal assessment are done, each carrying 25 marks. At the end best of two or average of two will be considered.

2.One external assessment should be done carrying 75 marks.

**Course Code: MMIT-103 Title of the Course: Advanced Technique and Instrumention in Ultrasound(Theory)**

**Lecture-45 Credit-2**

## COURSE LEARNING OUTCOMES (CLOs)

After completing this Course, the students should be able to …….

**CLO1**-Knowledge of basic principles of USG

**CLO2**-Knowledge of advanced USG procedures

**CLO3**-Knowledge and handling of USG equipments

**CLO4**-Handling & Maintenance of Transducer

**Mapping of Course Learning Outcomes (CLOs)with Program Learning Outcomes (PLOs) and Program Specific Outcomes (PSOs)**

| | PLO 1 | PLO 2 | PLO 3 | PLO 4 | PLO 5 | PLO 6 | PLO 7 | PLO 8 | PLO 9 | PLO 10 | PSO 1 | PSO 2 | PSO 3 | PSO 4 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CLO1** | 1 | | | | | 1 | | | 1 | | | | **2** | |
| **CLO2** | | | 2 | | | | | 2 | 1 | | | **1** | **1** | **1** |
| **CLO3** | 1 | 1 | 2 | 1 | 1 | 1 | | 2 | 1 | | **1** | **1** | **1** | **2** |
| **CLO4** | 2 | | | | | 2 | 2 | | | | **2** | **1** | **1** | |
| **CLO5** | | | | | | | | 2 | 2 | | | | **2** | **1** |

'3' in the box for 'High-level' mapping, 2 for 'Medium-level'mapping, 1 for 'Low-level'mapping.

**Detailed Syllabus-**

UNIT 1-Principles of Sound, Types of Sound, Transducer Frequencies, Continuous Wave, Pulsed, Pulsed Ultrasound Terminology, Amplitude, Intensity, Propagation Speed - Density and Stiffness

(2 hours)

UNIT 2-Speeds in the Body, Beam Formation, Focal ZonesResolution, Longitudinal Resolution, Lateral ResolutionElevation Resolution, Temporal Resolution, Resolution Phantoms

(3 hour)

UNIT 3-Echoes - Reflections, Reflection & Transmission, Specular Reflections, Scattering, Rayleigh Scattering. Penetration & Resolution, Echo Review Points

(2 hour)

UNIT 4-Transducers, Piezoelectric Materials, Depolarization, Construction, Frequency, Phased Arrays, Steering the Beam, Focusing the Beam, Transducer Footprints, Advancement in Technology, PureWave, Matrix

(3 hours)

UNIT 5-Instrumentation, Beamformer, Pulser / Pulse Delays, Transmit Receive Switch, Amplifiers / Converters, Echo Delays / Summer, Signal Processor, Image Processor, Digital Scan Converter, Image Memory

(3 hours)

UNIT 6-Display, Instrumentation Review Points, Artifacts, Slice Thickness, Refraction, Multipath, Mirror Image, Reverberation, Acoustic Shadowing, Acoustic Enhancement, Doppler, Doppler Effect, Doppler Shift

(3 hours)

UNIT 7- Speed versus Velocity, Measuring Velocities, Spectral Analysis, Aliasing (2 hours)

UNIT 8- CW Doppler, PW Doppler, PW & CW Spectrums, Color Flow Imaging, Packet Size, Blood Flow Direction

(5 hour)

**Referral Books-**

1.Diagnostic Ultrasound by CarolM.Rumack
2.Color Doppler Ultrasound by AllenPaul
3.Basic physics and technology of medical diagnostic ultrasound–M.Hussey
4.Doppler ultrasound physics instrumentation and clinical applications – D.H.Evans.
5. The essential physics of medical imaging–Bushberg

**Teaching-Learning Strategies in brief**

- In university,delievering knowledge by teachers through the means of lectures followed by the tutorials & workshops to a large number of students.
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**Assessment methods and weightages in brief**

1.Two internal assessment are done, each carrying 25 marks. At the end best of two or average of two will be considered.

2.One external assessment should be done carrying 75 marks.

**Course Code: MMIT-104 Title of the Course: Advanced Technique and Instrumention in Computed Tomography(Theory)**

**Lecture-75 Credit-3**

## COURSE LEARNING OUTCOMES (CLOs)

After completing this Course, the students should be able to understand the …….

**CLO1-**Knowledge of Basic principle of CT

**CLO2-**Knowledge of basic CT Protocols and advanced techniques

**CLO3**-Knowledge of CT Equipments & its handling

**CLO4**-Knowlegde of patient preparation & its post procedure care

**CLO5**-Caliberation Of CT equipments

**Mapping of Course Learning Outcomes (CLOs)with Program Learning Outcomes (PLOs) and Program Specific Outcomes (PSOs)**

| | PLO 1 | PLO 2 | PLO 3 | PLO 4 | PLO 5 | PLO 6 | PLO 7 | PLO 8 | PLO 9 | PLO10 | PSO 1 | PSO 2 | PSO 3 | PSO 4 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CLO 1** | 1 | 1 | 1 | 2 | 2 | 2 | 2 | 2 | 1 | | | 2 | 1 | |
| **CLO 2** | 3 | 2 | 1 | 1 | 3 | 3 | 1 | 1 | 2 | 2 | 2 | 1 | | 1 |
| **CLO 3** | 2 | 3 | 2 | 2 | 1 | 1 | 3 | 2 | 1 | 1 | 1 | | 1 | 2 |
| **CLO 4** | 2 | 1 | 2 | 1 | 2 | 2 | 2 | 1 | 1 | 1 | 1 | 2 | 2 | 1 |
| **CLO 5** | 1 | 2 | 2 | 1 | 2 | 2 | 1 | 2 | 1 | 2 | | | 2 | 1 |

‘3’ in the box for ‘High-level’ mapping, 2 for ‘Medium-level’mapping, 1 for ‘Low-level’mapping.

**Detailed Syllabus-**

**UNIT 1**

Imaging principles in computed tomography
Instrumentation of CTscan Advances in Detector technology Slip ring technology
Helical CT, Single slice and Multislice CT Scan system (6 hours)

**UNIT 2**

Isotropic imaging, Image display, Pre and Post Processing techniques
Image quality in single slice and multi slice helical CT scan, Patient radiation dose considerations in Helical CT (6 hours)

**UNIT 3**

Protocols for adult Whole Body Protocols for pediatric Whole Body CT Documentation Common and specific artifacts in Helical CT images (8 hours)

**UNIT 4**

HRCT of Lungs Technical aspects Volumetric HRCT Expiratory HRCT HRCT protocols Artifacts (3 hours)

**UNIT 5**

CT angiography CT fluoroscopy Multi dimensional reformations MPR, Curved MPR,MIP 3D imaging & 4D CT

(8 hours)

**UNIT 6**

CT Perfusion scan, CT colonoscopy, CT bronchoscopy (2 hours)

**UNIT 7**

CT coronary angiography ,CT calcium scoring Myocardial Imaging (2 hours)

**UNIT 8**

Care, Maintenance and tests, General care, Functional tests
Quality assurance program, Acceptable limits of variation Corrective action (1 hour)

**Referralbooks**


1. Computed Tomography – Physical Principles ,ClinicalApplications & Quality Control by Euclid Seeram
2.Computed Tomography by Stewart C.Bushong
3. The essential physics ofmedicalimaging–Bushberg
4.Clinical Computed Tomography for the Technologist – Chiu.L.C


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**MMIT-105 Radiographic Procedure & Principal of Radiographic Exposure (Practicle)**

**T-P-150 Credit-6**

Practical based on the syllabus mentioned in theory.

**MMIT-106 INSTRUMENTATION OF CONVENTIONALX-RAY EQUIPMENTS & INSTRUMENTATION OF SPECIALIZED RADIOLOGY EQUIPMENTS (Practicle)**

**T-P-60 Credit-3**

Practical based on the syllabus mentioned in theory.

**MMIT-107 Advanced Technique and Instrumention in Ultrasound (Practicle)**

**T-P-150 Credit-6**

Practical based on the syllabus mentioned in theory.

**MMIT-108 Advanced Technique and Instrumention in Computed Tomography (Practicle)**

**T-P-150 Credit-6**

Practical based on the syllabus mentioned in theory.

## BIO-STATISTICS & Reaesarch methodology (Subsidiary Subject)

(Classroom: 25 hours)

**UNIT 1**
**Introduction**
Introduction to Biostatistics & research methodology, types of variables & scales of measurements, measures of central tendency and dispersion, rate, ratio, proportion, incidence & prevalence (2 hours)

**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. (2 hours)

**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.SkewnessanKurtosis (2 hours)

**UNIT 4**
**Tests of significance**
Basics of testing of hypothesis-Nulland alternate hypothesis, type Iandtype 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.
(2 hour)

**UNIT 5**
**Correlation and Regression**
Simple correlation- Pearson's and Spearman's testing the significance of correlation coefficient linear and multiple regression. (2 hour)

### COURSE LEARNING OUTCOMES (CLOs)

After completing this Course, the students should be able to …….
**CLO1**- Biostatics help students in their thesis work
**CLO2**-It helps to make their result in thesis
**CLO3**-Frame the complete thesis work.

**Mapping of Course Learning Outcomes (CLOs)with Program Learning Outcomes (PLOs) and Program Specific Outcomes (PSOs)**

| | PLO 1 | PLO 2 | PLO 3 | PLO 4 | PLO 5 | PLO 6 | PLO 7 | PLO 8 | PLO 9 | PLO10 | PSO 1 | PSO 2 | PSO 3 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CLO 1** | 2 | | | 1 | 2 | 1 | 2 | | | | | | 2 |
| **CLO 2** | 1 | | 1 | | | | | 2 | 2 | | 1 | | |
| **CLO 3** | | | | | | | 3 | | 1 | | 1 | 1 | 1 |

‘3’ in the box for ‘High-level’ mapping, 2 for ‘Medium-level’mapping, 1 for ‘Low-level’mapping.

# YEAR-2

**Name of the Academic Program- MSc in Medical Imaging Technolog (2nd YEAR)**

**Course Code: MMIT-201**
**Title of the Course: Advanced technique & Instrumentation of MRI (Theory)**
**Lecture-60 Credit-3**

## COURSE LEARNING OUTCOMES (CLOs)

After completing this Course, the students should be able to …….
**CLO1-**Understand the basic knowledge of MRI
**CLO2-**Handle the equipments used in MRI and MRI machine
**CLO3-**Examine the MR scans and evaluation of the same
**CLO4-**Importance of MR and can differentiate between MR & other modalities

**Mapping of Course Learning Outcomes (CLOs)with Program Learning Outcomes (PLOs) and Program Specific Outcomes (PSOs)**

| | PLO 1 | PLO 2 | PLO 3 | PLO 4 | PLO 5 | PLO 6 | PLO 7 | PLO 8 | PLO 9 | PLO10 | PSO 1 | PSO 2 | PSO 3 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CLO 1 | 1 | | | 1 | | 2 | 2 | | 1 | 1 | 1 | 1 | |
| CLO 2 | | 2 | | 1 | | 2 | 1 | | 2 | 1 | | 2 | 1 |
| CLO 3 | | 1 | 1 | 1 | | 1 | 1 | | 1 | 2 | | 1 | 1 |
| CLO 4 | | 1 | 1 | | | 2 | 2 | | 2 | 1 | | 1 | 1 |

'3' in the box for 'High-level' mapping, 2 for 'Medium-level'mapping, 1 for 'Low-level'mapping.

**Detailed Syllabus-**

UNIT 1
Basic Principles
Spin Precession Relaxation time Pulse cycle
T1 weighted image T2 weighted image Proton density image (6 hours)

UNIT-2
MR Instrumentation, Types of magnets, RF transmitter &receiver coils
Gradient coils, Shim coils, RF shielding
Computers (6 hours)

UNIT 3
Pulse sequences
Spin echo pulse sequence – turbo spin echo pulse sequence Gradient echo sequence – Turbo gradient echo pulse sequence Inversion recovery sequence –

STIR sequence, SPIR sequence, FLAIR sequence, Echo planar imaging and Fast imaging sequences
Advanced pulse sequences. (8 hours)

UNIT 4
Image formation, 2D Fourier transformation method, K-space representation
3D Fourier imaging, MIP (4 hours)

UNIT 5
MR contrast media, MR angiography – TOF & PCA MR Spectroscopy (6 hours)

UNIT 6
Protocols in MRI for whole body, MRI artifacts, Safety aspects in MRI (6 hours)

UNIT 7
Cardiac MRI (3 hours)

UNIT 8
Musculoskeletal imaging protocols, Abdominal imaging protocols (2 hours)

UNIT 9
Functional MRI, BOLD Imaging (3 hours)

UNIT 10
Care, Maintenance and tests , General care, Functional tests
Quality assurance program Acceptable limits of variation Corrective action (1 hour)

**References**

1. MRI physics for Radiologist - Alfred Horowitz
2. Fundamentals of MRI – Stark & Bradley
3. MRI in Practice – Catherine brook
4. The essential physics of medical imaging – Bushberg

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**Assessment methods and weightages in brief**

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**Course Code: MMIT-202**
**Title of the Course:Nuclear Medicine Imaging and Interventional Radiology Techniques (Theory)**
**Lecture-60 Credit-4**

## COURSE LEARNING OUTCOMES (CLOs)

After completing this Course, the students should be able to …….
**CLO1**-Unterstand the basic knowledge of Interventional procedures & Nuclear medicine
**CLO2**-Understand the different procedures of Intervention & Nuclear Medicine
**CLO3**-Assist radiologist in DSA room.
**CLO4**- Differentiate different tools used in Intervention

**CLO5**-Perform NM examinations independently

**Mapping of Course Learning Outcomes (CLOs)with Program Learning Outcomes (PLOs) and Program Specific Outcomes (PSOs)**

| | PLO 1 | PLO 2 | PLO 3 | PLO 4 | PLO 5 | PLO 6 | PLO 7 | PLO 8 | PLO 9 | PLO10 | PSO 1 | PSO 2 | PSO 3 | PSO 4 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CLO 1 | 1 | | | | | 1 | | | 1 | | 1 | 1 | 1 | 2 |
| CLO 2 | | 2 | 1 | | | 1 | 1 | | 1 | | 1 | 1 | 2 | 1 |
| CLO 3 | | | 1 | | 1 | | | 1 | 1 | 2 | 1 | | 2 | 2 |
| CLO 4 | | | 1 | | 2 | | | 1 | | 1 | 1 | | | 1 |
| CLO 5 | | | | | | | | | | 1 | 1 | | | 1 |

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## Nuclear Medicine Imaging

**Detailed Syllabus-**
UNIT 1
Basic atomic & nuclear physics, Quantities and Units
Atom composition and structure Nucleus composition Radioactivity
Exponential decay, Specific activity, Parent / Daughter decay
Modes of Radioactive decay. (2 hours)

UNIT 2
Radiation detectors, Gas filled detectors - Basic principles

Ionization chambers Proportional counters Geiger Muller counters Semiconductor detectors, Scintillation detectors – basic principles (2 hours)

UNIT 3

Production of Radio nuclides Reactor produced radionuclide Reactor principles
Accelerator produced radionuclide
Radionuclide generators (3 hours)

UNIT 4

Instrumentation
The Anger Camera Basic principle System components
Detector system and electronics, Collimators, Image display and recording systems
Scanning camera (2 hours)

UNIT 5

Radio pharmacy
Radiopharmaceuticals
General principle of tracer technique
Preparation of different labeled compounds with technetium-99m isotope
Cold kit (3 hours)

UNIT 6

In vivo technique, Static and dynamic studies
Thyroid imaging Imaging of bone Respiratory system Urinary system
G.I.system, Cardiovascular system Iodine131 uptake studies
Iodine 131 therapy for thyrotoxicosis and thyroid ablation (4 hours)

UNIT 7

Image quality in Nuclear medicine, Spatial resolution, Contrast
Noise, Types of noise, Quality assurance of imaging equipments
Variation in Image perception – with physician, within technologist & technical parameter (3 hours)

UNIT 8

SPECT imaging (2 hours)

UNIT 9

PET imaging (2 hours)

UNIT 10

Radiation safety in Nuclear medicine, Radiation units and quantities
MPD
Safe handling of Radioactive materials Storage of radioactive materials Procedures for handling spills
Disposal of Radioactive waste
Radiation monitoring Survey meters Personnel dosimeters Wipe testing Contamination monitor
Isotope calibrator
Area monitor
Inventory of isotopes (6 hours)

**References**


1. Nuclear Medicine basics – Chandra.R
2. Principles & practice of Nuclear medicine – Early.P.J
3. Physics and Radiobiology of Nuclear Medicine – Gopal.
4. Essentials of Nuclear Medicine Imaging – Mettler
5. Radionucleid Imaging artifacts – Wells & Bernier


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# Interventional Radiology Techniques

**Detailed Syllabus-**

UNIT 1
Introduction
Need for interventional procedures, Informed consent, DSA, Basic Principle
Types, Equipments, Basics of Angiographic equipments, Single and biplane angiographic equipment
Angiographic Table Image intensifier Flat panel detector Recording systems Pulse oximetry
Cardiac resuscitation measures - ECG Pressure injector
Catheters, needles and other tools
3-D rotational angiography
Image processing Patient monitor ACT equipment CO2 angiography (6 hours)

UNIT 2
Patient care, Preparation for procedure Post procedure care
Role of radiographer in interventional procedure
Crash trolley- Emergency drugs (3 hours)

UNIT 3
Procedures, Diagnostic &Therapeutic interventional procedures
PTC, PTBD, Stenting Nephrostomy, ureteric stenting Guided biopsies of different organs Drainage of collections/abscesses
Angiograms, angioplasty, embolization
Venus access Radiofrequency ablation Image guided nerve blocks (6 hours)

UNIT 4
Neuro interventional procedures
Embolization of extra or intracranial tumors, vascular malformations
Vertebroplasty – direct puncture
Laser guided procedure (6 hours)

UNIT 5
Basics of cardiac catheterization (2 hours)

UNIT 6
Safety considerations in angiography room
Room design Protective devices Radiation monitoring (3 hours)

UNIT 7
Care, Maintenance and tests, General care, Functional tests
Quality assurance program Acceptable limits of variation Corrective action (2 hours)

**References**


1. Current Techniques in Interventional Radiology – Cope , Constantin
2. Interventional Radiology - A Practical Guide by Anthony Watkinson andAndreas Adam


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**Course Code: MMIT-203**
**Title of the Course: Care of Patient in Diagnostic Radiology (Theory)**
**Lecture-45 Credit-2**

## COURSE LEARNING OUTCOMES (CLOs)

After completing this Course, the students should be able to …….

**CLO1-**Understand the knowledge of different sterilisation techniques and also practice it.
**CLO2-**Understand and practice the knowledge of taking consent, explaining procedure and instructing required details.
**CLO3**-Perform investigations along with all the cares required during and after the procedure
**CLO4-**communicate with patients throughout the procedure.

**Mapping of Course Learning Outcomes (CLOs)with Program Learning Outcomes (PLOs) and Program Specific Outcomes (PSOs)**

| | PLO 1 | PLO 2 | PLO 3 | PLO 4 | PLO 5 | PLO 6 | PLO 7 | PLO 8 | PLO 9 | PLO10 | PSO 1 | PSO 2 | PSO 3 | PSO 4 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CLO 1** | 1 | | 1 | | | 1 | | 1 | 1 | | | | 2 | |
| **CLO 2** | | 2 | 1 | | 2 | 1 | | | 1 | | | 1 | 1 | 1 |
| **CLO 3** | | | 1 | | 1 | 1 | | 1 | 2 | 1 | | 1 | 1 | 1 |
| **CLO 4** | | | 2 | | 2 | 2 | | | | 2 | | 1 | | 2 |

‘3’ in the box for ‘High-level’ mapping, 2 for ‘Medium-level’mapping, 1 for ‘Low-level’mapping.

**Detailed Syllabus-**

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
Nursing procedure in Radiology General abdominal preparation Clothing of the patient, Giving an enema, Handling the emergencies in Radiology, First aid in the X-Ray department

UNIT 4
Patient care during Investigation
G.I. Tract, Biliary tract, Respiratory tract, Gynecology, Cardiovascular, Lymphatic system, C.N.S. etc

UNIT 5
Infection Control Isolation technique Infection sources – Transmission modes Procedures, Psychological considerations, Sterilization & sterile techniques.

UNIT 6
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
3. Basic Medical Techniques and patient care for Radiologic Technologist – Torres.

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**Course Code: MMIT-204**
**Title of the Course: Radiation Evaluation & Protection in Diagnostic radiology (Theory)**
**Lecture-60 Credit-3**

## COURSE LEARNING OUTCOMES (CLOs)

After completing this Course, the students should be able to ……
**CLO1-** Gain the knowledge of different bodies that provide guidelines of radiation protection

**CLO2-**Understand the harmful effects of radiation

**CLO3-**Understand the importance of different radiation monitoring devices

**CLO4-**Practice radiation protection limits

**Mapping of Course Learning Outcomes (CLOs)with Program Learning Outcomes (PLOs) and Program Specific Outcomes (PSOs)**

| | PLO1 | PLO2 | PLO3 | PLO4 | PLO5 | PLO6 | PLO7 | PLO8 | PLO9 | PLO10 | PSO1 | PSO2 | PSO3 | PSO4 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CLO1** | 1 | | 1 | | 2 | | | 1 | | | | | | 1 |
| **CLO2** | | 1 | 1 | | | | | 1 | | | | 1 | 1 | 2 |
| **CLO3** | | 2 | 2 | | 1 | | 2 | 2 | | 2 | | 2 | 2 | 1 |
| **CLO4** | | | | | | | 1 | | | 1 | | 1 | | 1 |

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**Detailed Syllabus-**

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. (6 hours)

UNIT 2
Limits for Radiation exposure
Concept of ALARA (or ALARP) ICRP regulation, Maximum permissible dose
Exposure in pregnancy, children (3 hours)

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 signages (6 hours)

UNIT 4
Technical protective consideration during Radiography
Evaluation of hazards Effective communication Immobilization
Beam limiting devices, Filtration Exposure factors Protection in :
- Fluoroscopy
- Mammography,
-Mobile radiography
- CTScan
- Angiography room (6 hours)

UNIT 5
Radiation measuring instruments, Area monitoring, Personnel dosimeters
- Film badge
- Thermo luminescent dosimeter
- Pocket dosimeter (3 hours)

UNIT 6
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 (6 hours)

**References**

1. Physics of Diagnostic radiology – Christensen
2. ICRP manual
3. Radiation protection measurement – Glenn F.Knoll
4. Radiation protection in hospitals – R.F.Mold
5. Advanced medical radiation dosimetry – Govinda Rajan
6. Radiation protection – Medical Radiography – Sher

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**Course Code: MMIT-205**
**Title of the Course: Advanced technique & Instrumentation of MRI (Practical)**
**T-P-150 Credit-6**

Practical based on the syllabus mentioned above.

**Course Code: MMIT-206**

**Title of the Course: Nuclear Medicine Imaging and Interventional Radiology Techniques (Practical)**
**T-P-200 Credit-8**

Practical based on the syllabus mentioned above.

**Course Code: MMIT-207**
**Title of the Course: Care of Patient in Diagnostic Radiology (Practical)**
**T-P-60 Credit-3**

Practical based on the syllabus mentioned above.

**Course Code: MMIT-208**
**Title of the Course Radiation Evaluation & Protection in Diagnostic radiology (Practical)**
**T-P-90 Credit-4**

Practical based on the syllabus mentioned above.