



SWAMI VIVEKANAND SUBHARTI **UNIVERSITY**

SYLLABUS

OF

MASTER OF SCIENCE IN MEDICAL IMAGING **TECHNOLOGY- M. Sc. MIT**

**Swami VivekanandSubharti University,
Subhartipuram,NH-58, Delhi-Haridwar Bypass Road, Meerut-250005**

Ordinance No – V (73A)

Ordinance relating to Master of Science in Medical Imaging Technology

(M.Sc. MIT) Course

Chapter - 1

General

1. The ordinance may be called the ordinance relating to Master of Science in Medical Imaging Technology (M.Sc. MIT) Course.
2. It shall into force with immediate effect.

Chapter - 2

Eligibility for admission

3. For the admission of M.Sc. (MIT) course an applicant should passed Intermediate (10+2) or its equivalent from a recognised board with minimum Fifty percent (50%) marks in Physics, Chemistry and Biology (PCB) with English as a subject of the course.
4. The student should have a three (3) years B.Sc. in Medical Imaging Technology/ B.Sc. Radio-diagnosis and Imaging Technology or an equivalent degree, from the recognised University with minimum 50% marks, provided the candidate should be registered with recognised medical faculty/council with valid registration number and completed six (06) Months compulsory rotatory Internship.
5. The foreign nationals/Non-resident Indians/person of Indian origin students who have passed an examination, which is equivalent to the B.Sc. in Imaging Technology shall be eligible for admission to this course provided marks obtained will not be less than 50%. The student must obtain certificate of equivalence from the Association of Indian Universities, New Delhi, before admission.
6. The reservation and relaxation for SC/ST/OBC/PWD and other categories shall be as per the rules of the Central Government/State Government, whichever is applicable.

Chapter- 3

Teaching Course

7. The course will be of Two Years (2 Years) duration.

8. The Academic calendar shall be as follows

Session:	-	Ist August to 15th June
Examination:	-	16th June to 30th June

Study & Evaluation Scheme

Program: Master of Science in Medical Imaging Technology (MMIT) 1st Year

S.No.	Course code	Subject	Periods			Credit	Evaluation Scheme		
			L	T	P		Internal	External	Total
1.	MMIT101	HUMAN ANATOMY & PHYSIOLOGY	2	-	-	2	30	70	100
2.	MMIT102	INSTRUMENTATION OF CONVENTIONAL RADIOLOGICAL EQUIPMENTS	2	-	-	2	30	70	100
3.	MMIT103	RADIOGRAPHIC PROCEDURES	2	-	-	2	30	70	100
4.	MMIT104	RADIATION PHYSICS	2	-	-	2	30	70	100
5.	MMIT105	ADVANCE TECHNIQUE & INSTRUMENTATION OF ULTRASOUND	2	-	-	2	30	70	100
6.	MMIT106	RADIATION PROTECTION AND MANAGEMENT OF RADIOLOGY DEPARTMENT	-	-	1	1	30	70	100
7.	MMIT107	BIostatISTICS	-	-	-	-	30	70	100
8.	MMIT151	HUMAN ANATOMY & PHYSIOLOGY (PRACTICAL)			1	1	50	50	100
9.	MMIT152	RADIOGRAPHIC PROCEDURES (PRACTICAL)	-	-	1	1	50	50	100
10.	MMIT153	ADVANCE TECHNIQUE & INSTRUMENTATION OF ULTRASOUND (PRACTICAL)	-	-	1	1	50	50	100
11.	MMIT154	HOSPITAL POSTING	-	-	10	10	100	-	100
		TOTAL	10		14	24	460	640	1100

MMIT 2nd Year

S.No.	Course code	Subject	Periods			Credit	Evaluation Scheme		
			L	T	P		Internal	External	Total
1.	MMIT201	ADVANCED TECHINQUES AND INSTRUMENTATION OF CT	2	-	-	2	30	70	100
2.	MMIT202	ADVANCED TECHINQUES AND INSTRUMENTATION OF MRI	2	-	-	2	30	70	100
3.	MMIT203	TECHIQUES AND EQUIPMENTS OF INTERVENTIONAL RADIOLOGY AND NUCLEAR MEDICINE TECHNOLOGY	2	-	-	2	30	70	100
4.	MMIT204	CARE OF PATIENT IN DIAGNOSTIC RADIOLOGY AND MANAGEMENT OF HEALTH CARE ORGANIZATION	2	-	-	2	30	70	100
5.	MMIT251	ADVANCED TECHINQUES AND INSTRUMENTATION OF CT (PRACTICAL)	2	-	-	2	30	70	100
6.	MMIT252	ADVANCED TECHINQUES AND INSTRUMENTATION OF MRI (PRACTICAL)	-	-	1	1	30	70	100
7.	MMIT253	TECHIQUES AND EQUIPMENTS OF INTERVENTIONAL RADIOLOGY AND NUCLEAR MEDICINE TECHNOLOGY (PRACTICAL)	-	-	1	1	30	70	100
8.	MMIT254	PROJECT/THESIS	-	-	1	1		100	100
9.	MMIT255	HOSPITAL POSTING	-	-	3	3	100	-	100
		TOTAL	10		6	16	310	590	900

- The candidate shall be provisionally allowed to join the next higher class but shall not be permitted to appear in next University examination unless he/she has passed in all the subjects of previous year examination.
- During the course a post-graduate student is expected to conduct actual practice of Medical Imaging Technology and acquire skills under supervision so that he/she may become capable of functioning independently.

Chapter- 4 **Attendance**

9. The students are expected to attend all the classes and should not have less than 75 % attendance in theory as well as in practical classes, wherever held, to become eligible to appear for the university examination. Short fall in attendance can, however be condoned in deserving cases to the extent of 10% by the Principal. If the short fall is more than 10% but not more than 15%, the Principal may recommend deserving cases to the Vice Chancellor for condonation. The order of the Vice Chancellor in this regard shall be final.

Chapter- 5 **Examination**

10. The theory examination shall be conducted in two parts:
- A. Internal assessment** will be of 30 marks as under:-
- a. Midterm written test including in-between snap tests if any, shall carry **20 marks** independently in each subject.
 - b. A maximum of **10 marks** in each subject shall be awarded for attending classes (theory / practical) as per the following norms:

85% or more attendance	-	10 Marks
80% or more but less than 85% attendance	-	9 Marks
75% or more but less than 80% attendance	-	8 Marks
70% or more but less than 75% attendance	-	7 Marks
65% or more but less than 70% attendance	-	5 Marks
60% or more but less than 65% attendance	-	3 Marks
51% or more but less than 60% attendance	-	2 Marks
50% attendance	-	1 Mark
Less than 50% attendance	-	0 Mark
- B. University Examination** carrying 70 marks.
11. Internal assessment will be held twice in a year for both Theory and Practical examination. The candidate should be declared passed in internal assessment with minimum 20% marks separately in theory and practical.
12. The entire course has to be completed within a maximum of four (04) yrs. from the date of original admission in the course.

Chapter-6
Paper setting, Evaluation & Results

13. The work of setting the University Examination papers, conduct of the End semester and Annual examinations, Evaluation and declaration of results shall be as per the laid down Examination policies / latest University Notifications.

Chapter – 7
Power to Modify

14. In the event of any emergent situation, if any deviation is considered necessary, the Vice Chancellor is authorised to modify the Ordinance. Subject to subsequent ratification by the Executive Council.

Chapter-8

Results

- a) Examination result shall be prepared at the end of each academic year by taking into account the marks obtained in all the year till date.
- b) A candidate shall be declared as passed at the end of an academic year if he/she secure minimum 50% marks in each paper and practical separately.
- c) The university shall issue a provisional M.Sc. MIT pass certificate on passing the final examination.
- d) the final result at the end of the course shall be prepared as below by aggregating the marks obtained in all the years

AGGREGATE	DIVISION	GRADE
Below 50% in aggregate	FAIL	D
50% or above but below 60% in aggregate	2ND	C
60% and above but below 70% in aggregate	1ST	B
70% and above but below 75% in aggregate	1ST	A
75% and above in aggregate	1ST HONORS	A+

- e) The Degree M.Sc. Medical Imaging Technology (M.Sc. MIT) shall be awarded to a candidate, indicating Division and the grading, after the candidate has successfully completed the following:
 - He has passed both the annual examinations
 - Candidate's work and conduct during the period of training have been found satisfactory.

SYLLABUS (M.Sc. MIT COURSE)

INTRODUCTION

Medical Science has made tremendous advances in last two decades. Newer diagnostic and therapeutic modalities like ultrasound; CT scan, MRI, PET scan, etc. are developing at a rapid pace. It is possible to impart this knowledge to the medical imaging students. However, there is acute shortage of medical imaging technologists familiar with the newer techniques. Medical Imaging Technologist plays an important role in helping the radiologist to make a diagnosis by providing good quality films and helping in technology expansion in medical care, hence there is increasing requirement of trained technologists to meet the expectations. Thus more and more job opportunities shall be available to the persons trained in Medical imaging technology.

With improving standards of medical care and for further up gradation, there is a need for highly qualified imaging professionals in this field all over the country. Further, placements are being solicited by the multinational companies for the bright technologist and highly skilled students as application experts specializing in different field. Further, with many upcoming institutions for providing training for radiography, there shall be increasing requirement for Faculty who have passed M.Sc. in Medical Imaging Technology on regular basis. The M.Sc. (M.I.T.) course in medical technology (Radio-diagnosis) is aimed at meeting this rising demand as well as at enhancing the quality of health care.

OBJECTIVES

- 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 (Radiography) and to update them with the newer developments taking place in the field of Radio diagnosis.
- 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.

FIRST YEAR

HUMAN ANATOMY & PHYSIOLOGY

Course Code: MMIT101

Course Contents:

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, centres 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, Oesophagus, stomach, small and large intestine, liver, gall bladder, pancreas

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

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

Human Physiology

Course Contents:

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 oesophagus, stomach, small 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.

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

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

Ductless gland s(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

INSTRUMENTATION OF CONVENTIONAL X- RAY EQUIPMENT'S

Course Code: MMIT102

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

UNIT 5

- 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 6

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

UNIT 7

- 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

RADIOGRAPHIC PROCEDURES

Course Code: MMIT103

GOAL

Student should be able to reliably perform all non-contrast plain radiography, conventional contrast studies and non-contrast plain radiography in special situations.

OBJECTIVES

1. Correctly position for radiography of a particular anatomical area.
2. Correctly select appropriate projection/projections to demonstrate the area of interest.
3. Use appropriate radiographic parameters to produce a radiograph with satisfactory results.
4. Competently use radiographic/fluoroscopic equipment and associated accessories.
5. Correctly identify anatomical features on the radiographs and identify some major pathological and traumatic conditions.
6. Help in administration of correct contrast dosage.
7. Take all correct steps for radiation protection.

RADIOGRAPHY

I. 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 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.

HYSTEOSALHINGOGRAPHY (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

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.

Refernce Books:-

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

RADIATION PHYSICS

Course Code: MMIT104

Contents:-

- 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

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

ADVANCE TECHNIQUE & INSTRUMENTATION OF ULTRASOUND

Course Code: MMIT105

Contents:-

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-

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

Course Code: MMIT106

Course Contents:

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

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

_ CT SCAN

_ Angiography room

UNIT 5

Radiation measuring instruments

Area monitoring

Personnel dosimeters

_ Film badge

_ Thermo luminescent dosimeter

_ Pocket dosimeter.

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

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

BIO-STATISTICS

Course Code: MMIT107

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

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

Recommended 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.
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.

PRACTICAL

HUMAN ANATOMY & PHYSIOLOGY (PRACTICAL)

Course Code: MMIT151

Course Code: BMIT151

Course Contents:

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

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 (PRACTICAL)

Course Code: MMIT152

Course Contents:

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*

ADVANCE TECHNIQUE & INSTRUMENTATION OF ULTRASOUND (PRACTICAL)

Course Code: MMIT153

Course Contents:

Based on theory

Reference Books:

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

HOSPITAL POSTING

Course Code: MMIT154

Course Contents:

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, CTScan, , Ultrasound 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 on continuous basis by the faculty posted in various sections. The faculty shall submit the assessment records of each student posted in his/her section on monthly basis to the HOD. Marks will be awarded out of 100.

SECOND YEAR

ADVANCED TECHNIQUES AND INSTRUMENTATION OF CT

Course Code: MMIT-201

Course Contents:

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

UNIT-5

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-6

CT Artefacts

Classification, Types, Causes, Remedies

UNIT-7

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-8

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

Course Code: MMIT202

Course Contents:

UNIT-1

Introduction and Basic Principle of Magnetic Resonance Imaging

History of MRI, Electricity & Magnetism, Laws of 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

UNIT-6

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-7

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-8

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-9

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-10

Recent advances in MRI

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

References:

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

TECHNIQUES & EQUIPMENT'S OF INTERVENTIONAL RADIOLOGY & NUCLEAR MEDICINE TECHNOLOGY

Course Code: MMIT203

Course Contents:

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

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

Iodine¹³¹ uptake studies

Iodine ¹³¹ therapy for thyrotoxicosis and thyroid ablation

Part-B:-Interventional Radiology

UNIT-6

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-7

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 & guidewires, seldinger technique,

UNIT-8

Digital Subtraction Angiography

Types, Instrumentation,

UNIT-9

Sterile Techniques & Radiation Protection

Laying up a sterile trolley, sterile techniques, radiation protection for staff and patient , protective devices, monitors .

UNIT-10

Sterile Techniques & Radiation Protection

Laying up a sterile trolley, sterile techniques, radiation protection for staff and patient, protective devices, monitors .

UNIT-11

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*

CARE OF PATIENT IN DIAGNOSTIC RADIOLOGY AND MANAGEMENT OF HEALTH CARE ORGANIZATION

Course Code: MMIT204

Care of Patient in Diagnostic Radiology

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

MANAGEMENT OF HEALTH CARE ORGANIZATION

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

ADVANCED TECHNIQUES AND INSTRUMENTATION OF CT (PRACTICAL)

Course Code: MMIT251

Course Content-

- 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)

Course Code: MMIT 252

Course Content-

- 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 & EQUIPMENT'S OF INTERVENTIONAL RADIOLOGY & NUCLEAR MEDICINE TECHNOLOGY(PRACTICAL)

Course Code: MMIT253

Course Content-

- 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*

PROJECT/THESIS

Course Code: MMIT254

Guidelines

Each M.Sc. Medical Imaging 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

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*

HOSPITAL POSTING

Course Code: MMIT255

Course Contents:

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 MRIScan, 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 on continuous basis by the faculty posted in various sections. The faculty shall submit the assessment records of each student posted in his/her section on monthly basis to the HOD. Marks will be awarded out of 100.

THE END