TAMIL NADU Dr. M.G.R. MEDICAL UNIVERSITY,

69, ANNA SALAI, GUINDY, CHENNAI - 600 032.

REGULATIONS & SYLLABUS

FOR

M.Sc – RADIOLOGY AND IMAGING TECHNOLOGY

(Post - Graduate Degree Course Under Allied Health Science)

THE TAMIL NADU Dr. M.G.R. MEDICAL UNIVERSITY, CHENNAI -600 032

REGULATIONS OF THE UNIVERSITY
(Post-graduate Degree course under Allied Health Science)

M.Sc – RADIOLOGY AND IMAGING TECHNOLOGY

In exercise of the powers conferred by Section 44 of the Tamil Nadu Dr. M.G.R. Medical University, Chennai Act 1987(Tamil Nadu Act 37 of 1987) the Standing Academic Board of the Tamil Nadu Dr. M.G.R.Medical University, Chennai hereby makes the following regulations:-

SHORT TITLE AND COMMENCEMENT:-
These shall be called as **REGULATIONS - M.Sc – RADIOLOGY AND IMAGING TECHNOLOGY** of the Tamil Nadu Dr. MGR Medical University, Chennai.

- They shall come into force from the academic year 2015-2016
- The regulations framed are subject to modification by the Standing Academic Board from time to time.

OVERALL OBJECTIVES:

The **M.Sc – RADIOLOGY AND IMAGING TECHNOLOGY DEGREE COURSE UNDER POST GRADUATE ALLIED HEALTH SCIENCES** is designed.

To provide specialized training in Radiology and Imaging and its application in order to create qualified manpower to handle modern radiological equipments with a successful carrier. Upto successful completion of the M.Sc. course, students will have developed a broad knowledge of the principles, technology, instrumentation, recent developments and proper handling of the modern radiological equipments and proper execution of the various radiological procedures and be able to embark upto a successful career in their chosen direction of Imaging Science research.

2. ELIGIBILITY FOR ADMISSION

B.Sc. in Radiology and Imaging Technology

2. AGE LIMIT:

No upper age limit for Admission

3. ELIGIBILITY CERTIFICATE:

Candidates who have passed any qualifying examination as stated in (1) other than the Tamil Nadu Dr. M.G.R. Medical University shall obtain an “Eligibility Certificate” from this University by remitting the prescribed fees along with the application form and required documents before seeking admission to any one of the affiliated institutions. The application form is available in the University website :web.tnmgrmu.ac.in.

4. REGISTRATION:

A Candidate admitted to **M.Sc – RADIOLOGY AND IMAGING TECHNOLOGY DEGREE COURSE UNDER POST GRADUATE ALLIED HEALTH SCIENCES** in any one of the affiliated institutions of this University shall register his / her name with this university by submitting the prescribed application form for registration duly filled along with the prescribed fee and a declaration in the format to the Controller of Examinations of this University through the affiliated institution within 30 days from the cutoff date prescribed for the course for admission. The applications should bear the date of admission to the said course.

5. MIGRATION/TRANSFER OF CANDIDATE:

(a) A student studying in **M.Sc – RADIOLOGY AND IMAGING TECHNOLOGY DEGREE DEGREE COURSE UNDER POST GRADUATE ALLIED HEALTH SCIENCES** can be allowed to migrate / transfer to another institution of Allied Health Science under the same University.

(b) Migration / Transfer can be allowed to another affiliated institutions under extraordinary circumstances. The Vice - Chancellor has the power to issue Migration / Transfer order.

6.. COMMENCEMENT OF THE COURSE:

The course shall commence from 1st September of the academic year. Cut off date for Admission is 30th September every year.

7 .MEDIUM OF INSTRUCTION:

English shall be the Medium of Instruction for all the Subjects of study and for examinations of the **M.Sc – RADIOLOGY AND IMAGING TECHNOLOGY DEGREE COURSE UNDER POST GRADUATE ALLIED HEALTH SCIENCES.**

8. CURRICULUM:

The Curriculum and the syllabus for the course shall be as prescribed in this regulations are subject to modifications by the Standing Academic Board from time to time.

9. DURATION OF THE COURSE:

The duration of certified study for the **M.Sc – RADIOLOGY AND IMAGING TECHNOLOGY DEGREE COURSES UNDER POST GRADUATE ALLIED HEALTH SCIENCES** shall be **Two** academic years including period of exam. The admitted candidates should complete this course within 4 years (double the duration) from the date of joining the course.

10. RE-ADMISSION AFTER BREAK OF STUDY:

The regulations for re-admission are as per the University Common Regulation for Re-admission after break of study for all courses.

11. **WORKING DAYS IN THE ACADEMIC YEAR.**

Each academic year shall consist of not less than 270 working days

Total No. of working days including (Term day 270 days 85% Attendance) Examination period

12. ATTENDANCE REQUIRED FOR ADMISSION / EXAMINATION:

(a) No candidate shall be permitted to appear in any one of the parts of **M.Sc – RADIOLOGY AND IMAGING TECHNOLOGY DEGREE COURSE UNDER POST GRADUATE ALLIED HEALTH SCIENCES** Examinations unless he/she has attended the course in the subject for the prescribed period in an affiliated institution recognized by this University and produce the necessary certificate of study, attendance and satisfactory conduct from the Head of the institution.

(b) A candidate is required to put in a minimum of 85% of attendance in both theory and practical separately in each subject before admission to the examinations.

13. CONDONATION OF LACK OF ATTENDANCE:

There shall be no condonation of lack of attendance.

14. VACATION:

There is no vacation

15. INTERNAL ASSESSMENT MARKS:

The Internal Assessment should consist of the following points for evaluation:-

i) Theory
ii)Practical

(a) A minimum of three written examinations shall be conducted in each subject during a year and the average marks of the three performances shall be taken into consideration for the award of Internal Assessment marks.

16. CUT-OFF DATES FOR ADMISSION TO EXAMINATIONS:

1. 30th September of the academic year concerned for Admission.
2. The candidates admitted up to 30th September of the academic year shall be registered to take up the 1st year examination during October of the next year.

17. COMMENCEMENT OF THE EXAMINAITONS:

15th October / 15th April
If the date of commencement of examination falls on Saturdays / Sundays or declared Public Holidays, the examination shall begin on the next working day.

18. MARKS QUALIFYING FOR PASS:

50% of marks in the University Theory Examinations
50% of marks in the Practical with Viva
50% of marks in aggregate in Theory, I.A & Oral taken together.

19. CARRY OVER OF FAILED SUBJECTS:

- Carry any number of failed papers to second year course but has to be completed before appearing for Second Year Examination..

2. The candidate has to successfully complete the course in double the duration (i.e. 4 years from the date of joining).

20. REVALUATION / RETOTALLING OF ANSWER PAPERS:

Re - totaling / Revaluation of answer papers is not permitted.

22. Submission of Project

1. Project should be in a bound volume of a minimum of 30 - 50 pages of typed in Double line spacing and on one side only.

2. The Project should be submitted to the Institution 3 months before the Second Year Examination.

3. The student should prepare a PPT presentation of the project at the time of Viva – Voce Examination..

24. **LOG BOOK**:

Based on the curriculum Log Book to be maintained and the same is periodically, assessed by HOD and presented at the time of discussion of project in Practical Examination.

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DEGREE OF M. Sc - RADIOLOGY AND IMAGING TECHNOLOGY SYLLABUS

Course Curriculum:

First Year:

Total Teaching hours for First year Syllabus

Sl. No.	Name of the Paper	Hours		Total
		Theory	Practical	
1.	Radiological Physics	50	80	130
2.	Conventional Radiological and Imaging Equipment	50	80	130
3.	Radiographic and Imaging Techniques	50	80	130
4.	Radiation Safety and Protection	50	70	120
5.	Modern Radiological and Imaging Equipment	50	90	140
6	Residency – I	---	---	350
	Total Hours	**250**	**400**	**1000**

Radiological Physics

Introduction

1. X-rays: Discovery of x-rays-X-ray production and properties: Bremsstrahlung radiations-Characteristics X-Rays, factors affecting X-ray emission spectra, X-ray quality and quantity, HVL measurements, heel effect, soft and hard X-Rays, added and inherent filtration, reflection and transmission targets.

2. Interaction of ionizing radiation with matter-Types of interactions of X-and gamma radiation, Photoelectric & Compton, Pair production, annihilation radiation.

3. Interaction of X and gamma rays: Transmission through matter, law of exponential attenuation, half value layer, and linear attenuation coefficient-coherent scattering-photonuclear disintegration-Particle interactions. Interactions of X rays and Gamma rays in the body; fat-soft tissue-bone-contrast media-total attenuation coefficient-relative clinical importance.

4. Exponential attenuation (linear/mass attenuation coefficients), Half Value Thickness (HVT), Tenth Value Thickness (TVT), dependence on energy and atomic number.

5. Radiation intensity and exposure, photon flux and energy flux density.

6. LET, range of energy relationship for alpha, beta particles with X-Rays.

7. X-ray tube: historical aspects, construction of X-ray tubes, requirements for X-ray production(Electron source, target and anode material), tube voltage, current, space charge, early X-ray tubes(Coolidge tubes, tube envelop and housing) cathode assembly, X-ray production efficiency, advances in X-ray tubes, anode angulation and rotating tubes-line focus principle-

space charge effect, tube cooling-Modern X-ray tubes-stationary anode, rotating anode, grid controlled X-ray tubes, heel effect, off focus radiation, tube insert and housing-Tube rating-Quality and intensity of x-rays-factors influencing them.

8. Grid controlled and high speed tubes, focal spot size, speed of anode rotation, target angle, inherent filtration, radiation leakage and scattered radiation).Interlocking and X-ray tube overload protection.

9. Heat dissipation methods, tube rating, heat units, operating conditions and maintenance and Q.A procedures.

10. Filament current and voltage, X-ray circuits (primary circuit, auto transformer), types of exposure switch and timers, principle of automatic exposure control (AEC) and practical operation, filament circuit, high voltage circuits, half wave, full wave rectification, three phase circuits. Types of generators, 3 phase, 6 and 12 pulse circuits-high frequency generators-falling load generators, Capacitors discharge and grid control systems.

11. X-ray generator circuits: Vacuum tube diodes-semi-conductor diodes-transistor-Rectification-half and full wave-self rectification-X-ray generator; filament circuit-kilo Voltage circuit-single phase generator-three phase generator-constant potential generator-Fuses, switches and interlocks-Exposure switching and timers-HT cables-earthing.

12. Physical quantity, its unit and measurement: Fundamental and derived quantity, SI unit, various physical/radiation quantity used in Diagnostic Radiology and its unit (for example, KVp, mA, mAs, Heat unit (HU).

13. Radiation quantities and units: Radiation intensity-exposure, roentgen, its limitations-kerma and absorbed dose-electronic equilibrium-rad, gray, conversion factor for roentgen to rad-quality factor-dose equivalent-rem, Sievert. Quality factor, dose equivalent, relationship between absorbed dose and equivalent dose.

14. Radiation detection and measurements: Principle of radiation detection-Basic principles of ionization chambers, proportional counters, G.M counters and scintillation detectors. Measuring system: free ionization chamber-thimble ion chamber-condenser chamber- secondary standard dosimeter-film dosimeter-chemical dosimeter-Thermo Luminescent Dosimeter-Pocket dosimeter.

15. Computed tomography, MRI, Ultrsonography, Digital Radiography-its principle, physics & equipment.

16. Picture archiving and communication system (PACS)

Conventional Radiological and Imaging Equipment

1. Production of x-rays: X-ray tube, gas filled x-ray tube, construction working and limitations; stationary anode x - ray tube; construction, working, 0methods of cooling the anode, rating chart and cooling chart; rotating anode x - ray tube: construction, working rating chart, speed of anode rotation, angle of anode inclination, dual focus and practical consideration in choice of focus, anode heel effect, grid controlled x - ray tube; effect of variation of anode voltage and filament temperature; continuous and characteristics spectrum of x - rays, inherent filter and added filter, their effect on quality of the spectrum.

2. High tension circuits: H.T. generator for x-ray machines, three phase rectifier circuits, three phase six rectifier circuit, three phase 12 rectifier circuit, high and medium frequency circuits; capacitance filter control and stabilising equipment; mains voltage compensator, mains resistance compensator, compensation for frequency variation, control of tube voltage, kV

compensator; high tension selector switch, filament circuit, control of tube current, space charge compensation.

3. Meters and exposure timers: Moving coil galvanometer: construction and working/conversion to milliammeter, ammeter and voltmeter, meters commonly used in diagnostic x-ray machines, pre reading kV meter and milliammeter, digital panel meters. Clockwork timers, synchronous motor timer, electronic timers, photo metric timers (fluorescent and photoelectric effect as applied in timers), ion chamber based timers, integrated timer.

4. Interlocking circuits: Relays: description and working, use of relays in diagnostic machines for over load protection, circuit diagram; simplified circuit and block diagrams illustrating sequence of events from mains supply to controlled emission of x-rays.

5. Control of scattered radiation: Beam limiting devices: cones, diaphragms, light beam collimator, beam centring device, methods to verify beam centring and field alignment; grids; design and control of scattered radiation, grid ratio, grid cut-off, parallel grid, focused grid, crossed grid, grided cassettes, stationary and moving grid potter bucky diaphragms, various types of grid movements; single stroke movement, oscillatory movement and reciprocatory movement.

6. Fluoroscopy: Fluorescence and phosphorescence - description, fluorescent materials used in fluoroscopic screens, construction of fluoroscopic screen and related accessories, tilting table, dark adaptation. Image intensifier - Construction and working, advantages over fluoroscopic device, principles and methods of visualising intensified image, basic principles of closed circuit television camera and picture tube. Vidicon camera, CCD. Automatic brightness control, automatic exposure control, chamber selection during fluoroscopy. Serial radiography: Manual cassette changer, rapid automatic film changer, basic principles of cine fluoroscopy and angiography use of grid controlled x-ray tube.

7. Portable and mobile x-ray units, dental x-ray unit, skull unit.

8. Mammography unit- Technical aspects of Mammography

9.General care; functional tests; testing the performance of exposure timers, assessing the MA settings, testing the available KV, measurement of focal spot of an xray tube, testing the light beam diaphragm, practical precautions pertaining to Brakes and locks, H.T. cables, meters and controls, tube stands and tracks as well as accessory equipment.

Radiographic and Imaging Techniques

1. Skeletal system:

a. Upper limb: Technique for hand, fingers, thumb, wrist joint carpal bones, forearm, elbow joint, radio ulnar joints and humerus supplementary techniques for the above. eg. carpal tunnel view, ulnar groove, head of the radius, supracondylar projections.

b. Lower limb: Technique for foot, toes, great toe, tarsal bones, calcaneum, ankle joint, lower leg, knee, patella & femur. Supplementary techniques: Stress view for torn ligaments,Subtalar joint and talo calcaneal joint. .Inter condylar projection of the knee.ibial tubercle, Length measurement technique.

c. Shoulder girdle and thorax: Technique for shoulder joint, scapular, clavicle, acromio clavicular joints, sternum, ribs, sterno-clavicular joint. Supplementary projections and techniques for recurrent dislocation of shoulder. Traumatic dislocation of shoulder. Cervical ribs.

d. Vertebral column: Technique for atlanto-occipital joint, cervical spine, cervico thoracic spine, thoracic spine, thoraco- lumber spine, lumbo sacral spine, sacrum and coccyx. Supplementary

techniques to demonstrate: Scoliosis, Kyphosis, Spondylolisthesis , disc lesion, Union of spinal graft. Adaptation of techniques to demonstrate specific pathologies.

e. Pelvic girdle and hip region: Technique for whole pelvis. Ilium, ischium, pubic bones, sacro iliac joint, symphysis pubis, hip joint, acetabulum neck of femur, greater and lesser trochanter. Supplementary techniques to demonstrate Congenital dislocation of hip joints, Epiphysis of femur, Lateral projections for hip joints to show femoral head and neck relationship.

f. Skeletal survey: Skeletal survey for metabolic bone disease, metastases, hormonal disorder, renal disorders.

g. Skull: Basic projections for cranium, facial bones, nasal bones and mandible. Technique for Petrous temporals for mastoids, Internal auditory canal, Accessory nasal sinuses,Tempero - mandibular joint, Orbits and optic foramen, Zygomatic arches,Styloid process, Pituitary fossa, Jugular foramen.

2. Dental Radiography: Technique for intra oral full mouth, Occlusal projections, Extra oral projections including orthopantomography,Supplementary techniques.

3. Upper respiratory tract:Technique for post nasal airways, larynx, trachea, thoracic inlet,Valsalva manoeuvre,Phonation.

4. Lungs and Mediastinum:Technique for routine projections,

5. Supplementary projections: Antero-posterior, obliques, lordotic, apical projection, use of penetrated postero-anterior projection, Expiration technique,Technique for pleural fluid levels and adhesions.

6. Abdominal viscera:Technique for plain film examination.- Projection for acute abdomen patients.- Technique to demonstrate: Foreign bodies, Imperforate anus.

7. Radiography using mobile Xray equipment: Radiography in the ward: Radiography in the specialised unit, such as: Intensive care unit, Coronary care, Neonatal unit,Radiography in the operating theatre.

8. Macroradiography: Principle, advantage, technique and applications.

9. Stereography: Procedure, presentation, for viewing, stereoscopes.

10. High KV techniques: Principle and its applications.

11. Soft tissue Radiography including Mammography : its techniques, equipment , advancements and applications.

12.Localization of foreign bodies: Various techniques

a 13. Operation theatre techniques: General precautions, Aspesis in techniques,Checking of mains supply and functions of equipment, selection of exposure factors, explosion risk, radiation protection and rapid processing techniques.

14. Trauma radiography/Emergency radiography,

15. Neonatal and Paediatric Radiography,

16. Tomography and Tomosynthesis

17. Dual energy X-ray absorptiometry

18. Forensic Radiography

19. Community Radiography.

Radiation Safety and Protection

Radiation safety in diagnostic Radiology

1. Introduction to Radiation protection-Need for protection,Aim of radiation protection,.

2. Limits for radiation exposure: Concept of ALARA ,maximum permissible dose ,exposure in pregnancy, children. Occupational Exposure Limits - Dose limits to public

3. Radiation Protection in: Radiography, Fluoroscopy, Mammography , Mobile Radiography ,CT Scan ,DSA and Interventional Radiology.

4. Radiation measuring instruments : survey meters , area monitor , personnel dosimeters ,film badge, thermo luminescent dosimeter, pocket dosimeter.

5. Radiation Quantities and Units: Radiation,Radioactivity,Sources of radiation - natural radioactive sources ,cosmic rays, terrestrial radiation , manmade radiation sources.Kerma, Exposure, Absorbed dose, Equivalent Dose, Weighting Factors, Effective Dose

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

7. Radiation detection and Measurements: Ionization of gases, Fluorescence and Phosphorescence, Effects on photographic emulsion. Ionization Chambers, proportional counters,G.M counters,scintillation detectors , liquid semiconductor detectors , Gamma ray spectrometer. Measuring systems : free air ionization chamber ,thimble ion chamber ,condenser chamber ,Secondary standard dosimeters, filmdosimeter ,chemical dosimeter-thermoluminescent Dosimeter,Pocket dosimeter,Radiation survey meter,wide range survey meter ,zone monitor,contamination monitor -their principle function and uses. Advantages & disadvantages of various detectors & appropriateness of different detectors for different type of radiation measurement.

8. Dose and Dosimetry, CT Dose Index (CTDI, etc.), Multiple Scan Average Dose (MSAD), Dose Length Product (DLP), Dose Profile, Effective Dose, Phantom Measurement Methods, Dose for Different Application Protocols, Technique Optimization. Dose area product in fluoroscopy and angiography systems, AGD in mammography.

9. Radiation protection, Hazard evaluation and control:: Philosophy of Radiation protection Radiation protection of self and patient and General Public, Principles of radiation protection, time - distance and shielding, shielding - calculation and radiation survey, Calculation of Work load, weekly calculated dose to radiation worker & General public Good work practice in Diagnostic Radiology.

10. Planning consideration for radiology, including Use factor, occupancy factors, and different shielding materials.Protection for primary radiation , work load ,use factor , occupancy factor , protection from scatter radiation and leakage radiation , X-Ray/Fluoroscopy/Mammography/Intervention/DSA/CT room design , structural shielding , protective devices.

11. Regulatory Bodies & regulatory Requirements: International Commission on Radiation Protection (ICRP) / National Regularity body (AERB - Atomic Energy Regulatory Board) - Responsibilities, organization, Safety Standard, Codes and Guides, Responsibilities of licenses,

registrants & employers and Enforcement of Regulatory requirements. (ICRP, NRPB, NCRP and WHO guidelines for radiation protection, pregnancy and radiation protection).

12. NABH guidelines, AERB guidelines, PNDT Act and guidelines

Newer Radiation safety protocols and recent advances in radiation safety. Role of Radiographer in Planning & Radiation Protection: Role of technologist in radiology department - Personnel and area monitoring., Setting up of a new X-Ray unit, staff requirement, AERB specifications for site planning and mandatory guidelines – Planning of X-ray/CT rooms, Inspection of X-Ray installations - Registration of X-Ray equipment installation- Certification -Evaluation of workload versus radiation factors – Occupational exposure and protection Tools/devices.

Modern Radiological and Imaging Equipment

1. High Frequency X-Ray Generators and their types and applications.

2. Modern x-ray tubes-their types and advancements.

3. Special radiological equipment: Computed radiography: its principle, physics & equipment. Digital Radiography, Direct and indirect digital radiography Digital Fluoroscopy , Digital Mammography; including cones compression devices Stereotactic Biopsy system including Prone Table Biopsy system.

4. Image Receptors: Flat Panel Detectors, Image Processing Workstation and Imaging Cameras.

5. Tomography: Body section radiography, basic principle and equipment, multi section tomography, various types of topographic movements,

6. Tomosynthesis, Stitch radiography

7. Dual energy x-ray absorptionometry (DEXA) scan.

8. Vascular Imaging Equipment: Introduction, historical developments DSA Equipment-Principle, applications and definition of terms, Single Plane, Biplane, Hybrid DSA Lab- digital subtraction techniques.

9. Scatter radiation its formation and control: beam centering devices, collimators, cone diaphragms and grids.

10. Fluoroscopy and IITV systems including cine radiography with various recording devices.

11. Computed Tomography -Principle, data acquisition concepts, image reconstruction, instrumentations, image manipulation Historical developments - Various generations, spiral/helical, single slice/multislice CT, Electron beam CT, mobile CT, Advances in volume scanning, continuous, subsecond scanning. Real time CT fluoroscopy, interventional guidance tool, 3D CT, CT angiography. Virtual reality imaging, including image quality and quality control in CT Scanners.

12. Ultrasonography: :Basic principle of U.S., various types of transducers, mechanism of image formation, various advancements including Doppler, Elastography, HIFU,ABVS and image artifacts.

13. MRI: Basic principle of MRI, complete imaging equipment and various requirements, T1 and T2 Relaxation behaviors of tissues, T1,T2 and proton density images, spatial localization of images. Types of imaging sequences (spin echo, fast spin echo, flash, inversion recovery, gradient echo etc. MR spectroscopy, principle and techniques, Contrast Agents in MRI, Image quality, Image artifacts and its compensators,NMR hazard and safety. Advances in MRI.

14. Radionuclide scanning including rectilinear scanner, gamma camera, PET, SPECT, their principles, working, applications and advancements.

15. Care and maintenance of radiological equipments

Residency part – I: In the residency the professional is expected to work and contribute in the medical imaging unit.

Second Year:

Total Teaching hours for Second year Syllabus

Sl. No.	Name of the Paper	Hours		Total
		Theory	Practical	
1	Radiological and Imaging Procedures	30	50	80
2.	Quality Assurance and Quality Control in Diagnostic Radiology and Imaging	40	70	110
3	Newer Imaging Modalities	30	40	70
4	Intervention Radiological Techniques and Patient Care	50	80	130
5	Newer Developments in Advanced Imaging Technology and Biostatistics	20	40	60
6	Seminars, Journal Clubs and Group Discussions	30	50	80
7	Residency – II (Project)	---	---	650
	Total Hours	200	330	1180

Radiological and Imaging Procedures

1. Special Radiographic/Radiological procedures

2. Selection of Fluoroscopy Equipment, general considerations, responsibility of radiographers. Patient Preparation, Indications Contraindications Technique Post Care and Preparation of Drug Trolley/Tray, Radiation Safety. Contrast Media - Positive and Negative, Ionic & Non – Ionic, Adverse Reactions To Contrast Media and Patient Management, Emergency Drugs in the Radiology Department ,Aseptic technique for the following procedures.

3. Gastrointestinal Tract: Barium swallow, pharynx and oesophagus. Barium meal and follow through. Hypotonic duodenography. Small bowel enema.Barium Enema routine projections for colon and rectum, colonic activators; double contrast studies; colostomy. Special techniques for specific disease to be examined. Including water soluble contrast media - eg. gastrograffin studies.Including CT,US and MRI Special Imaging Techniques.

4. Salivary glands: Routine technique, procedure - sialography.

5. Biliary system: Plain film radiography. Intravenous cholangiography. Percutaneous cholangiography, Endoscopic retrograde cholangio-pancreatography (ERCP). Operative cholangiography, Post-Operative cholangiography (T-tube Cholangiography). Including CT, US and MRI Special Imaging Techniques.

6. Urinary system: Intravenous urography, Retrograde pyelography. Antegrade pyelography. Cystography and micturating cystouresthrography. Urethrography (ascending) Renal puncture.

Including CT,US and MRI Special Imaging Techniques.

7. Reproductive system: All the Techniques relating to Male and Female reproductive system including Hysterosalpingography.

8. Breast Imaging: Mammography: Basic views, special views, wire localization. Ductography, Tomosynthesis, ABVS, Various Biopsy Techniques including Prone Table Biopsy, CT, US and MRI Special Imaging Techniques

9. Respiratory system: - Bronchography: Including CT,US and MRI Special Imaging Techniques.

10. Sinography:Routine technique and procedure.

11. Central Nervous System: Myelography. Cerebral studies.Ventriculography etc including CT, US and MRI Special Imaging Techniques.

12. Arthrography: Shoulder, Hip, Knee, Elbow joints etc including CT, US and MRI Special Imaging Techniques.

13. Angiographic Studies: Carotid Angiography (4 Vessel angiography). Thoracic and Arch Aortography.Selective studies: Renal, SMA, Coeliac axis. Vertebral angiography. Femoral arteriography. Angiocardiography, Peripheral angiography

14.Venography: Peripheral venography.Cerebral venography.Inferior and superior venocavography.Relevant visceral phlebography.

15. Microbiology:Introduction and morphology - Introduction of microbiology, Classification of microorganisms, size, shape and structure of bacteria. Use of microscope in the study of bacteria.Growth and nutrition -nutrition, culture media, types of medium with example and uses of culture media in diagnostic bacteriology, antimicrobial sensitivity test Sterilization and disinfection - principles and use of equipments of sterilization namely hot air oven, autoclave and serum inspissator, pasteurization, anti-septic and disinfectants.Introduction to immunology, bacteriology, parasitology, mycology

Quality Assurance and Quality Control in Diagnostic Radiology and Imaging

1. Objectives of Quality Control: Improve the quality of imaging thereby increasing the diagnostic value; To reduce the radiation exposure ; Reduction of film wastage and repeat examination ; To maintain the various diagnostic and imaging units at their optimal performance.

2. Quality Assurance activities: Equipment selection phase; Equipment installation and acceptance phase; Operational phase; Preventive maintenance.

3. Quality assurance programme in the radiological faculty level:Responsibility; Purchase; Specifications; Acceptance; Routine testings; Evaluation of results of routine testings; Quality assurance practical exercise in the X ray generator and tube; Image receptors from processing; Radiographic equipment; Fluoroscopic equipment; Mammographic equipment; Conventional tomography; Computed tomography; Film processing, manual and automatic; Consideration for storage of film and chemicals; Faults tracing; Accuracy of imaging- image distortion for digital imaging devices. LASER printer calibration

4. Quality assurance programme tests: General principles and preventive maintenance for routine, daily, weekly, monthly, quarterly, annually – machine calibration. Basic concepts of quality assurance – LASER printer - Light beam alignment; X-ray out-put and beam quality check; KVp check; Focal spot size and angle measurement; Timer check; mAs test; Grid alignment test; High and low contrast resolutions; Mechanical and electrical checks; Cassette leak check; Proper screen-film contact test; Safe light test; Radiation proof test; Field alignment test for fluoroscopic device; Resolution test; Phantom measurements - CT, US and MRI.

5. Quality assurance of film and image recording devices: Sensitometry; Characteristic curve; Film latitude; Film contrast; Film speed Resolution; Distortion; Artifacts of films and image recording. Monitor calibration. SMPTE pattern.

6. Maintenance and care of equipment: Safe operation of equipment; Routine cleaning of equipment and instruments; Cassette, screen maintenance; Maintenance of automatic processor and manual processing units; Routine maintenance of equipments; Record keeping and log book maintenance; Reject analysis and objectives of reject analysis programme.

7. Care and maintenance of diagnostic equipment: General principles and preventive maintenance for routine - daily, Weekly, monthly, quarterly, annually: care in use, special care of mobile equipment.

8. Quality Assurance and quality control of Modern Radiological and Imaging Equipment which includes Digital Radiography, Computed Radiography, CT scan, MRI Scan, Ultrasonography and PACS related. Image artifacts their different types, causes and remedies

Newer Imaging Modalities

1. Basic Computed Tomography- Basic principles of CT, generatiosn of CT, CT instrumentation, image formation in CT, CT image reconstruction, Hounsfield unit, CT image quality, CT image display

2. Advanced Computed Tomography - Helical CT scan: Slip ring technology, advantages, multi detector array helical CT, cone – beam geometry, reconstruction of helical CT images, CT artifact, CT angiography, CT fluoroscopy, HRCT, post processing techniques: MPR, MIP, Min IP, 3D rendering: SSD and VR, CT Dose, patient preparation, Imaging techniques and protocols for various parts of body, CT contrast enhanced protocols – CT angiography – (Aortogram, selective angiogram head, neck and peripheral) image documentation and Filing, maintenance of equipment and accessories.

3. Advanced technique & instrumentation of MRI

4. Basic Principle: Spin – precession – relaxation time – pulse cycle – T1 weighted image – T2 weighted image – proton density image.

5. Pulse sequence : 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 – Advanced pulse sequences.

6. MR Instrumentation: Types of magnets – RF transmitter – RF receiver – Gradient coils – shim coils – RF shielding – computers.

7. Image formation: 2D Fourier transformation method – K-space representation – 3D Fourier imaging – MIP.

8. MR contrast media – MR angiography – TOF & PCA – MR Spectroscopy – functional MRI Ultrasonography

Basic Acoustics, Ultrasound terminologies: acoustic pressure, power, intensity, impedance, speed, frequency, dB notation: relative acoustic pressure and relative acoustic intensity.

Interaction of US with matter: reflection, transmission, scattering, refraction and absorption, attenuation and attenuation coefficients, US machine controls, US focusing.

9. Production of ultrasound: Piezoelectricity, Medical ultrasound transducer: Principle, construction and working, characteristics of US beam.

10. Ultrasound display modes: A, B, M

11. Real-time ultrasound: Line density and frame rate, Real-time ultrasound transducers:

mechanical and electronic arrays, ultrasound artifacts, ultrasound recording devices, and Distance, area & volume measurements.

12. Techniques for imaging different anatomic areas, ultrasound artifacts, biological effects and safety.

13. Doppler Ultrasound- Patient preparation for Doppler, Doppler artifacts, vascular sonography,

14. Elastography, HIFU, ABVS etc.

15. Fusion Imaging -PET CT & PET MRI

Intervention Radiological Techniques and care of Patient

1. Basic Angiography and DSA:

History , technique, patient care, Percutaneous catherisation, catheterization sites, Asepsis ,Guide wire, catheters, pressure injectors, accessories, Use of digital substraction- single plane and bi-plane.

All forms of diagnostic procedures including angiography, angioplasty, biliary examination, renal evaluation and drainage procedure and aspiration cytology under flouoro,CT,US,MRI guidance.

2. Central Nervous System: Myelography.Cerebral studies.Ventriculography.

3. Arthrography: Shoulder, Hip, Knee, Elbow

4. Angiography: Carotid Angiography (4 Vessel angiography).Thoracic and Arch Aortography. Vertebral angiography, femoral arteriography. Selective studies: Renal, SMA, Coeliac axis.Angiocardiography.

5. Venography: Peripheral venography, Cerebral venography, Inferior and superior venocavography. Relevant visceral phlebography.

6. Cardiac catheterization procedures: PTCA, BMV, CAG, Pacemaker.

7. Microbiology Introduction and morphology - Introduction of microbiology, Classification of microorganisms, size, shape and structure of bacteria. Use of microscope in the study of bacteria. Growth and nutrition -nutrition, culture media, types of medium with example and uses of culture media in diagnostic bacteriology, antimicrobial sensitivity test.Sterilization and disinfection - principles and use of equipments of sterilization namely hot air oven, autoclave and serum inspissator, pasteurization, anti-septic and disinfectants.

Care of Patient in Interventional Radiology

1. Introduction to patient care: responsibilities of healthcare facility-responsibilities of the imaging technologist.

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-assisting in IV injection.

3. Surgical Asepsis:The Environment and Surgical Asepsis, Methods of Sterilization, Disinfection, Opening Sterile Packs, Changing Dressing.

4. 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

5. Patient care during investigation: GI tract, biliary tract, respiratory tract, Gynecology, cardiovascular lymphatic system, CNS etc.

6. Infection control: definitions- isolation techniques-infection sources-transmission modes-procedures-psychological considerations – sterilization & sterile techniques.

7. Patient education: communication – patient communication problems – explanation of examinations-radiation safety/protection – interacting with terminally ill patient.

8. Medical Emergencies : Shock, Pulmonary Embolus, Diabetic Emergencies, Respiratory Failure, Cardiac Failure, Airway Obstruction, Stroke, Fainting, Seizures.

9. Drug Administration: Sys tem of Drug Administration, Medication Error and Documentation, Equipment for Drug Administration, Methods of Drug Administration, Care of patient with Intravenous Infusions

Newer Developments in Advanced Imaging Technology and Biostatics.

1. In addition to existing Radiological and Imaging Modalities -Newer Developments in Digital Imaging CT,MRI,US and any other modality.

2. Newer Radiological and Imaging Equipment: including Computed radiography: Digital Radiography, Digital Fluoroscopy, Digital Mammography and DSA - Introduction to Newer Technology innovations, software and its applications.

3. Computed Tomography Introduction to Newer Developments/ Newer Technology innovations, software and its applications.

4. MRI Introduction to Newer Developments/Newer Technology innovations, software and its applications.

5. Advanced Ultrasonography Newer Developments/Newer, Technology innovations, software and its applications.Elastography, HIFU, ABVS etc.

6. Fusion Imaging -PET CT & PET MRI

7. Teleradiology, HIS, RIS, PACS, Imaging Processing and Archiving.

Biostatistics & Basic Research Methodology

1. What is statistics – importance of statistics in behaviors sciences- descriptive statistics and inferential statistics-usefulness of qualification in behavioral sciences – scales of measurements-nominal, ordinal, interval and ratio scales.

2. Data collection – classification of data-class intervals – continuous and discrete measurements-drawing frequency polygon-histogram-cumulative frequency curve-ogives-drawing inference from graph.

3. Measures of central tendency- need-types: mean, median, mode – working out these measures with illustrations. Measures of variability – need- types range, quartile deviation, average deviation, standard deviation, variance-interpretation.

4. Normal distribution-general properties of normal distribution-theory of probability-illustration of normal distribution-area under the normal probability curve. Variants from the normal distribution-skewness-quantitative measurements of skewness-kurtosis- measurements of kurtosis-factors contributing for non-normal distribution

5. Correlation-historical contribution-meaning of correlation-types: rank correlation, regression analysis.

6. Tests of significance- need for-significance of the mean-sampling error-significance of differences between means-interpretation of probability levels-small samples-large samples-inferential statistics-parametric and non-parametric methods-elements of multivariate analysis

Seminars, Journal Clubs and Group Discussions

Each student will be assigned topics for presentations as seminars, will explore recent innovations in MRIT for presenting topics during journal clubs and shall be holding group discussions along with other students in the presence of MRIT faculty. This will also include

visits to other Institutions, Factories or Industries in the field of MRIT.

Project

Each candidate will have to carry out of a project on the related subject. The project will be guided by one or two members of the faculty or medical Physicists of the department. The project will be evaluated by the External/Internal Examiners at the time of viva voice examination of the candidate during the second year. The candidate will be asked to make PPT presentation before the External / Internal Examiner at the time of practical Examination

Scheme of Examination:

First Year:

Sl. No.	Name of the Paper	Maximum Marks	Minimum Marks
1.	Radiological Physics	100	50
2.	Conventional Radiological and Imaging Equipment	100	50
3.	Radiographic and Imaging Techniques	100	50
4.	Radiation Safety and Protection	100	50
5.	Modern Radiological and Imaging Equipment	100	50

Second Year:

Sl. No.	Name of the Paper	Maximum Marks	Minimum Marks
1	Radiological and Imaging Procedures	100	50
2	Quality Assurance and Quality Control in Diagnostic Radiology and Imaging	100	50
3	Newer Imaging Modalities	100	50
4	Intervention Radiological Techniques and Patient Care	100	50
5	Newer Developments in Advanced Imaging Technology and Biostatistics	100	50

	Maximum Marks	**Minimum Marks**
Project	**100**	**50**
Practical / Viva	**100**	**50**
I.A	**50**	**25**
Total	**250**	**125**

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