SANTOSH DEEMED TO BE UNIVERSITY
PRATAP VIHAR, GHAZIABAD, UP

M.Sc. MEDICAL IMAGING TECHNOLOGY

PROPOSED GUIDELINE & SYLLABUS

EFFECTIVE FROM AUGUST (2021)
SESSION 2021-2022
DURATION – 2 YEARS

DEPARTMENT OF RADIO DIAGNOSIS
SANTOSH MEDICAL COLLEGE HOSPITALS
NO.-1, AMBEDKAR ROAD, GHAZIBAD, UP.

COURSE M.Sc. MEDICAL IMAGING TECHNOLOGY (M.Sc. MIT)

INTRODUCTION: ----------

AIMS : ----------

OBJECTIVES:----------

NO OF SEATS : 10 (TEN)

DURATION-2 YEARS

ELIGIBILITY

The Candidates who possess B.Sc. Allied Health Sciences/ Medical Laboratory Technology/ Biochemistry/ Microbiology or its equivalent qualifications from a Recognized Institution/ University.

COMMENCEMENT OF THE COURSE
August, 2021

ATTENDANCE: - minimum attendance for the course to be shown by the student is 80% in each year.

PROGRAM: -Master of Science in Medical Imaging Technology

STUDY & SYLABUS – EVALUATION SCHEME

M.Sc. MIT 1st Year

YEAR	PAPER TITLE	INTERNAL ASSESSMENT [THEORY]	UNIVERSITY [THEORY]	VIVA	INTERNAL ASSESSMENT [PRACTICAL]	UNIVERSITY [PRACTICAL]	TOTAL
1ST YEAR 4 Papers	1. Human anatomy and physiology.	20	80	20	10	20	150
	2. Radiation Physics, hazardous, prevention and protection.	20	80	20	10	20	150
	3. Conventional radiological Imaging.	20	80	20	10	20	150
	4. Radiographic imaging Techniques & procedures	20	80	20	10	20	150

MIT 2nd Year

YEAR	PAPER TITLE	INTERNAL ASSESSMENT [THEORY]	UNIVERSITY [THEORY]	VIVA	INTERNAL ASSESSMENT [PRACTICAL]	UNIVERSITY [PRACTICAL]	TOTAL
2ND YEAR 3 + 1 papers	1. Quality assurance and quality control in diagnostic radiology and nuclear medicine.	20	80	20	10	20	150
	2. Advance technique and instrumentations in Mammography, DEXA, CT, Ultrasound, MRI and Interventional radiological techniques.	20	80	20	10	20	150
	3. Biostatistics and Dissertation.	20	80	20	10	20	150
	[FULLY INTERNAL PAPER]					150	150
TOTAL		140	560	140	70	290	1200

M.Sc. MIT 1ST Year

PAPER-1

SUBJECT: - HUMAN ANATOMY& PHYSIOLOGY

UNIT- 1 Gross Anatomy, Radiological and Surface Anatomy of Human Body Introduction: human body as a whole, structure of cell and tissues of body: epithelial tissue, connective tissue, muscle tissue and nervous tissue

UNIT-II Anatomy of the various systems of body Skeletal system: Classification of bones- Axial skeleton, Appendicular skeleton, Bones – structure and functions, - formation of bone, growth of skeleton, centers of ossification, fracture and dislocation, disease of bones, and Radiological and Surface Anatomy. Joints: Classification of joints with example, anatomy of various joints of head and neck, trunk and limbs.

UNIT-III 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.

UNIT-IV Gastro-intestinal System: Parts of GIT, Oral cavity salivary glands, Esophagus, 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, supra-renal and pancreas.

UNIT-V 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

M.Sc. MIT 1ST Year

PAPER-2

SUBJECT:- RADIATION PHYSICS, RADIATION HAZARDS PREVENTION AND PROTECTION

RADIATION PHYSICS:

UNIT I - X-rays: Discovery of x-rays-X-ray production and properties: Bremsstrahlung radiation 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.

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

UNIT III - 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.

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

UNIT V - Radiation intensity and exposure, photon flux and energy flux density.

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

UNIT VII - 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.

UNIT VIII - 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.

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

UNIT X - 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.

UNIT XI - 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-earthen.

UNIT XII-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, Kepi, mA, mAs, Heat unit (HU).

UNIT XIII-Radiation quantities and units: Radiation intensity-exposure, roentgen, its limitations kerma and absorbed dose-electronic equilibrium-rad, gray, conversion factor for roentgen to radquality factor-dose equivalent-ram, Subvert. Quality factor, dose equivalent, relationship between absorbed dose and equivalent dose.

UNIT XIV-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.

RADIATION HAZARDS PREVENTION AND PROTECTION:

UNIT I - Radiation protection**,** Natural and background radiation (cosmic, terrestrial),Principles of radiation protection**,** Time - distance and shielding, shielding calculation and radiation survey, Personnel dosimeters (TLD and film batches), occupational exposure, radiation protection of self and patient, ICRP, NRPB, NCRP and WHO guidelines for radiation protection, pregnancy and radiation protection, Revision of Somatic & Genetic Radiation effects, Units Detection & measurements Radiation protection Standards, radiation surveys & regulations. Patient Protection

UNIT II - Biological effects of Ionizing Radiation**,** Ionization, excitation and free radical formation, hydrolysis of water, Action of radiation on cell, DNA, RNA, chromosome, tissue and organ, cytoplasm, cellular membranes, effects of whole body and acute irradiation.

UNIT III - Dose fractionation. Effects of ionizing radiation on each of major organ system including fetus stochastic and non-stochastic effects. Mean and lethal dose, direct and indirect effects, multi target and multi hit theory, stochastic and deterministic effects-Acute exposure and chronic exposure-LD50 - factors affecting radio sensitivity**UNIT IV-** Measuring systems – free air ionization chamber – thimble ion chamber – condenser chamber – Secondary standard dosimeters – film dosimeter – chemical dosimeter- Thermoluminiscent Dosimeter. -Pocket dosimeter Radiation survey meter- wide range survey meter -zone monitor-contamination monitor their principle function and uses. Advantages & disadvantages of various detectors & its appropriateness of different detectors for different type of radiation measurement.

UNIT V- Biological effects of non-ionizing radiation like ultrasound, lasers, IR, UV and magnetic fields.

M.Sc. MIT 1ST Year

PAPER-3

SUBJECT-CONVENTIONAL RADIOLOGICAL AND IMAGING EQUIPMENTS

UNIT- I X-ray tubes: x-ray tube, construction working and limitations, stationary anode x – ray tube; construction, working, methods of cooling the anode, 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.

UNIT-II Cassettes**:** Structure and function, Types, Design features and consideration with loading/unloading, Care and maintenance (cleaning)

UNIT-III Intensifying Screen & Filters: Structure and functions, common phosphors used for determination of relative speeds, types, screen mounting, care and maintenance of film screen contact.

UNIT-IV Control of scattered radiation: Beam limiting devices: cones, diaphragms, light beam collimator, beam centering device, methods to verify beam centering and field alignment.

Grid: Purpose and function, grid ratio, grid cut-off effect on radiation exposure, use of grid, structure and materials.

Types: Stationary, parallel, focused, cross-hatch Moving grids. Purpose/advantages/disadvantages

UNIT-V Fluoroscopic: Fluorescence and phosphorescence - description, fluorescent materials used in fluoroscopic screens, construction of fluoroscopic screen and related accessories, tilting table.

UNIT-VI Dental X-Ray & OPG.

UNITVII- DEXA SCAN.

M.Sc. MIT 1ST Year

PAPER-4

SUBJECT- RADIOGRAPHIC AND IMAGING TECHNIQUES & PROCEDURES

UNIT-I Introduction to X-Rays, Propertiesof X- Rays, X-Ray production, Bremsstrahlung phenomenon, factors affecting X-Ray emission spectra, X-Ray quality and quantity.

UNIT-II Film**:** Types, composition of single and double coated radiographic films, Screen &Non-Screen films, structure of film, characteristic curve. characteristics (speed, base + fog, gamma, latitude), Film storage rules and guidelines, film handling and care (size, construction and function), film contrast.

UNIT-III Introduction, purpose and location of dark room, layout of dark room, entrance, pass box, hatch, hangers, safe light, criteria of safe light, safe light test.

UNIT-IV Image formation, latent image processing, manual processing. Developer, fixer, rinser components, replenisher. Manual technique of developing film.

UNIT-V Automatic processing: Automatic film processor, common errors in processing.

UNIT-VI Radiographic positioning

UNIT-VII Special Radiographic/Radiological procedures. Selection of Fluoroscopic 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.

UNIT-VIII Gastrointestinal Tract: Barium swallow, pharynx and esophagus. 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 - e.g. gastrographic studies. Including CT, US and MRI Special Imaging Techniques.

Salivary glands: Routine technique, procedure -sialography.

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

Sinography: Routine technique and procedure and techniques.

UNIT-IX Urinary system: Intravenous urography, retrograde pyelography. Antegrade pyelography. Cystography and micturatingcystourethrography. Urethrography (ascending) renal puncture. Including CT, US and MRI Special Imaging Techniques.

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

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

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

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

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

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

Venography: Peripheral venography. Cerebral venography. Inferior and superior venocavography.

M.Sc. MIT 2nd Year

PAPER-1

SUBJECT- QUALITY ASSURANCE AND QUALITY CONTROL IN DIAGNOSTIC RADIOLOGY AND IMAGING

UNIT I

Various Radiographic equipment and accessories.

Component parts labelling .

Equipment used for sonography, computed radiography, CT, MRI and digital radiography

Differences in various types and models and portable radiographic equipment

UNIT II

X- Ray tubes

Theory of the operation of x-ray tube construction and function of an x ray tube.

Determine the maximum allowable exposure factors for various radiographic procedures using x ray tube rating chart

Determine the rate of anode and tube hosing cooling x ray tube warm-up procedure of radiographic equipment for various manufactures

UNIT III

Image quality

Image contrast, ABC (automatic brightness control), noise, sharpness magnification, spatial and temporal resolution

UNIT IV

Safety checks of radiographic equipment

Safety checks of radiographic equipment and accessories such as lead apron and gloves and collimator accuracy

Quality control and quality assurance

Identify symptoms of malfunction in radiographic equipment

UNIT V

Quality control and quality assurance

Quality assurance and quality control of x ray, CT,MRI ,USG, DEXA, DR,CR, Fluoroscopy, mammography, DSA, portable equipment .

Quality of dark room, PC, PNDT act and its rules.

M.Sc. MIT 2nd Year

PAPER-2

SUBJECT-ADVANCE TECHNIQUE AND INSTRUMENTATION OF ULTRASOUND, MAMMOGRAPHY DEXA, CT, ULTRASOUND, MRI AND INTERVENTIONAL RADIOLOGICAL TECHNIQUES

UNIT – I Mammography

Dedicated mammographic unit and its special features, Mammographic Positioning and technical considerations, film screen mammography, digital mammography, Tomosynthesis.

UNIT – II Ultrasound

Principle & history of Ultrasound, advantages and disadvantages of ultrasound, Types of Ultrasounds, Equipment description, Indication and Clinical Application, Physics of ultrasound imaging, Physics of transducers, Physics of Doppler, Ultrasound tissue characterization, Potential for three-dimensional ultrasound, Artifacts in ultrasound, Comparison of ultrasound equipment Computerization of data, Image recording, Ultrasound jelly & Safety of ultrasound.

UNIT – III USG Contrast Media

Production of ultrasound: Piezoelectricity, Medical ultrasound transducer: Principle, construction and working, characteristics of US beam. Types of Ultrasound Contrast media and its advantages

UNIT – IV Echocardiography

Introduction, indication and image formation. Uses of color Doppler in echocardiography and equipment description with the transducer

UNIT V Ultrasound display modes: A, B, M

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

Doppler Ultrasound- Patient preparation for Doppler, Doppler artifacts, vascular sonography, Elastography, HIFU, ABVS etc.

UNIT VI Basic Computed Tomography- Basic principles of CT, generations of CT, CT instrumentation, image formation in CT, CT image reconstruction, Hounsfield unit, CT image quality, CT image display.

UNIT VII 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.

UNIT-VIII Advanced technique & instrumentation of MRI

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

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.

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

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

MR contrast media – MR angiography – TOF & PCA – MR Spectroscopy – functional MRI

M.Sc. MIT 2nd Year

PAPER-3

SUBJECT-BIOSTATISTICS AND DISSERTATION

UNIT I

Rationale: The objective of this module is to help the students understand the basic principles of research and methods applied to draw inferences from the research findings. The students will also be made aware of the need of biostatistics and understanding of data, sampling methods, in addition to being given information about the relation between data and variables.

UNIT II

Research Methodology:

Introduction to research

methods Identifying research

problem Ethical issues in

research Research design

Basic Concepts of Biostatistics

Types of Data

UNIT III

Research tools and Data collection methods, sampling methods, Developing a research proposal.

UNIT IV

Biostatistics:

Need of biostatistics

What is biostatistics: beyond definition

Understanding of data in biostatistics

How & where to get relevant data

Relation between data & variables

Type of variables: defining data set

Collection of relevant data: sampling methods

UNIT V

Construction of study: population, sample, normality and its beyond (not design of study, perhaps), Summarizing data on the pretext of underlined study, Understanding of statistical analysis (not methods)