Syllabus for Medical Radio Imaging Associate

Course Name	**Medical Radio Imaging Associate**
Course Code	***STC - HLC /2023/1621***
Sector	***Healthcare; (Paramedical)***
Course Level	***4***
Occupation	***Medical Radiology Assistant / Technician***
Job Description	Medical Radio Imaging Associate assist Radio Technologist/Radiologist to operates advanced medical imaging equipment, ensuring precise patient positioning and applying appropriate imaging techniques. They prioritize patient safety, minimizing radiation exposure and addressing patient concerns. They process and review acquired images, collaborate with healthcare teams for accurate diagnoses and maintain comprehensive records.
Course Duration	***1260 hrs (Th. 390Hrs, Prac. 480Hrs, ES 60Hrs, OJT. 330 Hrs at* a Large Laboratory OR *at a 100 or more bedded hospital for a period of not less than 6 months.)***
Trainees' Entry Qualification	Class XII Pass Out with Chemistry & Biology
Trainers Qualification	Trainers already registered with West Bengal Allied & Paramedical Council in relevant training module OR Post Graduate in Medical Lab Technology with relevant experience OR Doctors with MD/MBBS/BHMS/BAMS or persons holding GNM/B.SC Nursing Certificate with relevant experience. *Post Graduate of relevant Allied Healthcare Community will be preferred***.**

Structure of Course:

Module No.	Module name	Outcome	Theory (Hrs)	Practical (Hrs)	Total (Hrs)
1	**Anatomy & Physiology**	Comprehend and explain the fundamental principles of human anatomy and physiology, including the structure and function of major organ systems, cellular processes and the integration of various physiological mechanisms within the human body.	30	60	90
2	**General & Radiation Physics**	Demonstrate the principles of general and radiation physics with behavior of radiation, interaction of X and Gamma rays, the operation of radiographic equipment with interpretation of medical images in radiology.	30	60	90
3	**Radiology Equipment**	Describe the essential operation, components and functioning of various radiology equipment used in medical imaging including X-ray machines, Fluoroscopic equipment, MRI scanners, CT	40	50	90

		scanners and other radiological equipment generate images, capture data, ensure patient safety and contribute to accurate diagnostic procedures.			
4	**Clinical Radiography**	Describe the process , step by step workflow of conducting radiological examinations of clinical radiology includes Extremities Radiography, Spine Radiography, Skull Radiography, Chest Radiography, Abdomen & Pelvic Radiography and Micro Radiography	60	60	120
5	**X-Ray Film / Image Processing Technique**	Recognize the essential steps and techniques involved in processing and enhancing X-ray films or images to produce diagnostically valuable results in radiology.	40	50	90
6	**Advance Radiography**	Demonstrate advanced radiography processes, encompassing specialized imaging procedures, intricate equipment operation, patient management and advanced image interpretation techniques.	60	60	120
7	**Advance Imaging Techniques**	Explain the process of advanced imaging techniques including Mammography, Ultrasonography, CT scan, MRI scan and Angiography to facilitate comprehensive diagnostic insights.	60	60	120
8	**Quality Control in Radiology**	Comprehend and implement the essential principles and procedures of quality control in radiology, ensuring optimal performance and accuracy of imaging equipment and procedures	60	60	120
9	**Medical Ethics**	Follow the principle of medical ethics in healthcare settings while upholding patient rights, confidentiality, and ethical standards	10	20	
10	**Employability Skill**		60		60
11	**OJT**	At a Large Laboratory OR at 100 or more bedded hospital for a period of not less than 6 months.		330	330
TOTAL:			***450***	***810***	**1260**

SYLLABUS:

Module No. 1: Anatomy & Physiology

Module Outcome: Comprehend and explain the fundamental principles of human anatomy and physiology, including the structure and function of major organ systems, cellular processes and the integration of various physiological mechanisms within the human body.

Theory Content:

1. General structure of the human body, anatomic terminology, planes of section-Structure and function of **human cell** with special reference to mitochondria and ribosomes.

2.Elementary tissues of human body- Epithelial tissue, muscular tissue, connective tissues and nervous tissue.

3. Cardio Vascular System - Anatomy of heart and functions- Structure and functions of various parts of the heart, arterial and venous system, brief account on common cardiovascular disorders. Blood pressure and its recording. Anatomy and function of arteries, capillaries and Arterial system, Venous system.

4.Hematology-Composition of Blood - functions of blood elements –Blood Group and coagulation of blood, disorders of blood.

5.Lymphatic system - Name and function of lymph glands, Lymphatics and Lymphatic pathway outline.

6.Respiratory System: various parts of respiratory system and their functions, Anatomy of upper respiratory tract, Structure and functions of lungs, Anatomy of bronchial tree, Physiology of Respiration.

7. Digestive System - names and various parts of digestive system-Buccal Cavity, Pharynx, Oesophagus, Stomach, intestine etc.-physiology of digestion and absorption, Structure functions salivary glands. Enzymes, Structure and functions of pancreas, Anatomy of teeth, Pharynx, Oesophagus, Functions of Stomach and duodenum, Small & Large intestine structure & functions.

Anatomy and function of liver, LFT, Physiology of Jaundice. Anatomy of Portal circulation and portal hypertension. Gall bladder, structure and function, Physiology of digestion and food components.

8.Urinary System: various parts of urinary system and its function-structure and function of kidneys-Anatomy of ureters, bladder and urethra –physiology of urine formation, its constituents- pathophysiology of renal disease and edema.

9. Reproductive System physiology and anatomy of Male & Female reproductive system-Prostate & Uterus & Ovaries etc. The Mammary glands – anatomy & physiology and & its importance in imaging.

10.Musculoskeletal System: Classification of bones & joints, structure of skeleton – structure of skeletal muscle – physiology of muscle contraction, Structure and classification of joints, movements at the joints. Bones & Joints of upper extremity, Bones of thoracic cage, Clavicle and scapula, Joints of shoulder girdle, Bones of pelvis, Bones & Joints of lower extremity, Bones of
skull and Fontanelles, Base of skull, Bones of face, Cervical spine and atlanto axial joints, Dorsal spine, Lumbo Sacral spine, Mandible and TM joints, Mastoids and PNS.

11. Eye & ENT: Anatomy of Ear, hearing, vision. Anatomy of eye, Orbits including orbital fissure and optic foramina. Nose, Throat- Elementary knowledge on functions of
taste, smell

Practical Content:

1. Study of human skeleton.
2. Study with the help of charts and models of the following systems and organs.
a) Digestive system e) Reproductive system
b) Respiratory system f) Nervous system
c) Cardio-vascular system g) Eye
d) Urinary system h) Ear
3. Microscopic examination of epithelial tissue, cardiac muscle, smooth muscle, skeletal muscle, connective tissue and nervous tissue.
4. Examination of blood films for TLC, DLC and malarial parasite.
5. Determination of clotting time of blood, erythrocyte sedimentation rate and hemoglobin value.
6. Recording of body temperature, pulse, heart rate, blood pressure and ECG.

Module No. 2: General & Radiation Physics

Module Outcome: Demonstrate the principles of general and radiation physics with behavior of radiation,

interaction of X and Gamma rays, the operation of radiographic equipment with interpretation of medical images in radiology.

Theory Content:

1. Basic concepts: Basic Units, Heat, Acoustics etc. Basic concepts of power, work, force, energy - Einstein's formula - Electronics, Electricity & Magnetism, -electromagnetic waves - Units and measurements - temperature and heat-SI units of above parameters-Atomic structure- Nucleus - Atomic Number, Mass Number electron orbit and energy levels-Periodic table -Isotopes-Isobars-Ionisation and excitation.

2. Electromagnetic induction: Electric charges-electric induction – electric potential capacitance and capacitors. electrical energy and power - unit of current-resistance and Ohm's law - circuit laws - heating effect of current – sources of electrical energy - e.m.f. Magnetism-Magnetic effect of an electric current - applications of magnetic field. Electro-magnetic induction, laws of mutual induction and self induction. Alternating current-transformers theory and losses - practical aspects-reactance –resonance - impedance and power factors.

3. Radioactivity: Natural and artificial radioactivity-alpha decay-beta decay and spectra – gamma emission-positron decay electron capture and internal conversion-Exponential decay-Half life-Unit of activity-specific activity. Nuclear Fission-Nuclear reactor. Radiation sources-Natural and artificial-production of radio isotopes-reactor produced isotopes-Fission products-Gamma ray source for Medical uses.

4 Interaction of X-and Gamma rays: Attenuation of X-ray or Gamma rays absorption and scattering-half value layer-coherent scattering-Photo electric absorption-Compton scattering-pair production and photoelectric disintegration. X-Ray transmission through medium-linear and mass attenuation coefficients. HVT - TVT and interaction of charged particle and neutrons with matter. Interaction of X-and Gamma rays in body-fat-soft-tissue-bone-contrast medium- Total attenuation coefficient. Relative important of different types of interactions.

5. Physics of Diagnostic Radiology : X-ray Tube: Anode & Cathode - Thermionic diode – X- ray valves and tubes –principle and practical aspects – semiconductors – triode valves – cathode ray oscilloscopes – X-ray circuits – self rectifying circuits – half wave pulsating voltage circuits – full valve pulsating voltage circuits - measurement of high voltage – control of KV circuit – mA circuit. X-ray beam quality.

X-Ray generators and circuits-Filament current and voltage, X-Ray circuits -primary circuit-auto transformer-switch and timers- principle of automatic exposure control 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- falling load generators capacitors discharge and grid control systems.

X-ray tables-floating top table & variable height table.

X-Ray Grids /Bucky

Scattered Radiation -Significance of scatter – Beam limiting devices.-Grid principle and structure – Types of Grids - vertical bucky- versatile bucky -Stationary grid, parallel grid, focused grid – crossed grid, moving grid – Potter Bucky Diaphragm- Control of scattered radiation and grids/Bucky - Methods of minimizing formation of scatter radiation, types of grids and grid ratio- use of cones – diaphragm/ light beam devices - effectiveness of collimation - limitations of the primary beam/the light beam diaphargm -Effects of scatter radiation on radiograph image quality, patient dose and occupational exposure.

X-Ray Casettes & Intensifying screens: Fluorescence – constituents of intensifying screens – types of screens-intensification factors-speed of screen unsharpness. Cassette-construction-types of cassettes- use of fluorescent screen in radiology, effect of screen in reduction of patient dose

Practical Content:

Topics:-

1. Congruence of Radiation and Optical field and beam.
2. Determination of focal spot size of diagnostic X-ray tube.
3. K.V. and Exposure time testing.
4. Linearity testing of the Timer.
5. Consistency of M.A. loading.
6. Consistency of Radiation Output.
7. Evaluation of Total filtration of the tube.

8. Film screen contact testing.
9. Table top Exposure rate measurement in fluoroscopy.
10. Radiation protection survey, in and around of diagnostic installations.

Module No. 3: Radiology Equipment

Module Outcome: Describe the essential operation, components and functioning of various radiology equipment used in medical imaging including X-ray machines, Fluoroscopic equipment, MRI scanners, CT scanners and other radiological equipment generate images, capture data, ensure patient safety and contribute to accurate diagnostic procedures.

Theory Content:

1. X-ray machines – X-Ray tube: historical aspects - early X-Ray tubes (Coolidge tubes) - construction of X-Ray tubes, requirements for X-Ray production (electron source, target and anode material), anode angulation and rotating tubes- tube voltage, current – space charge - tube envelop and housing - cathode assembly, production efficiency, advances in X-Ray tubes, Common factors affecting thermionic emission -specialized types- grid controlled and high speed tubes. Inherent filtration, radiation leakage and scattered radiation. Heat dissipation methods- Interlocking and X-Ray tube overload protection -tube rating, heat units- operating conditions, maintenance and Q.A procedures.

2. Portable/Mobile X-ray units- Equipment for mobile radiography-principle uses- mobile image intensifiers– Capacitor discharge unit- advantages and limitations -positioning differences-skill in using mobile units - - radiation protection.- mobile units types-differences-Cordless mobiles-selection of equipment.

3. Fluoroscopy: Fluoroscopic equipment-Direct fluoroscopy – The serial changer (spot film device) - Fluoroscopic screen -fluoroscopic image -factors affecting the Fluoroscopic image. Image intensifier tubes – principle construction and function regarding intensified image- cine flurography-mode of operation - Types of day light film handling system-optical coupling and methods of viewing- Automatic brightness control- tilting tables - over and under couch tubes-safety features. The television process – television camera tube– the Cathode ray tube – television image-CCTV. Quality assurance tests for fluoroscopic equipment.

4. Computed Radiography (C.R) –equipment parts –advances- principle of imaging – applications-advantages & disadvantages.

5. Digital Radiography– principle – photo stimulable phosphors-image acquisition-digital spot imaging - equipment parts –advances-imaging– advantages & disadvantages. Picture characteristics - archiving possibilities transfer system and designs- Image recording devices-laser imager and multi formatter-Future developments.

6. Mammography -basic principle, equipment & image acquisition-conventional & digital mammo studies- Mammotomogram.

7.Dental Radiography – Equipment Basics –types of equipments- Intra oral radiography unit-orthopantomograph unit -imaging techniques- Dental films-film types and processing.

8.Tomography: Theory of tomography – multi section radiography- Tomography equipment-Basic requirements and controls, attachments. Computed tomography – Scanning principle – Reconstruction of image – storing the image – viewing the image – evaluation of the image. Types of movements and applications-Effect on image of variation in focus object distance-Object film distance, exposure angle, and tube movement pattern.

9. Computed Tomography- Basic physics – Tomography principle – detectors technology-digital fundamentals- Basic data acquisition concepts –Scanning principle - basics of plain studies- Image reconstruction- artifacts- contrast studies,-special procedures – image quality-storing the image – viewing the image– evaluation of the image- Equipment for computed tomography – Table, scanning gantry X-Ray generator – CT control console. Scanner types – technologic considerations of sequential /spiral volume zoom -computer hard wire of software– CT computer and image processing system- Options and accessories for CT systems. -Tools for use in CT guided Interventional procedures-Dosimetry- Future developments.

10.Angiography Equipments- Basic physics and principle of image acquisition conventional angio- DSA-Cardiac Cath lab. Equipments- advantages-limitations Dosimetry – Maintenance.

Practical Content:

Demonstration of basic procedures with all radiographic equipment

1. X Ray & Portable X Ray
2. Fluoroscopy
3. CT
4. MRI

Module No. 4: Clinical Radiography

Module Outcome: Describe the process, step by step workflow of conducting radiological examinations of clinical radiology includes Extremities Radiography, Spine Radiography, Skull Radiography, Chest Radiography, Abdomen & Pelvic Radiography and Micro Radiography

Content:

Conventional Non contrast radiography-

Extremities Radiography – Hand- Finger –MCP- Wrist joint- Forearm -Elbow joint humerus - shoulder joint. Foot – Toes- Tarsal bones -Ankle joint - Knee joint – patella – tibia- femur – Hip joint – pelvis -sacroiliac joint.

Spine Radiography -Vertebral column – Atlanta occipital articulation- cervical spine- dorsal spine - lumbar spine – sacrum -vertebral canal- vertebral foramen.

Skull Radiography – general, sella – temporal bone – mastoid – optic foramen –Internal auditory canal – Superior and inferior orbital fissure – base of skull – facial bones – petrous apex – Zygomatic bone, nasal bone, sinuses of skull – mandible –Tempro-mandibular joint – Para-nasal sinuses Radiography.

Chest Radiography –Basic views (PA & AP) - inspiratory & expiratory films special chest views & their significance – larynx- trachea- thoracic inlet -Sternum - Ribs – Heart and great vessels – mediastinum -Diaphram – double exposure technique.

Abdomen & Pelvic Radiography – all projection – the acute abdomen investigation.

Macro radiography: Principle sizes of focal spot its limitation in its application.

High kv technique: technique & usefulness.

Foreign body localization: Preparation – Anatomical localization – various projections – use of skin markers – Tangential projection – uses – opaque – foreign bodies.

Dental radiography-types of equipment –techniques- indications-films-dental radiography in trauma patients.

Practical Content

To understand the process of;

Extremities Radiography

Spine Radiography

Skull Radiography
Chest Radiography
Abdomen & Pelvic Radiography
Micro Radiography
Dental Radiography

Module No. 5: X -Ray Film / Image Processing Technique

Module Outcome: Recognize the essential steps and techniques involved in processing and enhancing X-ray films or images to produce diagnostically valuable results in radiology.

Content:

1. X-Ray film
X-ray film construction and film characteristics – Composition of single and double coated radiographic films -structure of emulsion- film characteristics;
speed, base fog, gamma, latitude -effect of grain size on film response to exposure, interpretation of characteristics curve- exposure to x-rays.
2. Types of Radiographic Films applications-advantages/limitations of different types Structure, properties of different parts-Film storage - handling -film wrappings- andling of exposed and unexposed films -safe light requirements.
3. Radiographic Image: Meaning of radiographic image contrast, density, resolution, sharpness, magnification and distortion of image, noise and blur. Primary radiological image formation- Image quality – unsharpness- resolution – fog and noise - use of contrast media-density- contrast – brightness- optical density measurements- Image recording devices.
4. Image processing– Film developing principles- acidity, alkalinity, pH, the processing cycle process of film developing - development -developer solution- constituents of developer. Fixing- fixer solution- composition of fixer –washing – drying replenishment -checking and adjusting replenishment rates - other processing solution – effect of temperature and development time - film processing methods - common errors and faults while processing manual and automatic processing latent image formation– silver recovery and economics.
5. Film archieving systems- Image recording devices-Laser imager/camera functioning.
Multi-formatter- Optical Disc. System Film archieving systems - MOD/disc/PACS etc.
6. Automatic processing - Automatic film handling systems -Automated
Processors - equipment for Film Processing-functions of various components- film roller transport - transport time -film feed system-Importance and relation to temp, fixed and variable time cycles-Care and maintenance -cleaning routine and methods of cleaning.
7. Radiographic illuminators: and viewing conditions, visual acuity and resolution.
8. Dark Room- Site – layout - dark room design- construction- processing area– illumination-safe light compatibility - entrance safe lighting – types- storage shelving
of films-cleaning and maintenance.

Practical Content

To understand the process of;
Radiographic Films
Radiography Image
Image processing
Film Archieving
Automatic Processing
Radiographic Illuminators

Module No. 6: Advance Radiography

Module Outcome: Demonstrate advanced radiography processes, encompassing specialized imaging procedures, intricate equipment operation, patient management and advanced image interpretation techniques.

Content:

1. Mammography system:
History - Imaging requirements- Mammography system - construction/types accessories - tube, compression, grids, AEC etc.- nature of X-Ray beam suitable – accessories for immobilization - film processing - image quality – image recording devices - interventional procedures – accessories-biopsy equipment attachments - radiation dose- - mammo tomogram-Sonomammography-future developments.

2. Ultrasonography/ Doppler systems:
Basic acoustics principle- Basic physics of sound propagation in different media, production of Ultrasound (piezoelectric effect), ultrasound terminologies – interaction of ultrasound with matter – ultrasound properties propagation in tissue, absorption, scattering, reflection and refraction- acoustic impedence – piezo electric effect – transducer – Pulsar – receiver – beam/sensitivity and gain - generators- A, B and M scanning & echo modes- transducers-techniques of sonography-equipment selection- display methods – ultrasound image formation - data storage and display – image and artifacts – doppler instrumentation – doppler equation – transducer – quality assurance and performance tests – bio effects and safety considerations. Types of machines –portable systems- acoustic coupling agents-ingredients/preparation.

3. CT scan systems:
History- generations of scanners-CT technology -helical/spiral & multi slice C.Tultra fast scanners-system components - performance parameters - image quality and methods of image reconstruction- radiation dose measurements and technical aspects of Q.A -calibration and image acquisition-

4.MRI Scanners: History - basic physical principle - Physical principles –NMR signals– instrumentation- hard ware-MR system components- magnet system- Magnetic shielding- RF shielding- bioeffects of MRI- site selection and safety -reconstruction system - different coils used -NMR signals advantage –imaging methods – pulse imaging sequences - spectroscopy parameters -calibration and image acquisition - reconstructions- 3D images- - image contrast – factors affecting image quality - artifacts - difference between CT and MRI images- host computer -viewing archiving- hard copy - image formation and storage device.

5.Angiography and Cine Studies /DSA
Angiography equipments history –Conventional angiography X-Ray equipment Equipment construction-principle - DSA system basics - digital techniques -subtraction process-procedures for subtraction - care, choice and installation of the equipment – equipment, pitfalls and complications -pressure injectors contrast media -accessories-catheters, guide wires-uses of serial imaging devicescine camera - video-recorder -film processing-radiation protection.

6. Nuclear Medicine Equipments
Nuclear Physics - basics in Nuclear Medicine- Nuclear medicine equipments - Gamma Cameras- rectilinear scanners- radioisotope generators-SPECT-CT & PETCT- introduction-basic physics and principle involved-equipments basic structure
—differences- fusion techniques- image formation-storage devices– advantages limitations.

7. Recent Advances in Imaging Systems
Mobile units of Computer Radiography & Digital Radiography system.
3D/4D Sonography systems
128 slice & higher slice C.T equipment.
3 Tesla & higher T MRI scanners
Image processing & Display systems-Recent advances, concepts and applications in processing of images in digital form using computer based systems.
Bone Densitometry

8. Picture Archiving and Communication Systems (PACS)-newer advancements – updates - systems designs-transfer restrictions.

Practical Content

To understand the Radiographic process of ;
Mammography system
Ultrasonography/ Doppler systems
CT Scan
MRI
Angiography
Sonography

Module No. 7: Advance Imaging Techniques

Module Outcome: Explain the process of advanced imaging techniques including Mammography, Ultrasonography, CT Scan, MRI scan and Angiography to facilitate comprehensive diagnostic insights.

Content:

1. Mammography:
The Mammography as a clinical diagnostic tool- immobilization and identification techniques-positioning techniques for various projections - exposure factors-
Conventional & Digital studies- quality and advantage- diagnosis and screening-
Characteristics of benign and malignant lesions – patient care – female attendant - interventional procedures - radiation dose- recent advances in mammography
techniques -mammo tomogram & Sono-mammography procedures- advantages & limitations.

2. Ultrasonography/ Doppler studies:
Techniques of sonography-selection- Preparations - instructions and positioning of
patient for TAS, TVS, TRUS, neck USG and extremities- patient care and maintenance protocols-clinical applications display methods –quality image reproducible extend -assurance to patients.

3. CT scan studies acquisition/ protocols /techniques:
CT of head and neck – thorax – abdomen – pelvis – musculo skeletal system – spine – PNS. Anatomy – clinical indications and contraindications – patient preparation – technique – contrast media-types, dose, injection technique; timing, sequence - image display – patient care – utilization of available techniques & processing facilities to guide the clinician-CT anatomy and pathology of different organ systems.

4. MRI Scanners:
Methods of MRI imaging methods – Head and Neck ,Thorax, Abdomen, Musculoskeletal System imaging - Clinical indications and contraindications- types of common sequences-effects of sequence on imaging - Protocols for various studies- slice section- patient preparation-positioning of the patient -patient care calibration - paramagnetic agents and dose, additional techniques and recent advances in MRI -image acquisition-modification of procedures in an unconscious or un co-operative patient - plain studies-contrast studies -special procedures reconstructions- 3D images- MRS blood flow imaging, diffusion/perfusion scans - strength and limitations of MRI- role of radiographer.

5. Angiography and Cine Studies /DSA
Conventional / DSA studies- Abdominal, visceral, peripheral, cerebral and cardiac angiography - arterial/venous anatomy, physiology-clinical indications and contraindications - patient preparation-positioning of the patient -patient care contrast media - types of contrast - dosage - accessories catheters, guide wires pressure
injection- control of radiographic and fluoroscopic equipment – exposure factors for serial programmes-programming-injection protocols- outline on each radiological procedure- radiographer's role- patient

management before –during and after the procedure - venography- interventional angiography in hepatobiliary, GIT, urology and vascular system- coils/stents etc- indications and contraindications - role of radiographer-radiation safety.

6. Nuclear Scintiscan procedures:

SPECT-CT & PET-CT studies, protocols, Basics of common clinical Nuclear Medicin Procedures/techniques–comparison with different structural imaging studiesadvantages and limitations.

7. Recent Advances in Imaging: Dynamic CT & MRI studies Per operative application of various imaging systems including detector probes application in Nuclear Medicine

Imaging guidance in therapeutic procedures-IGRT, TACE & TARE etc.

Practical Content

To understand the Imaging process of;

Mammography system

Ultrasonography/ Doppler systems

CT Scan

MRI

Angiography

Sonography

Module No. 8: Quality Control in Radiology

Module Outcome: Comprehend and implement the essential principles and procedures of quality control in radiology, ensuring optimal performance and accuracy of imaging equipment and procedures

Theory Content:

1. Radiation Quantities and Units

Radiation- Radioactivity- Sources of radiation - natural radioactive sources –cosmic rays-terrestrial radiation - - man made radiation sources. Units of radiation - Quality factor - Flux-Fluence-Kerma-Exposure- Absorbed dose- Equivalent Dose- Weighting Factors-Effective Dose - Occupational Exposure Limits - Dose limits to public.

2. Biological Effects of radiation

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

3. Radiation detection and Measurements: Ionization of gases- Fluorescence and Phosphorescence - Effects on photographic emulsion. Ionization Chambers – counters- G.M counters- scintillation detectors – liquid semiconductor detectors – Gamma ray spectrometer. Measuring systems – free air ionization– thimble ion chamber – condenser chamber – Victorian electrometer – secondary standard dosimeters – film dosimeter – 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 -Calibration of Radiation Monitoring Instruments.

4. Radiation protection:

Radiation protection of self and patient- Principles of radiation protection, time - distance and shielding, shielding - calculation and radiation survey –ALARA personnel dosimeters (TLD and film batches)-occupational exposure.

5. Q.A in Diagnostic Radiology

Quality assurance (Q.A), acceptance testing and quality control tests in Radiology-

Meaning of the terms used and aspects of a QA programme, equipment and staff requirements, benefits of QA procedures in an imaging department –NABH guidelines. Verification of Optical & Radiation field congruence, Beam alignment, Focal spot size, Linearity of tube current mA and Timer, applied potential, HVT and total tube filter, Contact between film and intensifying screen, contrast resolution, Grid alignment, Special techniques like mammography, CT - CT Dose Modulation- Patient dose management.

6. Radiation Hazard evaluation and control

Philosophy of Radiation protection, effects of time, Distance & Shielding. Calculation of Work load, weekly calculated dose to radiation worker & General public Good work practice in Diagnostic Radiology. Planning consideration for radiology, including Use factor, occupancy factors, and different shielding material.

7. 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.

8. Role of Radiographer in Planning, QA & 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 rooms, dark 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. ICRP, NRPB, NCRP and WHO guidelines for radiation protection, pregnancy and radiation protection. Guidance level for patients dose reduction in radio-diagnosis. Dose constrains for comforters of patients. Radiation incidents involving X-Ray equipments, over exposure investigations and case studies.

Practical Content:

Practical involving not less than 10 numbers must be prescribed to the students. The title and nature of practical may be framed by the respective institution conducting the course as follows-

1. Time, Dose, Shielding, Measurement of HVT & TVT
2. Familiarization of Radiation Survey meters and their functional performance checks
3. Radiological Protection Survey of Diagnostic X-Ray installation
4. Diagnostic Imaging: Quality Assurance
5. AERB safety requirements- Atomic Energy Act, Radiation protection rules.

Module No 9: Medical Ethics

Module Outcome:

Apply ethical principles, legal guidelines, and professional values to ensure patient rights, uphold ethical standards, and maintain professionalism.

Theory:

1: Introduction to Medical Ethics

Differentiating between medical ethics and medical law, defining their goals and scope.
Understanding the healthcare Code of Conduct.
Exploring basic medical ethics principles, with an emphasis on confidentiality.
Providing an overview of malpractice and negligence, including rational and irrational drug therapy.

2: Ethics and Practice

Upholding patients' rights by understanding and implementing autonomy and informed consent.
Ethical considerations in caring for terminally ill patients.
Distinguishing medical diagnosis from physiotherapy diagnosis.
Exploring the medico-legal aspects of medical records, including types of medico-legal cases,

record-keeping, ownership, confidentiality, release of information, unauthorized disclosure, and retention.

3: Protocol & Principles

Understanding professional indemnity through insurance policies.
Developing standardized protocols to prevent near misses or sentinel events.
The process of obtaining informed consent.
Exploring biomedical ethical principles.
Discussing the code of ethics for para-medical staff.

4: Professionalism & Values

Understanding and actively applying professional values such as integrity, objectivity, competence, due care, and confidentiality.
Embracing core values in healthcare, including accountability, altruism, compassion, excellence, integrity, professional duties, and social responsibility.
Recognizing the ethical significance of personal values.
Demonstrating appropriate attitudes and behaviors in healthcare, including professionalism and treating all individuals equally.
Examining the code of conduct, professional accountability, responsibility, and addressing misconduct.
Recognizing the differences between professions and emphasizing the importance of teamwork in healthcare.
Considering cultural factors in the healthcare environment.
Understanding the role of entry-level healthcare practitioners, their autonomy, and their commitment to evidence-based practice.

Practical Syllabus:

1. Practical activities related to each topic, including case studies, role-playing, and discussions to apply ethical principles and legal guidelines in real-world healthcare scenarios.
2. Hands-on exercises in developing protocols, obtaining informed consent, and addressing ethical dilemmas.
3. Interactive sessions to explore biomedical ethical principles and their application in healthcare practice.
4. Ethical decision-making simulations and discussions on code of conduct.
5. Collaborative exercises emphasizing teamwork and cultural sensitivity in healthcare settings.
6. Practical demonstrations of handling medical records, ensuring confidentiality, and addressing medico-legal aspects.
7. Visits to healthcare facilities to observe and discuss real-world applications of medical ethics and professionalism.
8. Role-playing and case studies focused on patient interactions, informed consent, and ethical dilemmas.
9. Group discussions and activities to foster a deeper understanding of personal and professional values and their impact on healthcare practice.

Module No 10: Employability Skill (60 Hrs)

Content:

Introduction to Employability Skills Duration: 1.5 Hours

After completing this programme, participants will be able to:

1. Discuss the Employability Skills required for jobs in various industries
2. List different learning and employability related GOI and private portals and their usage

Constitutional values - Citizenship Duration: 1.5 Hours

3. Explain the constitutional values, including civic rights and duties, citizenship, responsibility towards society and personal values and ethics such as honesty, integrity, caring and respecting others that are required to become a responsible citizen
4. Show how to practice different environmentally sustainable practices.

Becoming a Professional in the 21st Century Duration: 2.5 Hours

5. Discuss importance of relevant 21st century skills.
6. Exhibit 21st century skills like Self-Awareness, Behavior Skills, time management, critical and adaptive thinking, problem-solving, creative thinking, social and cultural awareness, emotional awareness, learning to learn etc. in personal or professional life.
7. Describe the benefits of continuous learning.

Basic English Skills Duration: 10 Hours

8. Show how to use basic English sentences for everyday conversation in different contexts, in person and over the telephone
9. Read and interpret text written in basic English
10. Write a short note/paragraph / letter/e -mail using basic English

Career Development & Goal Setting Duration: 2 Hours

11. Create a career development plan with well-defined short- and long-term goals

Communication Skills Duration: 5 Hours

12. Demonstrate how to communicate effectively using verbal and nonverbal communication etiquette.
13. Explain the importance of active listening for effective communication
14. Discuss the significance of working collaboratively with others in a team

Diversity & Inclusion Duration: 2.5 Hours

15. Demonstrate how to behave, communicate, and conduct oneself appropriately with all genders and PwD
16. Discuss the significance of escalating sexual harassment issues as per POSH act.

Financial and Legal Literacy Duration:5 Hours

17. Outline the importance of selecting the right financial institution, product, and service
18. Demonstrate how to carry out offline and online financial transactions, safely and securely

19. List the common components of salary and compute income, expenditure, taxes, investments etc.
20. Discuss the legal rights, laws, and aids

Essential Digital Skills Duration: 10 Hours

21. Describe the role of digital technology in today's life
22. Demonstrate how to operate digital devices and use the associated applications and features, safely and securely
23. Discuss the significance of displaying responsible online behavior while browsing, using various social media platforms, e-mails, etc., safely and securely
24. Create sample word documents, excel sheets and presentations using basic features
25. utilize virtual collaboration tools to work effectively

Entrepreneurship Duration: 7 Hours

26. Explain the types of entrepreneurship and enterprises
27. Discuss how to identify opportunities for potential business, sources of funding and associated financial and legal risks with its mitigation plan
28. Describe the 4Ps of Marketing-Product, Price, Place and Promotion and apply them as per requirement
29. Create a sample business plan, for the selected business opportunity

Customer Service Duration: 5 Hours

30. Describe the significance of analyzing different types and needs of customers
31. Explain the significance of identifying customer needs and responding to them in a professional manner.
32. Discuss the significance of maintaining hygiene and dressing appropriately

Getting Ready for apprenticeship & Jobs Duration: 8 Hours

33. Create a professional Curriculum Vitae (CV)
34. Use various offline and online job search sources such as employment exchanges, recruitment agencies, and job portals respectively
35. Discuss the significance of maintaining hygiene and confidence during an interview
36. Perform a mock interview
37. List the steps for searching and registering for apprenticeship opportunities

Module No. 11: OJT

Outcome: Work in real job situation with special emphasis on basic safety and hazards in this domain

Practical Content:

Assessor will check report prepared for this component of Practical training of the course and assess whether competency has been developed to work in the real job situation with special emphasis on basic safety and hazards in this domain.

(OJT to be completed at a Large Laboratory OR 100 or more bedded hospital with facility of relevant training. OJT will be for a period of not less than 3 months.)

List of Tools, Equipment & materials required for 30 Trainees (Practical)

No.	Name of Equipment	No. Required
1	Digital X-Ray Machine 300 Mato 700 MA/100 MA/200 MA	4 nos
2	Mobile X-ray Machine	1 no
3	Portable X-ray Machine	2 nos
4	U. S. G. Scanar	1 no
5	CT SCAN	1 no
6	MRI	1 no

Marks Distribution

Outcome	Outcome Code	Total Th Marks	Total Pr. Marks
Comprehend and explain the fundamental principles of human anatomy and physiology, including the structure and function of major organ systems, cellular processes and the integration of various physiological mechanisms within the human body.	HLC/1621/OC1	10	60
Demonstrate the principles of general and radiation physics with behavior of radiation, interaction of X and Gamma rays, the operation of radiographic equipment with interpretation of medical images in radiology.	HLC/1621/OC2	10	60
Describe the essential operation, components and functioning of various radiology equipment used in medical imaging including X-ray machines, Fluoroscopic equipment, MRI scanners, CT scanners and other radiological equipment generate images, capture data, ensure patient safety and contribute to accurate diagnostic procedures.	HLC/1621/OC3	20	60
Describe the process, step by step workflow of conducting radiological examinations of clinical radiology includes Extremities Radiography, Spine Radiography, Skull Radiography, Chest Radiography, Abdomen & Pelvic Radiography and Micro Radiography	HLC/1621/OC4	20	60

Recognize the essential steps and techniques involved in processing and enhancing X-ray films or images to produce diagnostically valuable results in radiology.	HLC/1621/OC5	20	60
Demonstrate advanced radiography processes, encompassing specialized imaging procedures, intricate equipment operation, patient management and advanced image interpretation techniques.	HLC/1621/OC6	20	60
Explain the process of advanced imaging techniques including Mammography, Ultrasonography, CT scan, MRI scan and Angiography to facilitate comprehensive diagnostic insights.	HLC/1621/OC7	20	60
Comprehend and implement the essential principles and procedures of quality control in radiology, ensuring optimal performance and accuracy of imaging equipment and procedures	HLC/1621/OC8	20	60
Follow the principle of medical ethics in healthcare settings while upholding patient rights, confidentiality, and ethical standards	HLC/1621/OC9	10	20
OJT	HCL/1621/OC10	0	300
Employability Skill-60 Hrs	DGT/VSQ/N0102	50	0