Details of Syllabus

S. No.	COMPUTED TOMOGRAPHY (CT) TOPIC
01	**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, sub-second scanning. Real-time CT fluoroscopy • Interventional guidance tool, 3D CT, CT angiography. • Virtual reality imaging, including image quality and quality control in CT Scanners.
02	**Patient Care and Assessment** • Patient assessment, an essential skill • Assessing personal concerns of patients • Assessing physiological needs • Taking a history: Elements of a history and questioning techniques • Assessing physical status: Checking the chart, physical assessment, vital signs • Common laboratory tests for patient assessment • Electronic patient monitoring
03	**Image Formation** • Image display • Pre and Post Processing techniques • Image quality in single slice and multi slice helical CT scan • Patient radiation dose considerations in Helical CT
04	**Protocol** • Protocols for adult Whole-Body CT • Protocols for paediatric Whole-Body CT • Documentation • Common and specific artefacts in Helical CT images
05	**HRCT** • HRCT of Lungs &Temporal bone • Expiratory HRCT • HRCT protocols • Artifacts
06	**Angiography** • CT angiography

07	**Care, Maintenance and Tests** • General care • Functional tests • Quality assurance program • Acceptable limits of variation • Corrective action
08	**Special Procedures** • Biopsies • Drainage / Aspirations • Radiation therapy planning
09	**CT Cross Sectional Anatomy of Head** • Eyeball-lens • Optic nerve. • Bony margins of orbit, • Extra ocular muscles-mainly medial and lateral recti. • Lacrimal gland. • Maxillary, ethmoid, sphenoid and frontal sinuses. • Nasal septum. • Mastoid air cells. • Petrous bone, internal auditory meatus. • Styloid process. • Foramen magnum. • Cerebellar hemispheres. • Pons, 4th ventricle. • Basilar artery. • CP angle cistern. • Temporal lobes, temporal horns, hippocampus. • Dorsum sellae, clivus. • Pituitary fossa. • Circle of willis-aca, mca, pca. • Mid brain. • 3rd ventricle, pineal gland. • Frontal horns, frontal lobes, occipital horns, occipital lobes. • Sylvian fissures. • Lateral Ventricles • Falx cerebri. • Superior sagittal sinus. • Cerebral hemispheres (parietal lobes), gray and white matter

Details of Syllabus

S. No	**MAGNETIC RESONANCE IMAGING – (MRI)** **TOPIC**
1.	**Basic Principles** • Spin • Precession • Relaxation time • Pulse cycle • T1 weighted image • T2 weighted image • Proton density image
2.	**MR Instrumentation** • Magnetism • Permanent magnets • Electromagnets • Superconducting electromagnets • Shim coils • Gradient coils • Radio frequency (RF) • Patient transportation system • MR computer systems and the user interface
3.	**Encoding** • Gradients • Slice selection • Frequency encoding • Phase encoding • Sampling **Data collection and image formation** • K space filling • Fast Fourier transform (FFT) • K space traversal and gradients
4.	**Pulse sequences** • **Spin echo pulse sequences** **1.** Conventional spin echo **2.** Fast or turbo spin echo **3.** Inversion recovery **4.** Fast inversion recovery **5.** STIR (short tau inversion recovery) **6.** FLAIR (fluid attenuated inversion **7.** recovery)
5	**MR contrast media** • Mechanism of action of contrast • agents • Magnetic susceptibility • Relaxivity • Gadolinium safety

6	**MRI Artifacts** • Phase mis mapping • Aliasing or wrap around • Chemical shift artefact • Zipper artefact • Shading artefact • Moiré artefact • Magic angle
7	**Whole body MRI protocols** • Indication • Contraindications • Patient selection and preparation with screening • Coils used • Imaging protocols and parameters • Post- processing and PACS
8	**Functional MRI & BOLD Imaging** • Diffusion weighted imaging (DWI) • Diffusion tensor imaging (DTI) • Perfusion imaging • Susceptibility weighting (SWI) • Functional imaging (fMRI) • MR spectroscopy (MRS) • Whole body imaging
9	**Care, Maintenance and tests** • General care • Functional tests • Quality assurance program • Acceptable limits of variation • Corrective action
10	**MRI Specific Procedural Requirements** The 5 categories include: • Head and Neck • Spine • Thorax • Abdomen and Pelvis • Musculoskeletal
11	**Head and Neck** • Routine brain • Internal auditory canal • Orbit • Pituitary • Vascular head • Cranial nerves • Posterior fossa

	• Head trauma • Sinuses • Soft tissue neck • Vascular neck
12	**Spine** • Thoracic • Lumbar • Cervical • Sacrum/coccyx • Spinal trauma • Bony pelvis
13	**Thorax** • Brachial plexus • Mediastinum • Cardiovascular • Breast • Aorta • Heart and great vessels
14	**Abdomen and Pelvis** • Liver / spleen / pancreas • Kidneys • Adrenals • MRCP

S. No	RADIATION PROTECTION AND SAFETY TOPIC
1	**Basic radiation units and quantities** • Exposure • Absorbed dose • Equivalent Dose • Effective Dose • Radiation Quality factor • Tissue weighting factor • Mean Glandular Dose • Radiation unit of Radioactive materials
2	**Principle for Radiation exposure** • Cardinal Principle • Concept of ALARA • Concept of ALARP • Maximum permissible dose
3	**Construction of Radiology Department** • Factors for calculation for primary radiation • Factors for calculation of scattered radiation and leakage radiation • X-Ray room design • Structural shielding • Protective devices • AERB guidelines for installation of x-ray equipments.
4	• Radiation signage's and its significances
5	**Radiation measuring instruments** • Area monitoring principles and types • Personnel dosimeters principles and types
6	**Biological aspects of Radiological protection** • Direct & Indirect actions of radiation • Deterministic & stochastic effect of radiation - somatic and genetic effects • Radiation Effect at cellular level • Dose Curve relationship • Radiation Determinants • Acute Radiation Syndromes

7	**Exposure dose during special conditions-** • Pregnancy • Infants • Paediatrics • Geriatrics • Radiation worker • 10th Day Rule/14th day rule/28th day Rule
8	**Radiation protection in** • Nuclear medicine department • Radiation therapy department

S. No.	RADIOGRAPHIC AND IMAGING TECHNIQUES TOPIC
1.	**Skeletal system:** **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. **Lower limb:** • Technique for foot • Toes, great toe, • Tarsal bones, • Calcaneum, • Ankle joint, • Lower leg, • Knee, • Patella & femur. **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. **Vertebral column:** • Technique for atlanto-occipital joint, • Cervical spine, • Cervico thoracic spine, • Thoracic spine, • Thoraco- lumbar spine, • lumbo sacral spine, • Sacrum and coccyx. **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, • femoral head and neck relationship. **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,
3.	**Upper respiratory tract:** • Technique for post nasal airways, • Larynx, • Trachea, • Valsalva manoeuvre.
4.	**Lungs and Mediastinum:** • Technique for routine projections,
5.	**Abdominal viscera:** • Technique for plain film examination. • Projection for acute abdomen patients. • Technique to demonstrate**:** Foreign bodies, Imperforate anus.

Sr.No	RADIOLOGICAL PROCEDURE AND PATIENT CARE TOPIC
1	Basic review of all Radiographic Techniques and Projections
2	**Contrast Media** • Application & types • safety aspects • mode & volume of administration • administration techniques
3	**Digestive System** • Anatomy and physiology • Associated pathology and radiographic appearance • Plain radiography • Barium swallow • Barium meal • Barium meal follow through • Enteroclysis • Barium enema
4	**Genito urinary system** • Anatomy and physiology • Associated pathology and radiographic appearance • Plain radiography • Intravenous urogram (IVU) • Micturating Cystourethrogram (MCU) • Ascending Urethrogram (ASU) • Hysterosalpingography (HSG) • Fallopian Tube Recanalization (FTR)
5	**Mammography** • Anatomy and physiology • Indications, contraindications and techniques ICRP guidelines
6	**Other procedures** • Sialography • Dacrocystography • Sinography • Fistulography
7	**Patient Care and Assessment** • Patient assessment, an essential skill • Assessing personal concerns of patients • Assessing physiological needs • Taking a history: Elements of a history and questioning techniques • Assessing physical status: Checking the chart, physical assessment, vital signs • Common laboratory tests for patient assessment • Electronic patient monitoring

8	**Medications and their Administration** • Radiographer's role • Medication nomenclature • Medication properties: Pharmacokinetics, pharmacodynamics and effects • Routes of administration and dosage • Charting medications

S. No.	RADIOLOGICAL PHYSICS TOPIC
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 • Heal 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 layers • 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 • LET, range of energy relationship for alpha, beta particles with X-Rays.
6.	**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 angulations and rotating tubes-line focus principal space charge effect • Tube cooling-Modern X-ray tubes-stationary anode • Rotating anode and grid-controlled X-ray tubes • Heel effect

	• Off focus radiation • Tube inserts and housing-Tube Rating-Quality and intensity of x-rays-factors influencing them.
7.	• 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.
8.	• Heat dissipation methods • Tube rating, heat units • Operating conditions and maintenance and Q.A procedures.
9.	• 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 • Capacitor's discharge and grid control systems.
10.	**X-ray generator circuits:** • Vacuum tube diodes-semi-conductor diodes-transistor-Rectification-half and full wave-self rectification • X-ray generator • Filaments circuit-kilo Voltage • Circuit-single phase generator-three phase generator- • Constant potential generator • Fuses, switches and interlocks-Exposure switching and timers-HT cablesearthing.
11.	**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).
12.	**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 • Sievert, rem, Quality factor, dose equivalent,

	• Relationship between absorbed dose and equivalent dose.
13.	**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.
14.	• Computed tomography • MRI • Ultrasonography • Digital Radiography-its principle • Physics & equipment • Picture archiving and communication system (PACS)