SANJAY GANDHI POSTGRADUATE INSTITUTE OF MEDICAL SCIENCES

Raebareli Road, Lucknow-226014 (U.P.)

Syllabus for the post of Technician (Radiology) (Core Subject)
Advt No. I/10/4/Rectt/2026-27

ANATOMY AND PHYSIOLOGY OF HUMAN BODY – PART 1

1. Introduction to the body as a whole , the cells, tissues of the body

2. The cell: Structure, multiplication.

Tissue: Types, structure, characteristics, functions

Epithelium:

Simple : Squamous, Cuboidal, columnar, ciliated

Compound: Stratified, transitional

Connective: Areolar, adipose, fibrous, elastic, Cartilage, blood and bone

Muscle: Striated (Voluntary), Smooth (Involuntary, Cardiac)

Nervous tissue, Fibrous tissue, Cell regeneration

Membranes: Mucous, Serous, Synovial

3. Osteology (including whole Skelton, bones and joints)

Development of bone (osteogenesis) : Cells involved

Types and functions of bone, Types of joints and various movements.

AXIAL Skeleton:

Skull : Cranium, face, air sinuses, Vertebral column: regions, movements and characteristics, Sternum, Ribs

Appendicular Skelton: Bones involving -Shoulder girdle and Upper limb, Pelvic girdle and lower limb,

Healing of bones: cellular activity, Factors that delay healing, Diseases of bones and joints.

4. The Respiratory System:

Organs: Position and structure

Nose and nasal cavities

Functions: respiratory, Olfactory, Pharynx, and Larynx:

Functions - respiratory, vocal, Trachea, Bronchi, lungs: lobes, lobules, pleura

Respiratory functions: External and internal respiration, common terms relating to disease and conditions of the system.

RADIOGRAPHIC AND IMAGE PROCESSING TECHNIQUES

1. Images produced by radiation, Light sensitive photographic materials, Real and virtual images, Reflected transmitted and emitted light images, Light sensitivity salts of silver, Photographic emulsions, A brief outline of the formation of the latent image & positive process (conventional & digital).

2. Radiographic Film:

Type of film, screen and non-screen film, single and double emulsion films, Dental films

Structure of film emulsion-film characteristics (speed, base + fog, gamma, latitude), Spectral sensitivity of film material, Effect of grain size on film response to exposure, interpretation of characteristics curve-Grain technology-Gelatin-Basic film types-Film formats and packing-Direct exposure duplitised films-Single coated emulsions-Films for specialized use-manufacturing process. Structure, properties of different parts, handling, film wrappings. Handling of exposed and unexposed films. Types, applications, advantages/limitations of different types, safe light requirements.

3. Sensitometer: Photographic density, characteristic curve, features of characteristic curve, Information from the characteristic curve-speed Vs definition. Variation in the characteristic curve with the development.

4. Storage of X-ray film: Storage of unprocessed films, Storing of radiographs, Expiry date, Shelf life, Storage condition, Stock control

5. Control of scattered radiation: Methods of minimizing formation of scatter radiation, effectiveness of grids-grid ratio-preventing scattered radiation, use of cones, diaphragm light beam devices and effectiveness of collimation in reducing effects of scatter. Effects of scatter radiation on radiograph image quality, patient dose and occupational exposure.

5. Intensifying screens: Luminescence, Fluorescence and Phosphorescence, Structure and functions, common phosphors used-types, screen mounting, care and maintenance of film screen contact. Intensifying factor, speed and detail-crossover effect, Resolution, Quantum mottle, reciprocity failure, screen asymmetry, cleaning. New phosphor technology-influence of kilo voltage. Photo-stimulable phosphor Imaging.

6. Cassettes (conventional and CR based): Structure and function-Types-single, gridded, film holder-Design features and consideration with loading/unloading-Care and maintenance (cleaning).

7. Photochemistry: Principles: Acidity, alkalinity, pH, the processing cycle, development, developer solution. Fixing, fixer solution, washing, drying replenishment, checking and adjusting-latent image formation--nature of development-constitution of developer-development time-factors in the use of developer.
Fixers-constitution of fixing solution-factors affecting the fixer-replenishment of fixer-silver conservation-Drying-developer and fixer for automatic film processor-rinsing-washing and drying.
Replenishment rates in manual and automatic processing-Silver recovery-Auto and manual chemicals. Control of chemicals temperature by heating and thermostats, Immersion heaters as well as cooling methods.

8. Manual processing, care of processing equipment, automatic processor-manual VS automatic processing,

9. Automatic Film Processor: 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).

10. Dark room layout and planning , Dark room construction, Nature of floor, walls and ceiling and radiation protection, Type of entry, Door design, Dark room illuminations , White light and safe lighting, Dark room equipment, Location of pass through boxes or cassette hatches.
11. Daylight film printing systems – parts and functioning
10. Radiographic image, components of image quality, unsharpness in radiographic image, contrast of the radiographic image, distinctness of the radiographic image-size, shape and spatial relationships. Factors affecting Image Quality (image contrast, density, resolution, sharpness, magnification and distortion of image, noise and blur).
12. The presentation of the radiograph, Identification markers and orientation, Documentary preparation, Viewing accessories, Viewing boxes, Magnifiers, Viewing conditions.
13. Monitor images: Characteristics of the video image, television camera, imaging camera, medical grade TFT monitors.
14. Detectors used in DR system, Digital fluorography
15. Image processing in digital radiography systems: Post processing techniques on console using CR, DR and flat panel fluoroscopy systems

CLINICAL RADIOGRAPHY POSITIONING PART I

1. Lungs and Mediastinum: Technique for routine projections (chest X-ray PA view, lateral view), Supplementary projections: Antero-posterior, obliques, lordotic, apical projection, use of penetrated postero-anterior projection. - Expiration technique. - Technique for pleural fluid levels and adhesions.
2. Whole upper limb:
Technique for hand, fingers, thumb, wrist joint carpal bones, forearm, elbow joint, radio ulnar joints and humerus supplementary techniques for the above. e.g. Carpal tunnel view, ulnar groove, head of the radius, supracondylar projections.
3. Whole 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.
- Tibial tubercle.
- Length measurement technique.

4. Shoulder girdle Technique for shoulder joint, scapular, clavicle, acromio clavicular joints, sternum, ribs, sterno-clavicular joint. Supplementary projections and techniques

- Recurrent dislocation of shoulder.

- Traumatic dislocation of shoulder.
- Cervical ribs.

5. Abdomen- Technique for plain film examination, Projection for acute abdomen patients, Technique to demonstrate: Foreign bodies, Imperforate anus.

6. 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 for congenital dislocation of hips, epiphysis of femur, lateral projections for hip joints to show femoral head and neck relationship.

BASIC PHYSICS INCLUDING RADIOLOGICAL PHYSICS

Unit 1: SI units, Force, mass, momentum, work, energy, power, density, pressure, heat, sound, wave and oscillation.

Unit 2: Atomic structure: Atom, Nucleus, Atomic No., Mass No., Electron orbit and energy levels, Isotopes and isobars, Bohr theory of hydrogen atom, atomic mass and energy units, distribution of orbital electrons atomic energy levels, nuclear forces, nuclear energy levels, particle radiations, electromagnetic radiation, electricity and magnetism.

Unit 3: Nuclear transformation, Radioactivity, decay constant, activity half-life, mean life, radioactive series, radioactive equilibrium, modes of decay: alpha decay, beta decay, electron capture, internal conversion, isometric transition.

Nuclear reactions; proton bombardment, deuteron bombardment, neutron bombardment, photo-disintegration, fission, fusion, activation of nuclides, nuclear reactors.

Unit 4: Production of X-rays: Basics of X-ray production (Bremsstrahlung and characteristic X-rays), Filters, Quality of X-rays, Effect of voltage and current on the intensity of X-rays, properties of X-rays, X-rays-tube, anode, cathode construction, Working principles of transformers and autotransformers used in X-ray circuits, voltage rectification and measurements in X-ray circuits.

Unit 5: Interaction of radiation with matter: ionization and excitation, various types of interaction processes (photoelectric effect, Compton scattering, Pair production, Photo-disintegration, etc). Interaction of charged particles and neutrons with matter. Comparative beam characteristics, LET, HVL, TVL, shielding material, Radiation absorption characteristics, HVT, TVT measurement

HUMAN ANATOMY AND PHYSIOLOGY PART- II

Review of types of cells, tissues, bones and joints. Introduction to system and cavities of the body.

Heart and blood vessels (Circulatory system):
Blood vessels: arteries, veins, capillaries, sinusoids, structure and functions
Heart: Position, structure and functions
Circulation of blood: pulmonary, systemic, portal, main blood vessels, their origins and distribution.
Diseases of blood vessels and heart and conditions of the system

The Lymphatic system:
The parts of the lymphatic system.
Lymph channels: Capillaries, vessels, ducts structure and functions
Lymph nodes: position, structure and functions
Lymphatic tissues: tonsils, adenoids, intestinal nodules
Spleen: position, structure and functions, diseases and conditions of the system.

The digestive system:
Elementary tract structure:
Mouth, pharynx, salivary glands, oesophagus, stomach, liver, gall bladder, small intestine, large intestine: Position, structure and functions of these organs.
Digestion and absorption, Metabolism of carbohydrates. Proteins and fats. Diseases and conditions of the system.

The Urinary System
Parts of urinary system
Position, structure and functions
Kidneys, ureters, urinary bladder and urethra
Formation and composition of urine
Water and electrolyte balance
Diseases and conditions of the system

The reproductive system:
Female reproductive system:
External genitalia: positions and structures and functions.
Perineum.
Internal organs: positions and structures.
Vagina, uterus, uterine tubes, ovaries.
Menstrual cycle" stages, hormone control, ovulation.
Breasts (Mammary glands)
Changes: puberty, in pregnancy, during lactation.

Male reproductive system:
Scrotum, testis, epididymis: positions.
Spermatogenesis,
Spermatic Cords, seminal vesicles,
Ejaculatory ducts: position, structure & functions
Prostate gland: position

Functions of male reproductive system, puberty
Diseases of female and male reproductive system.

The Endocrine system:
Endocrine glands:
Pituitary and hypothalamus: Position & structure
Thyroid gland, parathyroid glands
Adrenal (supra renal) glands
Pancreases: Position, types of cells
Hormones: secretion, function and control, pineal gland
Common terms and diseases related to the system

The organs of sense:
Hearing and the ear:
External, middle and inner ear
Physiology of hearing and diseases of ear.
Sight and the eye: position, structure, sclera, cornea, choroid, ciliary body.
Iris, lens, retina, optic nerves
Physiology of sight and diseases of the eye.

Sense of smell
Olfactory nerves, origins, distribution
Physiology of smell
Sense of taste : tongue

The nervous system
Neurons: Structure, types and properties
Central nervous system: neurons, neuralgia meninges.
Ventricles of brain, CSF
Brain, spinal cord: structures, functions, peripheral nervous system.
Spinal and cranial nerves: origin distribution and functions.
Automatic nervous system
Sympathetic and para sympathetic: origin distribution and function.
Common diseases of the system.

The Skin
Structure of skin
Epidermis, dermis
Functions of skin
Hypothermia
Wound healing: primary and secondary diseases of skin

RADIOLOGICAL AND IMAGING EQUIPMENTS

X-ray tube:

Historical aspects, early X-ray tubes

General features and Construction of X-ray tubes

Fixed anode x ray tube, Rotating anode x ray tube - speed of anode rotation, angle of anode inclination (target angle), rotating tubes-line focus principle, dual focus and practical consideration in choice of focus, Focal spot sizes, anode heel effect

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.

Quality and intensity of x-rays, factors influencing them, Tube voltage, current, space charge, X-ray production efficiency

Tube insert and housing, Rating of X-ray tubes

Grid controlled X-ray tubes

Methods of cooling the anode, rating chart and cooling chart, Methods of heat dissipation in x ray tube

Common tube faults

Advances in X-ray tubes and Modern X-ray tubes

Portable and mobile X-ray units

X-ray generator circuits:

Generator for x-ray machines, Rectification, Types of rectifier valve and solid state, Self-rectified high tension circuit, Half wave, Four valve full wave , Three phase, Full wave rectified circuit, High tension Generators, Voltage wave forms in high tension generators, Automatically programmed generators and modular Generators.

The high tension transformer, The control of kilovoltage , Kilovoltage indication, The filament circuit and control of tube current, Milliamperes indications, Main voltage compensation, Mains supply and x ray set, Switching systems, Timing system, Exposure switching and its radiographic application.

Circuit breakers, Interlocking circuit, machine overload protection

Control of scattered radiation: Beam limiting devices: cones, diaphragms, light beam collimator, beam centering device, methods to verify beam centering 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. Other scatter reduction methods, Air gap technique.

CR and DR system

Computed radiography: its principle, physics & equipment.

Digital Radiography. Flat panel digital fluoroscopy and radiography system, advantages, disadvantages and applications. Stich radiography, Picture archiving and communication system (PACS)

Fluoroscopy: Fluorescence and phosphorescence - description, fluorescent materials used in fluoroscopic screens, Structure of fluorescent screen, The fluoroscopic image, The fluoroscopic table, Spot film devices and explorators, Protective measures and physiology of vision, Image quality.
Image intensifier - Construction and working, advantages over fluoroscopic device, principles and methods of visualizing intensified image, basic principles of closed circuit television camera, picture tube, CCD. Automatic brightness control, automatic exposure control, Cine radiographic cameras, Remote control table.
Mammography equipment
Equipment for conventional mammography and Digital Mammography, principles and advances in mammography
Angiography equipments
Rapid serial radiography, Rapid film changer, Rapid cassette changer, Angiographic tables, Contrast medium injection devices
Digital subtraction angiography: Equipment, principle, advancements.
Tomography: Body section radiography, basic principle and equipment, multi section tomography, Transverse axial tomography, various types of tomographic movements, Tomosynthesis, applications in present time
DEXA equipment- principle, advancements and applications.
Basic principles used in nuclear medicine imaging (radiotracers, SPECT cameras)

CLINICAL RADIOGRAPHY POSITIONING PART II

1. Skull: Basic projections for cranium, facial bones, nasal bones and mandible.
Technique for temporal bone, mastoids. Internal auditory canal.
Paranasal sinuses, Temporo - mandibular joint. - Orbits and optic foramen.- Zygomatic arches.
Styloid process. - Pituitary fossa. - Jugular foramen.
2. 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 intervertebral foramina.
3. Upper respiratory system- Technique for post nasal airways, larynx, trachea, thoracic inlet, Valsalva maneuver, Phonation.
4. Mammography: Positioning, compression view, Digital tomosynthesis
5. Skeletal survey: Skeletal survey for metabolic bone disease, metastases, hormonal disorder, renal disorders.

6. Ward /mobile radiography - electrical supply, radiation protection, equipment and instructions to be followed for portable/ward radiography.

8. High KV techniques principle in radiography and its applications.

9 Operation theatre radiography: General precautions, Asepsis in techniques - Checking of mains supply and functions of equipment, selection of exposure factors, explosion risk, radiation protection and rapid processing techniques.

10. Trauma radiography/Emergency radiography

11. Neonatal and Pediatric Radiography,

12. Dental Radiography- Technique for intra oral full mouth.- Occlusal projections.- Extra oral projections including orthopantomography.- Supplementary techniques.

13. Forensic Radiography

RADIATION PROTECTION AND REGULATORY REQUIREMENTS

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

2. 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 – film dosimeter – 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 & its appropriateness of different detectors for different type of radiation measurement. 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.

3. 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.

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, occupation exposure limits and protection Tools/devices. Dose limits to public.

5. 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

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Regulatory requirements. ICRP, NRPB, NCRP and WHO guidelines for radiation protection, pregnancy and radiation protection. NABH guidelines, AERB guidelines, PNDT Act and guidelines

6. 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 rooms, dark rooms – Inspection of X-Ray installations - Registration of X-Ray equipment installation- Certification -Evaluation of workload versus radiation factors.

Pathology

1. General Pathology : Adaptations, Cell Injury and Repair: Hyperplasia, atrophy, metaplasia, necrosis and apoptosis - Differences between apoptosis and necrosis.

2. Acute and Chronic inflammation : Five cardinal signs of inflammation- Outcomes of acute inflammation-Chronic inflammation-Granulomatous inflammation-Acute phase proteins

3. Tissue repair, regeneration and hemodynamic disorders : Cutaneous wound healing-Pathologic aspects of repair-Hyperaemia and congestion-Thrombosis and Virchow triad-Embolism-Infarction-Shock ; Bronchial asthma, COPD, Tumors

4. Diseases of immune system : Hypersensitivity reaction-Type I, II, III, and IV hypersensitivity reactions

5. Neoplasia: Definition of neoplasia. Differences between benign and malignant tumors ; Metastasis ; Carcinogenesis – Causes ; Carcinoma of oral cavity – Causes; Etiology of Carcinoma cervix – type of virus implicated, high risk sero-types, Screening investigations; Breast carcinoma – Risk factors

6. RBC and Bleeding disorders: Anaemia – Definition and classification, Haemolytic anaemia, Iron deficiency anemia, Thrombocytopenia, Coagulation disorders – Terminology, Uses of Bleeding Time, PT and aPTT

7. WBC disorders: Leukocytosis, Leukemia – acute and chronic, Causes of splenomegaly

8. Disease of the GIT: Peptic ulcer – causes; Carcinoma stomach – causes; Intestinal obstruction – causes; acute appendicitis – causes; Colonic carcinoma - causes

9. Diseases of Liver, Biliary tract and Pancreas: Jaundice – classification based on pathophysiology; Cirrhosis – Definition and causes; Hepatitis – Types of viral hepatitis and transmission; Portal hypertension – Symptoms; Hepatic failure

10. Endocrine System: Diagnostic criteria of diabetes mellitus, Major subtypes of diabetes mellitus, Differences between type I and Type II diabetes mellitus, Complications of diabetes mellitus, thyroid, parathyroid and adrenal diseases

11. Blood vessels: Atherosclerosis – Risk factors; Human atherosclerosis ; Hypertension – diagnostic criterion, types and causes ; Varicose veins; Thrombophlebitis and Phlebothrombosis

12. The Heart: Heart failure; congenital heart diseases causing left to right shunt and vice versa; Myocardial infarction – causes, laboratory changes and complications; Cor-pulmonale; Rheumatic fever

13. Diseases of the Lung: Chronic obstructive pulmonary disease; Asthma – pathogenesis; Pneumonia – lobar and bronchopneumonia; Lung carcinoma – Incidence and Causes

14. The Kidney and Lower urinary tract: Acute Renal failure – definition and causes of Pre-renal, renal and post-renal ARF ; Chronic renal failure – definition and causes; Acute nephritic syndrome – definition and causes; Nephrotic syndrome – definition and causes; Acute tubular necrosis – definition and causes; Urolithiasis – types of stones

15. Female genital tract : Endometriosis – Definition ; Adenomyosis – Definition; Leiomyoma

16. Male genital tract : Carcinoma penis – causes; Testicular tumors – Classification terminology; Prostatic Hyperplasia – Causes, symptoms and PSA screening

17. Nervous system : Intracerebral, Subarachnoid and Subdural haemorrhage, Meningitis and Encephalitis – Bacterial and viral causes and CSF findings; Epilepsy – Causes; Epilepsy – Classification terminology; CNS tumors – Classification terminology
18. Introduction to pathologic techniques – FNAC, Histopathology, IHC, molecular methods

SPECIAL RADIOGRAPHY PROCEDURES & NEWER IMAGING TECHNIQUES

1. Responsibility of Radiographer during Radiological Procedures.
2. Preparation of Patient for Different Procedures, trolley set up.
3. Contrast Media - Positive and Negative, Ionic & Non – Ionic
4. Adverse Reactions To Contrast Media and Patient Management
5. Emergency Drugs in the Radiology Department
6. Emergency Equipments in the Radiology Department
7. Aseptic technique

a. **Gastrointestinal Tract:**

- Fluoroscopy, general considerations, responsibility of radiographers
- Barium swallow, pharynx and oesophagus
- Barium meal follow through, 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
- Water soluble contrast media - eg.gastrograffin studies

b. **Salivary glands:** Routine technique, procedure – sialography

c. Biliary system:

- Intravenous cholangiography, Percutaneous cholangiography
- Endoscopic retrograde cholangio-pancreatography (ERCP)
- Operative cholangiography
- Post-Operative cholangiography (T - tube Cholangiography)

d. Urinary system:

- Intravenous urography
- Retrograde pyelography
- Antegrade pyelography
- Cystography and micturating cystouresthrography
- Urethrography (ascending)
- Renal puncture

e. Female reproductive system: Hysterosalpingography.

f. Mammography related:

- Stereotactic biopsy, Specimen radiography, Wire localization, Ductography. Cyst puncture

g. Arthrography: Shoulder, Hip, Knee, Elbow

h. Sinography: Routine technique and procedure.

i. Awareness about macroradiography, Bronchography, ventrilography, encephalography, myelography, Lymphography, Dacrocystography.

j. Localization of foreign bodies:

- General location principles.
- Ingested; inhaled; inserted; embedded foreign bodies.
- Preparation of the area to be investigated.
- Appropriate projection for all
- Techniques to locate non-opaque foreign body.

k. Angiography and Interventional Radiology:
Basic angiography and DSA: History , technique, patient care , Percutaneous catherisation, catheterization sites, Asepsis, Guidewire, catheters, pressure injectors, accessories , Use of digital substraction- single plane and bi-plane , Indications, contraindications, contrast medium, technique film sequences, and post-procedure care.
Angiography: Carotid, cerebral and vertebral Angiography , Thoracic and Arch Aortography , Selective studies: Renal, SMA, Coeliac axis , Angiocardiography
Venography: Peripheral venography , Cerebral venography , Inferior and superior venocavography, Spleno-venography

Interventional radiology techniques: PTC, PTBD, Fine needle aspiration, percutaneous nephrostomy, Catheter drainage
Percutaneous balloon dilatation, stenting, embolization
Cardiac catheterization procedures: PTCA, BMV, CAG, Pacemaker

ADVANCED IMAGING TECHNOLOGY & CROSS SECTIONAL ANATOMY

1. Ultrasonography and Doppler

a. Basic Acoustics, Ultrasound terminologies: acoustic pressure, power, intensity, impedance, speed, frequency, dB notation: relative acoustic pressure and relative acoustic intensity.
b. Interaction of US with matter: reflection, transmission, scattering, refraction and absorption, attenuation and attenuation coefficients, US machine controls, US focusing.
c. Production of ultrasound: Piezoelectricity, Medical ultrasound transducer: Principle, construction and working, characteristics of US beam.
d. Ultrasound display modes: A, B, M
e. 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.
f. Physics of doppler imaging
g. Technique of ultrasonography/ Doppler studies: selection, Preparations, instructions and positioning of patient for TAS, TVS, TRUS, neck USG and extremities, patient care and maintenance protocols, clinical applications, display methods, image quality image, reproducibility, biopsy procedures.

2. Computed Tomography

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a. 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

b. 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, image documentation and Filming, maintenance of equipment and accessories, Dual source CT scanner, Advancements.

c. CT scan studies acquisition/ protocols /techniques: clinical indications and contraindications, patient preparation, technique, contrast media-types, dose, injection technique; timing, sequence, image display, patient care. Imaging techniques and protocols for various parts of body, CT of head and neck – thorax – abdomen – pelvis – Musculo-skeletal system – spine – PNS, CT angiography – (Aortogram, selective angiogram head, neck, cardiac and peripheral)

3. Magnetic Resonance Imaging

a. Principle, nuclear magnetism, Quantum mechanical Description , A spinning proton induces nuclear magnetism, Larmer equation, Net magnetization

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

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

d. MR contrast media

e. MRI safety concerns : General considerations, Bioeffects of static magnetic field, Mechanism of interaction, Patient safety considerations, Screening and safety considerations

f. MR sequences: 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 angiography – TOF & PCA – MR Spectroscopy – functional MRI

g. Technique of MRI scanning: 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 cooperative patient - plain studies- contrast studies -special procedures- reconstructions- 3D images- MRS blood flow imaging, diffusion/perfusion scans - strength and limitations of MRI

4. PET imaging – principles and application, Fusion Imaging including PET-CT, PET- MRI.

5. Cross Sectional Anatomy including important pathological conditions

a. Introduction to Sectional Anatomy & Terminology- Sectional planes, Anatomical relationships/terminology

b. CT/MRI Imaging of the Thorax - Normal and pathologic

c. CT/MR Imaging of Abdomen & pelvis- Normal and pathologic

d. CT/MR Imaging of the Male/Female Pelvis- Normal and pathologic

e. Neuro Anatomy (CT / MRI)- Scan plane

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Brain - Cerebral hemispheres, Sinuses, Ventricles, Brainstem and associated parts, Arterial/venous systems, Basal ganglia, Cranial nerves
Spine- Vertebra and disc, Spinal cord and meninges
f. CT / MRI imaging of Neck

QUALITY ASSURANCE AND QUALITY CONTROL

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 at the radiological facility: Responsibility; Purchase; Specifications; Acceptance; Routine testing; Evaluation of results of routine testing; 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 , View box maintenance

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 Radiation safety protocols and recent advances in radiation safety including AERB guidelines.

HOSPITAL PRACTICE AND PATIENT CARE

1. Departmental Organization & record maintenance
Department staffing; performance appraisal, conflict management

Procedure appointments, organization; minimizing waiting time.

Records relating to patients and departmental statistics

Sanjay Gandhi Postgraduate Institute of Medical sciences,

Raebareli Road Lucknow

Syllabus for the post of Technician Radiology

2. Basics of emergency care and life support skills - Basic life support (BLS) is the foundation for saving lives following cardiac arrest. The student is also expected to learn about basic emergency care including first aid and triage. Topics to be covered under the subject are as follows:

a. Vital signs and primary assessment - Body temp, respiratory rate, pulse, blood pressure

b. Basic emergency care – first aid and triage

c. Ventilations including use of bag-valve-masks (BVMs)

d. Choking, rescue breathing methods

e. CPR

f. Using an AED (Automated external defibrillator).

g. Managing an emergency including moving a patient

h. Oxygen therapy, oxygen devices.

3. First aid for common conditions:

Aims and objectives of first aid

Wounds and bleeding, dressing and bandages; fractures and splints, supports etc.

Shock; unconsciousness, asphyxia; convulsions; drug reactions, Foreign bodies; poisons.

Electric shock; burns; scalds; hemorrhage (pressure points; compression band).

Chest tubes and lines

4. Infection and principles of asepsis

Introduction of microbiology, Classification of microorganisms (viruses, bacteria, fungi, protozoa, parasitic infection), Mode of spread of infections, auto-infection or cross-infection

Universal precautions, hospital acquired infections- HIV, Hepatitis B, C, and MRSA etc.

Principles of asepsis: Sterilization - methods of sterilization; use of central sterile supply department; care and identification of instruments (autoclave, serum inspissator, pausturization). Handling of infectious patients in the department and in the ward.

5. Drugs in the department: Storage: classification; labelling and checking. Administration of drugs and contrast media. Regulation of dangerous drugs. Emergency drugs