

Syllabus of Technical Supervisor (Radiology) in H&FW

1. *Gross Radiological & Surface. Anatomy of Human body :*

Introduction of Anatomy as a whole, structure of human cells and tissue types. Tissue types, connective tissue-muscle tissue-nervous tissue epithelial tissue. Skeleton bones and joints-formation of bone growth of skeleton. Centers of ossifications, types of the bones-types of joints. Thoracic contents and general location of the organs and vessels. Abdominal viscera and the location of major organs. Fracture and dislocations, Diseases of the bones and joints. Radiological Anatomy. Surface Anatomy.

2. *Physiology in Radiography :*

Blood-its composition and function-nerve tissue-muscular tissue and types. Abnormalities in tissue-ulceration-sepsis-asepsis and

antisepsis-the nature of neoplasm-common tumours-Malignant tumours-dissemination of malignancy, primary and Secondary spread.

Respiratory system-Nasal passages and para nasal sinuses-Pharynx and larynx-Trachea, Bronchus and lungs-The pleura-Nature and functions of respiration-common terms relating to diseases and conditions of this system. Lymphatic system-Lymph and tissue fluid-Main glands and drainage areas in the lymphatic system-Lymphoid tissue and the tonsils.

Reticulo-endothelial system-Liver and spleen-Bone marrow, Life cycle of red and white corpuscles of the blood. Alimentary systems-function of mouth, tongue and teeth, salivary glands-Pharynx and oesophagus-Stomach-small intestine (jejunum)-Large intestine (colon)-Liver and biliary tract-pancreas-Functions of the alimentary system-digestion and absorption of food-metabolism-common terms used in connection with abnormalities of this system.

Urinary tract-kidney, ureters and bladder-urethra-urinary Excretion.

Reproductive system-Male genitalia-Female genitalia Mammary glands-Menstruation, Pregnancy and lactation-Common terms related to abnormalities of this system.

Ductless glands (Endocrine system)-Anatomical location of pituitary, thyroid, parathyroid, adrenal, thymus, pancreas and gonads-their function common term related to this system. Nervous system-Main subdivisions, lobes and ventricles of the brain-Spinal cord-Meninges and cerebro-spinal fluid-common terms used in abnormalities of this system. Organs of sense-Structure and function of the eye-Structure and function of the ear.

Surface landmarks and topography in relating to organs on the body for radiographic positioning-positional terms-anatomical terminology with regard to location.

3. Basic Physics, Electricity and Magnetism & Radiation Physics:

Revision of mathematics related to radiography, measurements and units of B.C.S. and M.K.S. system. Electrical charges, Potential difference, current and resistance. Ohm's law for electrical circuits, direct current. Conductor, Insulators and semi-conductors. Electrical

power meters and voltmeters. Electromagnetism, Electromagnetic induction self and mutual. Production of A.C. Generators. Transformers- losses construction regulations a types used in X-ray apparatus. Thermionic emission, vacuum, diode-variation of tubes current and anode voltage. The diode as rectifier and as an X-ray tube. Types of rectification and methods used in diagnostic and therapy units H.T. Cables, Capacitor and capacitance, generation and property of X-rays, interaction of X-ray with matter.

X-ray tube-diagnostic type method of heat dissipation, failure, measurement in Radiation exposure. Scattered Radiation and method to reduce it. Inverse square law and grid.

4. Dark Room Procedure

Fundamental of photographic emulsion, light sensitive materials, construction and emulsion formation. Formation of latent image. Chemical development of the latent image. Storage of X-ray films and its transportation. Types of photography emulsions Size of grain-speed of the films. Sensitometry-evaluation of emulsion characteristic-density, contrast and latitude-basic log-characteristic curve-Luminescence-fluorescence and phosphorescence. Fluorescent screens, types of intensifying screens mechanism-care of intensifying screens and cassettes, Intensification factor, size of crystals, reciprocity failure and test for it, Cassettes-test for cassettes for screen contrast and light leakage. Construction & types of films (X-rays, material etc.).

X-ray Developer-characteristics-possibility of retaining standard results with regeneration-low fog and staining properties long active life.

Developing agents-function and constituents of the developer-standardization by time and temperature-Process of development-latitude-exhaustion of developer-regeneration by replenishment.

Types of developer used in radiography-powders and liquid concentrates-standard, high contrast and high energy developers. Ultrarapid development methods-increased temperature, use of replenisher, special ultrarapid developer combined developer/fixer solutions.

Fixation-fixing agents-constituents of radiographic fixer and function of the chemicals-fixation time-exhaustion of fixer-silver recovery combined with generation of fixer (electrolysis)-other silver recovery methods-rapid fixer. Film rinse-acid stop bath-washing of films static bath-water flow and rate of change-test for washing-film drying methods.

Practical processing-preparation of solutions-water supply mixing vessels-order of mixing chemicals-stock solutions and storage-storage of dry chemicals and liquid concentrates. Processing apparatus-temperature control-immersion heaters-thermostat-ice cooling and refrigeration cooling. Theatre processing-ultra-rapid processing-dish and small tank techniques-ultra-rapid processing-dish and small tank techniques-special theatres processors-types and care of hangers.

Technical and processing faults-fog, static, pressure, screen artifacts.

Chemical reduction of film density-farmers reducer-preparational and selective techniques-local application.

The X-ray Dark Room-minimum dimensions-services required-planned circulation and layout-lightproofing-ventilation-radiation protection-flooration and chemicalproof materials-Bench design, film hoppers, film makers, hanger location-Location of processing unit-pass-Box fixers or wash tanks-Illumination and testing of illumination-separate drying room with drying cabinets-wet or dry viewing rooms following manual of automatic processing rapid drying apparatus-effects of circulation and layout planning on efficiency.

The radiographic image-effects of exposure factors on contrast, detail and image sharpness-relationship between kilovoltage and exposure time and tube current (mAs)-Effects of distance, filtration, collimation, screens, grids, film speed developers and processing techniques.

Presentation of the radiograph-identification-orientation-technical information-techniques for film marking-actinic markers using radiation sources preparation of stereo radiographs for straight of mirror viewing-mounting of dental films-use of lead letters and numbers-embossing machining-incising materials.

Accessories-viewing boxes-magnifier-high intensity localised viewers-projectors and viewing screens for miniature and cineradiography-film trimmers-corner cutters-dental mounts, films envelopes-filling system and units-Store viewers.

Fluorescent screen photography-photofluorography and cineradiography-optical principles lenses, speed, focal length, depth of field function of the diaphragm-focussing-Equipment for photofluorography (Radiophotography, miniature, radiography)-Conventional lens units-Mirror lens units-Cassettes types-film magazines-manual and automatic operation-Automatic exposure control-optical identification devices-Safety relays and interlocks-independent generator-design of static and mobile units-Units for battery operation-Battery ("reservoir" units).

Fluorescent screen types-spectral emission for maximum photographic efficiency-lens resolution and colour sensitivity-Fluorination, radiography technique and its role in preventive, epidemiological and diagnostic. System-Exposure techniques to ensure uniformity with and without automatic exposure control-Special protective measures-Viewing and projection-filling system-records-organisation of surveys.

5. Hospital practice and care of the patients ;

Hospital staffing and administration-records-professional ethics in attitudes to patients, Cooperation with other staff and departments. Departmental organisation. Handling of the patients-moving of injured patient Normal pulse, temperature and respiration Preparation of the patients for general and special examinations. Supervision of patients undergoing special examinations. Supervision of patients undergoing special examination.

Administration of enemas-aseptic and sterile procedures. Use of opaque media. Trolley setting for special X-ray examinations.

6 Apparatus for Radiography :

Basic circuits of X-ray machine, construction and functioning of each part, component. Construction and function of Imaging equipment like Ultrasound and C.T. Scan and MRI etc.

7 Radiographic Technique of Bones & Joints :

Individual bones of skeletal system of human body and its different projections. Special projection, whenever, required and indicated as in skull including petrous, Icm oral, mastoids, accessory nasal arches, nasal bone, maxilla, mandible, T.M. joint, optic foramina, teeth, intra oral and extra oral projection-occlusal view.

Projections for scaphoid, shoulder joint, sternum, S.I. Joint, Hip joint, patella, calcaneum, lordotic view chest, apicogram.

8. Radiographic Techniques (Special) :

Salivary glands-routine projections for calculi-Sialography with opaque media, Macroradiography, general and selective abdominal angiography, peripheral angiography, cerebral angiography, venograms with valsalva manoeuvre.

Respiratory system-Upper respiratory tract-Naso-pharynx-Larynx-Trachea-Barium swallow with valsalva manoeuvre-Thyroid and parathyroid glands-Bronchus-Tomographic techniques.

Lungs-Routine projections-evaluation of unilateral density-Exposure on inspiration and expiration-Valsalva and Muller manoeuvres-Pleura-Techniques to demonstrate fluid levels, effusions and adhesions-Oblique, lordotic and decubitus A.P. and lateral projections-Pneumothorax, expiration and inspiration.

Diaphragmatic excursion-Double exposure technique-Fluorocopy, Mediastinum-routine projections.

Bronchography-danger of anaesthesia of larynx-Inhibition of coughing-methods of introduction of opaque media-positioning and technique during the introduction of media.

Genito-urinary system-Plain film examination of K.U.B.-Differentiation of opacities especially in right hypochondrium Erect, lateral, double exposure on inspiration and expiration Excretory pyelography-Intravenous pyelography (I.V.P.)-Drip infusion pyelography-Pyelography in children-

Use or non-use of compression-Trendelenberg position, High density technique-Appreciation of factors causing variation in concentration of media, contrast media to be used and quantities to be injected-

supplementary techniques-Retrograde pyelography-position and identification of ureteric catheters.

Cystography-Introduction of the media-exposure in relaxed and straining micturition-control by image intensifier and cineradiography demonstration of fistulae, post micturition radiographs-urethrography-excretory or retrograde technique.

Radiography of exposed kidney during surgical operation-Renal angiography during selective aortography-retroperitoneal and perinephric gas insufflation techniques.

Obstetrics and gynaecology-Pregnancy-techniques for evaluation of foetal development, maturity, abnormality, position and multiplicity-Placentography-Use of compensating filters-contrast media and soft tissue techniques-cystography and arteriography-pelvimetry-Consideration of radiation hazard-Cephalometry-Hysterosalpingography-Preparation of patient-Alternative injection procedures-Radiation hazards in Obstetric and Gynaecological Radiography.

Central Nervous system-Routine projections for skull and spine-Ventriculography and encephalography-Injection of contrast media-Film series to cover all ventricular outlines-Cerebral angiography-Myelography-Methods of contrast injection.

Alimentary system-Barium swallow-Pharynx and oesophagus-contrast technique with valsalva manoeuvre-fistula-Barium meal-Procedure for fluoroscopic examination of stomach, jejunum and colon-appropriate timing-Diaphragmatic hernia-Post-operative examinations-the Barium meal follow through-Plain film, erect, P.A., decubitus for abdominal obstruction-Barium enema-Preparation of the patient-Administration of opaque medium-routine projections under fluoroscopic control, special techniques in colostomy, Hirschsprung's disease-double contrast enema with insufflation technique-Intussusception.

Biliary system-Routine projections for plain films-differentiation of opacities in Right Hypochondrium (see Genito-Urinary system)-Respiratory movements-Oral cholecystography-preparation of the patient-advice on taking of oral opaque medium-reasons for non-appearance of opaque medium in system-Intravenous cholecystography

(I.V.C.) Occlusion of biliary tract-Direct and indirect cholangiography-Demonstration of hepatic ducts.

Liver and spleen-Pneumoperitoneum-Fluoroscopy and radiography of diaphragmatic excursion-Selective Aortogram-splenohepatic encephalography

Salivary glands-Routine projections-sialography.

Arthrography Method for visualizing joint space-asepsis, special projections.

Sinography tracing of fistulae and inflammatory conditions by opaque media and fluoroscopic control.

Lymphatic system-soft tissue differentiation for regions concerned-calcification of glands-technique for lymphography with colour tracer and opaque media.

Tomography-Advantages of various movements. Linear, circular elliptical, hypocycloidal Basic of tomographic principles-effects of operational angle, PFD, vibration blur, magnification-Estimation of relevant layer thicknesses and localization of required area by plain films and fluoroscopy sequential tomography-Horizontal tomography-simultaneous multifaction tomography.

Fluoroscopy general considerations of the role of the radiographer-dose hazards-limitation of K.V., mA, Focus-skin distance-Fluoroscopic timer Radiation protection to staff during fluoroscopy and associated examinations.

Stereography Principles involved-Tube shift in relation to patient-Stereography apparatus for viewing and orientation of films in relation to viewing method correct marking of stereographs.

Soft tissue techniques-non-screen techniques-simultaneous screen and non screen technique-Mammography.

High voltage technique-General principles-Relationship to patient dose-change in contrast, range and detail-elimination of scatter-Accessories for H.V. techniques-Radiographic factors.

Localization of foreign bodies-Necessity for removal of all clothing and other opaque objects from the region to be examined-

Anatomical location by projections at right angles--Fluoroscopic control for alimentary tract--Principles of geometrical localization

Techniques for intraocular F.B.--Technique for swallowed barium and obstruction to Barium Swallow--Techniques to locate non-opaque F.B.--Technique for inhaled F.B.

9. *Recent advances in Imaging and contrast media :*

Radio Nuclide, Scintigraphy, G.I. Scanning, Ultrasound, NMR, Digital Radiography contrast Media, Types, Properties, reactions commonly used in diagnostic radiology.

10. *Radiation hazards and its protections & planning of department :*

Introduction, Hazards, protections, units, aims and objectives, principles and methods, diagnostic X-ray methods, design layout, room size, shielding, illumination, control panels, waste area, choice of equipment.

Wards mobile and domiciliary Radiography--Electrical safety--Radiation protection-cooperation with staff and care of ill patients--special considerations of patients having radioactive sources in body.

Operating theatre techniques--revision of procedures--collaboration with theatre staff--Checking of mains supply and function of apparatus and selection of exposure factors prior to examination--Explosive risks--Aspects in technique--Protection--Rapid processing techniques.

Planning of Radiology Department, rating of X-ray tube

ANATOMY

Introduction	:	Human Body, Anatomical Terms and various System.
Skeletal system	:	Skull, vertebral Column, pelvis, bones of all Extremities.
Joints	:	Types, movements, structure of major joints.
Muscular system	:	Major muscles and their position.

Circulatory system	:	Heart, Major Arteries and veins, renal & Portal System.
Digestive system	:	Mouth, Pharynx, esophagus, stomach, Large & Small intestines, spleen, liver, gall bladder, Pancreas, salivary glands.
Respiratory system	:	Nose, Larynx, Trachea, lungs.
Nervous system	:	Brain, spinal cord.
Reproductive system	:	Male and Female genital tract.
Urinary system	:	Kidneys, ureters, bladder and prostate.
Endocrine glands	:	Names, position and their hormones.
Special senses	:	Structure of eye, ear, skin, tongue and nose.

PHYSIOLOGY

Circulatory system	:	Heart, Arteries, veins, capillaries, hepatic portal System, lymphatic system.
Respiratory system	:	Pulmonary circulation, exchange of gases in lungs.
Endocrine system	:	Endocrine glands & their main functions.
Urogenital system	:	Function of kidneys, structure of nephron, male and Female genital system, basic physiology.
Nervous system	:	Central nervous system, peripheral nervous system and autonomic nervous system.
Special senses	:	Skin, Eye, Ear and Tongue, Nose basic physiology.
Muscular system	:	Structure and function of: 1) Cardiac muscle 2) Skeletal muscle 3) Stomach muscle.
Digestive system	:	Physiology of alimentary canal, digestive glands & juices and their secretion, spleen, liver pancreas.

gall bladder. Absorption of digested food.

PATHOLOGY

Pathology

Definition-Cell growth-Cell deformities, Cell-Damage-defence mechanism, cell repair.

Cause of disease

Congenital, Traumatic, metabolic, deficiency, Infective, Micro-organisms, Immunisation.

Blood Diseases

Leukemias, Anaemia

Neoplasia:

Benign and Malignant, effects- local and systemic, Modes of growth and metastasis.

GENERAL AND RADIATION PHYSICS

Units of Measurement, Force, Work, Energy, Heat & Energy. Various methods of transmission of Heat.

MAGNETISM: Classification of Magnets, Properties of Magnets, Magnetic Fields & Lines of forces, Magnetic fields and their measurements, Electro Magnetism.

ELECTRICITY: Electrostatic, conductor & insulators, Elementary electron theory, Units of electric charge, Potential, Condensers & capacity of condensers.

CURRENT ELECTRICITY: Ohm's Law, various units of current, voltage and Resistance, Heating effects of current, units of power and power consumption calculations, Principle & working of Moving Coil & moving iron type of meters.

ELECTRO MAGNETIC INDUCTION: Transformers, their losses, rating, induction motors.

DIRECT & ALTERNATING CURRENTS: Impedance, Capacitance & Inductance.

Thermionic commissions & characteristic curves of Diode and Triode Valves, semi conductors.

RADIATION PHYSICS

1. Production & Properties of X-rays.
2. Interaction of radiation with matter - X-ray circuit.
 - Various radiation units- rontgen, Rad, REM, RBE etc.
 - Dosimetry & various radiation measuring instruments.
 - I.C.R.P. Recommendations.
 - Measurement of X-ray beam.
 - Radiation protection in the Department.
3. Structure of Atom, Radioactivity- natural & artificial.
4. Rectification & various circuits.

DARK ROOM TECHNIQUE

Photographic Process:	Light image, Image produced by radiation, Light sensitive materials, Latent image.
Film Material:	The structure of X-ray films, Resolving power Graininess of film, sensitivity of film, speed of film, contrast of photographic films.
Sensitivity:	Characteristic Curve & its usefulness.
X-ray film storage	Storage of unexposed films.
Screens	Construction of intensifying screens, choice of fluorescent material, Intensifying factors, Detail, Sharpness, speed screen contact and care of intensifying screen.
Cassettes	Cassette design, care of cassettes, Mounting of intensifying screen in the cassette.
Film processing	Constituents of the processing, solutions and replenisher. Factor affecting the developer, Types of developer and fixer, Factors affecting the use of the fixer.
Film rinsing washing And drying	Intermediate rinse, washing, drying, Quality Assurance of film. Artefacts.
Film processing equipment	Manual & Automatic processing tanks.
Dark Room Design	Outlay & materials used.

The Radiographic Image

The sharpness, contrast, details, definition, viewing conditions.

Administration

Trimming, Identification of films, legends, Relevant papers of the patients, records, filing reports distribution.

RADIOLOGICAL EQUIPMENTS

1. Main supply, High tension switches & cable, three phase supply, voltage stabilizers, Cut-offs.
2. Basic X-ray circuit control, meters, exposure timers, control of scattered radiation, Mobile X-ray unit.
3. X-ray equipments, X-ray tube, grids, Intensifying screens and cassettes, centering Devices, botter bucky attachments.
4. High tension generator:
 - a) Transformers
 - b) Half and full wave rectification
 - c) Protecting of X-ray circuit
 - d) Three phase & multiple generator.
5. X-ray tubes:-
 - a) Stationary anode
 - b) Rotating anode
 - c) Rating of x-ray tube
 - d) Faults in X-ray tube
 - e) Collimation
 - f) Filtration
 - g) Beam width & centering.
6. Cathode Ray Oscilloscopes (Television)
7. Photosfluorography and cameras Mass Miniature Radiography (odelca)
8. Mammography.
9. Orthropentomography.
10. Xero radiography.
11. Care and maintenance of equipments.

RADIOLOGICAL TECHNIQUES

CONVENTIONAL TECHNIQUES OF RADIOGRAPHY

Upper Limb	Fingers (individual), hand, Carpal tunnel wrist, forearm, Elbow, head of radius, humerus, shoulder joint, Acromio-Clavicular joint, scapula, clavicle, Sterno-clavicular joint.
Lower Limb	Toes, Foot, Calcaneum, ankle joint, leg, knees, patella, fibula, femur, intercondylar notch.
Hip & Pelvis	Hip, Neck of femur (theatre procedure for hip pinning or reduction), pelvis, sacroiliac joints, pubic bones, Acetabulum.
Vertebral Column	Curves, Postures, relative levels, Atlanto-occipital region, Adenoid, Cervical spine, Cervico-thoracic spine, dorsal spine, thoraco-lumbar spine, lumbo-sacral spine, sacrum, coccyx, scoliosis, kyphosis, flexion and extension.
Bones of thorax	Sternum, ribs
Skull	Land marks, planes, Cranium, facial bones, maxilla, mandible, Zygomatic, J.M. joints, mastoids, petrous-bones, optic foramen, sella turcica, Stenver's view.
Chest	Chest in teleradiography, chest supine, MMR.
Abdomen	Preparation, indication and contra-indication, acute abdomen, pregnancy abdomen, pelvimetry.

SPECIAL TECHNIQUES (PROCEDURES) AND THE USE OF CONTRAST MEDIA

Urinary Tract	Intravenous urography, Retrograde Pyelography, Cystourethrography.
Biliary Tract	Oral Cholecystography, percutaneous transhepatic cholangiography, per-operative cholangiography, T-Tube cholangiography, ERCP.
Gastro-intestinal Tract	Barium swallow, Barium meal, Barium meal follow through, Barium Enema.

Genital Tract

Hysterosalpingography.

Cranium

Carotid angiography

Tomography

Principle, equipment and types of movements, procedures.

Spine

Myelography

Vascular system

Angiography

Mamography

Positioning, factors.

Theatre-technique

Sterile technique in the O.R. Cleanliness of mobile unit.

Portable radiography

I. Contrast Medium

- Types
- Preparation
- Chemical composition
- Concentration
- Use
- Reactions

ULTRASOUND EQUIPMENTS & TECHNIQUES

Pulse echo techniques.

1. A mode, B mode & M mode
2. B Scan - Real time scanning techniques
 - Contact jelly.

Transducers

1. Sector scanning/ Linear scanning.
2. Linear/ Phased array electronic multi element transducers.
3. Special transducers.

Basic principle of ultrasound and transducers
2-3 lectures.

Sonographic instrumentation
Scanner components

Doppler Techniques.

Basic principle