

**DETAILED SYLLABUS FOR THE POST OF X-RAY TECHNICIAN**  
**GRADE II IN INSURANCE MEDICAL SERVICES (Cat.No.: 379/2020)**

**I. GENERAL AND RADIATION PHYSICS**

i. General Physics:

**(Marks 3)**

Measurements and units, Electricity and magnetism- laws of magnetic forces. Electrostatics-Laws of electric forces, conductors and insulators, Unit of Electric charges, Current Electricity-Magnetic Effects of Currents, Ampere, coulomb, Volt Ohms law and resistance, Ammeter and voltmeter, Electromagnetic Induction laws of Mutual and self-Induction.

ii. Radiation Physics:

**(Marks 17)**

- a. Electromagnetic Radiation, Electromagnetic Spectrum,
- b. Production and Properties of X rays- X ray spectrum, spectrum of x rays from X ray tube. X ray tube, structure of x ray tube, Anode cathode, focal spot, fine and broad focus, Line focus principle, tube housing, X-ray collimator, tube cooling, Anode heel effect
- c. X ray generating Circuits -Transformers' used in X-ray machine, high tension, filament and auto transformer, Rectifiers, self-rectified, half and full wave rectifiers, single and three phase generators, filament Circuit, Kilo voltage Circuit, selection of kVp, mA and mAs, constant potential x ray generators, High frequency generators.
- d. Filters, Inherent filtration, added filtration, Heavy metal filters, Beam hardening, HVL, TVL. Exposure timers, hand timer synchronous timer, electronic timer, mAs timer, ionization Timer, AEC testing of timers, Rating of x ray tubes -power rating and thermal rating, rating charts.
- f. Interactions of X rays with Matter - photon attenuation, X and Gamma rays interactions, coherent scattering, Photo electric effect, Compton effect, Pair production, Photo disintegration, Interaction Cross sections, dependence of Interaction Cross section on energy and atomic number, Relative importance of these interactions in Radiology and Radiotherapy, HVT, TVT, Attenuation coefficients- Linear and mass energy coefficients..
- g. Radiation quantities and units- Exposure-Roentgen -absorbed dose, Karma, Grey, Equivalent dose, Sievert.
- h. Radiation Detection and Measurements: Principles of radiation detection, Types of Detectors, Gas Filled Detectors, Solid state Detector, Free air ionization chamber, Measurement of exposure, Ionization Chamber, Thimble chamber, Farmer chamber, GM counters, Proportional Counters, Scintillation counters, pocket dosimeters, Contamination monitors, Survey meters, Isotope calibrators, Film dosimeters-, Film Badges, TLD badges, Chemical dosimeters. Biological Dosimeters

## **II ANATOMY:**

**(Marks 5)**

Osseous system-description of bones and joints of upper limb, shoulder girdle lower limb pelvic girdle, vertebral column, thorax, skull, radiographic appearance of above structures

Urinary system-structure position, functions of kidney

Elementary Anatomy and Physiology of Lymphatic system

Elementary anatomy and physiology of male and female reproductive system-organs and their relation and surface markings radiographic appearance of uterus and tubes as shown by injection of opaque media, pregnancy at various stages.

Elementary anatomy of ductile glands

Thyroid gland and para thyroid gland

The muscular system –voluntary and involuntary muscles with special attention to sternocleidomastoid, pectoral major diaphragm, deltoid supraspinatus, biceps, triceps, brachialis, femoris erector spinae

## **III PHYSIOLOGY AND PATHOLOGY**

**(Marks 10)**

i. Physiology:

General Physiology

Physiology of CNS, Cardiovascular system, Respiratory system, Muscle and nerve,

Gastrointestinal System, Genitourinary System, Reproductive system, Endocrinology

ii. General Pathological terms –inflammation, pyrexia, ulcer, bacterial and the specific granuloma, neoplasms, benign and malignant tumours with some common examples.

Common pathological terms of osseous system, muscular system, cardiovascular system, Respiratory system, central Nervous system, lymphatic system, male and female reproductive system.

Elementary pathology for common conditions-Benign tumours, papilloma, adenoma, hyperkeratosis, haemangioma, pigmented mould.

Malignant tumours –precancerous tumours methods of spread of malignant tumours

## **IV. PHYSICS OF MEDICAL IMAGING:**

**( Marks 10)**

i. a. Primary radiological image: Latent image formation, developing and fixing, processing

Chemistry, action of developer, fixer, steps in film processing, automatic processing.

X-ray films - Construction, Types of film, double emulsion film, screen film, non screen film, single coated film, Characteristic of Film- characteristic curve, optical density, contrast, gamma speed, latitude.

b. Intensifying screen, construction and action, type of screens, intensifying factors, rare earth screens, screen unsharpness.

Grids: Basic Principles, types of grid-linear grids, Moving grid, Potter Bucky grids, grid ratio, grid factor, air gap technique.

Image Quality - Resolution, Noise, Geometric Factors, contrast media and contrast in image formation,

c. Xeroradiography- General principle-photo conduction- xeroradiographic system, Patient exposure

Radiographic image – optical density, gamma, characteristic curve speed, contrast,

Grids-Type of grids, grid factor grid ratio.

- d. Radiographic artefacts –density errors-contrast errors, sharpness, fog, and quantum mottle.
- e. Basic Physics principles of CT –CT generations scanning techniques, radiation dose to patients from CT, MRI basic physics principle, relaxation times, and scanning techniques.
- f. Radiation protection: Biological effects of radiation, Time, Distance, and Shielding Radiation safety considerations in diagnostic Radiology, Maximum permissible dose limits as per AERB,

## **V RADIOGRAPHY INCLUDING DARK ROOM TECHNIQUES:**

### **i. General radiography**

**(Marks 30)**

- a. Control of magnification and distortions, Geometry of shadow projection, effect of focus Film distance, Estimation of magnification, Sharpness.  
Radiographic Accessories Control of beam cross section by fixed aperture diaphragms Variable aperture diaphragms, grids angle board, film holders.  
Dark room practice.

- b. Positioning and techniques for various Projections –  
Summary of the factors involved Radiography, Introduction to Radiographic techniques, isocentric and non Isocentric techniques.

- c. Radiographic technique for individual system –

Upper limb –Technique for hand, Wrist, fingers, thumb, scaphoid, carpal bones, carpal tunnel, Forearm, elbow joint, humerus, shoulder Coracoid Process, Acromio-clavicular joint, clavicle, sterno-clavicular joint, Glenohumeral joint, scapula.

Lower limb – Leg Alignment, -Technique for foot, Subtalar joint, toes, great toe, calcaneum, ankle joint, leg, knee joint, patella, femur, Hip joint, Sacro-iliac joint, upper third of femur.

Vertebral column – Vertebral curves and Vertebral Levels, Atlanto-occipital articulation, cervical vertebra, Cervico-thoracic vertebra, swimmer's view, thoracic vertebra, thoracolumbar vertebra, lumbar vertebra, lumbo-sacral vertebra lumbo-sacral articulation, sacrum, coccyx.

Bones of the thorax – Techniques for ribs – upper and lower, sternum.

Skull – Cranium, sella turcica, optic foramen, Jugular foramina. Temporal bones – Mastoids, petrous bone

Nasal bones, Mandible, Techniques for mandible, Temporomandibular joint.

Paranasal sinus - Techniques for frontal – maxillary, ethmoid, sphenoid, Facial bones

Thorax, Pharynx, Larynx and Trachea

- Respiratory system and Heart – Technique for trachea, lungs, mediastinum, Sub diaphragmatic conditions – erect and supine chest x ray – projections relative to collapse.  
Chest,

Abdomen, Pelvic Cavity, Acetabulum

d. Dental Radiography:

Introduction- – vertical and horizontal positioning abnormalities use of general and dental units – dental request formula identification and handling of films –use of dental filmholders. Technique for full mouth, edentulous subjects, children, intra oral and extra oral crowns, occlusal views, localization. Intra-oral radiography, occlusal radiography –extra oral oblique lateral view.

e. Trauma Care - Bedside Radiography – techniques for acute chest, intestinal obstructions – abdominal perforation – vertebral injuries, skull injuries – spine fractures – thomas splint, Plaster cases etc.

f. Operation Theatre Radiography –Theatre Techniques, Techniques of Asepsis- anaesthetic dangers – precautions.

g Records in Radiography – Register of X-ray examinations, Despatch register, Film accounts, Machine Log book Maintenance.

**ii. Special investigations-**

**(Marks 25)**

a. Introduction to Contrast Media -Types , Positive, Negative, water soluble water insoluble, ionic, non-ionic -Structure- Patient Preparation -Route of Administration- Toxicity-Complications-.

b. GI Tract- Contrast media – Basic principles – Barium Sulphate, Pharynx and oesophagus, – erect and supine posture – – stomach, duodenum, small intestine, colon and rectum, fluoroscope – compression techniques. single and double contrast techniques, enteroclysis,

c. Urinogenital System – IVU– principles – contrast medium – preparation of patient – children – Serial radio-graphs, variation of time intervals depending on suspected pathology, value of compression – precautions and contra indications.

d. Retrograde pyelography (RGP), RGU. MCU. Approximating cysto urethrogram.

e. Hysterosalpingography (H.S.G) – Principles – contrast media, method for injection – reactions – fluoroscopy- technique

f. Sialography – Sialography contrast medium – method of injection and techniques

g. Salivary Glands – Demonstration of opaque salivary calculus, techniques for parotid, sub mandibular-sublingual- glands and ducts.

h. Liver and spleen – Technique of PTC, SPV .Gall bladder – Technique for oral cholecystography – PTC – preparation of patient – contrast medium, and intravenous cholangiogram,T tube cholangiogram.

i. Nervous system – special care of neurological patient – myelogram Ventricles – Ventriculography, Encephalography

- j. Bronchography – Lymphatic system – lymphangiograph,
- k. Breast – ductoographytechnique
- l. Lacrimal ducts,
- m. Angiography – Principle-contrast media, method of injection , DSA,Venogram  
Fistulogram and Sinusogram
- n. Fluoroscopy , MMR ,Soft issue Radiography
- o. Paediatric Radiography - Paediatric Radiography Techniques and safety considerations
- p. Nuclear Medicine – Gamma Camera etc., PET and SPECT, Digital Radiography, –  
–Imaging Investigation Techniques of CT, Diagnostic Ultrasound, MRI basic Principles only),  
Digital Radiography and Advances in Medical Imaging- DR, CR, DSA, PACS

**NOTE: - It may be noted that apart from the topics detailed above, questions from other topics prescribed for the educational qualification of the post may also appear in the question paper. There is no undertaking that all the topics above may be covered in the question paper.**