DETAILED SYLLABUS FOR THE POST OF

X-RAY TECHNICIAN IN ANIMAL HUSBANDRY

(Cat.No.: 63/2021)

(Total Marks - 100)

Module 1

General Physics **(Marks- 5)**

1. Units and dimensions: fundamental units, Derived Units, Systems of units

2. Magnetism: magnetic poles, coulombs law, permeability, magnetic field, flux and flux density, magnetic induction, Weber and Tesla, magnetic properties, Intensity of magnetization, types of magnetic materials – ferromagnetic, paramagnetic and diamagnetic, magnetic susceptibility hysteresis.

3. Electrostatics: electric charges, coulombs law, dielectric constant, electric filed strength, conductors and insulators, electric potential and potential difference, volt, electric capacitance, Farad, capacitors, capacitors in series and parallel, capacitors in DC circuits, capacitors in radiography.

4. Current electricity, ampere, resistance, ohms law, electrical energy joule and watts, power in resistor, kWh, power losses in cables, mains cable resistance and X-ray exposure.

5. Electromagnetic Induction: Magnetic effects due to electric currents, solenoid, Eddy Current, Flemings left hand rule, electromagnetic relays, self and mutual induction, Faradays laws, lenz's law, henry, electric motors and generators.

6. Alernating currents : meaning of AC and its advantages over DC, AC generators, peak, RMS, effective and average values of currents and voltages, phase difference, LC Circuit, RC Circuit, LR Circuit, LCR circuit, LCR circuits series and parallel, three phase AC, star and delta connections, Three phase in X-ray applications.

7. Transformers, turns ratio, step up, step down and even ratio transformer, efficiency, transformer losses, constant voltage transformer, transformer rating, auto transformer, mains voltage compensation, transformers used in X ray circuits.

8. Measuring instruments : galvanometer, moving coil and moving iron type, voltmeter, ammeters, shunts, conversion of galvanometer to ammeters and voltmeters, multimeters, meters used in X-ray circuits, mains voltmeter, pre reading kilovoltmere, mA meter and mAs meter.

9. Electronics: Thermonic emission, space charge effect, diode, thermonic emission in radiography, triode and its applications, gas filled diode thyratron tubes, semi conductors, intrinsic and extrinsic semi conductors, N type and P type, PN junction, biasing of PN junction,

PN junction diode, senor diode, transistors, field effect transistors, MOSFET, thyrsitor SCT, semi conductors in radiography, introduction to digital electronics, gate circuits, AND, OR, NAND, NOR or NOT gates.

10. Modern physics, LASER, super conductivity, super conducting magnets, fluorescence, phospherence and scientilations, band theory and band structure, applications in radiography and radiotherapy.

Module 2 Radiation physics (Marks- 10)

1. Atomic structure, elements and compounds, atoms and molecules, protons, neutrons, nucleons, electrons, electron shells, binding energy, atomic number, mass number and atomic weight, Avogadro number, atomic mass unit, mass defect, mass energy equivalence, distribution of orbital electrons, atomic energy levels, nuclear forces, periodic table, ionization and excitation, characteristic and continuous spectrum.

2. Electromagnetic radiations, wave length, frequency, energy and their relations, inverse square law, quantum nature, particle nature, electromagnetic spectrum, properties.

3. Radio activity, radio active disintegrations, radio active emission, alpha, beta and gamma emission, electron capture, internal conversion, Auger electrons, exponential law of radio active decay, half life, decay constant, natural radio active materials, radio active equilibrium. Artificial radio activity, nuclear reactions, neutron bombardment, proton bombardment, nuclear fission and fusion, nuclear reactor and cyclotrons.

4. X-Ray Production: Interaction of electrons with matter X-ray tubes, construction of diagnostic tubes, stationary and rotating anode, focal spot, fine and broad focus, line focus principle, tube housing, X-ray collimators, transformers used in X-ray machine, high tension, filament and auto transformer X-ray rectifiers, self rectified, half wave, full wave, three phase rectifiers, principle of high frequency circuits, Basic X-ray circuits, Filament Circuit, Kilovoltage Circuit, selection of kVp, mA and mAs, Filters, Inherent filtration, Added filtration, different types of filters, filters used in X-ray machines, Heel Effect, Hardening, HVL, TVL. Exposure timers, hand timer synchronous timer, electronic timer, mAs tiemr, ionization tiemr, photo timer, testing of tiemrs.

5. X-ray spectrum: bremsstrahlung, and characteristic X-rays, quantity and quality, factors affecting quality and quantity, efficiency of X-ray production, effect of KV, target material wave form on X-ray spectrum, Duane Hunt limit and spatial distribution of X-rays.

6. Interactions of X and gamma rays with matter, ion pairs, Photo electric effect, Compton effect, pair production, dependence on energy and atomic number, relative importance of these interactions in radiology.

7. Charge particle interaction LET, range, Braag peak, photon attenuation, HVT, attenuation co-efficients, coherent scattering, Interaction of electron , neutron interaction and proton interaction.

8. Quantities and Units of Radiations : Exposure, Roentgen and Coulomb/kg, Activity, curie ,Becquerel, Absorbed dose, Gray, dose equivalent, Effective Dose, KERMA, Air KERMA, quality factor, rem, sivert.

9. Principles of radiation detection and measurement, effects of energy absorbed by secondary electrons, physical, chemical and biological effects, measurement of exposure, free air ionization chamber, secondary standard dosimeters, Gas Filled Detectors, Ionization Chamber, thimble chamber, effective attenuation, condenser chamber, chamber sensitivity, correction factors, Farmer chamber, electrometers, parallel plate chamber, GM counters, Proportional Counters, scintillation counters, pulse height analysers, gamma ray spectrometers, survey meters, contamination monitors, pocket dosimeters, isotope calibrators, film dosimetry, thermoluminscent dosimeters, chemical dosimeters, Biological Dosimeters.

Module 3 Anatomy (Marks-10)

1. General Anatomy – Introduction, Cell, Epithelium, Connective tissue, Cartilage, bones, joints in both for limb and hind limb in cattle, sheep and goat, dog, cat, birds and other exotic animals. Vascular tissue, Lymphatic tissue, Muscular tissue, Nervous tissue and skin.

2. Nervous system – Spinal cord, cerebrum, cerebellum, brainstem, white matter, ventricles, blood supply.

3. Circulatory system – Thoracic wall & thoracic cavity, Pericardium, heart, chambers great vessels from heart, vascular system, lymphatic system.

4. Respiratory system – Nasal cavity, Larynx, Trachea, Bronchial tree, alveoli, Pleura, lungs, blood supply. Air sacs anatomy and its function in birds

5. Skeletal system – Fore limb bones, Hind limb bones, vertebral column, sternum, ribs, skull, joints in cattle, sheep and goat, dog, cat and birds.

6. GIT – Oral cavity, tongue, Pharynx, Oesophagus, Stomach, small intestine, large intestine, rectum & Anal canal, salivary glands, liver, gall bladder, pancreas, spleen, peritoneum.

7. Genito urinary system – Kidney, Ureter, Bladder, urethrea, male reproductive organs, female reproductive organ.

8. Endocrine system – Pituitary gland, thyroid gland, parathyroids, adrenal glands, Ovaries, Testis.

Module 4

Physiology (Marks-5)

1. General Physiology – Cell Physiology, Transport across cell membrane. Extracellular and intra cellular fluids – relative properties of each, classification, measurement of body fluids. Blood function, composition, properties. Plasma proteins – types, quantity functions. RBC functions, properties – PCV, ESR, Osmotic fragility. Definition and normal values. RBC Count – normal values, variation. Erythropoeisis – different stages, factors regulating blood indices. Anaemia – definition, classification, WBC – morphology, normal differential counts variations, total count. Normal values. Platelets – normal count, stages in the development of platelets, function – blood coagulation – anticoagulants bleed time, clotting time. Blood groups landstener law, , Rh system. Tissue fluid – Lymph formation, circulation. Skin and temperature regulation function of skin.

2. Cardiovascular system – Functional anatomy of heart and blood properties of cardiac muscle. Conducting system of heart – origin and spread of cardiac impulse. Cardiac cycle– definition, phases of cardiac cycle. Heart sounds – causes, character abnormalities, genesis of murmers. Cardiac output – definition, normal values, valuation factors affecting cardiac output method of measurement, fick principle, heart rate and its regulation. Blood pressure – definition, normal value, variation determinants of blood pressure – regulation of blood pressure, local and systematic mechanism, both neural, hormonal. HCG – normal ECG pattern. Arterial Pulse – definition, characters of pulse. Regional circulation – coronary, cerebral, pulmonary entraneosis and splanchnic.

3. Respiratory system – Define respiration. Physiological anatomy of respiratory system, functions. Mechanism of ventilation. Breath sounds, surfactant, pressure changes during respiratory cycle. Lung volumes and capacities. Alveolar ventilation, Respiratory deadspace. Ventilation perfusion ratio, Mechanism of gas exchange. Structure of blood gas barrier, factors affecting diffusion across respiratory membrane. Transport of O2 and CO2. Regulation of respiration. Hypoxia – definition, chemical features types, treatment. Arterial respiration.

4. Gastrointestinal System – Functional anatomy of gastrointestinal tract, Saliva – composition, functions, regulation of secretion. Gastric juice – composition function, regulation phase. Pancreatic secretion – composition, regulation of secretion, Pancreatic junction tests. Liver – composition, functions of bile, regulation of secretion, enterohepatic circulation. Gall bladder – functions, filling and emptying. Small intestinal juice – Composition, functions, movement of GIT –mastication, deglution, gastric movements, vomiting, movement of small intestine. Secretions of large intestine. Absorption of
carbohydrate, protein, fat. Special tests of gastrointestinal function, barium studies.

5. Endocrine system – Endocrine glands, hormone – definition, mechanism of action. Hypothalamic hormones. Pituitary gland hormones, function disorders. Thyroid gland –synthesis of hormones, function, disorders. Parathyroid glands- function, disorders. Endocrine pancreas – secretion, regulation glucose tolerance test. Pineal gland hormones, prostaglandins, G.I hormones, focal hormones.

6. Renal System – Functional anatomy of kidney, blood supply. Composition of urine. Process involved in urine formation. Glomecular filtration rate- definition, factors affecting glomecular filtration. Tubular function – reabsorption and secretion. Reabsorption of sodium, glucose, urea, water. Clearance – definition, method of measurement. Formation and concentration of urine-counter current system. Renal function tests. Dialysis. Renal Disorders. Diuresis, acid-base balance.

7. Nervous system – Functional anatomy, physiology of neuron. Synopses, receptors.
Spinal cord – structure, ascending and descending tract. Brain –sensory and motor areas cerebral cortex. Functions of cerebellum, brainstem. Reflexes, cranial nerves. EEG, Cerebrospinal fluid. Sensory and motor pathways. Special sense vision – functional anatomy of eye ball. Refractive errors, Visual pathway. Audition –structure, physiology of hearing deafness, auditory pathway.. Autonomic nervous system.

8. Reproductive system – Functions of female reproductive organs. Pregnancy, parturition. Functions of placenta. Functions of male reproductive system.

9. Muscle and nerve – Distribution of ions in ECF and ICF, resting membrane potential. Action potential. Muscle – comparison between skeletal, cardiac and smooth muscle. Electrical properties of muscle. Mechanical properties of muscles.

Module- 5 Pathology (Marks- 5)

1. Elementary Pathology of Common conditions: Definitions and general account of factors relating to their formation. (a) Benign tumours – Papilloma adenoma, keloid hyperkeratosis, hemangioma (b) Malignant tumours – difference between benign and malignant tumours, Pre cancerous lesion, method of spread of malignant tumours, biopsy its purpose and methods, epithelial tumours – Squamous cell Carcinoma, Adeno Carcinoma, Basal cell Carcinoma, Malignant melanoma – definition & general features. Connective tissue tumours – Organs and tissue affected.

2. General Pathology – Inflammation – types, signs, chemical mediators of inflammation, exudates and transudate. Healing and repair – wound healing, fracture healing. Degeneration-definition, types with examples. Necrosis – Definition, types with examples. Gangrene – definition, types with examples, difference between wet & dry gangrene. Atrophy & Hypertrophy – definition, types with examples. Oedema – chronic venous congestion. Thrombosis, embolism, Infarction, Shock, Calculi – Renal and Gall Bladder, Jaundice, Rickets with X-ray findings in detail, Hypertension, Pneumonia – types, lobar pneumonia in detail, Pneumothorax, plural effusion, empyma – definition, Osteomyelitis – in detail with X-ray findings, Radiation injury – in detail, Chemical carcinogen, Cirrhosis, hepatitis. Inflammatory processes – allergic, parasitic, toxic – definition with examples.

3. Hematology : Normal blood parametrs in all species of animals and birds. Anemia – classification, iron deficiency anaemia in detail, megaloblastic anaemia, Agranulocytosis, Polycythemia, Luekemia. Lymphoma.

4. Systemic Pathology

a. CNS – Definition – Meningitis, encephalitis, Tumour Pathology, Glioma-types, grading, clinical behavior. Medulloblastoma –CSF Pathway (spread), Meningioma.

b. Musculoskeletal system – Bone tumours – classification, site. Osteosarcoma – clinical features, X-ray , Pathology, Chondrosarcoma, Bone secondaries, Multiple myeloma/Plasmacytoma, Muscle – Soft tissue sarcoma – classification

c. Head and Neck – Oral cavity Most common carcinoma – squmous cell Carcinoma, Larynx – pappilloma. Carcinoma – supraglottis, glottis, infraglottis - %
and lymphatic drainage. Nasopharyngeal carcinoma – types

d. Respiratory System – Carcinoma – Small cell, Non small cell, Paraneoplastic syndrome.

e. Mammary gland tumours – benign – Fibroadenoma, fibrosarcoma, malignant – carcinoma – etiology, classification.

f. Kidney & Lower Urinary Tract – Renal Cell carcinoma, Ca Bladder – TCC – Clinical features.

g. Hepatobilliary System – Hepatocellular carcinoma, Cholangiocarcinoma.

h. GIT – Oesophagus – Ca – etiology, Gastric Ca – types, site – cardia, Fundus, Pylorus. Rectum – Ca, Lymphatic drainage. Anal canal – Squamous cell carcinoma, Malignant melanoma.

i. Skin – Squamous Cell Carcinoma, Basal cell Carcinoma- other sites, Malignant melanoma.

Module 6 Physics of medical imaging (Marks- 10)

1. Primary radiological image, latent image, developing and fixing, processing chemistry, action of developer, fixer, steps in film processing, processing solutions, automatic processing. X-ray films construction, double emulsion film, screen film, non screen film, single coated film, characteristic curve, optical density, contrast, gamma speed latitude. Intensifying screen, construction and action of type of screens, intensifying factors, rare earth screens, screen unsharpnes. Scattered radiations, grids, linear grids, grid factor, grid ratio, types of grid, potter bucky grids. contrast media and contrast in image formation, Xeroradiography

2. Fluoroscopy: Conventional Flouroscopy, dark adaptation, limitations, Image intensifier, principles and operation, Modern Fluoroscopic Imaging Systems- Fluoroscopic Equipment, AEC, Electronic magnification, Performance of Imaging Systems, Contrast, Noise, Sharpness,

Artefacts , Remote Fluoroscopic Systems, Portable and mobile Fluoroscopes , Capacitor discharge and high frequency sets, Mobile IITV, C-ARM. DSA principles, DSA systems.

3 Dental Radiography : Dental Radiography units, self rectified tubes, grid control tubes, dental equipments, cones, filters, factors OPG and cephalo units, tubes, applications.

4.Digital Imaging- Digital Image Receptors- Digital Imaging Systems, Computed Radiography, Digital Radiography, Artefacts of Digital Images. Digital Imaging Management, PACS, DICOM, Radiology Information System, Image Compression, Image Post processing and analysis

5. Mammography, equipments, X-ray tube and filter film screen combination. Digital mammography.

6. Computed Tomography : Physics of CT, types of CT scanners, CT Gnerations Spiral and multi slice CT,. CT Imaging Systems- Image reconstruction and Processing, Filtered back projection, Image acquisition, Scanned Projection radiographs, Axial CT, Helical CT, MD CT, Cardiac CT, CT Fluoroscopy, Artefacts in CT,

7. Magnetic Resonance Imaging (MRI): Basic Physics of MRI, MRI systems, design considerations. Relaxation Time, Tissue Contrast, Contrast Agents, Screening techniques Gradient echo imaging, spin echo imaging, Multi-slice imaging, 3D imaging, Artifacts in MRI.

8. Ultrasound : Physics of Ultrasound, Production of ultrasound waves, interaction of ultrasound waves, Ultrasound systems , Doppler Effect, scanning principles., Continuous wave doppler, Pulsed wave doppler, Electronic focussing and beam steering, three and four dimensional imaging, Quality Assurance in Ultrasound.

9 Nuclear medicine: Physics of Nuclear Medicine, Isotopes used in Nuclear Medicine Production and Properties , Biological and Effective half lives, Radio pharmaceuticals, Uptake studies, Scanners,Nuclear Medicine instrumentation, Gamma camera, Radio Immuno Assay, SPECT, PET.

Module 7. Darkroom Techniques (Marks-20)

1. A Summary of the factors involved in Radiography – Structure of a Medical X-ray film, film gradation, Kilo voltage, Millimpere– exposure time (mA second) cones and diaphragms, Radiographic Grids, intensifying screen, screen and non-screen films.

2. Darkroom Techniques – Location of darkroom, Construction, Colour treatment of walls Accessory equipments – safe light – storage shelves, or cabinet loading bench, hanger racks, hangers, solution tanks and master tank – water temperature control –thermometer – timer and stop watch, drying equipments, pass box, film corner cutter, paddles brushed apron. Composition of Processing chemicals – developer and fixer. Processing of films (exposed) – latent image – development. Rinsing – fixing and washing.

3. Factors controlling development and fixing – Defects occurring in films while processing-definition of fog – contrast – density. Automatic film processor. Dry laser camera.

4. Control of Definition (Sharpness) – Control of beam cross-section by fixed aperture diaphragms –

5. Viewing – Illumination and care of viewing boxes – Stereoscopic viewing.

6. Cautions before radiographic techniques –Age, Breed and sex, anatomical landmarks – postural variations – respiratory movement , Regional densities, preparation and immobilization of patient- pathological condition-injuries, fractures and dislocations, , positioning, terminology, identification systems.

7. Practical Protective Measures – Film and ionization method – distance, diaphragm, use of protective screens and gloves (Recommendation of the BARC)

8. Care and Comfort of patient & Medical Ethics – Psychological approach to patient as an individual, not as a case in relation to Pathological condition – handling of fracture cases, stretcher and bed patient, method of dealing with helpless patient, ventilation and temperature of X-ray room, awareness of cross infection, general hygiene, organization to avoid delay, waiting and rest rooms, special apparatus for children, neck and head injury patient, casualty management.

9. Records – Register of X-ray examination, Recording of radiography reports.

Module 8. Radiographic technique for individual system (Marks- 15)

I. Radiographic technique for individual system – (Technique refers to the position of the patient, the relative position of the tube to the patient and the exposure factors)

a. Fore limb –Technique for digits, forearm, knee joint, arm elbow joint, shoulder joint and shoulder
b. Hind limb – Digits, Hock joint, leg , stifle joint, patella ,thigh, pelvis and hip joint.
c. Vertebral column – Atlanto-occipital articulation, cervical vertebra, cervico-thoracic vertebra, thoracic vertebra, thoraco-lumbar vertebra, lumbar vertebra, lumbo-sacral vertebra lumbo-sacral articulation, sacrum, Tail.
d. Bones of the thorax – Techniques for ribs – upper and lower, sternum.
e. Skull – Carnium, sella turcica, optic foramina, Jugular foramina.
f. Temporal bones – Mastoids, petrous bone.
g. Paranasal sinus =- Techniques for frontal – maxillary, ethmoid, sphenoid,
h. Facial bones – Nasal bones, techniques for mandible, Temporo-mandibular joint.
i. Teeth – Introduction- – vertical and horizontal positioning abnormalities use of general and dental units.
j. Dental Radiography – Terminology, Intra-oral radiography, occlusal radiography – extra oral oblique lateral view.

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

l. Contrast radiography – Contrast media –methods of introduction- preparation of instruments Thoracic and Abdominal Viscera – General consideration, preparation and care of patient, factor variation in relation to thickness, visceral screening examination, optimum distance and exposure time, variation for abnormal and difficult subjects, demonstration of fluid levels, , soft tissue techniques, techniques for diaphragm,

II. Special investigations

a. Investigation of G.I Tract- Contrast media – Basic principles – elements involved, precautions against poisoning organic compounds of Barium Sulphate, Bismuth Carbonate, Sodium Iodide, specifications and trade names, air and other gases. Pharynx and oesophagus, stomach, duodenum small intestine, colon and rectum, fluoroscopy – compression techniques, single and double contrast techniques.

b. Urinogenital System – Genitorurinary system – IVP– principales – contrast medium – variation of time intervals depending on suspected pathology, value of compression – precautions and contra indications.

c. Retrograde pyelography (RGP) and AGP – Principles – contrast medium – techniques. Cystography and Urethrography – Principles – contrast medium – method of injection – Techniques.

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

e. Sialography – Technique following injection of apaque medium.

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

g. Lymphatic system – lymphangiography

n. Angiography – Principle-contrast media, method of injection, DSA

p. Lacrimal ducts sialography – contrast medium – method of injection, dacrocystorhinography.

q. Contrast – positive and negative contrast, Types of contrast media, Oral and I.V. Contrast media, I.V iodinated contrast media, Ionic, Non Ionic, Low osmolar, High osmolar, Indication, intra indication, adverse reaction. Management of adverse reaction. CT – contrast, MRI – contrast, Ultrasound – contrast

u. Fluoroscopy – technique

v. Cine Radiography – General principles – direct and indirect methods of exposure.

w. General Principles – Routine procedure – identification – protection of operation, projection filing.

x. Kymography ,Principles , Microradiography, Portable X-ray, Macro radiography, Xero radiography.

Module 9. Radiation safety and biological effects of radiation (Marks-10)

1. Atomic structure, Nucleus, Atomic number, mass number, Electron Orbit and energy levels, isotopes and isobars, radioactivity, radioactive decay, half-life, Particle radiation, Electromagnetic radiation, Production of X-Rays, Continuous X-Ray Spectrum, Bremsstrahlung radiation, Characteristic X-rays , Filters, Quality of X-rays, Effect of voltage and current on the intensity of X-rays, Properties of X-rays.

2. Interaction of Radiation with matter- Photoelectric effect, Compton Effect, Pair Production, Ionization of matter, Energy absorbed from X-rays, X-rays scattering, X-rays transmission through the medium, linear and mass attenuation coefficient, HVT and TVT, Interaction of charged particle and neutrons with matter.

3. Radiation Quantities and Units- Radioactivity, Flux, Fluence, Kerma, Exposure, Absorbed Dose, Equivalent Dose, Weighting Factors, Effective Dose, Natural Background radiation, Occupational Exposure limits, Dose limits to public.

4. Radiation Hazard evaluation and control- Philosophy of Radiation Protection, Effect of Time, Distance and Shielding, Calculation of workload, calculation of weekly dose to the radiation worker and general public, good work practices in diagnostic radiology and/or radiotherapy practices, Planning consideration for radiology and/or radiotherapy installation including workload, use factor & occupancy factors, effect of different shielding material.

5. The Cell, Effect of ionizing radiation on cell, chromosomal aberration and its application for the biological dosimetry, Somatic effects and hereditary effects, stochastic and deterministic effects, Acute exposure and chronic exposure, LD50/60

6. Detection and Measurement of radiation & measuring instruments Ionisation of gases, Fluorescence, and phosphorescence, Effect of photographic emulsion, Ionisation chambers, Proportional counters, G M counters, Scintillation Detectors, Liquid scintillator, Pocket Dosimeters, TL Dosimeters and their uses in personnel monitoring badges. Advantages and disadvantages of various detectors, appropriateness of different types of detectors for different types of radiation measurement.

7. Radiation Emergency Preparedness- Safety and security of radiation sources, case history of emergency situations and preparedness, equipments and tools including role of Gamma Zone Monitor, Regulatory requirements and prevention of emergency, Preventive maintenance and safety culture, Role of technicians in handling radiation emergencies.

8. Regulatory requirements-National Regulatory Bode, Responsibilities, organization, Safety Standards, Codes and Guides, Responsibilities of Licensees, registrants and employers and Enforcement of Regulatory requirements. Dose limits

Module 10. Advanced Medical Imaging technologies (Marks-10)

1. Digital Radiography – CR, DR History and development; Direct and indirect digital radiography. Theory and principle – digital Fluoroscopy system – digitized image-digital subtraction techniques – digital image processing- future equipment developments – clinical application – PACS (Picture Archival and Communication System) – Digital Image quality – Laser film printers. Image acquisition – Digital Spot Imaging (DSI) – Digital chest radiography – future developments.

2. Computed Tomography (CT scan equipments) Historical information, fundamentals, computer hardware and software, scanner types, technologic considerations of sequential/spiral volume zoom-– Basic data acquisition concepts, CT computer and image processing system-Image display, storage, recording system, CT control console, options and accessories for CT systems. Tools for use in CT guided Interventional procedures, Basic principle-data accumulation-image reconstruction-storing the image-viewing the image-evaluation of image-equipment for tomography-table-gantry-X-ray generator-different generations-image quality, Clinical applications, artifacts, CT advantages and limitations, Future developments,

3. Dual energy CT- Dual energy CT equipment - Basic principle-Instrumentation-clinical applications-newer developments.

4. Nuclear Medicine- Basic principle Instrumentation-Gamma camera, PET, clinical applications-newer developments.

5. MRI Equipments – structure and operation – MR system components – The reconstruction system – host computer, viewing archiving, hard copy – magnetic shielding– RF shielding, spin echo imaging sequence multi slice imaging-multi echo imaging-contrast-multi planar imaging-inversion recovery pulse sequence-signal to noise ratio-fast imaging techniques-safety considerations. Newer sequences and emphasis on, Relaxation parameters and spin echoes, Magnetic field gradients, slice selection and frequency encoding 2-D FT Imaging, k-space, Clinical applications of MRI, Basic Imaging sequence: spin-echo and gradient echo Hardware-RF Requirements and RF coils Image artifacts, Safety considerations Introduction to in vivo MR Spectroscopy, Single and multi-voxel MRS Processing MRS Data, Flow and angiography, Advanced pulse sequences and techniques,

6. PACS (Picture Archiving and Communication System) Technique of storing retrieving, presenting and sharing images like x-ray, ultrasound, CT scan and MRI. Dicom images PACS, VNAs and RIS PACS Architecture Cloud PACS

7. DSA – equipment and operation Equipment (present and past)-serial imaging devices-subtraction process, accessories and choice-catheters, guide wires, Interventional Angiography: Accessories and uses eg: coils/stents , pressure Injectors: Types, programming, injection protocols and uses. DSA Subtraction process, x-ray equipment, injection pump and serial imaging devices, cine camera, optical system, x-ray equipment and film processing.

8. Interventional Radiology - Practical interventional radiology in the diseases of the Hepatobiliary, GIT, Urology, Vascular System and other areas, Indications and contraindications, pitfalls and complications, role of radiographer/imaging technologist in the team. Interventional procedures – CT guided procedures: Fine needle aspiration, cytology; fine needle aspiration – fine needle aspiration biopsy. Fluoroscopy guided procedures percutaneous nephrolithotomy; percutaneous nephrostomy; percutaneoustrans hepatic biliary drainage; angioplasty; embolisation – Trans jugular liver biopsy, Vascular Intervention Techniques

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.