# King George's Medical University, Lucknow, U.P. (India)-226003

## Syllabus for Group B and Group C posts

## Notice No. 230/Recruitment Cell/2024 Dated 22/10/2024

# King George's Medical University, Lucknow, U.P. (India)-226003

**PART-A**

The Common Recruitment Test (CRT) will be of 02 hours duration & will be of 100 marks. It will contain multiple choice questions (MCQs)

- 60 Marks from the core subject related to the post and of the level of the qualificationsrequired.
- 10 Marks on General English.
- 10 Marks on General Knowledge.
- 10 Marks on Reasoning.
- 10 Marks on Mathematical Aptitude.

**Indicative Syllabus: For General Aptitude**

**A] Reasoning:** It would include questions of both verbal and nonverbal type. This component may include questions on analogies, similarities and differences, spatial orientation, problem solving, Analysis, judgement, decision making, discrimination, observation, relationship concepts, arithmetical reasoning and figural classification, arithmetic number series, nonverbal series, coding and decoding, statement conclusion, etc. the topics are, symbolic/ number analogy, figural analogy semantic classification, symbolic/Number Classification, Figural Classification, semantic series, number series, Figural series, problem solving, word building, coding & decoding, Numerical operations, symbolic operations Trends, space orientation, space Visualization, Venn diagrams, Drawing inferences, Punched hole/pattern-folding & unfolding. Figural pattern- Folding and completion, indexing. Address matching, Date & city matching, Classification of Centre codes/roll numbers, small & capital letters/numbers coding, decoding and classification, Embedded Figures, Critical thing, Emotional Intelligence, Social Intelligence, Other sub- topics, if any.

**B] General Knowledge:** Questions in this component will be aimed at testing the candidate's general awareness of the environment around him and its application to society. Questions will also be designed to test knowledge of current events and such matters of everyday observations and experience in the

scientific aspect as may be expected of any educated person. The test will also include questions relating to India and its neighboring countries especially pertaining to history, culture geography, economic scene general policy & scientific research.

**C] Mathematics Aptitude:** The questions will be designed to test the ability of appropriate use of numbers and number sense of the candidate. The scope of the test will be computation of whole numbers, decimals, fractions and the relationship between numbers percentage, Ration & Proportion, Square roots, Averages, Interest, Profit & Loss, Discount, Partnership, Elementary Surds, Graphs of Linear Equation, Triangle and its various kinds of centers, Congruence and similarity of triangles, Circle and its chords, tangents, angles subtended by chords of a circle common tangents to two or more circles, Triangle, Quadrilaterals, Regular polygons, Circle, Right Prism, Right circular cone, Right circular cylinder, Sphere, Hemispheres, Rectangular Parallel pipe, Regular right pyramid with triangular or square base, Trigonometric ration, Degree and radian Measures, Standard Identities, Complementary Angles, Heights and Distances, Histogram, Frequency, polygon, Bar diagram & pie chart.

**D] General English:** Candidates ability to understand correct English, basic comprehension and writing ability will be tested, Questions in this computer will be designed to test the candidates understanding and knowledge of the English language and will be based on spot the error, fill in the blanks, synonyms, antonyms, spelling/detecting mis-spelled words, idioms and phrases. One word substitution, improvement of sentences, active/passive voice of verbs, conversion into direct/indirect narration, shuffling of sentence parts, shuffling of sentences in a passage, comprehension passage and any other English Language questions at the Level of Matriculation /Higher Secondary.

## Name of post: Technical Officer (Medical Perfusion)

## Part – B
## Core Subject

- General concepts of patient care and nursing
- Basics of human anatomy / physiology/ pathology/ microbiology / Biochemistry
- Basics of Central Sterilization Services
- Basics of Cardiopulmonary bypass, priming solutions, transducers, cannulation techniques, mechanics of pumps and oxygenators
- Effects on various organs during CPB and introduction to IABP (Intra-aortic balloon pump) and ECMO(Extra corporeal membrane oxygenation devices)
- Clinical Monitoring, problem detection, and problem solving during bypass and understanding ofcomplications.
- Basics of cardiac physiology, respiratory physiology in normal and diseased states, basics of ECG,fundamentals of Echocardiography, and Pulmonary function testing
- Knowledge about transfusion of blood and blood products and maintaining and monitoring anticoagulationduring bypass.
- Applied Perfusion Technology, Introduction to Perfusion Technology, Perfusion Equipments, BiomedicalElectronics

## Name of post: Technician (Radiology)

## Part – B

## Core Subject

### 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 Skeleton, 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 Skeleton: 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-Designfeatures 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 gradeTFT monitors.

14. Detectors used in DR system, Digital fluorography

15. Image processing in digital radiography systems: Post processing techniques on console using CR, DR andflat 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, acromioclavicular 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, sacroiliac 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 spotsizes, 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 andapplications. 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 mediuminjection devices Digital subtraction angiography: Equipment, principle, advancements.

**Tomography:** Body section radiography, basic principle and equipment, multi section tomography, Transverseaxial 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 processingtechniques.

Trauma radiography/Emergency radiographyNeonatal and Pediatric Radiography, Dental Radiography- Technique for intra oral full mouth.- Occlusal projections.- Extra oral projections including orthopantomography.- Supplementary techniques.

Forensic Radiography

## RADIATION PROTECTION AND REGULATORY REQUIREMENTS

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

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.

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.

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.

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

Introduction to pathologic techniques – FNAC, Histopathology, IHC, molecular methods

**SPECIAL RADIOGRAPHY PROCEDURES & NEWER IMAGING TECHNIQUES**
Responsibility of Radiographer during Radiological Procedures.
Preparation of Patient for Different Procedures, trolley set up.
Contrast Media - Positive and Negative, Ionic & Non – Ionic
Adverse Reactions To Contrast Media and Patient Management
Emergency Drugs in the Radiology Department
Emergency Equipments in the Radiology Department
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
- Salivary glands: Routine technique, procedure – sialography

## b. Biliary system:

- Intravenous cholangiography, Percutaneous cholangiography

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

**c. Urinary system:**

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

d. **Female reproductive system:** Hysterosalpingography.

**e. Mammography related:**

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

f. **Arthrography:** Shoulder, Hip, Knee, Elbow

g. **Sinography:** Routine technique and procedure.

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

**i. 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.

## j. 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-procedurecare.

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 andattenuation 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, clinicalapplications, display methods, image quality image, reproducibility, biopsy procedures.

2. Computed Tomography

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 – RFshielding – 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 – T2weighted 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 uncooperative 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

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

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, pasteurization). 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

## Name of post: Technician (Radiotherapy)

## Part B
## Core Subject

1. Introduction to healthcare delivery system
    a. Healthcare delivery system in India at primary, secondary and tertiary care
    b. Community participation in healthcare delivery system
    c. Health system in developed countries.
    d. Private Sector
    e. National Health Mission
    f. National Health Policy
    g. Issues in Health Care Delivery System in India
2. National Health Programmes
3. Introduction to AYUSH system of medicine
4. Health scenario of India- past, present and future
5. Demography & Vital Statistics
6. Epidemiology

Medical terminologies and record keeping

1) Derivation, prefixes, and suffixes.
2) Conventions for combined morphemes and the formation of plurals.
3) Form medical terms utilizing roots, suffixes, prefixes, and combining roots.
4) Interpret basic medical abbreviations/symbols.
5) Utilize diagnostic, surgical, and procedural terms and abbreviations related to the integumentarysystem, musculoskeletal system, respiratory system, cardiovascular system, nervous system, and endocrine system.
6) Interpret medical orders/reports.
7) Data entry and management on electronic health record system.

Basic computers and information science

Introduction to computer: Introduction, characteristics of computer, block diagram of computer,generations of computer, computer languages.
Input output devices: Input devices(keyboard, point and draw devices, data scanning devices, digitizer, electronic card reader, voice recognition devices, vision-input devices), output devices(monitors, pointers, plotters, screen image projector, voice response systems). Processor and memory/ Storage Devices: Sequential and direct access devices, magnetic tape, magnetic disk, optical disk, mass storage devices. Introduction of windows / Introduction to MS-Word / Introduction to Excel/ Introduction to power-point: introduction, creating and manipulating presentation,
Computer networks: introduction, types of network (LAN, MAN, WAN, Internet, Intranet), network topologies (star, ring, bus, mesh, tree, hybrid), components of network.

Medical law and ethics

1. Medical ethics - Definition - Goal - Scope
2. Introduction to Code of conduct/ Confidentiality/ Malpractice and negligence / Autonomy andinformed consent - Right of patients/ Care of the terminally ill- Euthanasia

3. Organ transplantation
4. Medico legal aspects of medical records
5. Professional Indemnity insurance policy
6. Development of standardized protocol to avoid near miss or sentinel events / obtaining an informed consent

Communication and soft skills

1. Basic Language Skills: Grammar and Usage.
2. Business Communication Skills/ Basic concepts & principles of good communication /Special characteristics of health communication/ Types & process of communication
3. Barriers of communication & how to overcome

Introduction to Quality and patient safety

1. Quality assurance and management -
    a. Concepts of Quality of Care
    b. Quality Improvement Approaches
    c. Standards and Norms
    d. Quality Improvement Tools
    e. Introduction to NABH guidelines

2. Basics of emergency care and life support skills - Basic life support (BLS) is the foundation for saving lives following cardiac arrest. Fundamental aspects of BLS include immediate recognition of sudden cardiac arrest (SCA) and activation of the emergency response system, early cardiopulmonary resuscitation (CPR), and rapid defibrillation with an automated external defibrillator (AED).

3. Bio medical waste management and environment safety :
    a. Definition of Biomedical Waste
    b. Waste minimization
    c. BMW – Segregation, collection, transportation, treatment and disposal (including colorcoding)/ Liquid BMW, Radioactive waste, Metals / Chemicals / Drug waste
    d. Modern technology for handling BMW / Use of Personal protective equipment (PPE)
    e. Monitoring & controlling of cross infection (Protective devices)

    Infection prevention and control - The objective of this section will be to provide a broad understanding of the core subject areas of infection prevention and control and to equip AHPs with the fundamental skills required to reduce the incidence of hospital acquired infections and improve health outcomes. Concepts taught should include –
    a. Evidence-based infection control principles and practices [such as sterilization, disinfection, effective hand hygiene and use of Personal protective equipment (PPE)],
    b. Prevention & control of common healthcare associated infections,
    c. Components of an effective infection control program, and
    d. Guidelines (NABH and JCI) for Hospital Infection Control

4. Antibiotic Resistance and antibiotic stewardship
5. Disaster preparedness and management- The objective of this section will be to provideknowledge on the principles of on-site disaster management

Professionalism and values

1. Professional values- Integrity, Objectivity, Professional competence and due care,Confidentiality

Research Methodology and Biostatistics: Basic conceptsElementary mathematics & physics:

1. Elementary Mathematics
   - ✓ Calculation of percentage, Profit & Loss, Simple interest, compound interest, time & work ,Ratio & proportion, Surds, Indices, Logarithm, Inverse Square Law,
   - ✓ Geometry of triangles, similar triangles, Properties of Triangles.
   - ✓ Trigonometry: Height & Distance.
   - ✓ Graphical Representation of Exponential and Inverse exponential functions, Linear and semi log graphs.
2. Basic Physics, Electrostatics, Magnetism & Current Electricity
   - ✓ Units & Dimension, Newton's Laws of Motion, Velocity & Speed, Force, Momentum etc.
   - ✓ Coulomb's Law, Electric field & potential, Capacitance, Ohm's Law, Heating effect of current, Biot–Savart law, Definition of Tesla and Gauss, Magnetic field due to circular coil. Elementary Principles of Magnetization of Materials by electric current, Electromagnets. Lorentz force. Magnetic flux. Electromagnetic induction, mutual and self-inductance. Transformer, Eddy current. Alternating Current, RMS and Average Current. Variation of Voltage and current in AC circuit consisting only Resistor, Only Induction and Only Capacitor. Power factor of the AC circuit. Instruments: Electrometer, Galvanometer, Ammeter,& Voltmeter.

Human Anatomy and Physiology: Basic and Applied

Radiographic Anatomy

Emphasis on plain and cross-sectional radiographic anatomy

1. Surface anatomy
2. Plain film / conventional radiographs
3. Mammography
4. Computed Tomography (CT)
5. Magnetic Resonance Imaging (MRI)
6. Ultrasound
7. Nuclear medicine
8. Digitally Reconstructed Radiographs (DRR)
9. Portal imaging

Oncology Science

1. Pathology- general pathology of tumours
2. Malignancies- local and general effects of tumours and its spread
3. Carcinogenesis
4. Co-morbidities
5. Etiology and epidemiology
6. Genetics
7. Prevention
8. Early detection
9. Signs and symptoms
10. Public awareness on early signs and symptoms

11. High risk groups
12. Staging of tumours

Principles of Radiation and Radiotherapy Techniques

1. Effects of various radiation on normal tissues and malignant tumor: Early and late reaction on Skin, Mucous membrane, GI tract, Genito urinary system, respiratory system, CNS
2. Application of radiotherapy in benign conditions
3. Application of radiotherapy in malignant condition
4. Single and multiple field techniques for all treatment sites (from Head to Feet) with appropriate immobilizing device(s).
5. Fix, Rotation, Arc and Skip therapy procedures.
6. Use of Rubber traction, POP, Or fit, Body Frame in treatment technique.
7. Evaluation of patient setup for simple techniques.
8. Use of Beam Modifying devices, such as wedges, Tissue compensators, Mid Line Block (MLB) in the treatment of respective sites.
9. Customized shielding blocks and its properties.
10. Asymmetric jaws
11. Motorized wedges
12. Simulation procedures including CT simulation

Radiation Quantities, Units and Detection/Measurement

1. Radioactivity, Flux, Fluence, Kerma, Exposure, Absorbed Dose, Equivalent Dose, Weighting Factors, Effective Dose, Natural Background Radiation, OccupationalExposure Limits, Dose limits to Public.
2. Detection and measurement of radiation - Ionisation of gases, Fluorescence and phosphorescence, Effect on photographic emulsion, Ionisation chambers, Proportional Counters, G.M. Counters, Scintillation Detectors, Liquid scintillator, Pocket Dosimeters, TL Dosimeters and their use in personnel monitoring badges. Advantages and disadvantages of various detectors, appropriateness of different types of detectors for different types of radiation measurement.

Basic Radiation physics

1. Atomic Structure, Nucleus, Atomic No., Mass No., 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, Ionisation 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.

Radiotherapy Equipment

1. Brachytherapy- Design features, Radiation sources, Technique, High dose-rate (HDR),Low dose- rate

(LDR),Pulsed dose-rate (PDR), various types of applicators.

2. Teletherapy Machines & Accessories:
    - Telecobalt Machines
    - Medical linear accelerators.
    - Tomotherapy
    - Machine properties.
    - Beam directing, modifying and defining devices.
    - Other accessories.

Radiation safety

- Radiation Hazard evaluation and control
- Radiation Emergency Preparedness
- Regulatory requirements

Patient care, positioning and immobilization

1. Principles of positioning and immobilization
    - Positioning aids-Breast boards, Lung boards, Belly boards, Head-and-neck fixation devices, Vacuum packs, Stereotactic systems
    - Internal organ motion control- Bite blocks, Gating systems, Active breathing control, Diaphragm compression, Prostate immobilization, Tracking systems. Laser/ positioning systems
    - Marking systems
    - Isocentre determination
    - Reference points
    - Treatment couch
    - Image acquisition for planning (and/or verification)
    - Modalities for image acquisition for planning
    - Simulation- Conventional Simulation, CT Simulation, Virtual Simulation
    - Image processing and archiving
    - Treatment verification
    - Protocols- Imaging protocols: development and implementation, Non-action levels (NAL), On-line/off-line corrections, Matching/co-registration procedures, Geometric uncertainties, Documentation, Adaptive radiotherapy, Information management35

Radiotherapy Equipment

- Familiarization with treatment planning systems-external beam planning and brachytherapy
- Various types of phantoms including the water-phantoms, RFA
- Various types of dosimeters including in-vivo dosimeters
- EPID and other on-board imaging systems
- Record and Verify Systems, Oncology Information Systems, Image/Patient data archiving, storage and transfer.
- CT Simulator

Quality Assurance in Radiotherapy

Basic Radiotherapy Physics

Historical developments in Radiotherapy, Physical components of Telecobalt Unit / LinearAccelerator Unit

/ Remote After Loading Brachytherapy Unit / Gamma Knife Unit / Simulator /Brachytherapy units and their descriptions, Various types of sources used in Radiotherapy and their properties, Physics of Photons, electrons, protons and neutrons in radiotherapy, Physical parameters of dosimetry such as Percentage Depth Dose, Tissue-Air Ratio, Tissue Maximum Ratio, Physics of Bolus and Phantom materials, Compensators, Wedges, Shielding Blocks, Patient immobilization devices, Port film, processing and development, Special techniques in Radiotherapy such as SRS, SRT, IMRT, IGRT and Tomotherapy.

Biological Effects of Radiation

The Cell, Effect of ionising radiation on Cell, Chromosomal aberration and its application forthe biological dosimetry, Somatic effects and hereditary effects, stochastic and deterministic effects, Acute exposure and Chronic exposure, LD50/60. Role of RTT in managing the acute effects of radiation.

Clinical Radiobiology

- Cell kinetics
- Cell cycle control mechanisms
- Tumour biology
- The five 'R's of radiobiology
- Tissue structure and radiation effect
- The Linear Quadratic (LQ) model
- Tumour control probability (TCP), Normal Tissue Complications Probability (NTCP)models
- Acute and late side effects
- Sensitizers/protectors/side effect reduction
- Fractionation
- Treatment combinations
- Treatment scheduling
- Mould Room /Motion Management Techniques

Mould room and motion management techniques are essential part of modern precision radiotherapy. An RTT has to be competent in designing various types of moulds for patient immobilization and applicator fixation (in brachytherapy) as well as in various motion management techniques:

- Historical evolution of the mould materials and techniques to make moulds
- Thermoplastic moulds
- Breath hold, motion reduction, tracking and gating techniques

Special RT Techniques and Recent advances

Wedges-tissue compensator-irregular field-SSD&SAD technique-oblique field-arc-rotational and moving field

- Mantle field-irregular field-Hemi body irradiation-whole body irradiation-total body skin irradiation
- Special techniques in Radiation Therapy, (SRT) – Stereo tactic Radio surgery (SRS) –. Methods – BRW and CRW frames – angiographic localizer box – preparation of target sheets – Quality Assurance – Isocentric check – Treatment execution – care to be taken – check list.
- Conformal Radiotherapy: Principles of 3 D treatment.
- Recent developments in radiotherapy and treatment techniques

Radiological/Nuclear Medicine/Other Imaging Techniques in Radiotherapy Planning

- 2D ( radiography, fluoroscopic, USG), 3D ( CT, MRI) and functional ( PET/SPECT) imaging and their application in radiotherapy planning
- Understand Gross Tumour Volume (GTV), Clinical Target Volume (CTV), Internal Target Volume (ITV), Planning Target Volume (PTV), Organs at Risk (OAR) delineation
- Conduct image fusion at the treatment machine console
- Do bony matching
- Do soft tissue matching for estimating the preliminary data for applying shifts
- Prepare documentation
- The RTT should understand the principles of: Four-dimensional (4D) planning and be familiarized with IMRT and IGRT planning.

Radiotherapy treatment delivery

- Orthovoltage / superficial
- Supervoltage / Megavoltage
- Brachytherapy

- Stereotactic radiotherapy- Stereotactic radiosurgery, Stereotactic radiotherapy, Cranial Extra cranial (Stereotactic body radiotherapy SBRT),Total Body Irradiation (TBI),Total Skin Electron Irradiation (TSEI), Radiation therapy with neutrons, protons, and heavy ions

- Operational Issues in Radiotherapy

## Name of Post: Technical Officer (Ophthalmology)

## Part - B

## Core Subject

- Anatomy of eye
- Physiology of eye : Anterior chamber, Posterior chamber, Colour Vision & visual Field
- General consideration of different terms used in ophthalmology.
- Common diseases of eyelids
- Common diseases of conjunctiva
- Common diseases of sclera / Common diseases of iris & ciliary body
- Common diseases of Cornea
- Glaucoma & Cataract
- Anatomy and physiology of Orbit
- Examination of eye - General examination of eye including :
    - Visual acuity
    - Accommodation
    - Colour vision
    - visual Fields
- Principle of Retinoscopy & methods
- Refraction techniques including prescription of glasses,
- Errors of refraction (Computerized and Non-computerized techniques)
    - Myopia
    - Hypermetropia
    - Astigmatism
    - Presbyopia
    - Aphakia / Pseudophakia
    - Anisometropia
    - Anisokonia
- Physical optics
- Properties of light
- Principles of refraction
- Lenses and their combinations
- Spectacles designs & fitting
- Keratometry
- Cross Cylinder
- Contact lenses
    - Indications
    - Types
    - Uses
    - Fitting
- Ocular Pharmacology
- Orthoptics

- Ophthalmic Instruments & appliances
- Investigative Ophthalmology
- Eye Bank
- Community Ophthalmology
- Management Of Ophthalmic Operation Theater

# Name of Post: Technical Officer (ENT)

## Part – B
## Core Subject

**INTRODUCTION TO HUMAN COMMUNICATION**:

History and development of the profession of Speech-Language Pathology (SLP) specifically in India

➢ Interdependency & interrelation between communication, hearing, speech, and language.
➢ Function of communication, speech and language
➢ Modes of communication (Verbal & Non-verbal)
➢ Characteristics of good speech
➢ Interactive bases of human communication:

Nervous system: Divisions and functions of the nervous system, nerve cell, receptors and synapse, types of nerve fibers. Peripheral nervous system. Brief description of spinal cord and CSF.

- Structure of the brain and divisions: general and lobes of cerebrum. Reticular formation, Basal ganglia and cerebellum. Reflex action and common reflexes. Cranial nerves, distribution and supply with the special reference to II , V, VII , IX, X , XII., Nerve tracts (motor and sensory), Brodmann's area, anatomy of the nervous system related to speech and language.

Basic Acoustics of speech

- Vibrating system – simple harmonic motion – simple vibrating system – system with two or more masses – system with many modes of vibrations – vibration spectra. Waves – What is a wave? Progressive waves – sound waves – wave propagation – Doppler effect – reflection, diffraction, interference,
  absorption.Resonance of a mass spring vibrator- standing waves – partials, harmonics and overtones – Acousticimpedance – Helmholtz resonator – sympathetic vibrations.
  Mechanism of speech and language production
- Anatomy and physiology of laryngeal system • Development of voice • Bases of pitch and loudness change mechanism

Mechanism of speech and language production

Semantics: A brief introduction to different types of meaning homonyms, synonyms and antonyms.
Morphology: Morpheme – bound and free, process of word formation, content and function words.
Syntax: grammatical and syntactic categories, sentence types, Syntactic analysis.
Pragmatics: Introduction to verbal and non-verbal communication and other indicators, intent of communication.
Theories and models of language Acquisition – Behavioral, Nativistic, Cognitive, Linguistic, Pragmatic, Biological and Information processing model.

Developmental issues in communicative development – genetic, neurological, medical, behavioral, social and psychological.
Bilingualism / multilingualism in children; Bilingual Language learning contexts at home and schoolsituations, compound / coordinate context and others.
Definition, Etiology, Characteristics, Classification and Impact of Hearing Impairment, Mental Retardation, Cerebral Palsy

Definition, Etiology, Characteristics and classification of Autism Spectrum Disorders/Pervasive Developmental

Definition, Etiology, Characteristics, Classification and Impact of Specific Language Impairment • Learning Disability • Acquired aphasias in childhood • Traumatic Brain Injury • Multiple disabilities Introduction to assessment procedures, differential diagnosis and management

**INTRODUCTION TO HEARING & HEARING SCIENCES:**

Origin of Audiology • Its growth in India • Scope of Audiology, Branches of Audiology • Audiovestibular system: Anatomy of the external, middle and internal ears.
Ascending and descending auditory and vestibular pathways. • Physiology of the external, middle & inner ear, central hearing mechanisms, cochlear microphonics, action potentials, theories of hearing (AC & BC) , Theory of bone conduction • Vestibular system: Functions of utricle, saccule and vestibular apparatus. Posture and equilibrium. Tests of posture and equilibrium • Causes of hearing loss Genetic (congenital, late onset, progressive, syndromic / non- syndromic), Non-Genetic (Congenital/acquired)

Role of hearing (threshold concept, binaural hearing, head shadow, pinna shadow effect, MAF, MAP – Curve for threshold of hearing) • Sound Pressure, Power and Loudness. Physical and psychophysical scales, Equal loudness contours, Frequency weighting curves, combined sources, Pitch and Timbre. Physical and psychophysical scales. Fourier analysis of complex Tones • dB concept: power and pressure formulae: zero dB reference for pressure and power calculation of actual SPL, reference and dB values with any to given values, calculation of overall dB when two signals are superimposed. • Phones and Sones: relation between phones and sones; use of phone and sonograph; computation of relative loudness of two given sounds using these graph. Frequency and intensity, their psychological correlates: dL for frequency and intensity

Calibration: Biological and instrumental for AC & BC transducers • Procedure • interpretation • precautions to be taken while testing • Audiometric room construction • Acoustics of Rooms. Sound propagation in outdoors and indoors. • Direct, early and reverberant sound. Calculation of reverberation time. • Air absorption. Background noise.

**Basic concepts of AC & BC testing**

- Pure Tone audiometery • Need and scope • Instrumentation, Different types of transducers • Standards • Permissible ambient noise levels for audiometric testing
- Classification of audiograms • Sound field & closed field testing • Factors affecting AC & BC testing
- Screening Vs Diagnostic pure tone testing • Extended high frequency testing & its interpretation • Masking: Definition, types of masking, types of noises, critical band concept, • Terminology related to masking: Test ear, non-test ear, masker, maskee, crossover, cross hearing and shadow curve • Interaural attenuation; Factors affecting IA; Criteria for masking during AC &BC • Factors determining amount of masking noise, AB gap in masked ear, masking dilemma in bilateral symmetrical conduction hearing loss. • Fusion Inferred Test (FIT) •Types and degrees of hearing loss
  Tuning fork tests: Tuning fork tests (Rinne, Weber, Bing, Schwabach), interpretation, merits & demerits. • Speech audiometry • Orientation to speech audiometry • Need for speech audiometry • Speech recognition threshold, speech identification score, UCL, MCL, dynamic range, articulation index • Tests developed in India and abroad • Factors affecting speech audiometry • Limitations of

speech audiometry • Masking for speech audiometry • PI-PB function

**MANAGEMENT OF THE HEARING IMPAIRED:** Definitions and goals of rehabilitation & aural rehabilitation Early identification and its important in aural rehabilitation • Unisensory Vs Multisensory approach • Manual Vs oral form of communication for children with hearing impairment • Total communication Methods of teaching language to the hearing impaired o Natural method o Structured method o Computer aided method Educational problems, of children with hearing impairment in India • Educational placement of hearing impaired children • Criteria for recommending the various educational placements • Factors affecting their outcome • Counseling the parents and teachers regarding the education of the hearing handicapped • Parent Infant Training Programme (PIP) & Mother's Training Programme, Home training – need, preparation of lessons; correspondence programs (John Tracey Clinic, SKI-HI), follow up

Introduction to hearing aid technology: Parts of hearing aids & its functions • Type of hearing aids: - Body level Vs ear level - Monaural Vs Binaural Vs Pseudobinaural - Directional hearing aids, modular hearing aids Classroom amplification devices; Group amplification systems– hard wired, induction loop, FM, infrared rays. • Setting up class rooms for the hearing handicapped • Classroom acoustics preferential seating and adequate illumination

Ear moulds: Importance, types (hard, soft), procedure of making each type of ear mould, styles of ear moulds, criteria for selection of one style over the other, ear mould modifications, EAC of hearing aid

along with ear mould. • Importance of counseling for users & parents – importance of harness, BTE loops. Tips to facilitate acceptance of hearing aids, battery life, battery charger. Counseling for geriatric population,Trouble shooting of hearing aids

**ENT:**

- Anatomy & Physiology of external, middle & inner ear, auditory pathways, vestibular pathway. Diseasesof the external middle and inner ear leading to hearing loss: Congenital malformations, traumatic lesions, infections, management of middle ear and Eustachian tube disorders. Other causes of hearing loss – Facial paralysis, Tumors of the cerebello-pontine angle, Acoustic neuroma. Infection and management of inner ear diseases. Cochleovestibular diseases and its management.
- Anatomy & Physiology of pharynx & oro-peripheral structures Causes of speech disorder, Disorders of the mouth, Diseases of tonsils and adenoids. Oesophageal conditions: Congenital abnormality – Atresia, Tracheo- oesophageal fistula, Stenosis, Short oesophagus. Neoplasm – Benign, Malignant, Lesions of the oral articulatory structures like cleft lip, cleft palate, submucosal cleft, Velopharyngeal incompetence.
- Anatomy & Physiology of larynx – physiology of phonation/physiology of respiration. Congenital diseases of the larynx – difference between an infant and an adult larynx. Stridor – causes of infantilestridor. Disorders of structure – Laryngomalacia, Bifid epiglottis, Laryngeal web, Atresia, fistula, Laryngeal cleft, Tumors and Cysts, Laryngitis, Laryngeal trauma and Stenosis. Neuromuscular

dysfunctions of the larynx – Vocal cord palsy, Spastic dysphonia, Hypothyroidism, gastro oesophageal reflux disorders, Laryngectomy, artificial larynx, oesophageal speech, tracheo oesophageal puncture.

**PSYCHOLOGY RELATED TO SPEECH AND HEARING**:

Introduction to psychology- Definition, History and perspectives, Branches and scope, application of psychology in the field of speech and hearing. • Introduction to Clinical psychology – Definition, Perspectives and models of mental disorders

Psychology of learning – Introduction, Definition of learning, Theories of learning, Classical conditioning, Operant conditioning and Social learning. Application of learning theories in the field of speech and hearing (therapeutic, educational and rehabilitative applications).

Cognitive Psychology – Introduction, Definition and theoretical perspectives (David Rumelhart and David Mc Clelland, Noam Chomsky, George Miller, Allan Newell). • Applications of cognitive psychology in the field of speech and hearing. • Neuropsychology – Introduction, definition, principles of neuropsychological assessment, diagnosis and rehabilitation. • Applications of neuropsychology in the field of speech and hearing. Psychodiagnostic – Case history taking, Mental status examination, behavioural analysis, psychological testing. Counselling- Meaning and definition, types of counselling, Counselling in rehabilitation practice.

Developmental psychology: • Introduction, Definition, Principles, Motor development, Emotional development • Cognitive development- Definition, Piaget's theory • Play as a therapeutic tool • Personalitydevelopment- Introduction, Stages,

- **SPEECH LANGUAGE DIAGNOSTICS AND THERAPEUTIC**: Speech-language diagnostics Client history – definition, description, utility & need. Essential factors to be included in the client history form – comparison of adults vs. children's history – usefulness of the client history, Basic terminologies and concepts • Introduction to diagnostics • Terminologies in the diagnostic process • General principles of diagnosis • Diagnostic setup and tools

  Diagnostic approaches and methods • Approaches to diagnosisDiagnostic models – SLPM, Wepman, Bloom and Lahey • Types of diagnoses – Clinical diagnosis, direct diagnosis, differential diagnosis, diagnosis by observation, diagnosis by exclusion, diagnosis by treatment, instrumental diagnosis, provocative diagnosis, provisional diagnosis;

  advantage/disadvantages • Team approach to diagnosis • Characteristics of a good clinician as diagnosticianSpeech therapeutics

  Basic concepts of therapeutics • Terminologies in speech therapeutics • General principles of speech and language therapy • Speech therapy set-up • Individual and group therapy • Integrated and inclusive education, Procedures for speech-language therapy • Approaches to speech and language therapy – formal, informal and eclectic approaches • Types of speech and language therapy • Planning for speech and language therapy – goals, steps, procedures, activities Techniques for: Speech and language therapy for various disorders of speech and language Importance of reinforcement principles and strategies in speech and language therapy, types and schedules of rewards and punishment

  Clinical documentation and professional codes • Documentation of diagnostic, clinical and referral reportsIntroduction to parent counselling, facilitation of parent participation and transfer of skills, follow-up •

  Evaluation of therapy outcome • Ethics in diagnosis and speech language therapy • Self-assessment andcharacteristics of a clinician

**ARTICULATION AND PHONOLOGICAL DISORDERS**: Review of phonological development and articulatory mechanism • Fundamentals of Articulatory phonetics

Definition and types of coarticulation • Transcription methods in perceptual analysis •

Phonologicalprocesses – types, language-specific issues, identification and classification of errors.

Distinctive features – types, language specific issues, identification of errors and analysis. • Acousticaspects of production and perception of speech sounds; use of spectrograms • Factors related to articulation and phonological disorders: •Structural •Cognitive – Linguistic •Neurological

•Psychosocial •Social •Metalinguistic

Assessment procedures: Types of assessment, sampling procedures, scoring procedures, criteria for selection of instruments for assessment. • Assessment of Oral peripheral mechanism • Speech sounddiscrimination, stimulability and oral stereognosis. • Analysis and interpretation of data: • Intelligibility and severity judgments • Normative data • Error patterns. • Characteristics of disordered phonology and differential diagnosis

Intervention: Stages of treatment and measuring improvement, long term goals, short term goals and activities for achieving goals in cases with misarticulation. • Issues in maintenance and generalization. •Team approach and

professional communication (inter, intra professional and client oriented) • Approaches to treatment: moto kinesthetic, traditional approaches integral stimulation, phonological, distinctive feature, minimal contras therapy, learning theories, programmed, paired – stimuli. • Computerized intervention packages,metaphon therapy

Cleft Lip and Palate • Etiological factors • Embryology of the Face and Palate • Types of Cleft lip and Palate, Classification systems • Syndromes • Velopharyngeal mechanism- muscles and function; inadequacy, incompetency and insufficiency • Speech and Language problems of individuals with Cleft • Associated problems of individuals with Cleft • Diagnostic procedures and Instruments used in Assessment of speech in Cleft palate • Team Management: Composition, responsibilities and co-ordinator • Treatment concepts • Treatment procedures for speech • Prosthetic speech appliances for patients with Cleft palate Glossectomy and Mandibulectomy • Effect of partial and Total Glossectomy on speech Characteristics of Glossectomy speech • Rehabilitation of speech • Prosthetic fitting, design, assessment • Dysphagia specific to glossectomy and mandibulectomy: assessment and rehabilitation

**MOTOR SPEECH DISORDERS:**

- Introduction to neuromotor organization and sensorimotor control of speech - Motor areas in cerebral cortex, motor control by subcortical structures, brainstem, cerebellum and spinal cord. - Central nervous system and peripheral nervous system in speech motor control. - Centrifugal pathways and motor control - Neuromuscular organization and control - Sensorimotor integration - Introduction to motor speech disorders in children- Dysarthria and Developmental apraxia of Speech
- Definition, causes and classification - Neuromuscular development in normals and children with cerebral palsy - Reflex profile - Associated problems - Speech and language problems of children with cerebral palsy - Assessment of speech in cerebral palsy- objective and subjective methods - Differential diagnosis of cerebral palsy - Management: Introduction to different approaches to neuromuscular education (Bobath, Phelps and the others); Speech rehabilitation in cerebral palsy- Verbal approaches: vegetative exercises, oral sensorimotor facilitation techniques, Compensatory techniques- correction of respiratory, phonatory, resonatory and articulatory errors; Team approach to rehabilitation; Neurosurgical techniques for children with cerebral palsy

- Different types of Cerebral palsy: - Disorders of muscle tone: Spasticity, rigidity, flaccidity, atonia - Disordersof movement: Hyperkinesias and dyskinesias- Ballismus, tremor, tic disorder, myoclonus, athetosis, chorea, dystonia, hypokinesia – Disorders of coordination- Ataxia Syndromes with motor speech disorders- Examples: - Juvenile progressive bulbar palsy - Congenital supranuclear palsy - Guillain- Barre syndrome -Duchenne muscular dystrophy
- Apraxia of speech in children or developmental apraxia of speech - Definition - Description: verbal and non-verbal apraxia - Differential diagnosis- dysarthria and other developmental disorders of developmental apraxia of speech- Facilitation techniques for oral motor movements, speech therapytechniques, generalization of speech
- Definition - alternative and augmentative communication (AAC). Application of alternative and augmentative communication methods in developmental dysarthrias and developmental apraxia of speech- Symbol selection, techniques for communication, assessment for AAC candidacy, choosing an appropriate system andtechnique, training communication patterns, effective use of AAC

**Adult Motor Speech Disorders**

**DYSARTHRIA AND APRAXIA**: Definition and classification of dysarthria in adults. b) Types of dysarthria in adults. c) Neurogenic disorders learning to dysarthria in adults. • Vascular disorders – dysarthria following strokes, CVA, cranial nerve palsies and peripheral nerve palsies. • Infection condition of the nervous system

– eg. Meningitis, polyneuritis and neuro syphilis. • Traumatic conditions – Traumatic brain injury and dysarthria • Toxic conditions – dysarthria due to exogenic and endogenic causes. • Degenerative and demyelinating conditions – multiple sclerosis, Parkinson's disease, motor neuron diseases, Amyotrophic lateral sclerosis. • Genetic conditions – Huntington's chorea, Guillian–Barre syndrome. • Others leading todysarthria

– Anoxic conditions, metabolic conditions, idiopathic conditions and neoplasm.

Assessment of dysarthria Instrumental analysis • Physiological and Electrophysiological methods • Acoustics • Advantages and disadvantages of instrumental analysis of speech in dysarthria. Perceptual analysis – measures, standard tests and methods, speech intelligibility assessment scales, advantages and disadvantages of perceptual analysis of speech in dysarthria. e) Differential diagnosis of dysarthria from functional articulation disorders, apraxia of speech, aphasia and allied disorders.

Management of dysarthria - Medical, surgical and prosthetic approaches - Speech therapy • Vegetative exercises • Oral sensory motor facilitation techniques • Compensatory approaches

– correction of respiratory, phonatory, articulatory and prosodic errors. • Strategies to improve intelligibilityof speech.

Apraxia of speech in adults • Definition of verbal and nonverbal apraxia of speech • Different types, characteristics and classification • Assessment of apraxia of speech – standard tests and scales, subjective methods and protocols

- Management of apraxia of speech – different approaches • Improving intelligibility of speech.

Dysphagia: • Definition • Phases of normal swallow • Etiology of swallowing disorders • Assessment and Intervention

**DIAGNOSTIC AUDIOLOGY**: Introduction to Diagnostic Audiology:

- Need for test battery approach in auditorydiagnosis & integration of results of audiological tests.

- Indications for administering audiological tests to identify Cochlear pathology, Retro-cochlear pathology, functional hearing loss, Central processing disorders.

2. Tests to differentiate between cochlear & retro-cochlear pathology - ABLB, MLB -SISI - Test for adaptation - Bekesy Audiometry - Brief tone audiometry - PIPB function

Immittance Audiometry - Introduction - Principle of Immittance audiometry - Instrumentation - Tympanometry – Tympanometric peak pressure, static immittance, gradient/tympanometric width. - Reflexometry – Ipsilateral & contralateral acoustic reflexes, special tests - Clinical application of Immittance evaluation - Immittance evaluation in the pediatric population Unit 3 4. Auditory Brainstem Response

Central Auditory Disorders

Test findings in subjects with central auditory disorders Operational characteristics, types and specifications. Microphones as transducers.

Measuring Instruments

Multi-meter. Cathode ray oscilloscope. Sine wave generator. Function Generator, Frequency counter, Measuring microphones, Sound Level Meter, Integrated Sound Level Meter, Artificial ear, Artificial Mastoid, Couplers, Hearing aid test box, Measurement of different types of sound Electroacoustic Characteristics & measurements for hearing aids

# Name of Post: Medical Lab Technologist

## Part B
## Core Subject

**Anatomy & Physiology**

a) Musculoskeletal system: Bones- Types, structure and functions

b) Digestive system: Gross anatomy of digestive organs, Physiology of Digestion, Digestive juices- secretion, composition and functions

c) Respiratory system: Gross anatomy of respiratory organs, physiology of respiration, oxygen and carbon dioxide transport

d) Cardiovascular System: Gross anatomy of heart & vessels

e) Excretory System: Gross anatomy of excretory organs, function of kidneys, mechanism of urine formation, structure and function of Kidney

f) Reproductive System: Gross anatomy of Male & Female reproductive organs, Physiology of menstruation

g) CerebroSpinal Fluid: Formation, composition of CSF

h) Endocrine System: Gross anatomy of endocrine organs: Brief description of endocrine hormone and their functions

**Biochemistry**

a) Introduction and scope of Biochemistry, cleaning and care of laboratory glass ware and equipments, preparation and storage of distilled water, analytical balance, calorimeter, spectrometer, pH meter, flame photometer, S.I unit of measurement, preservation and disposal of biological sample, basic statistics- mean, median, modes, SD, CV, normal references ranges. Acid and base, pH, buffer solution, indicator, standard solution, storage of chemicals, water, electrolytes, acid base balance

b) Carbohydrate, lipids, proteins- Classification, properties, Biological importance, functions.

c) Amino acids, nucleic acid, Enzymes, co-enzymes- definition, classifications, Biological role/importance.

d) Glycolysis, TCA cycle, Electron transport chain, Pentose phosphate pathway, Glyconeogenesis, Gluconeogenesis, cori-cycle, Blood sugar and its regulation.

e) Amino acids, vitamins, mineral-classification, Biological role, deficiency state. Transamination, Deamination, Biological importance of catecholamine, GABA, serotonin, Histamine, Melanin.

f) Tumour markers: Brief history, classifications, clinical applications.

g) Laboratory Test (AFP, CEA, PSA)

- Liver function test, renal function test.
- Thyroid function test, Enzymes and co-enzymes in diagnosis of the diseases, Hormone analysis.
- Cardiac function test
- Qualitative test for- Carbohydrates, lipids, proteins, Bence Jonce"s Protein
- Estimation of serum electrolytes, and bicarbonates Blood sugar
- Quantitative test for organic constituent (Urea, uric acid, creatinine) inorganic constituent (Sodium, potassium, calcium,ammonia, chloride, phosphate, bicarbonate and sulphate in urine with clinical significance and study of abnormal constituent or urine (Glucose, Protein ketone bodies, blood, bile salt, bile pigments).
- Radio Immunoassay (RIA)
- Enzyme link Immuno sorbent Assay (ELISA)
- Chromatography (thin layer paper, gas, liquid Electrophoresis, (gel electrophoresis, liquid electrophoresis)

**Microbiology**

a) Introduction, brief history of Microbiology, origin of microbial life- theory of spontaneous generation. Safety Measures in Microbiology

 Classifications and nomenclature of bacteria (five kingdom concepts)

 Sterilization- principle, methods, antiseptic, disinfectants.

 General characteristics of bacteria, anatomy of bacteria (shape, size, components)

 Growth and nutrition of bacteria, classification of bacteria on the basis of nutritional requirements, measurement of cell mass, and factors affecting growth.

 Cultivation of Microbes (Bacteria)

 Culture technique (media preparation and inoculation)

 Isolation of pure cultures (streak plate, spread plate, pours plate and serial dilution)

 Identification of microbes by colony morphology.

b) Bacteriology, Normal Micro flora of human body, Germ theory of diseases, microbial infection (types, sources and transmission)

 Bacterial Toxin (Endotoxin & exotoxin)

 Bacterial Morphology, isolation, identification, Pathogenicity, lab diagnosis (Culture, Biochemical test, Hanging drop method for motility, Anaerobic, aerobic culture methods of staphylococcus, streptococcus, Neisseria Gonorrhea, N. meningitidis, clostridium tetani & C. perfringens

 E.coli, vibrio cholera, salmonella typhi, shigella,
Mycobacteruim/Mycobacterium tuberculosis, spirochetes- Treponema pallidum.

 Collection, preservation, transportation of clinical specimens for microbial investigation.

 Bacteriological methods examination of blood, faeces, pus, sputum, throat swab and urine

 Antibiotic sensitivity test (Disc diffusion and broth dilution methods)

 Hospital acquired infections and their control.

 Waste disposal and management.

c) Instruments & Glassware:

 Autoclave, Incubator, Laminar Airflow.

 Hot air oven, water bath, vortex shaker.

 Petri dish, test tube, screw cap tube, glass spreader/L-rods, Pasteur pipettes.

d) Medical Mycology:

 Classification and nomenclature of fungi

 General characteristics, structures, reproduction, cultivation

 Medically important division of fungi.

 Morphology, culture characteristics, Pathogenicity, Lab diagnosis of common
pathogenic fungi, (AspergillusAp, Candida Sp, Dermatophytes, Penicillium Sp.)

e) Immunology

 Introduction, Antigens (Types and properties) Antibodies/Immuno globin types and
properties)

 Antigen-antibody reactions and their application (Agglutin, precipitation,
complement fixation and neutralization tests)

 Immunity (Innate and Acquired)

 Hypersensitivity

 Immunodeficiency diseases

f) Serology

 Quality control measures in serology

 Common serological technique and their applications (VDRL, Widal, RA test, ASO, Pregnancy test, Hbs Ag and HCV, HIV, Mantoux test)

g) Medical Virology

 Classification, nomenclature, general characteristics (Morphology, Chemical, biological properties and multiplication)

 Cultivation of viruses (chick embryo, cell culture and animals)

 Bacteriophages (lytic and lysogenic cycles)

 Morphology, cultural characteristics, Pathogenicity and laboratory diagnosis of the following viruses

 Poliomyelitis

 Mumps

 Measles

 Hepatitis A,B,C

 Cytomegalovirus

 Rabies

 HIV/AIDS

h) Molecular Biology

 Introduction

 DNA & RNA

 Isolation of DNA (Genomic & Plasmid)

 Plasmids (types & importance)

i) Principles, methods and application of

 ELISA, Immunofluorescence test, Western Blot

 PCR

Parasitology

a) Introduction, classification, characteristics of human parasites

 Collection, storage and transportation of specimens, preservation of parasites.

 Morphology, transmission, life cycle, Pathogenicity and lab. Diagnosis of:- Entamoeba histolytica, Giardia Lamblia, Trichomonas vaginalis, Leishmania donovani and L tropica. Plasmodia species, Toxoplasma gondii, nematodes- Intestinal flukes, lung flukes, liver fluke.

b) Common vectors of human diseases (mosquito, flies, ticks and fleas)

Pathology and Clinical Pathology, Basic Lab. Techniques and Instruments

a) Pathology- definition, Branches

 Acute and chronic Inflammation (definition, characteristics)

 Subacute, granulomatous inflammation (definition, characteristics)

 Changes in Inflammation

 Chemical mediators of Inflammation.

b) Cell Injury

 Definition, causes, Ischemia, Necrosis

 Apoptosis, degeneration, dehydration

c) Cellular adaptation of growth & differentiation (Atrophy, Hypertrophy, Hyperplasia, metaplasia, Dysplasia, Anaplasia)

d) Neoplasia (Benin and Malignant, definition, characteristics, etiology, spread)

e) Cell of Immune system (B&T lymphocytes, macrophage, dendritic and Langerhans cells, NK cells)

f) Laboratory organization, role of laboratory technicians and responsibilities, safety measures, instruments, reporting and recording, common laboratory accidents and its preventions, handling of infectious materials, prevention and disposal, reagents and its storage.

g) Types of solution (isotonic, hypotonic, hypertonic) quality control-(Principles & Types)

h) Routine examination and clinical significance of-

 Urine
 Stool
 Body Fluids (Ascitic fluid, pleural fluids, pericardial fluids, synovial fluids, CSF seminal fluids, sputum)
 Medico-legal importance of semen analysis and abnormal morphology of sperm.

**Hematology**

(i) Blood- Components, collection, anticoagulants, preparation of smears and quality haemoglobin, TLC, DLC with absolute count, WBC, Red cell Indices, Reticulocytes (methods of estimation, clinical significant) Erythropoiesis, Granulopoiesis, Megakaryopoiesis (normal, abnormal & clinical significant) Blood parasites, bone marrow smears

(a) Haemoglobin normal and abnormal, Biosynthesis, Haemoglobinopathies and its investigation)

(b) RBC- structure, erythropoietin, functions

(c) WBC- Physiology, pathological variation

(d) Platelets- functions, purpuras, investigation of disorders, thrombocytosis, thrombocytopenia

(e) Haemostasis (Coagulation)- Normal mechanism, abnormal, investigation of abnormal haemostasis)

(f) Thrombosis- definition, causes

(g) Leukemia- definition, classification (FAB), Acute & Chronic leukemia, lab features of acute & Chronic leukemia (AML, ALL, CML, CLL) Aleukemia, Leukaemoid reaction, Myelodysplastic syndrome (definition lab features)

(h) Anemias (Normochronic, Normocytic, Megaloblastic, Microcytic hypochronic, Anaemia of infections, Haemolytic Anaemias)- Definition, classification, causes, laboratory, features and investigations)

(i) Thalassaemia (Trait, Minor, Major) Sideroblastic anaemia Pancytopaenia, Aplastic Anaemias, Pure red cells aplasia (Definition, causes, lab investigation etc)

(j) Coagulation disorders, lab diagnosis, causes, haemophillia, DIC

(k) Lymphoma- definition, causes, classification, lab features/diagnosis

(l) Myeloma- definition, causes, classification, lab features/diagnosis

(m) Polycythaemia- definition, causes, classification, lab features/diagnosis

(n) Purpuras- definition, causes, classification, lab features/diagnosis

(o) Staining-Leishman’s stain, MGG, Giemsa’s, PAS, Sudan B-Black, Iron, NAP, Acid phosphate, esterase (Principle, composition, methods & results)

(ii) Blood banking & Immuno Haematology

(a) Introduction

 Blood bank organisation, equipment, donor registration.
 Blood Groups- Types, technique of grouping
 Donor’s selection, collection of blood
 Preservatives(storage), Laboratory screening of blood for transfusion

(b) Cross matching, compatibility testing, Coomb’s Test, Transfusion reaction, Antigens, Antibodies (properties, production), Complements, sensitization, Agglutination, Haemolysis, Neutralization, Precipitation, Complement fixation, Immune response.

(c) Diseases transmitted through blood and their screening, Haemolytic diesases of new born.

(d) Blood component preparation and its uses, Haemophereis, Massive transfusion, Autologous transfusion, exchange transfusion.

(iii) Histopathology- Basic & Technique

(a) Cells & tissues- definition, cells and its organelles, function, cell cycle, mitosis, meiosis, epithelial cells, definition, classification & functions. Connective tissues (Bone & cartilage) Muscle tissues Nerve tissues

(b) Histology of different systems and organs- Respiratory system, Alimentary system, excretory systems, reproductive system (male & female), endocrine system

(c) Histopathology technique-
 Sample reception, registering, labelling
 Fixative & fixation, (definition, classification, details of fixative, aims & object, fixation and preservation)
 Decalcification (definition, methods & test of end point decalcification)
 Grossing (definition, material required)
 Processing of tissues (manual & automatic)
 Waxes (types of waxes)
 Microtomies (types of microtome, knives, honing & stropping)
 Dehydration, clearing, impregnation, embedding or blocking (definition, chemicals used etc)
 Section cutting, mounting, labelling
(d) Demonstration of (Staining)
 Nucleic acids
 Lipids
 Proteins
 Nerve cells
 Muscles
 Bone
 Carbohydrates
 Amyloid
 Pigments
 Micro-organism & Parasites
(e) Biopsies of-
 Renal biopsy, Lymph node biopsy
 Liver biopsy, muscle biopsy
 Kidneys, nerves fibres, skin biopsy (Processing, fixation, blocking, staining)
(f) Museum technique
(g) Immunohistochemistry (definition, Purposes)
(h) Staining
 Theory, progressive & regressive, metachromasia, mordants, accentors
 Staining preparation, procedure of-
 Haematoxylene and Eosin stain
 MGG Stain, connective tissue stains
 Giemsa's stain, mucicarmine stains
 Z.N stain
 PAS Stain
(iv) Cytology (Basic, Technique)
(a) Definition of cytology, material for operation and establishment of cytology laboratory, role of cytology in the diagnosis, branches of cytology
(b) Reception, registration, numbering and supply of material for collecting specimens.
 Preparations of Cytological smears.
 Cytological fixation- aims and objects, chemical use for cytological fixation and methods of fixation
 Progressive changes of the cells.

 Nuclear criteria of Malignancy.
(c) Exfoliative cytology- definition, source of samples for exfoliative cytology
 Body cavity fluid (pleural effusion, Pericardial effusion, Ascitic fluids, sputum, urine, synovial fluids, CSF, Pus and Abscess)
 Methods of collection, fixation, methods of cyto preparations & staining
 Clotted & blood fluids (methods of cytopreparations)
 Cellular components in benign and malignant effusion, acute and chronic inflammations
(d) Interventional cytology (FNAC) Fine needle aspiration cytology. Definition,
Application, Methods.
 Role of FNAC
 Common Sites
 Advantage and disadvantage, limitations
 Complications, precautions & contraindications
 Preparation of smears
 General properties of wet & dry smears
 Imprint, crush smears, biopsy sediments, cell block preparations
(e) Aspiration of specific lesion eg: cyst, thyroid, lung, peritoneum, prostate, testis, radiological imaging aids of FNAC
(f) Methods of collection, fixation and cytopreparation of samples from- Female genital tracts, respiratory tracts, gastro-intestinal tracts, urinary tracts etc.
(g) Staining
 Pap's Stain
o Chemical requirements, preparations of various chemicals for PAP'S stain.
o Various psp's stain methods
o Types of haematoxylene and its preparation
o Stain maintenance
o Preparation of graded alcohols (50%, 60%,70%,80%,85%)
o Preparation of 0.5% HCL, lithium carbonate, EA modified, 0.2% HCl, 1% Ammonium hydroxide in 70% ethanol, Orange G-6
 Bismark brown, EA-50, EA-36
o Procedures of Pap's Stain
 MGG Stain
o Giemsa's stain
o Modified pap's stain
o PAS stain, Alcian blue staining
o Mayers & south gate Mucicarmine stain
o Gram's stain
o ZN stain
 Quality controls (Internal & External) definition, methods, advantage

## Name of Post: Jr. Medical Lab Technologist

- **Syllabus is Essentially the same for Medical Lab Technologist.**
- **However, level of difficulty of the paper will be lower.**

## Part B
## Core Subject

**Anatomy & Physiology**

a) Musculoskeletal system: Bones- Types, structure and functions

b) Digestive system: Gross anatomy of digestive organs, Physiology of Digestion, Digestive juices- secretion, composition and functions

c) Respiratory system: Gross anatomy of respiratory organs, physiology of respiration, oxygen and carbon dioxide transport

d) Cardiovascular System: Gross anatomy of heart & vessels

e) Excretory System: Gross anatomy of excretory organs, function of kidneys, mechanism of urine formation, structure and function of Kidney

f) Reproductive System: Gross anatomy of Male & Female reproductive organs, Physiology of menstruation

g) CerebroSpinal Fluid: Formation, composition of CSF

h) Endocrine System: Gross anatomy of endocrine organs: Brief description of endocrine hormone and their functions

**Biochemistry**

a) Introduction and scope of Biochemistry, cleaning and care of laboratory glass ware and equipments, preparation and storage of distilled water, analytical balance, calorimeter, spectrometer, pH meter, flame photometer, S.I unit of measurement, preservation and disposal of biological sample, basic statistics- mean, median, modes, SD, CV, normal references ranges. Acid and base, pH, buffer solution, indicator, standard solution, storage of chemicals, water, electrolytes, acid base balance

b) Carbohydrate, lipids, proteins- Classification, properties, Biological importance, functions.

c) Amino acids, nucleic acid, Enzymes, co-enzymes- definition, classifications, Biological role/importance.

d) Glycolysis, TCA cycle, Electron transport chain, Pentose phosphate pathway, Glyconeogenesis, Gluconeogenesis, Cori-cycle, Blood sugar and its regulation.

e) Amino acids, vitamins, mineral-classification, Biological role, deficiency state. Transamination, Deamination, Biological importance of catecholamine, GABA, serotonin, Histamine, Melanin.

f) Tumour markers: Brief history, classifications, clinical applications.

g) Laboratory Test (AFP, CEA, PSA)

 Liver function test, renal function test.

 Thyroid function test, Enzymes and co-enzymes in diagnosis of the diseases, Hormone analysis.

 Cardiac function test

 Qualitative test for- Carbohydrates, lipids, proteins, Bence Jonce's Protein

 Estimation of serum electrolytes, and bicarbonates Blood sugar

 Quantitative test for organic constituent (Urea, uric acid, creatinine) inorganic constituent (Sodium, potassium, calcium,ammonia, chloride, phosphate, bicarbonate and sulphate in urine with clinical significance and study of abnormal constituent or urine (Glucose, Protein ketone bodies, blood, bile salt, bile pigments).

 Radio Immunoassay (RIA)

 Enzyme link Immuno sorbent Assay (ELISA)

 Chromatography (thin layer paper, gas, liquid Electrophoresis, (gel electrophoresis, liquid electrophoresis)

**Microbiology**

a) Introduction, brief history of Microbiology, origin of microbial life- theory of spontaneous generation.
Safety Measures in Microbiology

 Classifications and nomenclature of bacteria (five kingdom concepts)

 Sterilization- principle, methods, antiseptic, disinfectants.

 General characteristics of bacteria, anatomy of bacteria (shape, size, components)

 Growth and nutrition of bacteria, classification of bacteria on the basis of nutritional requirements, measurement of cell mass, and factors affecting growth.

 Cultivation of Microbes (Bacteria)

 Culture technique (media preparation and inoculation)

 Isolation of pure cultures (streak plate, spread plate, pours plate and serial dilution)

 Identification of microbes by colony morphology.

b) Bacteriology, Normal Micro flora of human body, Germ theory of diseases, microbial infection (types, sources and transmission)

 Bacterial Toxin (Endotoxin & exotoxin)

 Bacterial Morphology, isolation, identification, Pathogenicity, lab diagnosis (Culture, Biochemical test, Hanging drop method for motility, Anaerobic, aerobic culture methods of staphylococcus, streptococcus, Neisseria Gonorrhea, N. meningitidis, clostridium tetani & C. perfringens

 E.coli, vibrio cholera, salmonella typhi, shigella,
Mycobacteruim/Mycobacterium tuberculosis, spirochetes- Treponema pallidum.

 Collection, preservation, transportation of clinical specimens for microbial investigation.

 Bacteriological methods examination of blood, faeces, pus, sputum, throat swab and urine

 Antibiotic sensitivity test (Disc diffusion and broth dilution methods)

 Hospital acquired infections and their control.

 Waste disposal and management.

c) Instruments & Glassware:

 Autoclave, Incubator, Laminar Airflow.

 Hot air oven, water bath, vortex shaker.

 Petri dish, test tube, screw cap tube, glass spreader/L-rods, Pasteur pipettes.

d) Medical Mycology:

 Classification and nomenclature of fungi

 General characteristics, structures, reproduction, cultivation

 Medically important division of fungi.

 Morphology, culture characteristics, Pathogenicity, Lab diagnosis of common
pathogenic fungi, (AspergillusAp, Candida Sp, Dermatophytes, Penicillium Sp.)

e) Immunology

 Introduction, Antigens (Types and properties) Antibodies/Immuno globin types and
properties)

 Antigen-antibody reactions and their application (Agglutin, precipitation,
complement fixation and neutralization tests)

 Immunity (Innate and Acquired)

 Hypersensitivity

 Immunodeficiency diseases

f) Serology

 Quality control measures in serology
 Common serological technique and their applications (VDRL, Widal, RA test, ASO, Pregnancy test, Hbs Ag and HCV, HIV, Mantoux test)
g) Medical Virology
 Classification, nomenclature, general characteristics (Morphology, Chemical, biological properties and multiplication)
 Cultivation of viruses (chick embryo, cell culture and animals)
 Bacteriophages (lytic and lysogenic cycles)
 Morphology, cultural characteristics, Pathogenicity and laboratory diagnosis of the following viruses
 Poliomyelitis
 Mumps
 Measles
 Hepatitis A,B,C
 Cytomegalovirus
 Rabies
 HIV/AIDS
h) Molecular Biology
 Introduction
 DNA & RNA
 Isolation of DNA (Genomic & Plasmid)
 Plasmids (types & importance)
i) Principles, methods and application of
 ELISA, Immunofluorescence test, Western Blot
 PCR
Parasitology
a) Introduction, classification, characteristics of human parasites
 Collection, storage and transportation of specimens, preservation of parasites.
 Morphology, transmission, life cycle, Pathogenicity and lab. Diagnosis of:- Entamoeba histolytica, Giardia Lamblia, Trichomonas vaginalis, Leishmania donovani and L tropica. Plasmodia species, Toxoplasma gondii, nematodes- Intestinal flukes, lung flukes, liver fluke.
b) Common vectors of human diseases (mosquito, flies, ticks and fleas)
Pathology and Clinical Pathology, Basic Lab. Techniques and Instruments
a) Pathology- definition, Branches
 Acute and chronic Inflammation (definition, characteristics)
 Subacute, granulomatous inflammation (definition, characteristics)
 Changes in Inflammation
 Chemical mediators of Inflammation.
b) Cell Injury
 Definition, causes, Ischemia, Necrosis
 Apoptosis, degeneration, dehydration
c) Cellular adaptation of growth & differentiation (Atrophy, Hypertrophy, Hyperplasia, metaplasia, Dysplasia, Anaplasia)
d) Neoplasia (Benin and Malignant, definition, characteristics, etiology, spread)
e) Cell of Innmune system (B&T lymphocytes, macrophage, dendritic and Langerhans cells, NK cells)

f) Laboratory organization, role of laboratory technicians and responsibilities, safety measures, instruments, reporting and recording, common laboratory accidents and its preventions, handling of infectious materials, prevention and disposal, reagents and its storage.
g) Types of solution (isotonic, hypotonic, hypertonic) quality control-(Principles & Types)
h) Routine examination and clinical significance of-
 Urine
 Stool
 Body Fluids (Ascitic fluid, pleural fluids, pericardial fluids, synovial fluids, CSF seminal fluids, sputum)
 Medico-legal importance of semen analysis and abnormal morphology of sperm.

**Hematology**

(i) Blood- Components, collection, anticoagulants, preparation of smears and quality haemoglobin, TLC, DLC with absolute count, WBC, Red cell Indices, Reticulocytes (methods of estimation, clinical significance) Erythropoiesis, Granulopoiesis, Megakaryopoiesis (normal, abnormal & clinical significant) Blood
parasites, bone marrow smears
(a) Haemoglobin normal and abnormal, Biosynthesis, Haemoglobinopathies and its investigation)
(b) RBC- structure, erythropoietin, functions
(c) WBC- Physiology, pathological variation
(d) Platelets- functions, purpuras, investigation of disorders, thrombocytosis, thrombocytopenia
(e) Haemostasis (Coagulation)- Normal mechanism, abnormal, investigation of abnormal haemostasis)
(f) Thrombosis- definition, causes
(g) Leukemia- definition, classification (FAB), Acute & Chronic leukemia, lab features of acute & Chronic leukemia (AML, ALL, CML, CLL) Aleukemia, Leukaemoid reaction, Myelodysplastic syndrome (definition lab features)
(h) Anemias (Normochronic, Normocytic, Megaloblastic, Microcytic hypochromic, Anaemia of infections, Haemolytic Anaemias)- Definition, classification, causes, laboratory, features and investigations)
(i) Thalassaemia (Trait, Minor, Major) Sideroblastic anaemia Pancytopaenia, Aplastic Anaemias, Pure red cells aplasia (Definition, causes, lab investigation etc)
(j) Coagulation disorders, lab diagnosis, causes, hemophilia, DIC
(k) Lymphoma- definition, causes, classification, lab features/diagnosis
(l) Myeloma- definition, causes, classification, lab features/diagnosis
(m) Polycythaemia- definition, causes, classification, lab features/diagnosis
(n) Purpuras- definition, causes, classification, lab features/diagnosis
(o) Staining-Leishman's stain, MGG, Giemsa's, PAS, Sudan B-Black, Iron, NAP,
Acid phosphate, esterase (Principle, composition, methods & results)
(ii) Blood banking & Immuno Haematology
(a) Introduction
 Blood bank organisation, equipment, donor registration.
 Blood Groups- Types, technique of grouping
 Donor's selection, collection of blood
 Preservatives(storage), Laboratory screening of blood for transfusion
(b) Cross matching, compatibility testing, Coomb's Test, Transfusion reaction, Antigens, Antibodies (properties, production), Complements, sensitization, Agglutination, Haemolysis, Neutralization, Precipitation, Complement fixation, Immune response.
(c) Diseases transmitted through blood and their screening, Haemolytic diesases of new born.

(d) Blood component preparation and its uses, Haemophereis, Massive transfusion, Autologous transfusion, exchange transfusion.
(iii) Histopathology- Basic & Technique
(a) Cells & tissues- definition, cells and its organelles, function, cell cycle, mitosis, meiosis, epithelial cells, definition, classification & functions. Connective tissues (Bone & cartilage) Muscle tissues Nerve tissues
(b) Histology of different systems and organs- Respiratory system, Alimentary system, excretory systems, reproductive system (male & female), endocrine system
(c) Histopathology technique-
 Sample reception, registering, labelling
 Fixative & fixation, (definition, classification, details of fixative, aims & object, fixation and preservation)
 Decalcification (definition, methods & test of end point decalcification)
 Grossing (definition, material required)
 Processing of tissues (manual & automatic)
 Waxes (types of waxes)
 Microtomies (types of microtome, knives, honing & stropping)
 Dehydration, clearing, impregnation, embedding or blocking (definition, chemicals used etc)
 Section cutting, mounting, labelling
(d) Demonstration of (Staining)
 Nucleic acids
 Lipids
 Proteins
 Nerve cells
 Muscles
 Bone
 Carbohydrates
 Amyloid
 Pigments
 Micro-organism & Parasites
(e) Biopsies of-
 Renal biopsy, Lymph node biopsy
 Liver biopsy, muscle biopsy
 Kidneys, nerves fibres, skin biopsy (Processing, fixation, blocking, staining)
(f) Museum technique
(g) Immunohistochemistry (definition, Purposes)
(h) Staining
 Theory, progressive & regressive, metachromasia, mordants, accentors
 Staining preparation, procedure of-
 Haematoxylene and Eosin stain
 MGG Stain, connective tissue stains
 Giemsa's stain, mucicarmine stains
 Z.N stain
 PAS Stain
(iv) Cytology (Basic, Technique)

(a) Definition of cytology, material for operation and establishment of cytology laboratory, role of cytology in the diagnosis, branches of cytology
(b) Reception, registration, numbering and supply of material for collecting specimens.
 Preparations of Cytological smears.
 Cytological fixation- aims and objects, chemical use for cytological
fixation and methods of fixation
 Progressive changes of the cells.
 Nuclear criteria of Malignancy.
(c) Exfoliative cytology- definition, source of samples for exfoliative cytology
 Body cavity fluid (pleural effusion, Pericardial effusion, Ascitic fluids, sputum, urine, synovial fluids, CSF, Pus and Abscess)
 Methods of collection, fixation, methods of cytopreparations & staining
 Clotted & blood fluids (methods of cytopreparations)
 Cellular components in benign and malignant effusion, acute and chronic inflammations
(d) Interventional cytology (FNAC) Fine needle aspiration cytology. Definition,
Application, Methods.
 Role of FNAC
 Common Sites
 Advantage and disadvantage, limitations
 Complications, precautions & contraindications
 Preparation of smears
 General properties of wet & dry smears
 Imprint, crush smears, biopsy sediments, cell block preparations
(e) Aspiration of specific lesion eg: cyst, thyroid, lung, peritoneum, prostate, testis, radiological imaging aids of FNAC
(f) Methods of collection, fixation and cytopreparation of samples from- Female genital tracts, respiratory tracts, gastro-intestinal tracts, urinary tracts etc.
(g) Staining
 Pap's Stain
o Chemical requirements, preparations of various chemicals for PAP'S stain.
o Various PSP's stain methods
o Types of haematoxylene and its preparation
o Stain maintenance
o Preparation of graded alcohols (50%, 60%,70%,80%,85%)
o Preparation of 0.5% HCL, lithium carbonate, EA modified, 0.2% HCl, 1% Ammonium hydroxide in 70% ethanol, Orange G-6
 Bismark brown, EA-50, EA-36
o Procedures of Pap's Stain
 MGG Stain
o Giemsa's stain
o Modified pap's stain
o PAS stain, Alcian blue staining
o Mayers & south gate Mucicarmine stain
o Gram's stain
o ZN stain
 Quality controls (Internal & External) definition, methods, advantage

## Name of Post: OT Assistant

## Part B
## Core Subject

**ANATOMY & PHYSIOLOGY**

1. Elementary Physics & Chemistry
2. Characteristics of Living Matter
3. Structure of Living Matter
4. Anatomy and Physiology related to the Cardiovascular system, Nervous system, respiratorysystem, circulatory system, digestive system, hepatobiliary system, endocrine glands and exocrine glands, urinary system, reproductive system, musculoskeletal system

SURGICAL INSTRUMENTS AND PROCEDURES

(Including Sterilization and Disinfection, Different Methods, Protection of Patients in Surgery, Preparation of Patients)

Preoperative Consideration Psychological Support of the Surgical PatientProtection of the Patient in Surgery

- Transfer Procedure Position
- Environmental Controls
- Electro Surgery
- Operative Records
- Counting Procedure
- Sterilization
- Emergencies & Disaster management

Surgical Instruments

- Instruments for General Surgery
- Operation of Face & Neck
- Operation of Nose, Throat and accessory Nasal Sinuses
- Ophthalmic Surgery
- Sinuses, Ear and Throat
- Operations on the Chest
- Operations on the Genito-Urinary Tract
- Gynaecological & Obstetric Operations
- Orthopedic Operations
- Neuro-Surgical Operations
- Operations on the Vascular System
- Radium Insertion
- Traumatic Surgery

Surgical procedures

– Neck Surgery

- Breast Procedures
- Abdominal Extra intestinal Surgery
- Gastrointestinal Surgery
- Gynaecological and Obstetric Surgery
- Genito-Urinary Surgery
- Thoracic Procedures
- Cardiovascular Surgery
- Orthopedic Surgery
- Neurological Surgery
- Plastic Surgery
- Otorhinolaryngologic (ENT) Surgery
- Ophthalmic Surgery
- Pediatric Procedures

**ANAESTHESIA**

1. General anaesthesia
2. Regional anaesthesia
   - Spinal
   - Epidural
   - Caudal
   - Local
   - Topical
3. Methods for preparation of the patients for anaesthesia
4. Pharmacology and clinical use of intravenous and inhalational anesthetic agents, opioids, NSAIDS, neuromuscular blocking agents, reversal agents, autonomic nervous system, and local anesthesia agents.
5. Emergency resuscitation , ALS and BLS protocols
6. Emergency drugs
7. Vasopressor and ionotropic drugs
8. Sterilization & Maintenance of anesthesia equipment
9. Difficult airway management, laryngoscopes, bronchoscopes.
10. Instruments and tubes used in anesthesia practices

SURGICAL PROCEDURES AND MONITORING, OPERATION THEATRE ETHICS/DISCIPLINE, SAFETY FOR OPERATING ROOM PERSONNEL, PREPARATION OF INSTRUMENTAL TRAYS

- Surgical Procedures & Monitoring
- Safety for operation room personnel
- Preparation of Instrumental Trays eg: Gynecological And Obstetric Trays, Genito-Urinary Tray, Cardiovascular trays, Orthopedic tray, Neurologic Procedures Tray, Otorhinolaryngologic (ENT) Tray, Ophthalmic Trays, Pediatric Tray

## Name of Post: Technician (Nuclear Medicine)

## Part B
## Core Subject

- Human anatomy including Nervous System, skeletal system, circulatory system, respiratory system, digestive system, excretory system, endocrine system and reproductive system.

- Human Physiology including Cell structure, Haematology, Reticulo endothelial system, Nervous System, skeletal system, circulatory system, respiratory system, digestive system, excretory system, endocrine system and reproductive system, Blood and Environmental Physiology.

HOSPITAL PRACTICE AND PATIENT CARE

I. Patient: As an individual, the reactions of patient and his family to illness.
- Qualities – Professional and Ethical behavior expected
- Role and responsibilities of a laboratory technician in the health team

II Hospital staffing and organization
III. Inter personal relations and communications.
IV. PATIENTS RECORDS AND REPORTS AND LEGAL IMPLICATIONS
V. CARE OF THE PATIENT:
a) Maintaining therapeutic environment
- Temperature
- Lighting
- Noise and humidity
- Cleanliness

b) Psycho – social environment
- Meaning and its importance.

VI. BASIC CARE NEEDS OF THE PATIENT
a) Hygiene needs
b) Physical Comforts

VII. CARE OF THE PATIENT:
a) Vital signs: Temperature, pulse, respiration and
b) Blood pressure: Normal and abnormal factors causing the variation
c) Gastric lavage, Nasogastric aspiration

VIII. FIRST AID
IX. PRINCIPLES OF ASEPSIS: STERILISATION:
a) Methods of sterilization. Use of central Sterilization department
b) Care and identification of instruments

XI. DRUGS IN THE DEPARTMENT:
Storage, classification, Labeling and checking, regulations regarding dangerous and other drugs, units of measurement.

XII. CHEMICALS USED IN LABORATORY:
XIII. INSTRUMENTS USED IN VARIOUS SECTIONS:

Microscope, Colorimeter, Cell counter, Auto Analyzer, Flame, Photometer, Autoclave, Hot air oven Incubator, Centrifuge.

XVI. LABORATORY PRINCIPLES:

- General Laboratory techniques and procedures.
- Specimen collection and processing.Basic Chemistry
- Concepts of Molecular Weight, Atomic Weight, Normality, Molarity, standards, Acids, bases, salts.
- Concepts of acid base reactions and hydrogen on concentration.

**BASIC BIOCHEMISTRY**

| Sr.No. | Topics |
|---|---|
| 1 | Carbohydrates:<br>Glucose; fructose; galactose; lactose; sucrose; starch and glycogen (properties and tests, Structure and function) |
| 2 | Proteins:<br>Amino acids, peptides, and proteins (general properties & tests with a few examples like glycine, trytophan, glutathione, albumin, hemoglobin, collagen) |
| 3 | Lipids:<br>Fatty acids, saturated and unsaturated, cholesterol and triacyglycerol, phospholipids and plasma membrane |
| 4 | Vitamins:<br>General with emphasis on A,B2, C, E and inositol (requirements, assimilation and properties) |
| 5 | Minerals:<br>Na, K, Ca, P, Fe, Cu and Se.(requirements, availability and properties) |

| No. | Topics |
|---|---|
| 1 | Hormones and their receptors basic concepts in metabolic regulation with examples, insulin, glucagons and thyroxine |
| 2 | Metabolism<br>General whole body metabolism (carbohydrates, proteins, lipids) |
| 3 | Clinical Biochemistry<br>Blood sugar, urea, creatinine and Bilirubin, cholesterol etc and significance of their estimation. |

Basics of computer and image hard copies production in Nuclear Medicine, including X-Ray filmimage processing techniques.

Types of nuclear medicine image e.g. static image, dynamic, list mode, frame mode, gating, tomographic mode. Image and data processing: region of interest, time activity curve generation,effect of matrix size, pixel size, zooming and smoothing of image.

Nuclear Medicine image hard copies, glossy prints, paper prints etc., X-Ray films, types, basic film structure & quality, choosing films for different studies, film processing techniques: dry and wet processing, manual and automatic. Wet film, processing solutions. Film processing rooms, film

processing equipments.

**Nuclear medicine physics**

Basics Physics: Elementary introduction to structure of matter, elements, compounds and mixtures, molecules and atoms. Atomic & Nuclear structures, Atomic models, Periodic table, simple ideas of quantum mechanics, Mass energy equivalence, fluorescence, Phosphorescence, luminescence, electromagnetic spectrum. Electricity, Magnetism and Electro magnetic induction: Electricity in ionized gases-electric charges-electric induction- Coloumb law-unit of charge-resistance-ohms law- electric power-Joules law. Magnetism-magnetic properties-electromagnetic effect-electrical instruments like Voltmeter, Ammeter & Multimeter. Transformer, transistor, rectifier, pre amplifier, pulse amplifier, power supply, circuits. Filters and their types.

Radioactivity: Discovery of radioactivity, Natural & Artificial Radioactivity, Isotopes and nuclides, binding forces between nuclear particles, types of radiation, alpha, beta particles and gamma radiation. Mechanisms of radioactive decay, physical, biological and effective half life. Interaction of X-rays & ɤ-rays with matter - Radiation intensity & exposure - radiation dose - Radiation quality – law of exponential attenuation – half value thickness, tenth value thickness – linear attenuation coefficient – Scattering – photoelectric effect – Compton-scattering – pair production – particle interactions – total attenuation coefficient- relative clinical importance.

**Physics of Nuclear Medicine Instrumentation**

Radiation detectors: Construction and Principles of Operation – lonization Chamber – Isotope calibrator – Proportional Counter – Geiger muller counter – Voltage calibration of a Geiger Mueller tube, optimum operating condition – Dead time correction – Uses of Gas – filled detectors – Semiconductor detectors.
Scintillation detector: Thallium activated Sodium lodide crystal – Photo multiplier tube, electron multiplication, high voltage supply, Shielding, collimators, field of view. Well counter – construction, design of shielding. Signal output, Pre-amplifier – reasons for use – Voltage amplifier – liquid scintillation detector.
Spectrometer: Basic principles of Pulse – height analyzer single channel and Multi – channel analyzers. Optimum operating conditions, window settings – Determination of gamma energy spectrum, Integral and differential counting. Spectra of commonly used radio nuclides e.g l131, Tc99, Cr51, Cs137. Problems in radiation measurements with worked examples

**Mathematical application and counting statistics**

Basic mathematics covering integration, disintegration, vector, function, radioactivity calculations, use of various types of graphs to display or represent the radioactivity calculations (linear, semi log, logit-log, Log-Log etc). Types of measurement error, Precision and Accuracy, Nuclear counting statistics, Mean, Mode, Median, Poison, Normal (Gaussian) distribution, Standard deviation, coefficient of variation, Probable error, confidence limits, Percent standard deviation, Statistical tests. – Chi – square test, Figure of Merit test, students test.
Gamma camera: Camera head construction and principle of operation, Collimators – parallel multi hole, high resolution, high sensitivity, pin hole, diverging & converging hole, slant hole. Scintillation

crystal, optical coupling, Photo multiplier tubes, per amplifiers. Pulse height analyzer, Timer, Data Processor and their function. Application of Cathode ray tube, persistence scope. Resolving time characteristics, Gamma camera Uniformity and intrinsic resolution, Sensitivity, Total – system resolution, Spatial volume resolution saturation.

**Computerized Tomography**: Basic principle of Computed Tomography, Generations of CT. X-ray tube, Filters, Collimators, CT detectors, Data Acquisition System (DAS), CT Image Quality, CT Dose Vs image quality. Image Formation in CT, Image Reconstruction, Hounsfield Unit, Windowing, image display, CT artifacts. Helical CT scan: Slip ring technology, Advantages, Multi Detector CT, Cone-beam geometry, Reconstruction of helical CT images, CT Fluoroscopy, HRCT, Post Processing Techniques: MPR, MIP, Min IP, 3D rendering: SSD and VR. Contrast material, contrast reaction, contrast material doses and route of administration. Whole body CT acquisition.

**Basic Radiation Physics**

Atomic structure, atomic number, mass number, isotopes, radioisotopes, radioactivity, specific activity, types of radioactive disintegrations, electron capture, characteristics of alpha, beta and gamma rays, energy ionizing radiation, half-life (Physical, Biological), effective half life, isomeric transitions, secular, transient and no-equilibrium, production of radioisotopes and X-rays (characteristic and Bremsstrahlung), neutron sources.

Interaction of Radiation with Matter

Interaction of charged particulars with matter, interaction of neutrons with matter, range of charged particles, interaction of photons with matter (photoelectric, Compton and pair production), absorption and attenuation of photons, Half Value Thickness (HVT) and Tenth Value Thickness(TVT).

**Radiation Quantities and Units**

Radiation Detection

Principal of radiation detection, gas detector (ionizing chamber, proportional counter and GM counter), solid state detector (scintillator, semiconductor and Thermoluminescent Dosimeter {TLD}), liquid scintillation counting systems, radiation monitoring instruments, personnel monitoring, area monitoring, environmental monitoring, direct reading devices, calibration and response of radiation monitoring instruments.

**RADIOPHARMACY**

Basic principles involving the radio chemical reactions regarding the binding efficiencies and the working principles of various isotope generators used in Nuclear Medicine department.

Basics of radiation chemistry:

(a) Atomic and molecular structure (b) Bonding: Electrovalent, covalent, Dative covalent bond and hydrogen bonds (c) Valency, Atomic wt., -Molecular wt -Normality and molarity of solution, (d) Acids and Bases - Hydrogen Ion concentration - pH value - The role of pH in the preparations of radiopharmaceuticals -(e) chemical reaction - solute - Solvents - Solubility - crystallization - (f) The chemical elements which are necessary for life (carbon - Hydrogen, oxygen and nitrogen, Phosphorous, Iron etc.). (g) Fundamental chemistry of carbohydrates and carbonyl groups (h) - Oxidation and Reduction (i) proteins and amino acids. Lipids and profiles. Enzymes - vitamins, Hormones.

(b) Basic in Laboratory Techniques

(i) Laboratory glassware (ii) Washing and autoclaving of glassware for the use in Radio-pharmacy areas

(iii) Correct use of Pipettes, Balance, Centrifuge, gloves, syringes, vacuum vials, saline bottles, elution

vials etc. (iv) hot lab tools for safe handling of active vials and syringes.

Isotope generators: Production of radio nuclides by artificial methods (b) Accelerator produced radio nuclide (c) Nuclear reactor produced radio nuclides, construction and Principles of generator systems - Ion Exchange system - Solvent extraction system - Parent - daughter relationship-growth of daughter product equilibrium with parent elements etc. Chemistry of Tc99m, Mo99-Tc99m generators Mo99 contamination check, Aluminum break through test etc (f) sterilization.

Radiopharmaceuticals: Principles of cold kits & lyophilisation, importance of lyophilisation in preparation of cold kits. Common pharmaceutical cold kits, contents, pharmacological properties, physiological principle in use of a particular cold kit, pediatric and adult doses, route of injection, route of excretion, radiation exposure, critical organ for DTPA, GHA, DMSA, MDP, macro aggregated albumin, sulphur colloid, MIBI, Tetrofosmin, Mebrofenin, etc. (c) Labeling procedure of cold kits with required radio isotopes, Quality control tests: RC purity, RN purity, sterility check, Chromatography (Various methods) pyrogen test, bio distribution studies.

Tracer methods - Behavior of radioactive tracers in biological process - characteristics of radio pharmaceuticals - Half life - (Physical and Biological)

Dispensing of radio pharmaceuticals - Specific activity, Tracer dose preparation - Tracer dose administration etc.

**RADIATION BIOLOGYRADIATION SAFETY**

Operational Limits

Introduction to natural background radiation, concept of occupational risk, philosophy of radiation protection, system of dose limitation, ALARA, dose limits to radiation workers and general public, AERB/CRP/ national regulatory guidelines, dose constraints for comforters of patients.

Radiation Hazard Evaluation and Control

Radiation Accidents, Case Studies and Lessons Learned

Radiation accidents involving radioisotopes, orphan and vulnerable sources, handling of emergency situations resulting from spillage of radiopharmaceuticals / liquid radioisotopes, misadministration of radiopharmaceuticals and its consequences, general methods of prevention of accidents, loss of radioisotope, fire accidents and explosions; follow up actions through emergency response plans, case studies and mitigation, lessons learned.

**Nuclear Medicine Techniques and procedures**

TECHNIQUES

1. Ordering nuclear medicine procedure
   - Preparation of the patients before the procedure
   - Care of Patients During the Nuclear Medicine Procedure
   - Care to be taken during the cardiac studies in the NM department
   - Preparation of the radioactive tracer for the study
   - Preparation with resuscitation
   - Specimen collection in a safe manner

**PROCEDURES**

1. Diagnostic – In vitro techniques: Principles of Radio immunoassays (RIA) standard curve, data analysis, Quality Control (QC) and applications, Methods of receptor assays, hormones, drugs. IRMA Immuno-radiometric assay, ELISA, RIA, estimation, T3, T4, TSH, thyroid antibodies, and current applications

using similar techniques.
2. In Vivo Techniques:  Non imaging procedures.

Imaging considerations related to organs such as thyroid/ Parathyroid / Skeletal system /Respiratory System/ Cardiovascular system / Urinary Tract/ GIT / Liver and Hepatobiliary system /

Basic principle of SPECT, SPECT data acquisition, SPECT reconstruction, use of filters in SPECT data processing, software based/ CT based attenuation correction, SPECT CT / PET CT imaging, construction and principle of PET Scanner, PET scanner crystals, co-incidence circuit, attenuation correction techniques of PET images, PET image reconstruction, PET CT image QC, principle of MRI, PET MRI fusion imaging.
Nuclear Medicine probes: Thyroid probe, sentinel lymph node probe, H pylori probe, construction and principle of  function.
Newer Computer applications in Nuclear Medicine, DICOM image format, PACS, LAN. Radiation Dosimetry :
Compartmental Model – in-vivo dosimetry using classical dosimetry mechanism, beta dosimetry, gamma dosimetry, geometrical factor, dosimetry of low energy electromagnetic radiation, MIRD formulation – cumulated activity, equilibrium absorbed dose constant, absorption factor, specific absorbed fraction and the dose reciprocity thereon, mean dose per cumulated activity, limitation of MIRD method; extremity dosimetry.
Quality Assurance of Nuclear Medicine equipmentsFlood check – Techniques and methods
Record Keeping and Equipment maintenance Radiopharmaceutical preparation and QC of given test:
Lymphoscintigraphy, infection imaging, MUGA scan, brain SPECT and cardiac SPECT etc. Recent advances in SPECT and PET radiopharmaceuticals: DAT scan, newer cardiac SPECT and PET imaging procedures, 18 F FDG, 18 F Sodium fluoride in conventional and molecular imaging for oncology patients. Ultra short and short lived radionuclide generators.
**RADIATION BIOLOGY: Principles**
**RADIATION SAFETY**: Radionuclide Therapy - Radiation Safety Aspects / Emergency Response Plansand Preparedness
Transport and Disposal of Radioactive Waste
Planning of Nuclear Medicine (NM) Laboratories

# Post Name: Technician Gr 2 (Dental)

## Part – B
## Core Subject

1. **Applied Physics:**

Specific gravity, density, properties of matter, including cohesion, capillarity, surfacetension viscosity, elasticity, diffusion, and osmosis.

Heat: Temperature and its measurements Thermometers and Pyrometers. General account of expansion by heat of solids, liquids and gases, Thermostats, Pressure gas and hydraulic. Boyle's and Charles Laws. Unit of heat, thermal capacity and specific Heat, Change of State; Latent heat; Melting Point. Properties of vapours, conduction, convection and radiation. Principles of electro-technology applied to dental work room, small motors, constructional features and characteristics, electric furnaces, heaters, thermostats, pyrometers, spot welders, electroplating, electroforming, and anodizing, Wiring regulations relating to low voltage supplies.

***Exercises/ Demonstrations:***

- Balance - weighing correctly to a milligram.
- Determination of specific gravity by the principle of Archimedes (Solids and liquids).
- Determination of surface tension of a liquid by capillary rise.
- Determination of Linear expansion of solids (level method).
- Determination of the specific heats of solids and liquids by the method of mixtures.
- Small motors-constructional features. and characteristics (Demonstration only)
- Determination of the electro-chemical - equivalent of copper.

2. **Applied Mechanics:**

Forces, Parallelogram and triangle of forces. Moments, Couples, Centre of gravity, Principles of lever and cantilever work, Energy; P-ower, Friction, Inclined plane, Screw Stress, Strain, Sheating Strain, Torsion, Bending movements, Strength. and stiffness of materials.

***Exercises/Demonstrations:***

- Verification of the parallelogram and triangle laws of forces.
- Inclined plane Determination of mechanical advantage.
- Determination of Young's Modulus by bending of beams.

3. **Applied Chemistry:**

Distinction between physical and chemical change; elements, mixtures, and compounds; composition of the atmosphere; Oxygen oxides, burning and rusting; water solvent properties and crystallization; action of water on metals; composition of water hydrogen; Laws of chemical combination; meaning of chemical symbols valency; simple chemical equations; acids, bases and salts.

Electrolysis, The ionic theory of solution. The electropotential series, electroplating, General characteristics of the metals including an elementary study of the common metals andtheir alloys with special reference to those used in the dental workroom.

Alcohol, ethers, aldehydes and ketones, fatty acids, and their more important derivatives, amines. Simple treatment of carbohydrates, fats, and proteins, Benzene and its homologs. General characteristics of aromatic substances. Synthetic resins and plastics used in Dentistry.

***Exercises/Demonstrations:***

- Tests for Acids and alkalis radicals.
- Acid-base titration- Neutralisation of acids with alkalis. Titration of N/ 10 NaOH with N/10 H2SO4 Phenolphthalein or Methyl red as indicator.
- Total Nitrogen determination in organic nitrogenous materials, digestion and distillation.
- Total Nitrogen determination in Inorganic (ammoniacal) solutions (or salts) by direct distillation with Mg.
- Determination of Phosphorus in inorganic materials by precipitation.
- Determination of Potassium in aqueous solution by perchlorate method.
- Electrolytic deposition (electrolysis and electroplating of metals). Deposition of Copper by electrolysis of copper Sulphate solution. Calculation of E.C.E.

**4. Applied Oral Anatomy:**

Elementary anatomy and structure of denture/bearing area.
Human dentition and occlusion.
Functions of teeth and morphology of Crowns of teeth.
Muscles of mastication and facial expression.
Mastication deglutition and phonation.
Movements of temporomandibular joint.

***Exercise/Demonstrations:***

- Tooth Carving in wax and plaster. (Crown and root, scale and enlarged models)

**5. Dental Mechanics (Primary):**

Infection control measures for impressions and models.
Impression Preservation and Boxing-in.
Cast Preparation, Trimming, including Orthodontic casts.
Cast duplication - various methods.
Construction of special trays – spacers
Bite blocks- base plates and wax rims.
Articulators: Classification, daily uses, and care of articulators.
Adjustments, Mounting of casts.
Articulation, Occlusal plane, protrusive balance, working bite, balancing bite, curve of space, compensating curve, lateral curve.
Principles of selection of teeth.

- Setting of teeth and wax finishing.
- Flasking, Dewaxing, Packing, curing and deflasking.
- Finishing and polishing of dentures.

Additions, repairs, relining and rebasing of dentures.

- Immediate denture construction.
- Making of acrylic teeth.
  Kennedy's classification of partial dentures.
- Principles of partial denture, design, clasp surveyor, surveying, path of insertionand removal.
  Establishment of clasp seat. Clasp's parts, classification, function and reciprocation.
- Principles of wire bending, Preparation of wrought clasps, occlusal rests, andlingual bars.

**6. Dental Mechanics (Final):**

Casting machines: Centrifugal and pressure casting machines, Furnaces, Principles of casting.
Casting techniques of partial denture (Skeletal) Clasps, bars, occlusion rest.
Setting of teeth and completion of dentures on metal skeletons.
Mechanical principles of Orthodontic appliances, anchorage, force, tissue changes and retention.
Stainless steel wire-preparation of clasps, springs and Arch wires for Orthodontic appliances
Use of various types of expansion screws.
**Designing –**Implant-supported Prosthesis (if facilities available for Dental Implants Ceramic, laminates and Veneers.
**Fabricating—**Maxillofacial prostheses such as eye, nose ear, cheek, obturator, and splint
-Indirect Resin Restoration preparation techniques.
-Porcelain firing techniques
Preparation of removable Orthodontic appliances, Activators, and Retention appliances and Oral screen.
Construction of fixed Orthodontic appliances, bands, tubes, and arches.
Soldering and spot welding-Soldering of clasps, tags, Straighteners, and lingualbars.
Inlays and Crowns-classification and construction facing & backings.Casting Procedures.
Principles of bridge work-types of abutments - abutments and pontics constructionof bridges using porcelain and acrylic pontics.

**7. Dental Materials and Metallurgy Dental Materials:**
Composition, Properties, Uses, Advantages & Disadvantages of the following materials:-
Plaster of Paris; Dental Stone, Die Stone
Investment Materials, All Impression Materials,Tray Materials, Denture Base Materials, both for cold curing and heat curing, Tooth Materials Waxes, Base Plates, Zinc Oxide, Dental Luting Cements, Dental Ceramics and indirect resin restoration materials.
**Dental Metallurgy:**
- Metallurgical Terms,
- General
- Study of:

(a) Metals used in Dentistry, particularly Gold, Silver, Copper, Zinc, Tin, Lead and Aluminum.

(b) Alloys used in Dentistry particularly, Casting Gold Wrought Gold Silver Alloys, Stainless Steel,

Chrome Cobalt Alloys.

-Heat treatment-annealing and tempering. Solders, Fluxes, Anti Fluxes. Tarnish and Corrosion. Electric Deposition.
-Dental implant materials

## 8. BASIC KNOWLEDGE OF COMPUTERS

General office routine economics, record-keeping services, Professional referrals and computing skills;
Record keeping of materials indented and Audit of use.
- Receipt and dispatch of work from clinicians

## 9. Anatomy, General & Dental:

General structure of mucous membrane (tongue, pharynx, lips), bones, muscles, blood vessels, lymphatics, glands & nerves. Blood and nerve supply in relation to the face in general and teeth and associated structures in particular.
Elementary knowledge of the development of the jaws and teeth.
Structure, nomenclature, and morphology of human teeth.
Eruption; resorption & occlusion of teeth.
Relationship of teeth with investing tissues.
Muscles of mastication and facial expression.
Temporomandibular Articulation.
Course and distribution of Vth and VII$^{th}$ Cranial nerves.

## 10. Physiology & Histology, General & Dental:

Cell structure of the human body.
Brief description of the histology and function of various dental and oral tissues e.g. Gingiva, Periodontal membrane, Alveolar process, Cementum, Enamel, Dentine, Nasmyths membrane, Pulp, etc.
Salivary glands, ducts, and their functions.
Composition and function of Saliva.
Blood Composition & Functions. Mastication, deglutition & Phonation.
General outlines of the physiological processes of the human body-particularly circulatory.

## 11. Pharmacology, General & Dental:

Brief description, nomenclature, derivation, dosage, pharmacological action and therapeutic uses of drugs commonly used in dentistry (Obtundent, astringent, mouthwash, antiseptics)

## 12. Pathology & Microbiology General & Dental:

General Principles of Pathology – Inflammation, degeneration, and repair.
Application of general principles of pathology to tooth and surrounding tissues.
Dental Anomalies.
Attrition, Abrasion and Erosion.
Oral manifestation of systemic diseases like diabetes, syphilis, anaemia, vitamin deficiencies, and infectious diseaseslike AIDS & Hepatitis B.
Infection Control in Dental Operatory and Bio-Medical Waste Management and Handling.
Neoplasm with reference to the oral cavity.
Elementary knowledge of Bacteriology, Asepsis, Infection, Immunity, Brief description of Pathology and Bacteriology of Dental Caries and Gingival Infections.

## 13. Dental Radiology:

Fundamental and elementary principle of Dental Radiology including X- Ray machine, its components and maintenance.
Basic knowledge of Radiovisiograpy technique &extra-oral radiographs includingPanoramic (Ortho-pantographs and cephalograms).
Automatic Film processing Cataloging & Indexing of IOPA Films.
Knowledge of occlusal, bitewing, and digital radiography.
Technical aspects of Dental Radiographs i.e. the taking, processing, and mounting of dental Radiographs.
Characteristics of an acceptable image, factors that influence finished radiographs, and rules of radiation protection. Radiation Hazards.

## 14. Food & Nutrition:

Basic 'food chemistry' in relation to general and Oral Health.
Physical nature of diet in the prevention of dental diseases.
Carbohydrates, fats, proteins, vitamins, minerals, and water in relation to dental and oral health.
General food requirements for growth, maintenance, and repair of the body.
Assessment & charting of individual diet & counseling.
Effect of malnutrition on oral health.
Special diet and its administration in maxillofacial injury cases.

## 15. Dental Hygiene & Oral Prophylaxis (Primary and Final)

Definition of Hygiene.
Objectives of Dental Hygiene.
Oral Prophylaxis - Various methods.
Oral Prophylaxis: treatment system
Stains on teeth - extrinsic, intrinsic and their management.
Dental plaque.
Brushing & Flossing Technique
Dental Calculus
Technical knowledge of ultrasonic scaling
Brief description and the role of Oral Prophylaxis in Gingivitis, Periodontitis, Periodontal and Alveolar abscess.

***Clinical:***

Instruments, technique of Oral Prophylaxis
Destaining and polishing of teeth.
Topical application of fluorides.
Care of oral cavity and appliances during treatment of maxillofacial cases.

## 16. Dental Health Education, Community Public Health Dentistry & Preventive Dentistry:

Definition of Health and Dental Health.
Aims and objectives of Dental Health Education.Dental Health and Children.
Steps in the preventive program, patient counselling.
Dental Health Education-Parents, mothers (anti and post-natal), infants pre-school Children and grownup Handicapped children.
Dental caries- Prevalence and Prevention.Prevention by fluoridation.
Periodontal Diseases.
Saliva in relation to dental health and disease.
Dietary habits and Dental Health.
Habits and Malocclusion.Oral Cancer.
Brief outline of historical background of public Health, History of dentistry and Public Health Services. Dental Health Team in relation to community health.
Technical knowledge of Topical Fluoride Application.

***Practical:***

Preparation of models of jaws and teeth-normal and pathological dental conditions.
Designing, drawing and painting of posters on dental health education.
Procedure for arranging. Short talks, skits, and features on dental and oral health, and visualaids.
Collection of Oral Health- related statistics by conducting a small survey of an area.

## 17. DENTAL ETHICS, JURISPRUDENCE AND ORIENTATION IN DENTISTRY

Difference between ethics and law, types of law.
Legal impositions in relation to dental practice, code of ethics.
Unlicensed practice of dentistry.
Regulatory and professional organisation.
Place and function of dental profession in the society and discussion of economicproblems involved therein.
Social factors in Dental Progress, income, and living standard of people. Objective and scope of dentistry.
Dental specialties

## 18. BASIC KNOWLEDGE OF COMPUTER

General office routine economics, record-keeping services, Professional referrals and computing skills.

## 19. DENTAL MATERIALS

General knowledge of various materials used in Dentistry such as impression material, gypsum products, waxes, investing materials, and various filling materials, Temporary and Permanent cements, orthodontic materials and implant materials, materials used in maxillofacial and surgical prosthesis.
Recognition and knowledge of various dental equipment and stores used in dental establishment.
Organization of dental stores, storage and accounting, handling, and maintenance of dental items, assembly, and minor repair of dental equipment.

## Name of Post: Technician (Dialysis)

## Part B
## Core Subject

**Anatomy:** Introduction to the body as a whole – Definition of anatomy and its divisions. Terms of location, positions and planes /Cell / Tissue/ Muscles / Skeleton/ Bone Anatomy of head and Neck / Thorax / Abdomen /Genitourinary system / Endocrine System /

**Physiology:** Blood / Blood cells /Lymph / Plasma / Serum Proteins/ Clotting factors / blood bank and transfusion / Anaemias Muscle nerve physiology / respiratory physiology /Cardiovascular physiology / Digestive physiology / Endocrine system /Sensory organs / Excretory System / Skin

Urine examination / Reproductive System

**Biochemistry**: Carbohydrates / Protein /Fat metabolism

Glucose and Glycogen Metabolism/ Classification of enzymes / Vitamins & Minerals: Fat soluble vitamins (A, D, E, K), water soluble vitamins / Acids and bases Definition, pH, Henderson – Hassel Balch equation, Buffers, Indicators, Normality

**Pharmacology:**

- IV fluid therapy
- Diuretics: classification, actions, dosage, side effects & contraindications.
- Anti-hypertensives: classification, actions, dosage, side effects & contraindications, special reference duringdialysis, vasopressors, drugs used in hypotension.
- Drugs & dialysis: dose & duration of administration of drugs.
- Dialyzable drugs:
- Vitamin D & its analogues, phosphate binders, iron, folic acid & other vitamins of therapeutic value.
- Iron
- Use of Iron therapy in dialysis; its metabolism, role in RBC formation and anemia; forms of iron therapy;indications for use; available forms and dosages
  - Erythropoietin in detail.
  - Heparin, low molecular weight heparin
  - Alternative anticoagulants.
  - Formalin, citrate, sodium hypochlorite, hydrogen peroxide: role as disinfectants & adverse effects of residualparticles applicable to formalin.
  - Hemodialysis concentrates: composition & dilution (acetate & bicarbonates).
  - Peritoneal dialysis fluid in particular hypertonic solutions: composition.

Potassium exchange resins with special emphasis on mode of administration

**Introduction to Kidney diseases**: Assessment and Diagnostic studies of the Urinary system - Physical assessment of a person with kidney disease, basics of assessment, list various diagnostic tests done for kidney diseases, laboratory tests, imaging studies, normal values, interpretation of the tests including the roles and responsibilities ofa technologist.

- Congenital abnormalities of urinary system.
- Classification of renal diseases.
- Glomerular diseases: Definition, etiology, pathophysiology of each type, medical and surgical management.

- Tubulo-interstitial diseases - Definition, etiology, pathophysiology of each type, medical and surgicalmanagement.
- Acute Kidney Injury - Definition, etiology, pathophysiology of each type, medical and surgical management
- Renal vascular disorders - Definition, etiology, pathophysiology of each type, medical and surgical management
- End stage renal diseases: Definition, etiology, pathophysiology, medical and surgical management

**Principles and practice of Dialysis**

- Indications of dialysis.
- History & types of dialysis.
- Dialysis Team – rights, responsibilities, patient-doctor relationship, responsibilities of a technologist, nurse and doctor in the dialysis setting; building effective working relationships; conflict management
- Principle of hemodialysis: diffusion, osmosis, ultra-filtration & solvent drag.
- Hemodialysis apparatus: types of dialyzer & membrane, dialysate. Dialysis Membrane:
- Structure,
- Characteristics [molecular weight cut off; Ultrafiltration coefficient (Kuf); Mass transfer coefficient (KoA) and efficiency; Low and high flux; Clearance (K)]
- Biocompatibility
- Newer membranes.
- High performance membranes.
- Physiology of peritoneal dialysis.
- Dialysis machines:

Latest Hemodialysis machine:

- Conventional and Portable Machines
- Wearable artificial Kidney
- The Bioartificial Kidney
- Home dialysis machines and patient training Mechanism of functioning & management:
- Hemodialysis machine Peritoneal dialysis machine.
- Biochemical investigations required for renal dialysis.
- Adequacy of dialysis Hemodialysis. Peritoneal dialysis.

Peritoneal equilibration test (PET). CRRT

- Anti-coagulation during dialysis
- Withdrawal of dialysis criteria
- Dialyzer reuse.
- Water treatment system, Dialysate delivery system, Composition of dialysis
- Vascular Access – Temporary & Permanent

Types of vascular access – Fistulae, Grafts, Catheters; pre-dialysis assessments for all types of vascular access; methods of needle insertion for AVFs and grafts; pre-dialysis assessment, accessing procedure, exit site care, and monitoring of catheters; understanding the role of a vascular access coordinator

- High flux / high efficiency dialysis

Definition of high flux / high efficiency dialysis, differences between high flux dialysis and hemodialysis, uses and indications for high flux dialysis, complications of high flux dialysis, precautions and contraindications, care during a high flux dialysis

- Computer applications in Dialysis
- Continuous Renal Replacement Therapy / Slow Low Efficiency Dialysis

/ Other dialysis related therapies.

Definition, indications, uses, method of initiation of dialysis, contraindications of therapy; complications of therapy and ways to prevent complications

- Complications in dialysis patients
- Dialysis in Neonates, infants & children: Special considerations
- Renal data maintenance: maintenance of records and report; medico-

legal aspects

- Infection control and sterilization techniques: Principles and practice of

biomedical waste management

- Introduction to Kidney Transplantation:

Comprehending recipient evaluation, understanding pre-transplant care of patients on dialysis, understanding the role of a coordinator in kidney transplantation

- Prevention of Renal Disease: Methodologies

**Preparation and positioning of patient for dialysis**

- Patient Assessment – Pre, intra & post dialysis & Machine and patient monitoring during Hemodialysis

Dialysate - Dialyzer and Bloodlines - Initiation of dialysis - Removing fluid

- Replacing fluid - Drawing blood samples - Testing blood samples. Measuring dialysis adequately: Urea reduction ratio - Urea Kinetic Modeling. Pre –dialysis and post dialysis - BUN Measurement.

Clinical complications - Technical Complications, Recording of the Treatment, Recording changes in Patient's condition, Preparation of status and progress reports, Equipment clean up and Maintenance, Recording the dialysis procedure on the medical report/chart of the patient

- Lab data analysis

Tests done for a patient on Hemodialysis, interpretation of tests and normal values.

- Acute and chronic dialysis prescription
- Medications in dialysis patients
- Nutrition management in dialysis patients
- Anticoagulation
- Hemodialysis machine specific technology:

Repair techniques and procedures, fault diagnostics, computer aided maintenance and planned preventative maintenance.

- Complications of Haemodialysis– Acute & chronic
- Peritoneal Dialysis

Acute and Chronic Peritoneal Dialysis. History, access, physiology of Peritoneal Dialysis.

- Infection control and universal precautions
- Psychosocial aspects & patient education
- Recent advances in Nephrology
- ISO RO water standard for hemodialysis, Wearable Artificial Kidney, Novel markers of AKI, Current Research in Dialysis, ABO incompatible transplantation, Online Hemodiafiltration, Online Hemofiltration, Online Hemodialysis, Extracorporeal Therapies in Special Situations

## Name of Post: Medical Social Service Officer Grade 2

## Part B
## Core Subject

a) Nature and development of social work

b) Sociological concepts and contemporary concerns Urban community development Human rights and social work practice, social policy,

c) Human behavior and social environment, state, political economy and governance, social work with communities, social work with individuals, social work with group research in social work: quantitative approaches

d) Social action and social movements, social work with the elderly, environment and social work, social work with families and children, occupational social work

e) Research in social work, qualitative approaches

f) Administration of welfare and development services, organizational behavior and employee development, social defense and correctional services, rural community development

g) Social justice and empowerment, social development, management of development organizations Social work with persons with disabilities, aspects of applied social work in hospitals etc. Human rights and social work practice Social work practice in mental health settings

h) Social work and disaster management, conflict mitigation and peace building, gender and development.

i) Counselling theory and practice

j) HIV/AIDS and social work practice, health care social work practice General principles of Physiology.

## Name of Post: Receptionist

## Part-B
## Core Subject

Basic Computer Knowledge: Introduction to MS Windows, MS Office, Basics of Internet etc. (f): Subject Knowledge Principles of Communication and Public Relations.

**COMMUNICATION:**

Definitions – Elements of Communication, Nature, Role and Scope of Communication, Communications, Public opinion and Democracy, Communication mass media and Socio-economic development.

**METHODS OF COMMUNICATION**: Face to face Communication, Group Communication, Mass Communication- Spoken, Written, Un-Spoken and Unwritten, Present state of Communication in India.

**MASS COMMUNICATIONS AND MASS MEDIA**: Marshal Mc Luchan's theory-the Medium is the message, One-step, two- step, multi-step flow of Communication, Mass Media and its characteristics Whatis Communication research, The nature and task of Communication research.

**PRINCIPLES OF PUBLIC RELATIONS**: Meaning and Definitions, Basic elements of PR, Nature, role and scope, PR as a tool of modern management – PR role in the Indian Setting- Developing economy. PR as distinct from other forms of Communication, PR and Publicity, Lobbying, Propaganda, Sales Promotion,and Advertising, PR and Corporate Marketing Services. Historical Perspective-Industrial Page | 103 revolution-the beginnings of PR – Pioneers-Ivy Lee in America – Technological and media revolution in the Society-PR during First and Second World Wars – The Development of Indian PR, Early Phase, Professionalism, Genesis and Growth of PRSI – Present status and Future of PR in India. Public Opinion – Meaning and Definition- Opinion Leaders-Individuals Institution, Roots of public attitudes – Culture, the family, religion, Economic and Social Classes – Role of PR in opinion formation-persuasion. The Ethics of PR – Social Responsibility Code of Professional Standards for the practice of PR – IRSI – Code of Ethics. Public Relations Media

**MEDIA CLASSIFICATION**: Introduction to Mass Media, Functions of Mass Media, Characteristics, Limitations, advantage and relative appeal of different media.

**NEWS-PAPERS AND MAGAZINES**: Principal categories of newspapers and periodicals, NewsAgencies, Government and Press – Mass Media as Social Instruments.

**RADIO BROADCASTING**: Ratio in India, Relative coverage and appeal of Radio and Press. Impact of Radio on rural India and rural development.

**TV IN INDIA**: A brief history of Television – Coverage, present status and impact on masses, Role of Satellite Communication, TV for Socio- Economic change, The future of Television in India.

**FILM IN INDIA**: Film as a tool of PR, Impact of films, Documentaries, PR Films, Feature Films, Script writing of newsreel and documentaries.

**PHOTOGRAPHS**: The Camera as a tool of PR, Uses of Photos in PR, News-photos, Photo features-photo Editing, Caption writing.

**EXHIBITIONS**: Exhibition as a PR tool, Types of Exhibitions, Planning an Exhibition- Theme andDisplay.

**MEDIA RELATIONS**: Page | 104 -Strategy for good media relations, Inter-Media Publicity, Press Conference. -Traditional Media as a PR tool – Types – Advantages - Role of traditional Media in ruralIndia. -Outdoor media as a PR tool – Hoardings – Posters – Transit media – Bus panels – Neon sings –Direct Mail – advantages. -The Art of News writing – What is News, Difference between newspapers

writing and Broadcast writing, Language, content and style. -Writing for Newspapers and House Journals - Reporting – How to write a press release, Press release – Its parts, headline, subhead lines, the lead, paragraphs, essentials of writing a press release. -Feature writing, Corporate features- Development-stories. -Editorial Writings: House Journal's Editorials, Writing for Radio & TV. Public Relations Practice.

**PUBLIC RELATIONS PRACTICE**: Scope of the Practice; Profile of the practitioner; Planning forPublic Relations; Measuring Public Relations Objectives; Organizing Public Relations department;- Organizing Public Relations Agency.

**PUBLIC RELATIONS SPECIALISATION**: Public Relations in Employee Relations; Public Relationsin Industrial Relations; Public Relations and the Community; Public Relations and the Govt.; Public Relations in Promotion of causes and Ideas.

# Name of Post: Pharmacist Grade-2

## Part B
## Core Subject

100% Questions to be based on Subject/Domain knowledge from the following topics:-

**Introduction of different dosage forms.** Their classification with examples-their relative applications. Familiarization with new drug delivery systems. Introduction to Pharmacopoeias with special reference to the Indian Pharmacopoeia.

**Metrology**-System of weights and measures. Calculations including conversion from one to another system. Percentage calculations and adjustment of products. Use of allegation method in calculations, Isotonic solutions.

**Packaging of pharmaceuticals**-Desirable features of a container and types of containers. Study of glass &plastics as materials for containers and rubber as a material for closure their merits and demerits. Introduction to aerosol packaging. Size reduction, objectives, and factors affecting size reduction, methods of size reduction- study of Hammer mill, ball mill, Fluid energy mill and Disintegrator.

**Size separation**-size separation by sifting. Official standards for powders. Sedimentation methods of size separation. Construction and working of Cyclone separator.

**Mixing and Homogenization**-Liquid mixing and powder mixing, mixing of semisolids. Study of Silverton Mixer Homogenizer, planetary Mixer; Agitated powder mixer; Triple Roller Mill; Propeller Mixer, colloid Mill and Hand Homogeniser. Double cone mixer.

**Clarification and Filtration**-Theory of filtration, Filter media; Filter aids and selection of filters. Study of the following filtration equipments-Filter Press, sintered filters, Filter candles, Meta filter.

**Extraction and Galenicals**-

Study of percolation and maceration and their modification, continuous hot extraction-Application in the preparation of tinctures and extracts.

Introduction to Ayurvedic dosage forms.

Heat process-Evaporation-Definition-Factors affecting evaporation-study of evaporating still and Evaporating pan.

**Distillation-**Simple distillation and Fractional distillation, steam distillation and vacuum distillation, Study of vacuum still, preparation of purified water I.P. and water for Injection I.P. construction and working of the still used for the same.

**Introduction to drying process**- Study of Tray Dryers; Fluidized Bed Dryer, Vacuum Dryer and Freeze Dryer.

**Sterilization-**Concept of sterilization and its differences from disinfection-Thermal resistance of microorganisms. Detailed study of the following sterilization process. Sterilization with moist heat, Dry heat sterilization, Sterilization by radiation, Sterilization by filtration And Gaseous sterilization.

**Aseptic techniques** Applications of sterilization process in hospitals particularly with reference to surgical dressings and intravenous fluids. Precautions for safe and effective handling of sterilization equipment.

**Processing of Tablets**-Definition; different type of compressed tables and their properties. Processes involved in the production of tablets; Tablets excipients; Defects in tablets; Evaluation of Tablets; Physical standards including Disintegration and Dissolution. Tablet coating-sugar coating; films coating, enteric coating and micro encapsulation (Tablet coating may be done in an elementary manner).

**Processing of Capsules**-Hard and soft gelatin capsules; different sizes of capsules; filling of capsules;

handling and storage of capsules. Special applications of capsules.

**Study of immunological products** like sera, vaccines, toxoids & their preparations.

**PHARMACOGNOSY**

1. Definition, history and scope of Pharmacognosy including indigenous system of medicine.
2. Various systems of classification of drugs and natural origin.
3. Adulteration and drug evaluation; significance of pharmacopeial standards.
4. Brief outline of occurrence, distribution, outline of isolation, identification tests, therapeutic effects and pharmaceutical application of alkaloids, terpenoids, glycosides, volatile oils, tannins and resins.
5. Occurrence, distribution, organoleptic evaluation, chemical constituents including tests wherever applicable and therapeutic efficacy of following categories of drugs.

(a) **Laxatives**- Aloes, Rhubarb, Castor oil, Ispaghula, Senna.

(b) **Cardiotonics**-Digitalis, Arjuna.

(c) **Carminatives & G.I. regulators**-Umbelliferous fruits, Coriander, Fennel, Ajowan, Cardamom, Ginger, Black pepper, Asafoetida, Nutmeg, Cinnamon, Clove.

(d) **Astringents**-Catecheu.

(e) **Drugs acting on nervous system**-Hyoscyamus, Belladonna, Aconite, Ashwagandha, Ephedra, Opium, Cannabis,
Nux-vominca.

(f) **Antihypertensive** -Rauwolfia.

(g) **Antitussives** -Vasaka, Tolu balsam, Tulsi.

(h) **Antirheumatics** -Guggal, Colchicum.

(i) **Antitumour** -Vinca.

(j) **Antileprotics** -Chaulmoogra oil.

(k) **Antidiabetics** -Pterocarpus, Gymnemasylvestro.

(1) **Diuretics** -Gokhru, Punarnava.

(m) **Antidysentery** -Ipecacuanha.

(n) **Antiseptics and disinfectants**- Benzoin, Myrrh, Neem, Curcuma.

(0) **Antimalarials** -Cinchona.

(p) **Oxytocics** -Ergot.

(q) **Vitamins**-Shark liver oil and Amla.

(r) **Enzymes**- Papaya, Diastase, Yeast.

(5) **Perfumes and flavoring agents**- peppermint oil, Lemon oil, Orange oil, lemon grass oil, sandalwood.

**Pharmaceutical aids**-Honey, Arachis oil, starch, kaolin, pectin, olive oil. Lanolin, Beeswax, Acacia, Tragacanth, sodium Alginate, Agar, Guargum, Gelatin.

**Miscellaneous**-Liquorice, Garlic, picrorhiza, Dirscorea, Linseed, shatavari, shankhpushpi, pyrethrum, Tobacco.Collection and preparation of crude drugs for the market as exemplified by Ergot, opium, Rauwalfia, Digitalis, senna. Study of source, preparation and identification of fibers used in sutures and surgical dressings cotton, silk, wool and regenerated fibers. Gross anatomical studies of-senna, Datura, cinnamon, cinchona, fennel, clove, Ginger, Nuxvomica & ipecacuanha.

**BIOCHEMISTRY AND CLINICAL PATHOLOGY**

**Introduction to biochemistry**. Brief chemistry and role of proteins, polypeptides and amino acids, classification, Qualitative tests, Biological value, Deficiency diseases.

**Carbohydrates:** Brief chemistry and role of carbohydrates, classification, qualitative tests, Diseases related to carbohydrate metabolism.

**Lipids:** Brief chemistry and role of lipids, classification and qualitative tests. Diseases related to lipids metabolism.

**Vitamins:** Brief chemistry and role of vitamins and coenzymes. Role of minerals and water in life processes.
**Enzymes:** Brief concept of enzymatic action. Factors affecting it. Therapeutics: Introduction to pathology of blood and urine. Lymphocytes and platelets, their role in Health and disease.
**Erythrocytes**-Abnormal cells and their significance. Abnormal constituents of urine and their significance in diseases.
**Therapeutics:** Introduction to pathology of blood and urine. Lymphocytes and platelets, their role in Health and disease.
**Erythrocytes-** Abnormal cells and their significance. Abnormal constituents of urine and their significance in diseases.

**HUMAN ANATOMY AND PHYSIOLOGY**
Scope of Anatomy and physiology. Definition of various terms used in Anatomy. Structure of cell, function of its components with special reference to mitochondria and microsomes.
**Elementary tissues**: Elementary tissues of the body, i.e. epithelial tissue, muscular tissue, connective tissue and nervous tissue.
**Skeletal System:** Structure and function of Skelton Classification of joints and their function. Joint disorders.
**Cardiovascular System:** Composition of blood, functions of blood elements. Blood group and coagulation of blood. Brief information regarding disorders of blood. Name and functions of lymph glands. Structure and functions of various parts of the heart Arterial and venous system with special reference to the names and positions of main arteries and veins. Blood pressure and its recording. Brief information about cardiovascular disorders.
**Respiratory system:** Various parts of respiratory system and their functions, physiology of respiration.
**Urinary System**: Various parts of urinary system and their functions, structure and functions of kidney. Physiology of urine formation. Patho-physiology of renal diseases and edema.
**Muscular System:** Structure of skeletal muscle, physiology of muscle contraction. Names, positions, attachments and functions of various skeletal muscles. Physiology of neuromuscular junction.
**Central Nervous System:** Various parts of central nervous system, brain and its parts, functions and reflex action. Anatomy and physiology of automatic nervous system.
**Sensory Organs**: Elementary knowledge of structure and functions of the organs of taste, smell, ear, eye and skin. Physiology of pain.
**Digestive System**: names of various parts of digestive system and their functions. Structure and functions of liver, physiology of digestion and absorption.
**Endocrine System:** Endocrine glands and Hormones. Location of glands, their hormones and functions. Pituitary, thyroid, Adrenal and pancreas.
**Reproductive system:** Physiology and Anatomy of Reproductive system.
**HEALTH EDUCATION AND COMMUNITY PHARMACY**
**Concept of health:** Definition of physical health, mental health, social health, spiritual health determinants of health, indicatory of health, concept of disease, natural history of diseases, the disease agents, concept of prevention of diseases.
**Nutrition and health:** Classification of foods, requirements, diseases induced due to deficiency of proteins, vitamins and minerals-treatment and prevention.
Demography and family planning: Demography cycle, fertility, family planning, contraceptive methods, behavioral methods, natural family planning methods, chemical methods, mechanical methods, hormonal contraceptives, population problem of India.

**First aid:** Emergency treatment in shock, snake-bite, burns, poisoning, heart disease, fractures and resuscitation methods, Elements of minor surgery and dressings.

**Environment and health:** Source of water supply, water pollution, purification of water, health and air, noise, light-solid waste disposal and control-medical entomology, arthropod borne diseases and their control. Rodents, animals and diseases.

**Fundamental principles of microbiology:** Classification of microbes, isolation, staining techniques of organisms of common diseases.

**Communicable diseases:** Causative agents, mode of transmission and prevention. Respiratory infections-chicken pox, measles, influenza, diphtheria, whooping cough and tuberculosis.

**Intestinal infection**-poliomyelitis, Hepatitis, cholera, Typhoid, food poisoning, Hookworm infection.

**Arthropod borne infections**-plague, Malaria, filariasis.

**Surface infection**-Rabies, Tranchoma, Tetanus, Leprosy.

**Sexually transmitted diseases**-Syphilis, Gonorrhoea, AIDS.

**Non-communicable diseases:** causative agents, prevention, care and control.

**Epidemiology:** Its scope, methods, uses, dynamics of disease transmission. Immunity and immunization: Immunological products and their dose schedule. Principles of disease control and prevention, hospital acquired infection, prevention and control. Disinfection, types of disinfection procedures, for-faces, urine, sputum, room linen, dead-bodies, instruments.

**PHARMACEUTICS (Dispensing Pharmacy)**

**Prescriptions**-Reading and understanding of prescriptions; Latin terms commonly used (Detailed study is not necessary),Modern methods of prescribing, adoption of metric system. Calculations involved in dispensing.

**Incompatibilities in prescriptions**- study of various types of incompatibilities-physical, chemical and therapeutic.

**Posology-** Dose and dosage of drugs, factors influencing dose, calculations of doses on the basis of age, sex, surface area and veterinary doses.

**Dispensed Medications:** (Note: A detailed study of the following dispensed medication is necessary. Methods of preparation with theoretical and practical aspects, use of appropriate containers and closures. Special labeling requirements and storage conditions should be highlighted).

**Powders-**Type of powders-Advantages and disadvantages of powders, Granules, cachets and tablet triturates. Preparation of different types of powders encountered in prescriptions. Weighing methods, possible errors in weighing, minimum weighable amounts and weighing of a material below the minimum weighable amount, geometric dilution and proper usage and care of dispensing balance

**Liquid oral Dosage forms:**

**Monophasic**-Theoretical aspects including commonly used vehicles, essential adjuvant like stabilizers, colorants and flavors, with examples.

Review of the following monophasic liquids with details of formulation and practical methods.

Liquids for internal administration Liquids for external administration or used on mucous membranes

Mixtures and concentrates, Gargles, Syrups, Mouth washes, Throat-paints, Elixirs, Douches, Ear Drops, Nasal Drops, Sprays, Liniments & Lotions.

**Biphasic Liquid Dosage Forms:**

**Suspensions (elementary study)**-Suspensions containing diffusible solids and liquids and their preparations. Study of the adjuvant used like thickening agents, wetting agents, their necessity and quantity to be incorporated, suspensions of precipitate forming liquids like tinctures, their preparations and stability. Suspensions produced by chemical reaction an introduction to flocculated/non-flocculated suspension system.

**Emulsions-**Types of emulsions, identification of emulsion system, formulation of emulsions, selection of emulsifying agent. Instabilities in emulsions, preservation of emulsions.

**Semi Solid Dosage Forms:**

**Ointments:** Types of ointments, classification and selection of dermatological vehicles..

Preparation and stability of ointments by the following processes:

| | |
|---|---|
| Titration | fusion |
| Chemical reaction | Emulsification. |

**Pastes:** Differences between ointments and pastes, Bases of pastes. Preparation of pastes and their preservation.

**Jellies:** An introduction to the different types of jellies and their preparation. An elementary study of poultice.

**Suppositories and pessaries**-Their relative merits and demerits, types of suppositories, suppository bases, classification, properties, preparation and packing of suppositories. Use of suppositories of drug absorption.

**Dental and cosmetic preparations:** Introduction to Dentifrices, facial cosmetics, Deodorants. Anti- per spirants, shampoo, Hair dressings and Hair removers.

**Sterile Dosage forms.**

**Parenteral dosage forms-**Definition, General requirements for parenteral dosage forms. Types of parenteral formulations, vehicles, adjuvant, processing and personnel, Facilities and quality control. Preparation of Intravenous fluids and admixtures-Total parenteral nutrition, Dialysis fluids.

**Sterility testing:** particulate matter monitoring-Faculty seal packaging.

**Ophthalmic products:** study of essential characteristics of different ophthalmic preparations. Formulation: additives, special precautions in handling and storage of ophthalmic products.

**PHARMACEUTICAL CHEMISTRY**

1. Introduction to the nomenclature of organic chemical systems with particular reference to hetero-cyclic system containing up to 3 rings.

2. The chemistry of following pharmaceutical organic compounds covering their nomenclature, chemical structure, uses and the important physical and chemical properties(chemical structure of only those compounds marked with asterisk (*). The stability and storage conditions and the different type of pharmaceutical formulations of these drugs and their popular brand names.

**Antiseptics and Disinfectants-**Proflavine*, Benzalkonium chloride, Cetrimide, Phenol, chloroxylenol, Formaldehyde solution, Hexachlophene, Nitrofurantoin.

**Sulphonamides**-Sulphadiazine, Sulphaguanidine, Phthalylsulphathaizole, Succinylsulphathiazole, Sulphadimethoxine, Sulphamethoxypyridazine, Co-trimoxazole, sulfacetamide*

**Antileprotic Drugs**-Clofazimine, Thiambutosine, Dapsone*, solapsone,

**Anti-tubercular Drugs** Isoniazid*, PAS*, Streptomycin, Rifampicin, Ethambutol*, Thiacetazone, Ethionamide, cycloserine, pyrazinamide*.

**Antiamoebic and Antihelminthic Drugs** Emetine, Metronidazole, Halogenated hydroxyquinolines, Diloxanidefuroate, Paromomycin, Piperazine*, Mebendazole, D.E.C.*

**Antibiotics-** Benzylpenicillin*, Phenoxy methyl penicillin*, Benzathine penicillin, Ampicillin*, Cloxacillin, Carbenicillin, Gentamicin, Neomycin, Erythromycin, Tetracycline, Cephalexin, Cephaloridine, Cephalothin, Griseofulvin, Chloramphenicol.

**Antifungal agents**-Udecylenic acid, Tolnaftate, Nystatin, Amphotericin, Hamycin.

**Antimalarial Drugs-**Chloroquine*, Amodiaquine, Primaquine, Proguanil, Pyrimethamine*, Quinine, Trimethoprim.

**Tranquilizers-**Chlorpromazine*, Prochlorperazine, Trifluoperazine, Thiothixene, Haloperidol*, Triperiodol, Oxypertine, Chlordizepoxide, Diazepam*, Lorazepam, Meprobamate.

**Hypnotics-**Phenobarbitone*, Butobarbitone, Cylobarbitone, Nitrazepam, Glutethimide*, Methyprylon, Paraldehyde, Triclofosodium.
**General Anaesthetics-**Halothane*, Cyclopropane*, Diethyl ether*, Methohexital sodium, Thiopecal sodium, Trichloroethylene.
**Antidepressant Drugs**- Amitriptyline, Nortryptyline, Imperamine*, Phepelzine, Tranylcypromine.
**Analeptics-**Theophylline, Caffeine*, Coramine*, Dextro-amphetamine.
**Adrenergic drugs** Adrenaline*, Noradrenaline, Isoprenaline*, Phenylephrine, Salbutamol, Terbutaline, Ephedrine*, Pseudoephedrine.
**Adrenergic antagonist-**Tolazoline, Propranolol*, Practolol.
**Cholinergic Drugs-** Neostigmine*, Pyridostigmine, Pralidoxime, Pilocarpine, Physostigmine*.
**Cholinergic Antagonists-** Atropine*, Hyoscine, Homatropine, Propantheline*, Benztropine, Tropicamide, Biperiden*.
**Diuretic Drugs-** Furosemide*, Chlorothiazide, Hydrochlorothiazidc*, Benzthiazide, Urea*, Mannitol*, Ethacrynic Acid.
**Cardiovascular Drugs-**Ethylnitrite*, Glyceryl trinitrate, Alpha methyldopa, Guanethidine, Clofibrate, Quinidine.
**Hypoglycemic Agents-** Insulin, Chlorpropamide*, Tolbutamide, Glibenclamide, Phenformin*, Metformin.
**Coagulants and Anti coagulants** Heparin, Thrombin, Menadione*, Bisphydroxycoumarin, Warfarin sodium.
**Local Anaesthetics-**Lignocaine*, Procaine*, Benzocaine.
**Histamine and anti-Histaminic Agents-** Histamine, Diphenhydramine*, Promethazine, Cyproheptadine, Mepyramine*, Pheniramine, Chlorpheniramine*.
**Analgesics and Anti-pyretics**-Morphine, Pethidine, Codeine, Methadone, Aspirin*, Paracetamol, Analgin, Dextropropoxphene, Pentazocine.
**Non-steriodal anti-inflammatory agents-** Indomethacin*, Phenylbutazone*, Oxyphenbutazone, Ibuprofen.
**Thyroxine and Antithyroids-** Thyroxine*, Methimazole, Methyl thiouracil, Propylthiouracil.
**Diagnostic Agents** Lopanoic Acid, Propyliodone, Sulfobromopthalein-sodium, Indigotindisulfonate, Indigo Carmine, Evans blue, Congo Red, Fluorescein sodium.
Anticonvulsants, cardiac glycosides, Antiarrhythmic, Antihypertensives & Vitamins.
**Steroidal Drugs** Betamethasone, Cortisone, Hydrocortisone, Prednisolone, Progesterone, Testosterone, Oestradiol, Nandrolone.
**Anti-Neoplastic Drugs-**Actinomycin, Azathioprine, Busulphan, Chloramubucil, Cisplatin, Cyclophosphamide, Daunorubicin Hydrochoride, Fluorouracil, Mercaptopurine, Methotrexate, Mytomycin.

**PHARMACOLOGY & TOXICOLOGY**

**Introduction to Pharmacology, Scope of Pharmacology.**
**Routes of administration of drugs,** their advantages and disadvantages. Various processes of absorption of drugs and the factors affecting them. Metabolism, distribution and excretion of drugs.
**General mechanism of drugs action** and their factors which modify drugs action. Pharmacological classification of drugs.
The discussion of drugs should emphasize the following aspects:
Drugs acting on the central Nervous system:
General anaesthetics- adjunction to anaesthesia, intravenous anaesthetics. Analgesic antipyretics and non-steroidal.
Anti-inflammatory drugs- Narcotic analgesics. Antirheumatic and anti-gout remedies.
Sedatives and Hypnotics, psychopharmacological agents, anticonvulsants, analeptics. Centrally acting muscle relaxants and anti-parkinsonism agents. Local anesthetics.

Drugs acting on autonomic nervous system.
Cholinergic drugs, Anticholinergic drugs, anticholinesterase drugs. Adrenergic drugs and adrenergic receptor blockers.
Neurone blockers and ganglion blockers. Neuromuscular blockers, used in myasthenia gravis.
Drugs acting on eye: Mydriatics, drugs used in glaucoma.
Drugs acting on respiratory system, Respiratory stimulants, Bronchodilators, Nasal decongestants, Expectorants and Antitussive agents.
**Autocoids:** physiological role of histamine and serotonin, Histamine and Antihistamines, prostaglandins.
Cardio vascular drugs.
Cardiotonics, Antiarrhythmic agents, Anti-anginal agents, Antihypertensive agents, peripheral Vasodilators and drugs used in atherosclerosis.
Drugs acting on the blood and blood forming organs. Haematinics, coagulants and anticoagulants, Haemostatic, Blood substitutes and plasma expanders.
**Drugs affecting renal function-** Diuretics and anti-diuretics.
**Hormones and hormone antagonists-** hypoglycemic agents, Antithyroid drugs, sex hormones and oral contraceptives, corticosteroids.
**Drugs acting on digestive system-**carminatives, digest ants, Bitters, Antacids and drugs used in peptic ulcer, purgatives and laxatives, Anti-diarrhoeal, Emetics, Anti-emetics, Antispasmodics.
**Chemotherapy of microbial diseases**:
Urinary antiseptics, sulphonamides, penicillin, streptomycin, Tetracyclines and other antibiotics. Anti-tubercular agents, Antifungal agents, antiviral drugs, anti-leprotic drugs. Chemotherapy of protozoal diseases, Anthelmintic drugs. Chemotherapy of cancer.
**PHARMACEUTICAL JURISPRUDENCE**
**Origin and nature of pharmaceutical legislation in India**, its scope and objectives. Evolution of the "Concept of pharmacy" as an integral part of the Health care system.
**Principles and significance of professional Ethics.** Critical study of the code of pharmaceutical Ethics drafted by Pharmacy Council of India.
**Pharmacy Act, 1948-**The General study of the pharmacy Act with special reference to Education Regulations, Working of state and central councils, constitution of these councils and functions, Registration procedures under the Act.
**The Drugs and Cosmetics Act, 1940**-General study of the Drugs and cosmetics Act and the Rules there under. Definitions and salient features related to retail and whole sale distribution of drugs. The powers of Inspectors, the sampling procedures and the procedure and formalities in obtaining licenses under the rule. Facilities to be provided for running a pharmacy effectively. General study of the schedules with special reference to schedules C,C1,F,G,J,H,P and X and salient features of labeling and storage conditions of drugs.
**The Drugs and Magic Remedies (objectionable Advertisement) Act, 1954-**General study of the Act, objectives, special reference to be laid on Advertisements, magic remedies and objections1 and permitted advertisements diseases which cannot be claimed to be cured.
**Narcotic Drugs and psychotropic substances Act, 1985-**A brief study of the act with special reference to its objectives, offences and punishment.
Brief introduction to the study of the following acts:
Latest Drugs (price control) order in force (as amended to date)
**Medicinal and Toilet preparations (excise Duties) Act, 1955 (as amended to date). Medical Termination of Pregnancy Act, 1971.**
**DRUG STORE AND BUSINESS MANAGEMENT**

**Introduction**-Trade, Industry and commerce, Functions and subdivision of commerce, Introduction to Elements for Economics and Management. Forms of Business Organizations. Channels of Distribution.

**Drug House Management**-selection of site, space Lay-out and legal requirements. Importance and objectives of purchasing, selection of suppliers, credit information, tenders, contracts and price determination and legal requirements thereto. Codification, handling of drug stores and other hospital supplies. Inventory Control-objects and importance, modern techniques like ABC, VED analysis, the lead time, inventory carrying cost, safety stock, minimum and maximum stock levels, economic order quantity, scrap and surplus disposal.

**Sales** promotion, Market Research, Salesmanship, qualities of a salesman, Advertising and Window Display.

**Recruitment, training**, evaluation and compensation of the pharmacist.

**Banking and Finance**-Service and functions of bank, Finance planning and sources of finance.

**HOSPITAL AND CLINICAL PHARMACY**

**Hospital**-Definition, Function, classifications based on various criteria, organization, Management and health delivery system in India.

**Hospital Pharmacy:** Definition Functions and objectives of Hospital pharmaceutical services. Location, Layout, Flow chart of materials and men. Personnel and facilities requirements including equipments based on individual and basic needs. Requirements and abilities required for Hospital pharmacists.

**Drug Distribution system in Hospitals.** Out-patient service, In-patient services-types of services detailed discussion of unit Dose system, Floor ward stock system, satellite pharmacy services, central sterile services, Bed side pharmacy.

**Manufacturing:** Economical considerations, estimation of demand.

**Sterile manufacture**-Large and small volume parenterals, facilities, requirements, layout production planning, man-power requirements.

**Non-sterile manufacture**-Liquid orals, externals, Bulk concentrates. Procurement of stores and testing of raw materials. Nomenclature and uses of surgical instruments and Hospital Equipments and health accessories.

**Hospital Formulary system** and their organization, functioning, composition.

**Drug Information service** and Drug Information Bulletin.

**Surgical dressing** like cotton, gauze, bandages and adhesive tapes including their pharmacopoeial tests for quality. Other hospital supply eg. I.V.sets, B.G. sets, Ryals tubes, Catheters, Syringes etc.

**Application of computers** in maintenance of records, inventory control, medication monitoring, drug information and data storage and retrieval in hospital retail pharmacy establishment.

**Clinical Pharmacy:**

**Introduction to Clinical pharmacy practice**-Definition, scope.

**Modern dispensing aspects**- Pharmacists and patient counseling and advice for the use of common drugs, medication history.

Common daily terminology used in the practice of Medicine.

**Disease, manifestation and patho-physiology** including salient symptoms to understand the disease like Tuberculosis, Hepatitis, Rheumatoid Arthritis, Cardio-vascular diseases, Epilepsy, Diabetes, Peptic Ulcer, Hypertension.

Physiological parameters with their significance.

**Drug Interactions:** Definition and introduction. Mechanism of Drug Interaction. Drug-drug interaction with reference to analgesics, diuretics, cardiovascular drugs, Gastro-intestinal agents. Vitamins and Hypoglycemic agents. Drug-food interaction.

**Adverse Drug Reaction:** Definition and significance. Drug-Induced diseases and Teratogenicity.

**Drugs in Clinical Toxicity**- Introduction, general treatment of poisoning, systemic antidotes, Treatment of insecticide poisoning, heavy metal poison, Narcotic drugs, Barbiturate, Organophosphorus poisons.
**Drug dependences,** drug abuse, addictive drugs and their treatment, complications.
**Bio-availability of drugs**, including factors affecting it.

## Name of Post: Librarian Grade 2

## Part B
## Core Subject

Library Methods and Techniques Library and Society: Laws of Library Science; Types of Libraries; Library Associations, Systems and Programmers; Library Movement and Library Legislation in India; Organizations and Institutions involved in the development of Library and Information Services-UNESCO, IFLA, FID, INIS, NISSAT, etc.;

Library Management: Collection development - Types of Documents and Selection Principles, Acquisition Procedure, Acquisition of Journals and Periodicals, Preparation of Documents for use; Library Personnel and Library Committee, Library Rules and Regulations; Library Finance and Budget; Principles of Library Management, Library Organization and Structure; Use and Maintenance of the Library - Circulation, Maintenance, Shelving, Stock Verification, Binding and Preservation, Weeding out, etc.; Library Classification Theory and Practice: Canons and Principles, Library Classification Schemes - DDC, CC, UDC;

Library Cataloguing Theory and Practice: Canons and Principles; Library Cataloguing Codes - CCC and AACR; Reference and Information Sources: Bibliography and Reference Sources - Types of Bibliography; Reference Sources- Dictionaries, Encyclopedias, Ready Reference Sources, etc.; Sources of Information - Primary, Secondary, Tertiary, Documentary, Non- Documentary; E-Documents, EBooks, E-Journals, etc.;

Information Services: Concept and need for Information; Types of Documents; Nature and organization of Information Services, Abstracting and Indexing Services; Computer based Information Services - CAS, SDI;

Information Technology: Basics Introduction to Computers; Use of computers in Library housekeeping, Library Automation; Software and software packages; Networks - DELNET, NICNET, etc.; National and International Information Systems - NISSAT, NASSDOC, INSDOC, DESIDOC, etc.

## Name of Post: Assistant Security Officer

## Part B
## (Core Subject)

(Syllabus is only Indicative. The questions can assess any aspect of knowledge, aptitude, attitude and practical skills, which is expected from a trained person to work efficiently at the advertised post)

- Role & Aim of Security Department
- Organisation of Security Setup
- Hospital Security Administration duties
- Disaster Management, both Natural and Manmade Disasters
- Role of intelligence in security
- Morale and Motivation of team Members
- Qualities of a good Security Professional
- Environmental Conservation
- Coordination with other Civil Agencies for Security
- Theft/Pilferage-Preventive steps
- Security Arrangements for VIP visits
- Duties & Responsibilities of Assistant Security officer
- Surface firefighting arrangement
- Utilization of Modern Gadgets in overall security Management
- Security Reports & Returns
- Importance of Physical Fitness in Uniformed Forces
- Lodging of FIR with Local Police in given situation

## Name of Post: Computer Programmer

## Part B
## Core Subject

**Subject knowledge**

**Programming Skills-**

Introduction to C Language, Structure of C program, Data Types, Variables, Constants, Input/ Output Management, Arrays, Functions, Pointers, Structures, Types of Error Handling, Introduction to OOPS, Classes, and Objects, Basic concepts of OOPS, Structure of C++ Program, Copy Constructors, Destructors, Friend Functions Operating

**System and Software Engineering** –

Operating System, Types of Operating System, Threads, Inter Process Communication, Concurrency, Synchronization, Deadlock, Memory Management and Virtual Memory, Information Systems and Software Engineering, Data Flow Diagrams, Planning and Managing the project

**Data Structures and Algorithms** –

Abstract Data Types, Stacks, Queues, Linked Lists, Trees, Binary search Trees, Graphs, Types of Graph, Searching, Sorting, Algorithms Analysis, Asymptotic complexity

**Computer Networks –**

OSI Model, Concept of Layering, Communication Media, LAN Technologies, Flow and error control Techniques, Application Layer Protocols, Basics of Wi-Fi

**Data Base Management Systems –**

Data Base Environment, Advantages of Database approach, Database Users, Data Models and Schemas, DBMS Architecture, Database Languages and Interfaces, Database Development Process, Introduction to Data Modeling, Entity Relationship Model