



PARAMEDICAL COUNCIL OF INDIA

DIPLOMA IN MEDICAL RADIOGRAPHIC TECHNOLOGY

SYLLABUS

FIRST YEAR

PAPER I & II PHYSIOLOGY & ANATOMY

1 .The Human Body - Definitions, sub-divisions of Anatomy, Terms of location and position, fundamental planes, vertebrate structure of man, organization of the body cells, Tissues.

2.The Skeletal System - Types of bones, structure and growth of bones, Division of the skeleton Appendicular skeleton, axial skeleton name of all the bones and their parts. Joints classification, types of movements with examples.

3.Anatomy of Circulatory System - Heart Size, position coverings, chambers, Blood supply, venous supply, the blood vessels, general plan of circulation, pulmonary circulation, Names of arteries and veins and their position - lymphatic system general plan.

4.Anatomy of the respiratory System - Organs of respiratory, Larynx, trachea, bronchial tree, Respiratory portion, Pleurae and lungs, Brief knowledge of parts and position.

5.Anatomy of the Digestive System - Components of digestive system, Alimentary tube, anatomy of organs of digestive tube, mouth, tongue, tooth, salivary glands, liver, biliary apparatus, pancreas, names and position and brief functions.

6.Anatomy of the Nervous System - Central nervous system, The Brain, hind brain, midbrain, fore brain, brief structure, locations, and peripheral nervous system, Spinal cord, Anatomy, functions, reflex - Arc, meninges. Injuries to spinal cord and brain.

7.Anatomy of the endocrine system - Name of all endocrine glands their position, hormones, and their functions- pituitary, thyroid, parathyroid, adrenal glands, gonads & islets of pancreas.

8.Anatomy of Excretory system and reproductive system - Kidneys location, gross structure, excretory ducts, ureters, urinary bladder, urethra, Male reproductive system, Testis, duct system, Female reproductive system, Ovaries Duct system, accessory organs.

9.Blood - Definitions, composition, properties and function of Blood, Haemogram (RBC, WBC, Platelet count, HB concentrations), Function of plasma proteins Haemopoiesis, Blood Group - ABO and RH grouping, Coagulation & Anticoagulants, Anemia causes effects & treatment, Body fluid compartments, composition, Immunity Lymphoid tissue, Clotting factors, mechanism of blood clotting, Disorders of white blood cells, Disorders of platelets, Disorders of clotting.

10.Cardio vascular system - Function of cardiovascular system, Structure of cardiovascular system, Cardiac cycle, functional tissue of heart & their function, Cardiac output, E.C.G., blood pressure, Heart Rate.

11. Respiratory system - Function of respiratory system, functional (physiological), Anatomy of Respiratory system, Mechanism of respiration, lung volumes & capacities, Transport of respiratory gases.

12. Digestive system - Function of digestive system, functional Anatomy of digestive system, composition and functions of all digestive juices, Movements of digestive system (intestine), Digestion & absorption of carbohydrate, proteins & fats.

13. Functions of nervous system - neuron - conduction of impulses, factors effecting, synapse - transmission, reception, reflexes, ascending tracts, descending tracts, functions of various parts of the Brain, cerebrospinal fluid (CSF), composition, functions & circulation, lumbar puncture, Autonomic nervous system - and its types function of (ANS).

14. Special Senses - Vision - Structure of Eye, function of different parts Refractive errors of and correction. Visual pathways, color vision & tests for color blindness. Hearing, structure and function of ear, mechanism of hearing, test for hearing (deafness).

15. Muscle Nerve Physiology - Type of muscle, structure of skeletal muscle, Sarcomere, Neuromuscular junction & transmission, Excitation and contraction coupling (mechanism of contraction).

16. Structure and function of skin - body temperature, fever, regulation of temperature.

17. Excretory system - Excretory organs, kidneys, function, Nephron, Juxta Glomerular apparatus, renal circulation, mechanism of urine formation, mechanism of micturition, cystometrogram, diuretics, artificial kidney.

18. Structure and function of reproductive system - Male reproductive system, Spermatogenesis, testosterone, Female reproductive system, Ovulation, menstrual cycleogenesis, tests for ovulation, estrogen & progesterone, pregnancy test, parturition, contraceptive, Lactation, Composition of milk, advantages of breast feeding.

PRACTICAL:

Labeled diagram of different organs and bones. Introduction to hemocytometry, Enumeration of total red blood corpuscles (RBC) count, Enumeration of white blood cell (WBC) count, Study of digestive, respiratory, cardiovascular systems, urinary and reproductive systems with the help of models, charts and specimens. Demonstration of total blood count by cell analyzer.

Text Books & Reference Books Recommended

- A. Text books of Physiology. Author: Guyton (Arthur C). Prism publishers Bangalore.
- Human Physiology. Author: Chatterjee (cc). Medical allied agency
- Concise Medical physiology. Author: Choudhary (Sujit km.). New central books Kolkata.
- D. Review Medical physiology. Author: Ganang. Application and Lange

PAPER III DARK ROOM TECHNIQUE

1. X-ray materials - Types of emulsion-characteristic and control screen and non-screen films dental films X-ray paper under and over exposure speed contrast.,

2. Intensifying screens - Fluorescence application of fluorescence in Radiography type of intensifying screens intensifying factors cleaning and general care of screen after glow.

3. X-ray cassettes- Testing and proving good screen contrast general care.

4. X-ray developers - Characteristics details and contrast freedom from chemical fog and staining function and constituent of developer standardization by time and temperature exhaustion of developer replenishes.

5. Powder and liquid solution - medium and high contrast developer ultra rapid development methods automatic processing.

6. X-ray fixers and fixing - Fixing agents acid and preservative in fixer inclusion of hardener time of fixation silver recovery.

7. Rinsing washing and drying - Object methods employed method of drying films.

8. Processing - Preparation of solution suitable water supply nature of mixing vessels order missing solutions filtrations making of stock solutions storage of dry chemical storage of solution.

9. Processing apparatus - Processing units hangers care of hangers refrigeration and use of ice.

10. Operation theatre processing, Dish units.

11. Technical and processing faults - Chemical reduction, Chemistry and characteristics of Farmer's reducer, local and general application. ,

12. X-ray Dark Room - Size light proof entrance hatches construction of walls for protection against chemicals and radiation ceiling color schemes water proofing of floors lighting bench designing disposition of processing attd necessary equipment for efficient working arrangement of drying cabinets in dark room or in adjacent rooms dark room illumination and testing for safety ventilation.

13. The Radiographic Image - Radiographic factors affecting image contrast and sharpens variation in exposure time in accordance with quality of radiation filters distance intensifying screens grids film speed developer and development.

14. Presentation of Radiograph - Identification of film aspect for direct and stereo (univeraprimatic) viewing mounting dental films, Accessories, Viewing boxes spot light illuminator projectors and viewing screens for miniature and cine radiography magnifiers film identification lead letter number actinic marker embossing machine film trimmers corner cutters dental mounts and cutter filling units.

15. Dark room procedures technique - Dark room adaptation techniques, safe light test, preparation of developer, fixer And its chemistry, design and planning of dark room, processing of exposed films, c~r~

of intensifying screens, storage of unexposed films, Accessories of dark room, AFP tech. dry camera and presentation of films etc. Chemistry for processing of exposed films manual and automatic processing, care of intensifying screens, storage of unexposed films, AFP tech. and presentation of films etc.

PRACTICAL

I Dark room adaptation techniques- safe light test, preparation of developer, fixer And its chemistry, design and planning of dark room, processing of exposed films, care of intensifying screens, storage of unexposed films, Accessories of dark room, AFP tech, dry camera and presentation of films etc., Chemistry for processing of exposed films manual and automatic processing, care of intensifying screens, storage of unexposed films, AFP tech. and presentation of films etc.

Text Books & Reference Books Recommend

Physics for Radiographer-Hay & Hughes.

Fundamental of X-ray and Radium Physics-Joseph Selman

Basic Medical Radiation Physics-Stanton

PAPER IV GENERAL PHYSICS & RADIATION PHYSICS

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RADIOLOGY PHYSICS

1. Dosimeter and Radiation Biology - Radiation units, Exposure Coulombs/kg, Air Kerma-gray absorbed dose-gray, equivalent dose-sievert, Effective dose-sievert, Interaction mechanisms, Ionization excitation free radicals, Introduction to concept of linear energy transfer (LET).

2. Interactions of charged particles interaction of electromagnetic radiation Neutron interactions. Introduction to thermography and microwave equipment and interactions. Optical interaction ultra sound interactions.

3. Basic concepts of electromagnetic radiation - Electromagnetic waves Relationship between frequency and wavelength The electromagnetic spectrum sources of Electromagnetic radiation. Risks from occupational exposure-public, occupational exposure of pregnant women. Diagnostic reference levels (DRL).

4. Basics of NMR and MRI - Basic Nuclear Magnetic Resonance (NMR) nuclear magnetic moments effect of external magnetic field, Nuclear precession. Equilibrium magnetization significance of Radio frequency (RF) pulse OIMR) and microwave (EPR) Equipment, Resonance and Larmor frequency. Free induction Decay (FID).

5. Radiation detectors - Radiation protection-biological aspects, Measurement of detriment, ICRP framework of radiological protection.

6. Nuclear medicine In vitro and in vivo testing gamma rays for imaging radio pharmaceuticals, Preparation and quality control chemistry and radio pharmacology of radionuclide's gamma Camera SPECT PET.

7. Ultrasound in medicine-Ultrasound imaging generation and detection of ultrasound propagation choice of frequency A-scan B-scan M-mode imaging and echo cardiography Use of Doppler techniques for blood flow etc.

PRACTICAL

1 Practical of measuring instruments, ionization chamber, TLD measuring technique, Focal spot measurement, KY measurement, linearity of mA station, Tube centring, Radiographic tech. of whole body, all sp. Investigations imaging, etc. Radiographic tech, of whole body, all sp. Investigations imaging, etc., table top dose measurement in fluoroscopy, image distortion of IITV, leakage of radiation through lead flaps, radiation level measurement during tube above table and below table, removal of grids.

Text Books & Reference Books Recommended

Physics for Radiographer-Hay & Hughes.

Fundamental of X-ray and Radium Physics-Joseph Selman

Basic Medical Radiation Physics-Stanton

SECOND YEAR **RADIOGRAPHY (GENERAL) PAPER I**

RADIATION HAZARD AND PROTECTION

1. Radiation protection - principles, history & development-National & international agencies, AERB, BARC, ICRP, WHO,IAEA and their role, Equivalent dose, effective dose sievert-rem, Sources of radiation-natural man made & internal exposures.

2. Biological effects of radiation - effects on cell-stochastic & deterministic effects radiation risk-tissues at risk-genetic, somatic& fetus risk-risk at other industries, Does equivalent limits philosophy-ICRP (60) AERB guidelines.

3. Planning of radiation installation-protection primary - leakage and scattered radiation, Concepts of workload use factor occupancy factor & distance, Barrier design barrier materials-concrete brick & lead, Primary & secondary barrier design calculations, Design of doors, Control of radiation-effects of time distance and shielding.

4. Personnel monitoring systems - Principle and objective-film badge-guidelines for use thermo luminescent dosimeter badge-pocket dosimeter, Area monitoring and radiation survey practical use of survey meter, zone monitors and phantoms, Survey in x-ray, fluoroscopy and CT scan units.
5. AERB safety code and ethics - Built in safety specification for diagnostic x-ray, fluoroscopy and CT units, Specification for radiation protection devices-room layout, Operational safety-Radiation protection programme-Personnel requirements and responsibilities-regulatory controls.
6. Patient protection - Safe work practice in diagnostic radiology, Radiation absorbed dose from general dental fluoroscopy x-ray and CT examinations-X-ray examinations during pregnancy x-ray examinations associated with illness, not associated with illness-medico-legal or insurance purpose x-ray examination-medical research x-ray avoidance of unnecessary radiation dose.
7. Radiation• emergencies-situation preparedness safety and prevention-legal requirements recent developments in radiation safety related topics.

PRACTICAL

Practical based on Radiation Hazards & control safety, Knowledge of all hazards, education of gen. Public by posters and seminars, Safety of women and children , pregnant women, safety of patient attendants, non radiation workers hospital skiff, checking of lead aprons, leakage radiation from tube head, radiation survey in and around X - ray installation, Use of TLD film badges and use of protective devices etc, Keeping of dose records of radiation workers, steps after high exposure report and investigations.

RADIOLOGICAL IMAGING AND CONTRAST INVESTIGATION

Computed Tomography – More classes should be allotted for CT & MRI History: Basic principle and data acquisition/C.T. generations, Gantry and patient table – Travel Speed, Load capacity, X-ray tubes. Rotating anode; cooling system; Collimator; Pencil beam; Fan beam Anode heat storage capacity; Detector system : Type, number, Efficiency Rectifier Scan parameters; Scan time, Number of views per second, Reconstruction time, scan cycle time, Acquisition matrix, Display matrix, Slice thickness. Image reconstruction; Pixel & Voxel; C.T. Number & Hounsfield Number. Image display; matrix, pixel, vexed, Window level, Window width, Double Window, Partial Volume phenomenon. Image quality: Patient exposure; Resolution Ultrafast C.T., Dynamic C.T. & C.T. angiography, C.T. guided FNAC. 3D C.T./Artefacts Radiation dose aspects. Clinical application – Scan planes specially in Cranial C.T. [Gross anatomy of conventional planes] Indication and contra-indication; Patient preparation and positioning Contrast enhanced C.T.

Magnetic Resonance Imaging BASIC PHYSICS WITH PRACTICAL APPLICATIONS: Magnets – types, powers, magnetism Radio Frequency (RF) pulse T1 (longitudinal relaxation time) T2 (transverse relaxation time) Basic sequences, basic parameters and basic tissue (like fat and water) Different types of coils. Contrast agents, MR angiography and dynamic MR.

Spectroscopy. Hazards, safety and limitations. **Ultrasonography** – Basic Physics : Characteristic of sound; Propagation of sound; Interaction between ultrasound and matter attenuation and reflection; Transducers; Ultrasound display, A, TM, B- mode Gray scale imaging; Scanning methods; Doppler techniques; Artifacts Safety Application

Contrast media: Barium preparation, Iodine preparation, Air-Oxygen.

Skeletal system: Upper limb, lower limb, shoulder, girdle and thorax, vertebral column, pelvic girdle and hip region. Teeth jaw. Accessory nasal sinuses. Lachrymal system

Cardiovascular system: Upper respiratory passage, lungs, pleura, diaphragmatic excursion, Mediastinum, bronchography, artificial pneumothorax.

Genito-urinary system: Straight X-ray of abdomen, pyelography, cystography, urethrography, gas insufflation, pneumo-peritonium.

Obstetrics and Gynaecology: Radiation protection, pregnancy, pelvimetry, hystero salpingography, placentography.

Central nervous system: Routine and special projections of skull, ventriculography and encephalography, cerebral angiography, myelograph. Alimentary system: Barium suspension, Barium-meal and follow through Barium emena.

Biliary system: Cholecystography, Oral and I V Cholangiography – Direct and Indirect. Liver and spleen: Spleno-portal venography.

Silvary glands : Sialography. Arthrography, singraphy, Lymhmpangiography, Operation theatre technique and ward radiography. Sterioscopy, Magnification, High and Low K.V. technique and Mammography.

PAPER II RADIOGRAPHY (SPECIAL)

POSITIONING IN RADIOGRAPHY AND TECHNIQUES

1. Upper limb

- a) Hand- postero-anterior view
- b) Fingers- postero-anterior view
- c) Thumb- Antero-posterior view
- d) Wrist- postero-anterior view, lateral, bending position
- e) Forearm- antero-posterior view, lateral
- f) Elbow- antero-posterior view, lateral
- g) Humerus- antero posterior view, lateral (supine position , erect position)
- h) Shoulder- antero-posterior view (subdeltoid bursa, external rotation, supero-inferior, infero-superior)

- i) Sterno clavicular articulation –(unilateral postero-anterior, oblique postero-anterior, postero-anterior)
- j) Scapula- anterior oblique, lateral
- k) Sternum- oblique postero-anterior, erect position

2. Lower limb

- a) Foot- antero-posterior, oblique, lateral, longitudinal arch
- b) Tose- antero-posterior, oblique, lateral
- c) Calcaneum- lateral, plantodorsal, dorsoplantar
- d) Ankle- antero-posterior, oblique, lateral
- e) Leg- antero-posterior, lateral
- f) knee- postero-anterior, lateral, intercondyloid space holblad position, intercondyloid space antero posterior
- g) Patella- postero anterior, axial projection
- h) Thigh- lateral, Antero-posterior
- i) Hip- antero-posterior, lateral
- j) Pelvis- antero-posterior, lateral
- k) Pubis- axial projection, postero-anterior
- l)Ilium- oblique

3. Vertebral Column

- a) Atlas and Axis antero-posterior (open mouth view), lateral
- b) Cervical vertebrae- antero- oblique, lateral
- c) Lower cervical vertebrae- antero-posterior
- d) Cervicothoracic region-lateral (Swimmer's view)
- e) Thoracic vertebrae- antero posterior, oblique
- f) Lumbar vertebrae- antero-posterior, lateral, lateral bending projections
- g) Sacro-iliac joint- oblique
- h) Lumbo-sacral articulation- antero-posterior, postero-anterior, lateral
- i) Sacrum- antero-posterior, lateral
- j) Coccyx- antero-posterior, lateral

4. Chest

- a) Posterior ribs- antero-posterior
- b) Upper anterior ribs- postero-anterior
- c) Chest- postero anterior, lateral, antero-oblique, postero-oblique, lateral decubitus position, ventral decubitus, semi-axial view

5. Skull and facial bone

- a) antero-posterior view
- b) Frontal view-postero-anterior
- c) Frontal parietal- occipito-frontal view

- d) occipital-parietal, fronto-occipital view, Temporomandibular articulation antero-posterior
- e) Occipital view – antero posterior
- f) Frontal ethmoid sinuses
- g) Maxillary sinus
- h) Sphenoid sinus
- i) Open mouth posture
- j) Posterior ethmoid sinus- postero anterior
- k) Sphenoid- Posterior ethmoid, supero inferior, posterior ethmoid infero superior
- l) Sphenoid sinus- open mouth projection
- m) Nasal bones
- n) Mandible body, ramus and angle, postero anterior, Temporo mandibular joints
- o) Styloid process- antero posterior, lateral
- p) Mastoid-petrous bone- schuller position, antero posterior
- q) Zygomatic arches- mento-frontal, Titterington's position

Practical:

Upper limb positions, Lower limb positions, Vertebral column, chest, skull & facial bones

PAPER III ELECTRO CARDIOGRAPH

Electro Cardiograph Technician) Course : Introduction Haeartanatomy and Physiology, common heart ailments, Cardio version Electrocardiogram Machine, Normal Patterns and variations of the Electrocardiogram Intensive cotonary care unit continous E.C.G. monitoring, method of analysis of the Electrocardiogram (Rate, Rhythm, Voltage, Axis, Deviation, P wave, R.R. interval, Q Wave, ORS complex, ST segment, T wave, Q.T. interval, Ischemic heart diseases (Myocardial intartion, cotonay)

PAPER IV PATHOLOGY

Hematology

1. Composition of Blood And Normal Erythropoiesis
2. Technique of Blood Collection
3. Estimation of Hemoglobin
4. Hematocrit
5. Selection And Registration of Donors

6. ABO Blood Grouping
7. Erythrocyte Sedimentation Rate (ESR)
8. Staining of PBF And Interpretation of Normal And Abnormal Red Cell Morphology
9. Maturation And Development of Leucocytes
10. Formation of Platelets of Leucocytes
11. Formation of Platelets and Thrombocytopenia

12. Rhesus Blood Group
13. Pretransfusion or Compatibility Testing

□ **Histopathology**

1. Introduction To Histopathology
2. Light Microscopy
3. Special Light Microscopy
4. Receiving of Surgical Specimens
5. Fixation of tissues
6. Decalcification
7. Tissue Processing
8. Embedding
9. Microtome
10. Hematoxylin And Eosin Staining
11. Staining Methods To Demonstrate Special/Specific tissues
12. Metachromatic Staining
13. Lipid Stain
14. staining Techniques For Demonstration And Identification of Microorganisms
15. Cryostat And Frozen Section

Records & viva voce:

MARK ALLOTMENT

THEORY: 400 Marks

PRACTICAL: 400 Marks

TOTAL MARKS: 800 Marks

PASSING MARKS: 40/100

BOOKS:

- Anatomy and Physiology for Radiographers- DR. N. MURUGESH
 Pathology for radiographers- Dr Dinesh Kumar Shukla
 Anatomy and Physiology for Radiographers- C.A. Werrick
 Imaging Atlas of Human Anatomy – Jamie Weir et al (Mosby-Elsevier)
 An Atlas of Normal Radiographic Anatomy – Richard and Alwin.
 Anatomy and Physiology for Nurses
 Comprehensive Radiographic Pathology. Ronald L. Eisenberg, NancyM. Johnson
 Surface and Radiological Anatomy – Hamilton et al (Heffer)
 An Atlas of normal radiographic Anatomy – Ross and Wilson.
 Radiology – Hariqbal
 The physics of Radiology and imaging – K.Thayalan
 Text Book of Radiological Safety – K. Thaylan (2010) Jaypee Brothers and medical Publishers, New Delhi.
 Radiological Procedures – SK.Bharagava Radiographic Imaging – Derrick
 Physics of Photography principles of Medical Radiography – Seeman & Herman
 Concepts in Medical Radiographic Imaging – Mariamme Tortoise
 An Atlas of Normal Radiographic anatomy – Richard and Alwin Solomon. E.A., (2008)

Introduction to Human Anatomy and Physiology 3rd Ed, Saunders: St Louis. Chaurasia, B.D., & Garg, K., (2012)

Human Anatomy Regional and Applied. CBS Publications: New Delhi T.S. Ranganathan – A text book of Human Anatomy Fattana,

Human anatomy (Description and applied) Saunder's & C P Prism Publishers, Bangalore – 1991 Anatomy and Physiology for Radiographers- C.A. Werrick.

SECRETARY