

Paper I

Radiographic Anatomy and Physiology

Unit 1 : Introduction to Human body - Anatomy, Physiology

Cells- structure and function - the tissues - epithelial tissue, connective tissue, muscular tissue, nervous tissue, structure and function.

Unit 2 : The Skeletal system

The skeleton - structure of bone - classification of bones - the skull - the bones of the skull-bones of the face - vertebral column - bones of thoracic cage - ribs and sternum - bones of upper limb - bones of lower limb - the pelvis - the arches of the foot.

Unit 3 : The joints of the skeleton

Classification of joints - movements of joints- joints of upper limb- shoulder joint, elbow joint, radio ulnar joint, wrist joint, joints of hands and fingers - joints of lower limb - hip joint, knee joint, ankle joint - joints of foot and toes.

Unit 4 : The Cardio Vascular system

Blood and its composition - plasma, RBC, WBC and platelets - function of blood- coagulation of blood - blood grouping- blood vessels - arteries, capillaries, veins- anatomy of the heart - blood circulation - types of circulation - systemic, pulmonary, coronary and portal circulation - function of the heart - cardiac cycle - ECG - cardiac output - blood pressure - blood volume.

Unit 5 : The Respiratory system

Respiratory passages - nasal cavity, pharynx, larynx, trachea, bronchi, bronchioles, alveoli - the lungs - blood supply of the lungs - transport of gases in the blood stream - the physiology of respiration - lung volume and capacities - artificial respiration.

Unit 6 : The Excretory system

Various parts of the urinary system and their function - kidney - structure and function of kidney - ureter, bladder, urethra - urine formation - physiology of micturition.

Unit 7 : The Digestive system

Organs of digestive system - structure and function - mouth, salivary glands, pharynx, oesophagus, stomach - small intestine - large intestine - rectum - anal canal - pancreas- liver - digestion and absorption of food - defaecation.

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Unit 8 : The Endocrine system

Position of Endocrine glands - structure and function- Pituitary glands- thyroid glands - adrenal glands - pancreas - gonads - thymus - pineal gland - somatostatin.

Unit 9 : The Central Nervous system

The brain- cerebrum - diencephalon, mid brain, cerebellum, pons - medulla oblongata- spinal cord - the meninges - thalamus - hypothalamus - CSF - ventricle of the brain- peripheral nervous system - cranial nerves, spinal nerves - sensation and sensory path- motor path ways - reflex action.

Unit 10 : The Reproductive system

Male Reproductive system - scrotum, testis, function of testis, penis, vas deferens, seminal vesicles, prostate gland, spermatozoa - Female Reproductive system- external genitalia - internal genitalia - vagina, uterus, ovaries, fallopian tubes- puberty in female - ovulation - menstrual cycle - menopause- breasts or mammary glands - structure and function of mammary glands.

Text Book:

1. Ross and Willson, 2003. Anatomy and Physiology in Health and Illness - Elsevier Science Ltd. Pp.463.
2. Evelyn C. Pearce, 1997. Anatomy and Physiology for Nurses - Jaypee Brothers, New Delhi. Pp411.
3. Muruges, N. 2004. Anatomy Physiology and Health Education - Sathya Publishers, Madurai. Pp.281.
4. Senthilkumar S. Anatomy & Physiology for Students - Sathiyam Offset, Madurai, Pp.238.

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1. Evelyn C. Pearce, 1997. Anatomy and Physiology for Nurses - Jaypee brothers, New Delhi. Pp411.
2. Moni, A.S. 1992. Human Anatomy and Physiology - Chandra printers, Madurai. Pp. 230.
3. Muruges, N. 2004. Anatomy Physiology and Health Education - sathya publishers, Madurai. Pp.281.
4. Ross and Willson, 2003. Anatomy and Physiology in Health and Illness - Elsevier Science Ltd. Pp463.
5. Satish K. Bhargava, 2004, Text book of Radiology for Residents and Technicians. CBS Publisher's & Distributors, New Delhi, Pp. 443.
6. Senthilkumar S. Anatomy & Physiology for Students - Sathiyam Offset, Madurai, Pp.238.

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Paper 2

Basics of Radiation Physics

Unit 1 : Basic Physics

Quantities and units - force, work, power and energy, temperature and heat. Electromagnetic radiation - EM Spectrum - atomic structure, atomic number, mass number, isotopes, ionization, excitation, binding energy, electron volt.

Unit 2 : Electricity and Magnetism

Electric charge and potential difference - resistance - ohm's law - AC, DC, single phase and three phase current - conductor- insulator and semi conductor, earthing - capacitor, capacitance - electric power- volt meter- ammeter - Magnetism- magnetic field, magnetic lines of force, neutral point - magnetic flux- properties of magnetism - Fleming's left hand rule.

Unit 3 : Electromagnetic Induction

Laws of electromagnetic induction - Fleming's right hand rule- self induction - mutual induction - transformer - open core, close core and auto transformer- step up transformer and step down transformer - transformer losses- construction of transformer - HT cable.

Unit 4 : X - ray circuits

Vacuum diode- triode- semi conductor diode - rectification in X- ray circuits- rectifier- half wave rectification - full wave rectification - self rectification - six pulse six rectifier, six pulse twelve rectifier circuit, twelve pulse three phase transformer - X- Ray circuit single phase- KV control circuits- mA control circuits- fuses- switches- relay- circuit breakers- inter locking circuits- timing system- switching system.

Unit 5 : Production of X- rays

History and production of X- rays - properties of X- rays - characteristics of X- radiation - Bremsstrahlung radiation - continuous spectrum of X- rays- stationary anode

X- ray tube- rotating anode X- ray tube- line focus principle - X- ray tube cooling - X- tube housing- Off focus radiation- anode heel effect - mammography X- ray tube - factors influencing the quality and quantity of X- rays.

Unit 6 : Physics of Radiation

Radioactivity - natural and artificial radioactivity - units of activity - alpha decay - beta decay - gamma ray emission - radioactive decay - Half life - Mean life - nuclear fission and fusion.

Unit 7 : Interaction of X- ray with matter

Attenuation, absorption and scattering - half value layer- tenth value layer- relationship between HVT and TVT - free electrons and bound electrons- elastic scattering- Photoelectric effect - Compton scattering- Pair production- annihilation radiation - Photonuclear interaction.

Unit 8 : Radiation units and Measurements

Radiation units - Rontengen- KERMA - rad - gray- RBE - equivalent dose- effective dose- radiation detector and measurements - types of detectors - free air ionization chamber - thimble ionization chamber - GM counter- scintillation counter- pocket dosimeter- secondary standard dosimeter- survey meter.

Unit 9 : Diagnostic Radiology Physics

Filters and filtration - inherent filtration - added filtration - wedge filtration - beam restrictors - aperture diaphragms - collimators- cones and cylinders- anti scatter grids- grid ratio - grid cut off - linear grid - crossed grid - focused grid- parallel grid- pseudo focused grid - moving grid- air gap technique- focusing and type of defocusing.

Unit 10 : X- ray hazards and Protection

Radiation hazards - biological effects - non stochastic effects - stochastic effect - genetic effect, somatic effect - ICRP 60 dose recommendation - ALARA-

inverse square law- principles of radiation protection - time , distance, shield
 - personal monitoring device- film badge - TLD badge- pocket dosimeter- safe
 work practice in diagnostic department - design of diagnostic X- ray machine
 installation.

Text book:

1. Christensen, 1990, Physics of Diagnostic Radiology- Lea & Febiger - Philadelphia - London . pp520.
2. Satish K. Bhargava, 2004, Text book of Radiology for Residents and Technicians. CBS Publisher's & Distributors , New Delhi, pp. 443.
3. Thayalan, K. 2006, Basic Radiological Physics- Jaypee brother's medical Publishers(P) Ltd., New Delhi. Pp 225.

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1. Christensen, 1990, Physics of Diagnostic Radiology- Lea & Febiger - Philadelphia - London . pp520.
2. Jerrold, T. Pushberg, The Essential Physics of Medical Imaging -
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4. Fiaz M. Khan, 1994. The Physics of Radiation Therapy- williams & wilkins Tokyo. Pp.542.
7. Laundrell Thompson and J. Ashworth, 2nd. Ed. X-ray Physics and Equipment- Back well publications. Edinbergh. Pp.807
8. Alan Martin and Samuel A. Harbison, 1986. An introduction to Radiation and Protection- chapman & hall, lponon. pp.242.

9. Rao, B.S. 1994. Biological bases of ICRP 60 Recommendations - BARC. Pub. Bombay. Pp. 12-18.
10. Madhavanath, U . 1989. Safety aspects of Diagnostic Radiology- BARC- Bombay. Pp.20.
11. Thayalan, K. 2006, Basic Radiological Physics- Jaypee brother's medical Publishers(P) Ltd., New Delhi. Pp 225.
12. Van Der Plaats, G.J. 1980. Medical X- ray techniques in Diagnostic Radiology- the Macmillan press ltd. Tokyo. Pp.463.
13. Meredith and J.B. Massey, W.J. 1977. Fundamental Physics of Radiology- bristol . John Wright & sons Ltd. pp.710
14. Jerrold T. Pushberg , The Essential Physics of Medical Imaging -
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16. Khandpur, R.S. hand Book pf Bio Medical Instrumentation . 405- 426.
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P.G. Diploma in Radiological Imaging Technology

Paper 3

Radiography Positioning and Dark Room Technique

Syllabus

Unit 1: Regional Radiography

Patient positioning terminology - supine, prone, lateral decubitus, erect and semirecumbent - positioning terminology - AP, PA, lateral, anterior oblique, posterior oblique - RAO, LAO, RPO, LPO - human body surfaces - various joints movements.

Unit 2: Radiographic Positioning for upper extremity

Upper limb - Fingers - AP and Lateral view - hand, butterfly view, PA, oblique and lateral view - wrist joints - PA view, lateral and oblique view, forearm - AP, lateral view, elbow joint - AP, lateral view, Humerus - AP, lateral view, Shoulder Joint - AP, AP (internal and external rotation), Axial projection (Supero - inferior and infero - superior) - Acromio-clavicular joint PA view - Scapula Anterior oblique and lateral view - Sterno clavicular joint.

Unit 3: Radiographic Positioning for lower extremity

Lower limb - foot - AP- lateral and oblique view - toes - AP view, lateral, oblique view - calcaneum - Axial view - ankle joint - AP, lateral and oblique view - leg - AP, lateral view - knee - AP, PA, lateral view, intercondyloid space (kneeling position) - patella - PA, axial projection - thigh - PA, lateral, - hips - AP, lateral, frog view, pelvis - AP, lateral, oblique. Ilium - antero oblique view

Unit 4: The Skull

Skull- PA, PA - occipito frontal, Caldwell's, Towne's and projections - base of skull, face- lateral view, PA (water's projections) sinuses - PNS - sphenoid sinuses, nasal bones, mandibles, temporo mandibular joints, styloid process, mastoid, optic foramen - Dental radiography.

Unit 5: Vertebral Column and The Chest

Vertebral column - cervical spine, AP. Lateral, cervico thoracic region - thoracic vertebra, lumbar, vertebrae, sacro iliac joints, lumbo sacral articulation, sacrum, coccyx. The Chest - all views - ribs - all views - abdomen - all views.

Unit 6: Special Radiographic Technique

Barium - swallow, meal, meal follow through and enema - bronchography- angiography - myelography - IVP, HSG - mammography.

Unit 7: Dark Room Technique and Photographic Technique for Radiography

Image formation by X-rays - light sensitive material of silver- photographic emulsion - formation of latent image - the screen film cassette - construction of X-ray cassette - types of cassettes - intensifying screen- construction of intensifying screen- types of intensifying screen - speeds of intensifying screen - factors affecting the speed of screen - conversion and absorption efficiency of screen - screen film contact- testing screen film contact - cleaning of cassette.

Unit 8: X-Ray film

X-ray film - structure of film - types of film - spectral sensitivity - storage of unexposed and exposed films - non screen film - single sided X-ray film- dental film- optical density - characteristic curve of X-ray film - film speed - fog - contrast- factors affecting film contrast.

Unit 9 : Film Processing and Developing

Latent image formation - development - developing chemicals - types of developer - Exhaustion of developer - fixer - constituents of fixer - rinsing - types of rinsing - washing and drying - manual and automatic film processing methods - types of hangers - replenishment.

Unit 10 : The Dark room

Dark room location - size and installation - light proof entrances - single and double door entrance - labyrinth type entrance - pass box entrance - floor - walls - wet bench, dry bench - protection against radiation - illumination - safe light, general and radiographic illumination - test for safe light illumination.

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1. Christensen, 1990, Physics of Diagnostic Radiology, Lea & Febiger, Philadelphia, London. pp520.
2. Jerrold T. Pushberg, 2nd ed. The Essential Physics of Medical Imaging, Lippincott Williams & Wilkins Tokyo. Pp915.
3. Satish K . Bhargava, 2004, Text book of Radiology for Residents and Technicians, CBS Publisher's & Distributors, New Delhi. pp. 443.

Reference :

1. Isadore Meschan, 1968. Radiographic positioning and related anatomy. W.b. saunders company London . 388.

Paper 4

Digital Radiography and Computerized Tomography

Unit 1 : Basics of Digital Radiography

Introduction – computed radiography – screen film detector – digital film detector
- storage phosphor – image capture system - charged coupled device(CCD)

Unit 2 : Flat Panel Detectors

Flat panel detectors- indirect detection and direct detection – comparison of digital detectors and radiography.

Unit 3 : Digital Fluoroscopy and Digital Mammography

Fluoroscopy and image intensification - television display of the fluoroscopic image - television cameras - digital fluoroscopy – Digital mammography - digital image storage- digital image display - PACS- DICOM.

Unit 4 : Tomography

Body section radiography - Basic method of tomography - multisection tomography - Types of tomography movement.

Unit 5 : Computed Tomography

Introduction - History of CT - Basic principles of CT – Tomographic reconstruction - CT generations – first to fourth generation – fifth generation – Sixth generation (Helical) –seventh generation (multiple detector array) - slip ring technology – 64 slice CT can.

Unit 6 : Detectors and Detectors Array

Types of detectors- scintillation detectors- Xenon Gas detector- solid state detector- helical pitch- advantages of multiple row detector CT.

Unit 7 : Reconstruction Technique of CT Scanning

Algorithm For Image Reconstruction - back projection reconstruction- - iterative method of reconstruction – analytical methods of reconstruction.

Unit 8 : CT Numbers (Hounsfield unit)

CT number - Attenuation - Linear attenuation co-efficient - CT numbers for various tissues – fluoroscopic reconstruction .

Unit 9 : Digital Image Display and Image Quality

Windowing and leveling- multiplanner reconstruction- three dimensional image display- slack mode viewing - Image quality - Quantum mottle (Noise) – resolution – Quality control.

Unit 10 : Artifacts and Radiation dose

Artifacts – beam hardening – motion artifacts – partial volume averaging – streak artifacts – ring artifacts – radiation dose.

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3. William R. Hendee, 2002. Medical Imaging Physics – wiley liss , inc , New York, pp.511.

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5. Khandpur, R.S. Hand Book pf Bio Medical Instrumentation. 405- 426.

Magnetic Resonance Imaging and Ultrasound

Unit 1: Principles of Magnetic Resonance Imaging

History of MRI – NMR - Basic Principles of NMR - Tomographic Imaging
- Imaging Coordinates - Imaging Planes - Advantages of MRI - Basic Principles of MRI – Magnetism – Ferromagnetism, Paramagnetism, Superparamagnetism, Diamagnetism - Atomic Structure - Magnetic characteristics of the Nuclei - Larmor frequency - Geometric Orientation

Unit 2: Generation and detection of the MR signal

Resonance and Excitation – Flip Angles – Relaxation - T1 Relaxation, T2 Relaxation (FID), T2* Relaxation - comparison of T1 and T2.

Unit 3: Pulse sequences

Spin Echo Sequence – T1 Weighting, T2 weighting - Inversion recovery (STIR) - FLAIR Sequence - Gradient Echo Sequences - Saturation Recovery Sequence - Spiral Pulse Sequences

Unit 4: Localization of MR signal

Magnetic field gradient - slice select gradient (SSG)- frequency encode gradient (FEG)- phase encode gradient (PEG)- gradient sequencing.

Unit 5: MR Image Characteristics

Signal-to-Noise Ratio (SNR) – Resolution – Time - Spatial Resolution and Contrast Sensitivity - Voxel Volume - Signal averages - RF detector bandwidth - RF coil quality factor: measure of RF coil sensitivity - Magnetic field strength - Slice-gap and cross-excitation - Image acquisition and reconstruction algorithms

Unit 6: MRI Contrast agent and Special studies

Contrast Agents - Positive Contrast Agents - Negative Contrast Agents - Ionic Contrast Agents - Nonionic Contrast Agents - Contrast Agent Safety - MR Angiography - Functional MRI

Unit 7: MRI artifacts

MRI artifacts - Chemical Shift Artifacts - Aliasing - Black Boundary Artifacts - Central Point Artifact - Gibbs or Truncation Artifacts - Zipper Artifacts - Phase-encoded Motion Artifacts - Entry Slice Phenomenon - Slice-overlap Artifacts - Magic Angle Effects - Moire Fringes - RF Overflow Artifacts - Susceptibility Artifacts - Zero-fill Artifact (Zebra Artifact).

Unit 8: MRI Instrument and Safety

Magnet- resistive magnet- super conductive magnet- Permanent Magnet - Ancillary Equipment - Magnet Siting - RF gradient coils- gradient amplifier- electronic data processing- Quality Control - MR Safety and Bio effects - RF antenna effect- guideline of MRI safety.

Unit 9: Basics of Ultra Sound

Ultra sound - history - Sound waves and ultrasound - properties of ultra sound -ultra sound velocity- intensity- density- attenuation of ultra sound - characterization of an ultrasonic beam - interaction of ultrasound with matter - reflection - refraction - absorption- scattering - acoustic impedance - angle of incidence

Unit 10: Ultrasound Instrumentation

Instrumentation - transducer- transducer design - Piezoelectric effect - curie temperature - resonant frequency- frequency response of transducer- beam

profiles - focused transducers - multiple element transducers- ultrasonic imaging - A mode- M mode - transducer array- two dimensional image display and storage - system components - image artifacts - Biologic effects .

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