

STAREX UNIVERSITY
SCHOOL OF PARAMEDICAL SCIENCE
Diploma in Radio-imaging Technology (1st to 4th semester)
Bachelor in Radio-imaging Technology (1st to 6th semester)

Syllabus (BRIT)

Instruction for paper setter:

Total marks: 75

Timing: 3 hrs.

The question paper will consist of four sections A, B, C & D or four units 1, 2, 3, 4 as the case may be. Paper-Setter will set nine questions in all, selecting two questions from each section/unit.

Question no. 1 will be of 15 marks and consists of short answer type questions of 2 to 3 marks each covering the entire syllabus e.g.

Q. 1 (a) Prove that a non-abelian simple group is not solvable.

(b) Give an example of a subnormal series which is not a normal series.

(c) Prove that every homomorphic image of a nilpotent group is also nilpotent.

(d) Define field extension and degree of extension.

(e) Show that \mathbb{C} (field of complex no's) is a normal extension of \mathbb{R} .

The duration of the examination will be of 3 hours.

Each question will carry equal marks i.e. 15

Attempt any five questions out of nine questions.

Question no.1st is compulsory.

SYLLABUS

Paper Code	Nomenclature of paper/course	Credit C(L-T-P)
	Semester 1st	
	General pathology (101)	6(3-1-2)
	<p>Unit I Introduction to Pathology & Hematology. Formation, Composition and function of Blood. Haemopoiesis (Erythropoiesis, Leucopoiesis & Thrombopoiesis), Anticoagulant, Mode of Action, Uses, Advantages & Disadvantages. Collection, Preservation, Transportation & Handling and disposal of Blood Sample. Standard & Universal Precautions in Hematology. Hematological Stain, Principle, Composition & procedure of Staining. Preparation of Blood Smear and their significance. Hem cytometer, principle, working procedure Care & Maintenance.</p> <p>Unit II Haemoglobin, its synthesis and types, normal and abnormal hemoglobins, extravascular and intravascular hemolysis. Anaemia and its classification, Morphological and etiological, pathogenesis, laboratory investigations and management, Iron deficiency anaemia, metabolism of iron, pathogenesis, laboratory investigations and management, principle and procedure of special test. Megaloblastic anaemia, pernicious anaemia, pathogenesis, laboratory investigations.</p> <p>Cell Injury and Cellular Adaptations- Normal Cell, Cell Injury- types of cell injury, etiology of cell injury, and morphology of cell injury, cellular swelling, and Cell death: types- autolysis, necrosis, and apoptosis. Inflammation- Acute inflammation - vascular event, cellular event, inflammatory cells Chronic Inflammation - general features, granulomatous inflammation</p> <p>Unit III Tissue Renewal and Repair, healing and fibrosis, cirrhosis, introduction of oedema, hyperaemia, congestion, haemorrhage, haemostasis, thrombosis, embolism, infarction, shock and hypertension.</p>	

Neoplasia: Definition, how does it differ from hyperplasia, difference between benign tumor and malignant tumor. Healing- Definition, different phases of healing, factors influencing wound healing.

Unit IV

Infectious Diseases: pathogenesis & overview of modes of infections, prevention and control with suitable examples like Typhoid, Dengue

Cancer: Definitions, nomenclature, characteristics of benign and malignant neoplasm, metastasis, Carcinogens and cancer, concept of oncogene, tumor suppressor genes, DNA repair genes and cancers stem cells.

PRACTICALS

1. Collection of blood Sample by Venous & Capillary Method
2. Estimation of Hb By Sahli's 's & CMG Method
3. Determination of RBC, WBC & Platelet Counts By Hem cytometer
4. Preparations of EDT & Sodium Citrate Vials
5. Preparation of thin & thick blood smear
6. Separation of Buffy Coat
7. Determination of ESR by Win Trobe & Western Green Method
8. Any other practical's based on theory paper
9. Blood group

RECOMMENDED BOOKS

1. Text Book of Pathology- Hares Mohan
2. Text Book of Pathology- Robbins
3. Practical Hematology- JVDecie & Lewis
4. Hematology- William J William, Ernest Butter
5. Lynch's MLT – Raphels
6. Atlas of Hematology – George, A Mcdolald, TC Codde
7. Blood & its Diseases- Chanari

Human Anatomy & Physiology-I (102)

6(3-1-2)

Unit I

Introduction to medical sciences. Organization of human body and integrated physiology:- Cell, Tissue, Organ, Organ system & body. Anatomical terms: - Body position, Section, Cavity & their related term.

Unit II

Respiratory system: - Anatomy & physiology of nose and nasal cavity, pharynx, larynx, trachea, lungs. Mechanism of respiration. Lungs capacity. Lobes of lungs, layers of lungs
Integumentary system: - Anatomy & physiology of skin & its layer, nails, hairs, structure and function of skin, care of skin.

Unit III

Digestive system: - Anatomy & physiology of mouths, pharynx, esophagus, stomach: parts, structure function, blood supply. Intestine: parts, structure, function and blood supply. Pancreas: parts, structure, ducts, functions. Liver: structure, lobes, quadrants, blood supply and function. Gall bladder: bile, duct, Mechanism of digestion.
Skeletal system:- Anatomy & physiology of bones, structure of bone, parts of bone, types of bone, blood supply of bone, Joints and its types with eg., .Upper limb, Lower limb, Vertebral column, Thorax/chest, skull.

Unit IV

Muscular system:-skeletal muscle, cardiac muscle, smooth muscle, Physiology of muscular contraction and controlling them various types of Joints and their physiology, neuromuscular junction
Cardiovascular system: - Anatomy & physiology of blood vessels, heart structure, chambers of heart, function of heart, systematic circulation, valves, pressure, circulation in adults & fetal, blood, artery, vein, capillary.

PRACTICALS

1. Demonstration of Human cell, Cell division Mitosis & meiosis - from chart& slides.
2. Demonstration of various tissues- Epithelial, Connective, Muscular & Nervous.
3. Demonstration of Individual Bones & Respiratory System from Chart
4. Measurement of Blood Pressure, Respiration & Heart Beat
5. Demonstration of Body Organ like Eye, Nose, Tongue etc.

6. Any other practical's based on theory paper

RECOMMENDED BOOKS

1. Anatomy & physiology- Rose & Wilson
2. Anatomy & Physiology- Tortora
3. Text book of Anatomy & physiology- B D Chaurasia
4. Text book of Anatomy & physiology- CC Chaterjee
Text book of physiology- K Sabuingum

**Basic Physics and Radiological Physics
(103)**

Unit I

Basic Physics

Ohms Law, direct current, alternating current, conductors, semiconductors, insulators, power, ammeter, voltmeter. Electric charges, electric power

Basic X-Ray circuits, transformer, types of transformer transformers laws, types of X-Ray machine, Rectifier.

Unit II

Basic Radiological Physics

X-rays: Discovery of x-rays-X-ray production and properties: Bremsstrahlung radiations-Characteristics X-Rays, factors affecting X-ray emission spectra, X-ray quality and quantity, heel effect, added and inherent filtration, reflection and transmission targets. Exponential attenuation (linear/mass attenuation coefficients), Half Value Thickness (HVT), Tenth Value Thickness (TVT), dependence on energy and atomic number.

LET, range of energy relationship for alpha, beta particles with X-Rays.

Unit III

X-ray tube: construction of X-ray tubes, X-ray production (Electron source, target and anode material), early X-ray tubes(Coolidge tubes, tube envelop and housing) cathode assembly, X-ray production efficiency, advances in X-ray tubes, anode angle, space charge effect, tube cooling-Modern X-ray tubes-stationary anode, rotating anode, grid controlled X-ray tubes, off focus radiation, tube insert and housing.

Grid controlled and high speed tubes, focal spot size, speed of anode rotation, target angle, radiation leakage and scattered radiation).

6(3-1-2)

Filament current and voltage, X-ray circuits, types of exposure switch and timers, principle of automatic exposure control (AEC) and practical operation, filament circuit, high voltage circuits, half wave, full wave rectification, three phase circuits. Types of generators, 3 phase, 6 and 12 pulse circuits-high frequency generators-falling load generators, Fuses, switches, HT cables-earthing.

Radiation quantity used in Diagnostic Radiology and its unit (for example, kVp, mA, mAS, Heat unit (HU)).

Attenuation, Absorption co-efficient, grids, cones and filter.

Unit IV

Line Focus principle, Anode Cooling chart

Tube overloads indication.

Fluoroscopy

Image Intensifier.

Portable and Non- Portable equipments, Care and maintenance of all X-Ray equipment and accessories

Practical

- Demonstration of X-Ray Tubes.
- Demonstration of Image Intensifier
- Demonstration of Transformer.
- Demonstration of X-Ray machine
- Demonstration of X-Ray equipment.

Books references-

1. Christensen's Physics of Diagnostic Radiology by Thomas S. Curry & James F. Dowdy
2. Textbook of Radiology for Residents & Technical by Satish K. Bhargwa 5th edition.

Image Acquisition Processing (104)

Unit I

X-ray film

Construction and types of x-ray films.

Composition of single and double coated radiographic films, Screen & Non Screen films, structure of film, characteristic curve. Characteristics (speed, latitude).

Unit II

6(3-1-2)

Film storage, handling, care of Intensifying screens and cassettes. Size, construction and function, types of intensifying screens and relative advantage, loading and unloading of cassettes and their care/maintenance, effects of kV and mA on variation of emitted radiation intensity.

Unit III

Image Processing

Manual processing, Components of Developer and fixer, 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). Factors affecting image quality.

Unit IV

Dark Room

Introduction, purpose and location of dark room, layout of dark room, entrance, pass box, hangers, safe light, criteria of safe light, safe light test.

PACS

Introduction, advantages, disadvantages (Functions with HIS/RIS)

DICOM

Introduction, advantages, disadvantages

Digital Radiography & Computed Radiography

Introduction, advantages, disadvantages

Practical

- Image processing.
- Dark Room processing.
- DICOM.
- Digital Radiography & Computed Radiography.
- PACS.
- Demonstration of x ray film.
- Demonstration of developer, fixer and other chemicals.
- Demonstration of equipments used in dark room.
- Demonstration of Automatic Film Processor.

Book Reference-

1. Radiographic Imaging by DN & Mo Chesney 4th edition
2. Manual of Darkroom Technique by W.H.O.
3. Textbook of Radiology for Residents & Technical by Satish K. Bhargwa 5th edition.

	<p style="text-align: center;">COMPUTER SCIENCE-I (105)</p> <p>Unit 1 Introduction to Computer: Meaning or Definition of Computer, Evolution of computer, Features of Computer, Main Operation of the Computer, Main Elements of Computer System, Bits, Bytes and Words, Device in Computer, Various Input & output Device.</p> <p>Unit II Applications of computer: advantages and limitations of computers. Memory: overview of storage devices. Main memory, storage evaluation criteria, random access memory, read only memory, secondary storage devices.</p> <p>Unit-III Generation of Computers and their Classification Generation of Computers, Classification of Computers</p> <p>Unit-IV Operating System Meaning of Operating System, Function of Operating System, Language Translators Database Meaning Of Database, Data Processing System, Function of Data Processing, Objectives of Database, Type of Database, Functions of Database Management System (DBMS), and Advantages & Disadvantages of DBMS, Various Database Structures or database models.</p>	0(0-0-0)
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	<p style="text-align: center;">Semester 2nd Human Anatomy & Physiology-II (201)</p> <p>Unit I Lymphatic system: Lymphatic organs, lymphocytes, Spleen, Bone marrow etc. primary & secondary immune response, Immunity. Primary defense mechanism of human body against pathogenic microbes. Physiology of various body fluids: CSF, peritoneal, Pericardial, Pleural and synovial fluids. Cartilage, ligaments, tendons.</p> <p>Unit II Excretory system: Anatomy & physiology of Kidney, Ureter, Bladder & Urethra. Mechanism of urine formation, GFR, mechanism of GFR, Nephron diagram and its function. Sense organ: Anatomy & physiology of eye, diagram of eye, ear, diagram of ear, nose & tongue.</p> <p>Unit-III Nervous system: Anatomy & physiology of Neurons structure and function, Brain and its parts, Spinal cord, Central & Peripheral nervous system. Endocrine system: Anatomy & physiology of hormones, glands, Pituitary gland & hypothalamus, thyroid gland, parathyroid glands, adrenal glands, pancreas, pineal gland & mechanism of action.</p> <p>Unit-IV Reproductive system: Male- Anatomy & physiology of Primary & secondary reproductive organs, sperm diagram and its function, spermatogenesis, testis, prostate gland, Female-Anatomy & physiology of Primary & secondary reproductive organs, ovary, ovum, uterus, Oogenesis, menstruation cycle</p> <p>PRACTICALS</p> <ol style="list-style-type: none"> 1. Demonstration of Reproductive System by Chart 2. Demonstration of Glands in chart in human body 3. Demonstration of Sense Organ 4. Demonstration of spinal & Cranial Nerve 5. Any other practical's based on theory paper <p>RECOMMENDED BOOKS</p> <ol style="list-style-type: none"> 1. Anatomy & physiology- Rose & Wilson 2. Text book of Anatomy & physiology- B D Chaurasia 	6(3-1-2)
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(202)

Unit I

Radiation quantities and units: Radiation intensity-exposure, roentgen, absorbed dose, rad, gray, rem, Sievert. Quality factor, dose equivalent, relationship between absorbed dose and equivalent dose. Radiation, types of radiation, sources of radiation. Effect of radiation, uses of x rays, gamma rays, alpha rays, beta rays.

Unit II

Area and personal radiation monitoring devices, Radiation detection and measurements: Principle of radiation detection-Basic principles of ionization chambers, G.M counters and scintillation detectors. Thermo Luminescent Dosimeter, Pocket dosimeter, Film badge.

Unit III

Interaction of ionizing radiation with matter-Types of interactions of X-and gamma radiation, Photoelectric & Compton, Pair production, annihilation radiation.
Radioactivity, types of radioactivity.

Unit IV

Transmission through matter, law of exponential attenuation, half value layer, and linear attenuation coefficient- coherent scattering- photonuclear disintegration-Particle interactions. Interactions of X rays and Gamma rays in the body; fat-soft tissue-bone-contrast media-total attenuation coefficient-relative clinical importance.

PRACTICALS

1. Demonstration of TLD.
2. Demonstration of area monitoring radiation devices.
3. Demonstration of personal monitoring radiation devices.

6(3-1-2)

General Radiography-I (203)

Unit I

Role of Radiographer in Hospital practice and Patient care

Appearance of radiographer

behaviour of radiographer,

professional conduct,

code of ethics

All View and techniques Chest

Chest

- PA,
- AP,
- Lateral,
- AP supine or semi erect,
- Lateral decubitus,
- AP lordotic,

Sternum

- RAO,
- Lateral,

Sternoclavicular Joints

- PA,
- oblique,

Ribs

- Posterior ribs (AP) or anterior ribs (PA)— bilateral study,
- unilateral rib (AP/PA) study,
- axillary ribs (anterior or posterior oblique)

Unit II

All Views and techniques of Upper Limb

Fingers

- PA,
- PA oblique,
- Lateral

Thumb

- AP,
- PA oblique,
- Lateral,

Hand,

- PA,
- PA oblique,
- Lateral

Ball catcher view (Norgaard method),

Wrist

- PA (AP),
- PA oblique,
- Lateral
- Scaphoid views
- ulnar deviation,

Forearm,

- AP,
- Lateral

Elbow Joint

- AP
- Lateral

Unit III**Humerus,**

- AP,
- Rotational lateral,
- Horizontal beam lateral

HUMERUS & SHOULDER GIRDLE

- AP,
- AP rotational lateral,
- Horizontal beam lateral,
- inferosuperior axial (lawrence method),
- PA transaxillary (Hobbs modification),

Shoulder (Trauma Routine)

- AP neutral rotation (AP),
- Scapular Y lateral,

Clavicle

- AP
- AP axial,

Scapula

- AP,
- lateral,

Unit IV

All Views and techniques of Lower Limb

Foot

- AP,
- oblique,
- Lateral,

Calcaneus

- Plantodorsal (axial),
- Lateral,

Ankle

- AP,
- AP mortise (15°),

- Lateral,
- oblique (45°)
- AP stress,

Leg

- AP,
- Lateral,

Knee

- AP,
- Lateral,
- AP (PA) weightbearing,
- PA axial
- AP axial,

Practical

- All views & techniques of chest
- All views & techniques of Upper Limb
- All views & techniques of Lower Limb

Book reference –

1. Clark’s Positioning in Radiology by Stewart Whittey
2. Handbook of radiographic positioning & technique by Bontrager

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**Communication Skills and Personality Development
(204)**

Unit I

Listening Comprehension

- Speeches
- Interviews
- audio-video clippings followed by exercises
- Introduction to Communication
- Importance of Communication
- Barriers to Communication and ways to overcome them

Unit II

Conversation Skills

- Greetings and Introducing oneself
- Framing questions and answers
- Role play
- Buying: asking details etc
- Word formation strategies

Vocabulary building: Antonyms, Synonyms, Affixation, Suffixation, One word substitution

Unit-III

Reading Comprehension

- Simple narration and Stories
- Newspaper and articles clippings
- Sentence types
- Note Making
- Paragraph Writing
- Comprehension
- Report Writing: types, characteristics

Unit --IV

Writing Comprehension

- Letters: types, format, style
- Précis Writing
- Paragraph: Order, Topic sentence, consistency, coherence
- Report and Proposal
- Project Writing: Features, Structure

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Computer Science-II (205) subsidiary subject

Unit I

Windows Graphical User Interface, Windows, Features of Windows, Control Button of windows, Various Icons on Desktop
Microsoft Word(INTRODUCTION)

Unit II

Microsoft Excel (INTRODUCTION)
Microsoft PowerPoint (INTRODUCTION)
Internet – Features, Different type of network, Internet,

Unit-III

Patient Management Medical Establishments using Computer, One or More Computer, Network, Software, Training, Service Operators of System Computerization in Hospitals and Nursing Homes, Features of a Hospital Software Packages, Password Protection ,Various Application of Different Medical ,Software and Support

Unit-IV

Picture archiving communicating system, DICOM,RIS,HIS, Uses of computer in hospitals in different department
Online reporting system, different types of software used in medical fields.

6(3-1-2)

Semester 3rd
General Radiography-II (301)

Unit I

All Views of Hip and Pelvis

Pelvis and/or Bilateral Hips

- AP projection
- lateral projection,
- AP pelvis or bilateral hips,
- AP bilateral frog-leg, (modified cleaves method) SPECIAL
- AP axial outlet projections, (Taylor method)
- AP axial inlet projection,
- Posterior oblique acetabulum, (Judet's method)
- Posterior axial oblique acetabulum, (Teufel method)

All Views and techniques of Skull

Skull Series

- AP axial (Towne method),
- lateral,
- PA axial 15° (Caldwell method) or
PA axial 25° to 30°,
- PA 0°,
- submentovertex (SMV),
- PA axial (Haas method),

Facial Bones (Orbits)

- lateral,
- Parietoacanthial (Waters method),

Unit II

Nasal Bones

- lateral,

Zygomatic Arches

- submentovertex (SMV),
- AP axial (modified Towne method),

Mandible

- AP axial (Towne method),
- submentovertex (SMV),

TMJs

- AP axial (modified Towne method),
- axiolateral 15° oblique (modified law method),

Paranasal Sinuses

- lateral,
- Parietoacanthial transoral (open mouth Waters method),

Unit III

All Views and techniques of Vertebral Column

Cervical Spine

- AP open mouth (C1 and C2),
- AP axial,
- lateral,
- lateral, horizontal beam,
- Cervicothoracic lateral (Twining method, swimmer's technique),
- lateral flexion and extension,

Thoracic Spine

- AP,
- lateral,

Lumbar Spine

- AP
- Lateral,
- Lateral L5-S1,

Unit IV

Spinal Fusion Series

Sacrum and Coccyx

- AP axial sacrum,
- AP axial coccyx,
- Lateral sacrum,
- Lateral coccyx,

Sacroiliac (SI) Joints

- AP axial,
- Posterior oblique,

All views and techniques Abdomen

Abdomen (KUB)

- AP supine,
- PA prone,
- Lateral decubitus (AP),
- AP erect,
- dorsal decubitus (lateral),
- Lateral,

Acute Abdomen (Three-Way, with PA Chest) ROUTINE

- AP supine,
- AP erect,
- PA chest erect,
- Left lateral decubitus (AP)

Skeletal Survey

All views required for skeletal survey

Practical

- All views & techniques of hips & pelvis
- All views & techniques of Skull
- All views & techniques of Vertebral Column
- All views & techniques of Abdomen
- All views & techniques of Skeletal Survey

Book reference –

1. Clark’s Positioning in Radiology by Stewart Whittey
2. Handbook of radiographic positioning & technique by Bontrager

6(3-1-2)

Special Investigations And Contrast Media (302)

Unit I

Patient preparation for Special procedure and related contrast Media

Contrast media,

Types of contrast media,

Contra indications for contrast media

Reactions to contrast

Emergency in Radiology Department

Emergency drugs and its dose

Unit II

Excretory System

Introduction, pathology of urinary system, indications, apparatus, procedure and patient care.

Intravenous pyelography/Intravenous Urography

Retrograde Urethrography

Micturation Cysto-Urethrography

Unit III

Special Procedures

Introduction, pathology of biliary tree, indications, apparatus, procedure and patient care.

Oral Cholecystography

Percutaneous Transhepatic Cholangiography

T-Tube Cholangiography

Bronchography

Arthrography
Myelography
Dacrocystography (DCG)
Endoscopic Retrograde Cholangio Pancreatography
Sialography

Unit IV

G.I.T Tract

Introduction, pathology of GI tract, indications, apparatus, procedure and patient care.

Barium Swallow

Barium Meal Study

Small bowel Enema

Barium meal Follow Through

Barium Enema

Double Contrast Studies

Gastro-graffin study

Introduction, Indications, Contraindications, Apparatus, Procedure technique and Patient Care

Hysterosalpingography (HSG),

High K.V Technique, Soft tissue Radiography, Air gap technique,

Forensic Radiography

Foreign bodies Radiography

Practical

- Patient preparation for Special procedure and related contrast Media.
- Demonstration of all Special Procedures film.

Book reference-

1. A guide to radiological procedures by Aitchison.
2. Chapman & Nakielny's Guide to Radiological Procedure by Watson

6(3-1-2)

Hospital practice & Care of Patient (303)

Unit I

Introduction to hospital staffing- Hospital staffing and administration

Medical records and documentation- Medical records and documentation

Legal issues

Legal issues in radiology department, PNDT Act, MLC.

Unit II

Professional ethics- Professional ethics and Code of conduct of radiographer

Handling of patients Seriously ill and traumatized patients, visually impaired, hearing and speech impaired patients, mentally impaired patients, infectious patients

Departmental Safety Safety from hazards due to radiation, electricity etc

Unit III

Infection control Skin care, donning of gowns, gloves, face masks, head caps, shoe covers

Vitals signs- Vitals signs. How to measure vital signs

Body mechanics and transferring of patient Draw sheet lift, use of slide boards, wheelchair to couch, couch to wheelchair, couch to table, three men lift and four men lift

Unit IV

First aid- Artificial respiration, haemostasis, first aid techniques, ABCD management

Anesthesia- Local anesthesia and general anesthesia, uses in hospital

Facilities regarding general Anesthesia in the X-ray department

Adverse reactions- Management of adverse reactions to contrast media

Practical

- Legal issues
- Handling of patients
- Body mechanics and transferring of patient
- First Aid
- Anesthesia

Book reference

1. Care of the Patient in Diagnostic Radiology by D. Nareen Chesney

Radiation Hazards & Protection (304)

Unit I

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.

Radiation protection devices,

AERB safety code and ethics

Built in safety specifications for diagnostic x-ray,

Fluoroscopy and CT units

Specifications for radiation protection devices-room layout.

Unit II

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 ICRP, AERB guidelines.

Planning of radiation installation-protection primary & secondary radiation

Unit III

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

Unit IV

Personnel monitoring systems

Principle and objective-film badge: guidelines for use thermo-luminescent dosimeter, 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

Practical

- i. AERB guidelines.
- ii. TLD
- iii. Film badge

iv. Role of AERB, BARC, ICRP, WHO, IAEA.

Book reference

1. Radiation protection in Diagnostic X-Ray by Euilid Seeram
2. Basic radiation protection technology by Daniel A Gollnicle
3. The physics of Radiology & Imaging by k. Thayalan.

6(3-1-2)

**Semester 4th
Ultrasonography
(401)**

Unit I

Ultrasound

Principle & history of Ultrasound, advantages and disadvantages of ultrasound, Types of Ultrasound, Equipment description
Indication and Clinical Application
Physics of ultrasound imaging,

Unit II

Transducers, Physics of transducers, types of transducer.
Piezoelectric crystal, modes of USG. Artifacts in ultrasound.
Image recording, Ultrasound jelly & Safety of ultrasound

Unit III

Pathologies and indications, patient preparation, positioning and scanning technique for whole abdomen USG, lower abdomen USG, upper abdomen USG.

Breast, & Scrotum

Pathologies and indications, patient preparation, positioning and scanning technique

Unit IV

Method of gynecologic ultrasound examination. Fetal USG, Assessment of Normal fetal growth, fetal behavior states, fetal breathing movements, fetal cardiac activity.
USG for reproductive system, USG (KUB).

Practical

1. Indication for USG whole abdomen.
2. Indication for USG upper abdomen.
3. Indication for USG lower abdomen.
4. Indication for USG (KUB).
5. Indication for USG Scrotum.

6. Demonstration of probes used in USG.

Book reference

1. Text book of radiography. SK Bhargwa
2. Radiological procedures. Chapman

6(3-1-2)

**MRI Techniques
(402)**

Unit I

Definition & Introduction
Physical principles of MRI
Comparison with radiography & CT
MRI- Components
MRI process & clinical applications
MRI basic safety

Basic Principle of Magnetic Resonance Imaging

History of MRI , Electricity & Magnetism, Laws of magnetism, Atomic structure, Motion within the atom, The Hydrogen nucleus, Precession, Larmor frequency, Resonance, MR signal, Free induction decay signal, Relaxation, T1 recovery, T2 decay, Pulse timing & parameters.

MRI Hardware

Permanent magnets, Electromagnets, Super conducting magnets, Fringe fields, Shim coils, Gradient coils, Radio-frequency coils.

Unit II

Encoding, Data collection & Image formation

Introduction, Gradients, Slice selection, Frequency encoding, Phase encoding, Scan timing, Sampling, data space, k-space, k-space filling and Fourier transformation.

MRI parameters

Introduction, Signal To Noise Ratio (SNR) & How to increase SNR, Contrast to Noise Ratio (CNR), Spatial resolution & how to increase the spatial resolution, Scan time & how to reduce time, Tradeoffs,

Unit III

MRI Artifacts

All types of Artifacts. Introduction, Phase miss-mapping, Aliasing or wrap around, Chemical shift artifact, Chemical miss registration, Truncation artifact/Gibbs phenomenon, Motion of the patient

Magnetic susceptibility artifact, Magic angle artifact, Zipper artifact, shading artifact

MRI contrast agents

Introduction, Uses, Mechanism of action, Dipole-dipole interactions, Magnetic susceptibility, Gadolinium safety, Current applications of contrast agents

Unit IV

Flow Phenomena & MRI angiography

Introduction, The mechanisms of flow, Time of flight.

Flow phenomena compensation

Gradient moment rephrasing, Pre saturation, Even echo rephrasing, MR Angiography. To know the patient preparation
Filling of MR consent form. Indication and contraindication of MRI.

Practical

1. Demonstration of artifacts in MRI images.
2. Demonstration of MR contrast. (Gadolinium)
3. Filling of MRI consent form.

Book reference

- 1- Stark & Bradley, Fundamentals of MRI
- 2- Stewart C B., MRI Physics & Biological Principle
- 3- Step by step MRI.
- 4- How does MRI work.
- 5- MRI protocol. SK Bhargwa.

6(3-1-2)

**CT Techniques
(403)**

Unit I

Basics Principles, General principles & definitions, Changes & advance, Volume & multi-slice scanners, Computer gray scale & CT numbers, Slice thickness & table increments, Pitch with helical scanners, Attenuation & conversion of voxel to pixels, Radiographic Anatomy

Unit II

Introduction to Computed Tomography and Principle of Computed Tomography

History, Advantage and Disadvantages of CT, Basic principle of CT

Generations of Computed Tomography

1st generation, 2nd generation, 3rd generation, Slip ring technology, 4th generation, Electron beam CT, Dual Source CT, Flat Panel Detector CT Single and Multi slice Technology

Unit III

Instrumentation

CT scanner gantry, Detectors & Data Acquisition System, Generator, Computer and image processing System Image display system, storage, recording and communication system, CT control console, Options and accessories for CT systems

Unit IV

Image Reconstruction

Basic principle, Reconstruction algorithms, Image reconstruction from projections, Types of data reconstruction.

Image Display and Image Quality

Image formation and representation, Image processing, Pixel and voxel, CT number Window level and window width, Qualities, Resolution, Contrast, Sharpness, Noise properties in CT

CT Artifacts

Classification, Types, Causes.
Emergency drugs used in CT scan room.

Practical

1. Demonstration of CT artifact.
2. Demonstration of CT machine and its parts.
3. Emergency drugs used in CT scan room.

Book reference

1. Physics of radiography. Christensen.
2. SK Bhargwa. Radiological physics.

Semester 5th

**Mammography, Echocardiography and Doppler
Imaging
(501)**

Unit I

Mammography
History of mammography
Mammographic equipment
Mammographic radiation dose and exposure
Dedicated mammographic unit and its special features

6(3-1-2)

Unit II

Types of mammography
Routine Mammographic Positioning & Views with additional views and technical considerations
Limitation of mammography
Beam limiting Device in mammography
Radiation Safety
Radiation Hazards in mammography

Unit III

Physics of Doppler,
Doppler, doppler effect, Types of Doppler
Uses of color Doppler in echocardiography and equipment description with transducer

Unit IV

Digital mammography
Echocardiography
Equipment
Introduction, indication and image formation

Practical

1. Demonstration of mammography procedure film.
2. Demonstration of mammography machine.
3. Write all the view's used in mammography.
4. Application of dopplers.

Book reference

1. Physics of radiography. Christensen.
2. SK Bhargwa. Radiological physics.

6(3-1-2)

**Nuclear Medicine & Radiotherapy
(502)****Unit I****Nuclear Medicine**

- 1) Introduction
- 2) Clinical applications
- 3) Linear Accelerators
- 4) Radio Isotopes: Radium, Caesium, Cobalt, Iridium, Iodine.

Gamma Camera

Application, Function and instrumentation

Unit II**SPECT**

Definition

Applications

Clinical uses, advantages & disadvantages

PET CT & PET MRI

Fusion Imaging,

Benefits v/s risk PET-CT

PET-MRI

Unit III**Radionuclide**

Characteristics and half-life of Radionuclide

Commonly used Radionuclide, Half life. Radioactivity and its types. Technetium.

ACD (Annihilation coincidence detection).

Protocols- Routine protocols

Indication, contraindications of PET Scans- Indication and contraindications of PET

Patient Preparation- Patient preparation technique in PET Scan

Unit IV**Radiotherapy**

Basic principles of radiotherapy.

Tele & brachy therapy treatment & planning.

- Orthovoltage machines.
- Megavoltage machines
- Cyclotron
- Klystron.
- Betatron

Practical

1. Patient Preparation- Patient preparation. technique in PET Scan.
2. Instrumentation of PET.
3. Indication and contraindication of PET Scan.

Interventional in Diagnostic Radiology (503)

Unit I

Interventional Radiology

Definition

Indication

Clinical Application

Advantages, disadvantages & risks

Unit II

Name of different type of Procedures and description All MRI

Angiography

All C.T. Angiography

Unit III

All Biopsy, FNAC, MRI Guided.

All Biopsy, FNAC, USG Guided.

All Biopsy, FNAC CT Scan Guided

Unit IV

DSA- Introduction

Its application

Instrumentation

All DSA procedures

Its advantages, disadvantages

Risks v/s benefits ratio

Patient's preparation for DSA procedures

Practical

- Intervention Radiology
- All MRI Angiography
- All CT angiography
- DSA

Quality Assurance and Quality Control In Diagnostic Radiology (504)

Unit I

1. Objectives: 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. QA activities. Equipment selection phase; Equipment installation and acceptance phase; Operational phase; Preventive maintenance

Unit I

3. QA programme at radiological faculty level :Responsibility; Purchase ; Specifications ; Acceptance ; Routine testing ; Evaluation of results of routine testing ; Record keeping; Quality assurance practical exercise in the X ray generator and tube ; Image receptors from processing

Unit III

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

Unit IV

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 examinations-medical research –x-ray-avoidance of unnecessary radiation dose. Radiation emergencies-situation preparedness, safety and prevention-legal requirements recent developments in radiation safety related topics.

Practical

1. How to check quality of x ray machine.
2. How to check quality of CT.
3. Parameters used in CT during post processing.

Reference book

1. Basic radiological physics. Jaypee bothers pvt ltd, New Delhi
2. An Introduction to Radiation Protection. Allen Martin & Samuel
3. Radiation safety in Medical practice. M.M. Rchami.

Semester 6th
Advanced In Computed Tomography
(601)

6(3-1-2)

Unit I

Advancement in CT

Spiral CT, Preparation of Patient

Contrast Media, Indications and Contraindications Technical

Aspects of various procedures in CT

Cardiac angiography

Prospective ECG

Triggering Retrospective ECG Gating

CT Urography

Principle and Image Reconstruction Technique

Radiation Safety.

CT Enterography

Principle and Image Reconstruction Technique

Radiation Safety

CT Angiography

Principle and Image Reconstruction Technique

Radiation Safety

Unit II

CT guided Biopsy

Principle and Image Reconstruction Technique

Radiation Safety

Virtual CT – Bronchoscopy, Endoscopy

CT artifact, CT angiography, HRCT, post processing techniques: MPR,

MIP, Min IP, 3D rendering: SSD and VR, CT Dose, patient preparation,

Imaging techniques and protocols for various parts of body, CT contrast

enhanced protocols – CT angiography – (head, neck and peripheral)

image documentation and Filing, maintenance of equipment and

accessories.

Unit III

Diagnostic aspects of CT and post Processing Techniques

HRCT, Isotropic imaging, Patient management, Patient preparation, positioning, Technologist role, Protocols for whole body imaging Clinical applications of CT, 2D & 3D imaging, MPR, SSD, Volume Rendering

Unit IV

NCCT & CECT

Brain, Face, Sinuses, Mastoid
Neck, Temporal Bone (HRCT),
Pituitary, IAC
Thorax (Routine & HRCT)
Abdomen, Pelvis,
Extremities: Indications. Contraindications, Patient preparation, Protocols and patient care

Practical

- Advancement in CT
- All the CT special procedures.
- Demonstration of CT images. (angiography, NCCT, CECT)

Advanced In Magnetic Resonance Imaging (602)

Unit I

Advanced technique & instrumentation of MRI, Basic Principles: Spin – precession – relaxation time, T1 weighted image, T2 weighted 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 Instrumentation: Types of magnets – RF transmitter – RF receiver – Gradient coils – shim coils – RF shielding – computers.

Image formation: 2D Fourier transformation method – K-space representation – 3D Fourier imaging – MIP.

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	<p>MR contrast media – MR angiography – TOF & PCA – MR Spectroscopy – functional MRI</p> <p>Unit II Pulse sequences Fast spin echo, Inversion recovery, SSFP, transverse magnetization, Incoherent residual transverse magnetization, Ultra-fast imaging, Advanced imaging techniques, EPI</p> <p>Clinical Applications, Scanning Protocols and Safety aspects Protocols for whole body imaging , The main magnetic field, Gradient magnetic field, Radiofrequency fields, Projectiles, Implants and prostheses, Pacemakers, Medical emergencies, Patient monitoring, Monitors and devices in MRI Claustrophobia, Quenching, Safety tips, Layout planning</p> <p>Unit III Protocols Brain Face & Sinuses, Neck Pituitary & Salivary gland IAC Abdomen, Pelvis Whole Spine Extremities: Indications. Contraindications, Patient preparation, Contrast used in MRI MRCP</p> <p>Unit IV Spectroscopy MR Urography MR Enterography MR Angiography Functional MRI CSF Flow Study Diffusion Tensor Imaging MR guided Biopsy</p> <p>Practical</p> <ul style="list-style-type: none"> • Advancement in MRI • All the MRI special procedures • Demonstration of all 	<p style="text-align: right;">4(4-0-0)</p> <p style="text-align: center;">Assignment (Project Work)</p>
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