

SYLLABUS FOR RADIOLOGY IMAGING TECHNOLOGY

Semester-I

Subject-1; HUMAN ANATOMY & PHYSIOLOGY

(Suggested number of teaching hours 120 including tutorials)

A knowledge of the normal structure and function of the different parts of the body must be coupled with some idea of the way in which disease arises and extends, so that the technologist can assist in the various procedures used in diagnosis and treatment.

The syllabus gives under the main headings the names of organs and systems to indicate the scope of teaching required. Both in diagnosis and treatment. Knowledge of the size and position of an organ is of paramount importance. The level to be aimed at here is difficult to define, but books on surface anatomy are available and only rarely will it be necessary to refer to major works on anatomy, such as Gray and Cunningham.

Under the repeating headings common terms used in connections with diseases of this system, no detailed list of diseases is required, but an explanation of those terms which the technologist may encounter in daily work is necessary.

1. General Anatomical Terms

2. Regions of the body

3. Description of a typical animal cell: Cell mitosis; genes; sex cell; ova and spermatozoa. Fertilisation of the ovum. Broad lines of embryonic development. Cell function and differentiation of tissues.

4. Structure of General Tissues : Epithelium; simple and complex epithelia; glands; skin. Connective tissue; fibrous tissue; cartilage; bone; Haversian systems; blood; numbers and types of cells in blood; clotting of blood. Muscle tissue; involuntary, voluntary and cardiac muscle. Nerve tissue.

5. Nature of neoplasm's: Common benign tumours. Malignant tumours and their dissemination.

6. Bones, joints and locomotors system: General description of bones, their main processes and attachments, 'including the skull with emphasis on the skull as a whole. Development of bones, Primary and secondary bone centres; diaphyses and epiphyses. Position and function of main joints. Some common diseases and injuries of bones and joints; Healing of fractures.

7. Thorax and Abdomen : Structure of thoracic cage, abdominal cavity; diaphragm and mediastinum.

8. Heart and Blood Vessels: Structure and function of the heart, pericardium, peripheral vascular system; names of main arteries and veins, circulation. Common terms used in connection with diseases of this system.

9. Respiratory system : Nasal passages and accessory nasal sinuses, pharynx and larynx, trachea, bronchi and lungs; pleura, nature and function of respiration. Common terms used in connection with diseases of this system.

10. Lymphnode Groups: Lymph and tissue fluid, main lymphatic gland groups and drainage areas, lymphoid tissue and tonsil.

11. Reticulo-Endothelial system : Spleen and liver, bone marrow, extent and nature, physiology of the red and white blood corpuscle's.

12. Alimentary system : Mouth, tongue and teeth, salivary glands, pharynx and oesophagus, stomach, small and large bowel, liver and biliary tract, pancreas, motility of the alimentary tract; digestion, absorption and metabolism, nutrition and dietetics, Common terms used in connection with diseases of this system.

13. Urinary tract : Kidneys, ureters, bladder and urethra; urine formation & excretion, common terms used in connection with diseases of the system.

14. Reproductive system : Male genital tract; testes, epididymis, seminal vesicle and prostate; female genital tract; uterine tubes, ovaries, uterus, vagina and vulva, the mammary glands; menstruation, pregnancy and lactation; common terms used in connection with diseases of this system.

15. Endocrine glands; Anatomy and function of pituitary, thyroid, para thyroids, adrenal, thymus, pancreas and gonads as endocrine organs; common terms used in connection with diseases of this system.

16. Nervous system: Brain; main subdivisions and lobes; ventricular system, spinal cord, concept of motor, sensory and reflex pathways; meninges and cerebrospinal fluid; its circulation; autonomic nervous system; common terms used in connection with diseases of this system.

17. Special sensory organs: Structure and function of the eye; structure and function of the ear; structure and function of the skin.

18. Surface markings and topographical relations; radiographic anatomy.

BOOKS FOR STUDY

Text book

1. Anatomy and Physiology for Radiographers - C.A. Warrick

Reference books

2. Gray's anatomy Descriptive and applied - T.B. Johnstor.

3. Foundation of Anatomy and Physiology - Ross and Wilson.

4. An Atlas of Normal Radiographic Anatomy - Richard & Alvin

5. Essentials of Human Anatomy - Russell

6. Best and Taylor : The Human Body – its anatomy and physiology (Chapman and Hall)

7. Blewett and Rackow : Anatomy and Physiology for Radiographers (Butterworth)

8. Dean : Basic Anatomy and Physiology for Radiographers (Blackwell)

9. Fitzgerald : Anatomy 1600 multiple choice question (Butterworth)

10. Hamilton et al : Surface and Radiological Anatomy (Heffer)

SEMESTER - I

SUBJECT 2 : BASIC PHYSICS & RADIATION PHYSICS

This syllabus should be augmented by as much of practical and demonstration classes as possible. Suggested number of minimum teaching hours: 120

1. Basic concepts: Units and measurements-Force, work, power and energy-Temperature and heat-SI units of above parameters. Atomic structure-atom model-Nucleus-electronic configuration-periodic table-Isotopes-Ionization-excitation-Binding energy-electron volt-Electro magnetic radiation-Quantum nature of radiation-mass energy equivalence-Fluorescence-electromagnetic spectrum

2. Electricity and magnetism: Electric charges, Coulomb's law-Unit of charge-Electric potential, unit of potential-Electric induction, capacitance and capacitors, series and parallel connection-electric current, unit, resistance, ohm's law, electric power, Joule's law

Magnetism: Magnetic induction-magnetic properties-Hysteresis-magnetic effect of current-Electrical instruments, Galvanometer, voltmeter, ammeter and multimeter.

3. Electromagnetic Induction: Induced electro motive force-Faradays experiments- laws of electro magnetic induction-Self and mutual induction-Alternating current- Ac generator- Peak and RMS values- AC circuits with resistance-capacitance and inductance- Choke coil- eddy current. Transformer-theory, design, losses- auto transformer- high voltage transformer- electric power transmission

4. X-rays: Discovery of x-rays- properties-production- x-ray spectrum- bremsstrahlung and characteristic x-rays- X-ray tube; Coolidge tube, tube design, line focus principle-space charge effect, tube cooling- Modern x-ray tubes-stationary anode, rotating anode, grid controlled x-ray tubes, heel effect, off focus radiation, tube insert and housing-Tube rating-Quality and intensity of x-rays-,factors influencing them.

5. X-ray generator circuits: Vacuum tube diodes-semi conductor diodes-transister-rectification, half and full wave-self rectification – X-ray generator; filament circuit-kilo voltage circuit-single phase generator-three phase generator-constant potential generator Fuses, switches and interlocks-Exposure switching and timers-HT cables-earthing

6. Radioactivity: Discovery of radioactivity, natural radioactivity-activity units- radium, thorium and uranium series- alpha, beta decay and gamma rays - radioactive disintegration-exponential decay, half life period, decay constant. Artificial radioactivity –production of radioisotopes-cyclotron-neutron-fission and fusion-chain reaction-atom bomb-nuclear reactor

7. Interaction of X and gamma rays: Transmission through matter, law of exponential attenuation, half value layer, linear attenuation coefficient-coherent scattering-photoelectric effect- compton scattering-pair production-photonuclear disintegration-Particle interactions. Interactions of x and gamma rays in the body; fat-soft tissue-bone-contrast media-total attenuation coefficient-relative clinical importance

8. Radiation quantities and units: Radiation intensity-exposure, roentgen, its limitations-kerma and absorbed dose-electronic equilibrium-rad, gray, conversion factor for roentgen to rad-RBE-LET-quality factor-dose equivalent-rem, sievert.

9. Radiation detection and measurements: Principle of radiation detection-Ionization chamber-proportional counter-GM tubes-scintillation detectors-semiconductor detector-Gamma ray spectrometer. Measuring system: free ionization chamber-thimble ion chamber-condenser chamber-victoreen electrometer-secondary standard dosimeter-film dosimeter-chemical dosimeter-thermoluminescent dosimeter-Pocket dosimeter. Radiation survey meter-zone monitor-contamination monitor, their function use and maintenance.

BOOKS FOR STUDY

Text book

1. First year Physics for Radiographers - Hay & Hughes.

Reference books

1. Basic radiological physics-K.Thayalan, Jaypee publishers (P) Ltd, New Delhi(2001)

2. Fundamental of X-ray and Radium Physics - Joseph Selman

3. Basic Medical Radiation Physics - Stanton.

4. Christensen's Physics of Diagnostic Radiology - Christesen.

Semester II**Subject : 3 : RADIOGRAPHIC PHOTOGRAPHY:**

(Suggested number of teaching hours is 120, including tutorials and practical demonstration).

This Radiographic photography syllabus is intended as a guide to the theory and practical knowledge required by the students. Appreciation and application of all the factors listed below will enable the technologist to produce x-ray films of good quality and diagnostic value. The lectures should be linked with practical demonstration to illustrate the importance of all that goes to make up correct exposure conditions.

1.X-ray film materials: Structure of film emulsion-Grain technology-Geletine-Basic film types-Film formats and packing-Direct exposure duplited films-Single coated emultions-Films for specialised use-manufacturing process.

Sensitometry :Photographic density—characteristic curve –information from the characteristic curve-speed Vs definition

Storage of x-ray film-unprocessed film-radiographs

2. Intensifying screens and cassettes: Intensifying screen- phosphor- Construction-Intensifying factor-speed and detail-crossover effect-resolution-mottle-reciprocity-screen asymmetry- screen-film contact- screen types and cleaning.

New phosphor technology-influence of kilo voltage. Photostimulable phosphor imaging

x-ray cassette-design-types- Identification of cassettes- General care of cassettes and storage.

3.Photochemistry: Film processing-latent image formation-Mechanism-theory-Developer-nature of development-pH scale-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.

4.processing equipment: Materials for processing equipment-manual processor-care of processing equipment-automatic processor-manual VS automatic-principles and typical equipment Microprocessor control-Cine processing-Daylight systems-Processing faults-maintenance

5.Processing room: Day light processing-location of the dark room-dark room illumination-equipment and layout-x-ray viewing room.

Daylight handling-daylight systems with cassettes-without cassettes.

6. 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.

Presentation of radiographs-opaque letters and legents-perporating devices-actinic markers-Identification of dental films-preparation of stereo radiographs-viewing conditions

7.Monitor photography- Characteristics of the video image-television camera-imaging camera—imaging film-sensitometric characteristics-processing-final image.

Laser-light and laser-laser imaging-laser imagers—imaging plates-principle of photo stimulated luminescence

BOOKS FOR STUDY

Text book

1. Radiographic Imaging - Chesney & Chesney, Blakwell scientific publications, oxford (1981)

Reference books

1. Radiographic imaging-Derrick P. Roberts and Nigel L. Smith. Churchill Livingstone, Edinburgh (1994)
2. Radiographic Latent image processing - W.E.J. Mckinney
3. Photographic processing, quality control and evaluation of photographic material -J.E. Gray
4. Photographic processing Chemistry - L.F.A. Mason.
5. Physical and photography principles of Medical Radiography - Seeman & Herman.

Semester II

Subject – 4; GENERAL PRINCIPLES OF HOSPITAL PRACTICE AND PATIENT CARE

Suggested number of teaching hours 100 including tutorials and demonstrations. This section is intended to emphasise to the student technologist the importance of patient welfare. Many of the points included in this section may be considered during the teaching of other subjects also; but it is strongly urged that specific teaching and as much practical demonstration and instruction as possible should be given in this section.

Modern hospital treatment is based on team work, it is essential that the student should appreciate the technologists role and that the importance of co-operation with wards and other departments.

The students should be attached to wards or the accident and emergency department for a definite training period, the length of time being suited to the individual hospital.

1. Hospital procedure: Hospital staffing and organisation; records relating to patients and departmental statistics; professional attitude of the technologist to patients and other members of the staff; medico- legal aspects; accidents in the departments, appointments, organisation; minimising waiting time; out-patient and follow-up clinics; stock-taking and stock keeping.

2. Care of the patient : FIRST contact with patients in the department; management of chair and stretcher patients and aids for this, management of the unconscious patient; elementary hygiene; personal cleanliness; hygiene in relation to patients (for example clean linen and receptacles , nursing care; temperature pulse and respiration; essential care of the patient who has a tracheotomy; essential care of the patient who has a colostomy; bedpans and urinals; simple application of a sterile dressing.

3. First aid : Aims and objectives of first aid; wounds and bleeding, dressing and bandages; pressure and splints, supports etc. Shock; insensibility; asphyxia; convulsions; resuscitation, use of suction apparatus, drug reactions; prophylactic measures; administration of oxygen; electric shock; burns; scalds; haemorrhage; pressure points; compression band. Fractures; splints, bandaging; dressing, foreign bodies ; poisons.

4. Infection : Bacteria, their nature and appearance ; spread of infections; auto-infection or cross-infection; the inflammatory process; local tissue reaction, general body reaction; ulceration; asepsis and antisepsis.

5. Principles of asepsis: Sterilisation - methods of sterilisation; use of central sterile supply department; care of identification of instruments, surgical dressings in common use, including filamented swabs, elementary operating theatre procedure; setting of trays and trolleys in the radiotherapy department (for study by radiotherapy students only)

6. Departmental procedures: Department staffing and organisation; records relating to patients and departmental statistics; professional attitudes of the technologist to patients and other members of the staff, medico-legal aspects accidents in the department; appointments; organisation; minimising waiting time; out-patient and follow-up clinics; stock taking and stock keeping.

7. Drugs in the department : Storage : classification; labelling and checking, regulations regarding dangerous and other drugs; units of measurement, special drugs, anti-depressive, anti-hypertensive etc.

BOOKS FOR STUDY

Text book

1. Deeley – A guide to Radiotherapy nursing -Livingstone

Reference books

1. Care of patient in diagnostic Radiography - Chesney & Chesney.

2. Chesney's Care of the patient in Diagnostic Radiography - Pauline J . Culmer.

3. Aid to Tray and Trolley Setting - Marjorie Houghton

4. First Aid - Haugher & Gardner

5. A guide to Oncology nursing (Livingstone) - Deeley

6. Practical nursing and first- aid - Ross and Wilson. Livingstone.

Semester - III

Subject – 5; PHYSICS OF DIAGNOSTIC RADIOLOGY AND EQUIPMENT

(Suggested number of teaching hours 120 including tutorials and practical demonstration).

1. Radiography: Primary radiological image-Image produced by contrast media-Attenuation-Linear and mass attenuation coefficient-Factors affecting attenuation-application in radiology-Filters-inherent and added filters-Heavy metal filters-X-ray beam restrictors-aperture diaphragm-cones and cylinders-collimators-function of restrictor

2. Scattered radiation: significance of scatter-Grid ,principle, design and type-evaluation of grid performance-lead content-Grid cut off-moving grids-Grid selection-air gap technique

3. Fluoroscopy: Direct fluoroscope-Image intensifier design—brightness gain-Imaging characteristics—multi field image intensifiers-Close circuit television-television scanning- television image quality-Fluoroscopic image recorders-TV image recorders.

4. Radiographic image: Image clarity-contrast- factors affecting contrast-Image quality-mottle, sharpness and resolution-Line spread function-Modulation transfer function-Noise and Wiener spectrum.

Magnification-distortion-penumbra-un sharpness-inverse square law-evaluation of resolution- quantum mottle-patient exposure

5. Body section radiography: Basic method of tomography-terminology-blurring-section thickness-narrow and wide angle tomography-circular tomography-tomographic motions-phantom images-tomographic angle determination-phantomography.

Stereoscopy- physiology of depth perception-stereoscopic filming—viewing-merits and demerits

6. Mammography: Technical aspects of Mammography, generator, x-ray tubes, Accessories, Resolution, quality control. Application and role in medicine.

Xeroradiography-principles-xeroradiographic plate powder development-image development- image quality-liquid toner xeroradiography.

7. Ultrasound: Physical characteristics of sound--transducer- characteristics of ultrasound beam- interaction of ultrasound and matter-quarter wave matching-ultrasonic display-imaging principles-Doppler techniques-real time ultrasound- ultrasound instrumentation-bio effects and safety considerations.

Books for study.

Text book

1. "Christensen's Physics of diagnostic Radiology" (Lea & Febiger)

Reference books

2." First year Physics for Radiographers Hay & Hughes (ELBS)

3."Basic Medical Radiation Physics Stantor (Appleton- Century & Crofts)

4 X- ray Equipment for student Radiographers" By: Chesney & Chesney (Blackwell)

5.A Manual of Radiographic equipment. By: Sybil M. Stockley (Churchill Livingstone)

6."Principles of Diagnostic X-ray apparatus" by : Hill (Macmillan.)

7.. "Radiologic science for Technologist" Stewart C. Bushong , (M Mosby.)

Semester -III

Subject- 6; PRINCIPLES OF RADIODIAGNOSIS & RADIOGRAPHIC TECHNIQUES

(Suggested number of teaching hours 120 including tutorials and demonstration)

The term technique in the text implies a full knowledge of the procedure for X-ray examination; preparation of the room, apparatus and instruments; position of the patient for at least two projections; at (right angles) relative positions of the X-ray tube and patients; relevant exposure factors; use of accessories, such as radiographic cones, grids and position aids.

Throughout the course attention should be given to (a). The close association of theory with practical work. (b). The anatomical and physiological basis of radiographic procedure.

The student should be made familiar with radiographic appearance both of the normal subject and of common abnormal conditions where elementary knowledge of the pathology involved will ensure the application of the appropriate radiographic technique

which may be necessary for various disabilities or types of subject. The need for radiation precautions should be emphasised, as they apply to both patients and all hospital staff

In this text the projections tested are considered to be university applicable. For each area studied, the topics will be presented under the following headings:

- | | |
|---|--------------------------|
| a. Anatomy (review), | b. Clinical indications. |
| c. Preparation of the room. | d. Accessory equipment. |
| e. Preparation of patient., | f. Routine views. |
| g. Supplementary views: + modifications in cases of trauma. | |
| h. Radiation protection., | i. Care of patient. |

For each view studied will be presented as follows.

- | | |
|--|--------------------|
| a. Positioning of patient. | b. Immobilisation. |
| c. Identification. | d. Centring point. |
| e. Direction of central X-ray relative to the film. | |
| f. Parts demonstrated. | |
| g. Exposure factor - KVP MA sec. (MAS) FFD grid/ Non-grid screen | |

Specialist problems: Where appropriate tutors should refer to the following list of specialist problems which may arise necessitating technique variations.

- | | |
|---------------------------|--|
| a. Children and neonates | b. Seriously ill or injured patients. |
| c. Elder patients. | d. Deaf and blind patients. |
| e. Language difficulties. | f. Unconscious patients or Anaesthetised patients. |

Radiographic technique: Skeletal system

1. Upper limb: Technique for hand, fingers, thumb, wrist joint carpal bones, forearm, elbow joint, radio ulnar joints and humerus supplementary techniques for the above. eg. carpal tunnel view, ulnar groove, head of the radius, supracondylar projections.

2. Lower limb: Technique for foot, toes, great toe, tarsal bones, calcaneum, ankle joint, lower leg, knee, patella & femur.

Supplementary technique: Stress view for torn ligaments -- Subtalar joint and talo calcaneal joint.- Inter condylar projection of the knee-- Tibial tubercle-- Length measurement technique.

3.Shoulder girdle and thorax: Technique for shoulder joint, scapular, clavicle, acromio clavicular joints, sternum, ribs, sterno-clavicular joint.

Supplementary projections and technique –(i). Recurrent dislocation of shoulder. (ii). Traumatic dislocation of shoulder.(iii). cervical ribs.

4.Vertebrae column: Technique for Atlanta-occipital joint, cervical spine, cervico thoracic spine, thoracic spine, thoraco- lumbar spine, lumbo sacral spine, sacrum and coccyx.

Supplementary technique to demonstrate(i.) Scoliosis (ii). Kyphosis (iii).

Spondylolisthesis (iv). disc lesion (v). Union of spinal graft. Adaptation of techniques to demonstrate specific pathologies.

5. Pelvic girdle and hip region: Technique for whole pelvis. Ilium, ischium, pubic bones, sacro iliac joint, symphysis pubis, hip joint, acetabulum neck of femur, greater and lesser trochanter.

Supplementary technique- Congenital dislocation of hips:

Epiphysis of femur:-Lateral projections for hip joints to show femoral head and neck relationship.

6. Skeletal survey: Skeletal survey for metabolic bone disease, metastases, hormonal disorder, renal disorders.

7. Skull: Basic projections for cranium, facial bones, nasal bones and mandible.
- Technique for- petrous temporals for mastoids - Internal auditory canal - Accessory nasal sinuses- Temporo - mandibular joint - Orbits and optic foramen - Zygomatic arches.- Styloid process. - Pituitary fossa - Jugular foramen.

8. Dental radiography: Technique for intra oral full mouth - Occlusal projections- Extra oral projections including orthopantomography - Supplementary techniques.

9. Cardiovascular system: Routine projections for heart and vessels (without the uses of contrast agent) Supplementary views for above.

10. Upper respiratory system: Technique for post nasal air ways, larynx, trachea, thoracic inlet, thyroid gland. 1. Valsalva Manoeuvres. 2. Phonation.

Lungs and mediastinum: Technique for routine projections:- Supplementary projections - antero posterior, obliques, lordotic and apical projection. Use of penetrated postero - anterior projection - Expiration technique - Technique for pleural fluid levels and adhesions.

Diaphragm: Inclusion of diaphragm on chest and abdominal films.

11. Abdominal viscera: Technique for plain film examination - Projection for acute abdomen patients - Technique to demonstrate (i). foreign bodies (ii). imperforate anus.

12. Radiography using mobile x-ray unit: Radiography in the ward - Radiography in the specialised unit. eg. - Intensive care unit - Coronary care.- Neonatal unit - Radiography in the operating theatre.

Books for study

Text book

- 1."Diagnostic Radiography" Glenda.J. Bryan (ELBS)
- 2."Positioning in Radiography" Clarks (CBS Publishers, New Delhi.)

Reference books

- 1."Radiographic positions and Radiological procedures" Vinita Merrill (Jaypee Brothers, New Delhi)
- 2."Manual of Radiographic Technique" T. Holn & P.E.S. Palmer (World Health Organisation)
- 3." Text book of Radiologic -Technology" Jacoby and Paris (Mosby)
- 4."Contrast Radiography" Scarrow (Schering Chemical)
- 5 " A manual of Radiographic positioning" Greenfield and Cooper (Lipincott)
- 6."Illustrated guide to X-ray Techniques" Culliman (Blackwell)
- 7.A Guide to Radiological Procedures" Stephen Chapman & Richard Nakielny. (A Prism books (P) Ltd., Bangalore)
8. Applied angiography for Radiographers Paul & Douglas (W.B. Saunder company)

SEMESTER- IV

Subject – 7; RADIOGRAPHIC TECHNIQUES &SPECIAL PROCEDURES

(The suggested number of teaching hours 120 including tutorials and demonstration)

For each of the examination the points listed below should be included.

Review the anatomy of the area - State the clinical indication for the examination- State contra indication if any for the examination - Describe the preparation of the patient including the pre medication if appropriate - Specify the type and quantity of contrast agent used - Describe the method of introduction of the contrast agent - Describe the series of projections taken during the examination - Indicate the timings of the radiographs in relation to the administration of contrast agent - Outline the practical problems and the way in which they may be overcome - Explain the choice of exposure factor - Detail the measures that should be taken for radiation protection - Explain the after care of the patient.

1. Contrast media : Terms used to describe contrast media - Structure of compounds - .Types of contrast media - General principles governing the uses of contrast agents- Strength and quantity of the contrast agents - Method of introduction of the contrast agents -. Discuss the records which should be kept regarding contrast media.

2. Emergencies in the x-ray department : Reactions to contrast media - Preventive measures -. Treatment of reaction - Basic emergency equipment and Emergency drugs.

3. Gastrointestinal tract : Fluoroscopy, general considerations, responsibility of radiographers-- Barium swallow, pharynx and oesophagus -- Barium meal and follow through -- Hypo tonic duodenography -- 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.

4. Salivary system : Routine technique, procedure - sialography.

5. Biliary system: Plain film radiography - Oral cholecystography -- Intravenous cholangiography -- Percutaneous cholangiography --Endoscopic retrograde cholangio-pancreatography. (ERCP)-- Operative cholangiography --Post-Operative cholangiography (T - tube Cholangiography).

6. Urinary system: Intravenous urography - Retrograde pyelography -- Antegrade pyelography -- Cystography and micturating cystography – Urethrography -- Renal puncture – Vesiculography -- Cavernosography.

7. Female reproductive system-- HysterosalpinGography.

8. Mammography: Mammography : cyst puncture, mammary duct injection.

9. Respiratory system : Nasopharyngography – Laryngography - Bronchography.

10. Central nervous system – Myelography -- Cerebral studies – Ventriculography -- Encephalography.

11. Arthrography-- Shoulder: hip, knee, elbow

12. Discography- Technique and procedures

13. Angiography-- Carotid Angiography (4 Vessels angiography)-- Thoracic and Arch Aortography.-- Selective studies (Renal; inferior and superior) Coeliac axis -- Vertebral angiography-- Femoral arteriography—Angiocardiography

14. Venography-- percutaneous transplenic portal venography -- Peripheral venography-- Intra - osseous venography - Frontal venography -- Jugular venography -- Inferior and superior venocavography-- Renal and adrenal phlebography.

15. Lymphatic system : Techniques for routine projection-- Soft tissues differentiation for region concerned- Lymphography

16. Dacrocystography-- Techniques and procedures

17 Sinussography –Routine Technique and procedure.

18. Tomography:- General Principles-- Estimation, selection of depth of layer-- Layer thickness required for different examination -- Spacing of layers-- Types and advantages of various movements -- Choice of tomographic movement- exposure factor-- Sequential, Horizontal and multi section tomography -- Application of Tomography to specific regions.

19. Macroradiography : General principles –Requirement –Equipment - Technique - use

20. Stereography :- Principles involved - tube shift in relation to patient.—Technique - Stereoscopic apparatus for viewing and orientation of films-- Correct marking of stereographs -- Application to specific regions.

21. Subtraction: - Photographic subtraction -- Colour subtraction -- Electronic subtraction

22. Soft tissue radiography : - High and low kilo voltage technique; differential filtration-- Non - screen technique - simultaneous screen and non -screen technique -- Multiple radiography -- Uses of soft tissue radiography.

23. High KV radiography : General principles -- Relation to patient dose -- Change in radiographic contrast- Scatter elimination; beam collimation; grid ratio -- Speed and type of grid movement -- Radiographic factor; application and uses.

24. Localization of foreign bodies : General location principles -- Ingested; inhaled; inserted; embedded foreign bodies -- Foreign bodies in eye -- Preparation of the area to be investigated -- Appropriate projection for all regions -Techniques to locate non-opaque foreign body.

Books for study

Text book

1. "Diagnostic Radiography" Glenda.J. Bryan (ELBS)
2. "Positioning in Radiography" Clarks (CBS Publishers, New Delhi.)

Reference book

- 1.. "Radiographic positions and Radiological procedures" Vinita Merrill (Jaypee Brothers, New Delhi)
2. "Manual of Radiographic Technique" T. Holn & P.E.S. Palmer (World Health

Organisation)

- 3." Text book of Radiologic -Technology" Jacoby and Paris (Mosby)
- 4."Contrast Radiography" Scarrow (Schering Chemical)
- 5." A manual of Radiographic positioning" Greenfield and Cooper (Lipincott)
- 6."Illustrated guide to X-ray Techniques" Culliman (Blackwell)
- 7." A Guide to Radiological Procedures" Stephen Chapman & Richard Nakielny.
(A Prism books (P) Ltd., Bangalore)
8. Applied angiography for Radiographers " Paul & Douglas (W.B. Saunder Company)

SEMESTER- IV

Subject-8; CARE OF THE PATIENTS RELEVANT TO DIAGNOSTIC RADIOLOGY

(Suggested number of teaching hours 100, including tutorials and demonstrations).

The aim of this subject is primarily to develop and ensure the successful interaction and manipulation of caring and communication skill which radiographers need to practice on a daily basis. This subject provides the students with a clear understanding of their role and responsibilities relevant to special diagnostic procedures, how the hospital organisation exists to serve the patient. It deals with the preparation of the patient before, during and after various diagnostic procedures. It also deals with various contrast agents used for different radiological procedures, their side effects and resuscitation are dealt here with.

1. Preparation of patients for general radiological procedures : Departmental instructions to out-patients or ward staff; use of aperients, enemas and colonic irrigations, flatulence and flatus; causes and methods of relief; principles of catheterisation and intubation, pre medication; its uses and methods; anaesthetised patients, nursing care before and after special x-ray examination (for example in neurological, vascular and respiratory conditions); diabetic patients special attention to food; hazards of trauma.

2 Radiological contrast agents : Opaque agents and gases. Relationship of x-ray transmission to density and atomic number of the elements of contrast medium. Types of Barium sulphate solutions, concentration and its particular uses, flavouring agents.

Iodine preparation : Organic compounds, water - soluble group; significance of iodine content, proprietary preparations, iodised oil, Application of various systems of human body , Volume, contra-indications, methods of administration and route. Sensitivity test, side effects and management, elimination from the body.

Gases : Air, Oxygen and carbon di-oxide application and dangers.

3 Emergencies in the x - ray department and management: External defibrillation, direct cardiac massage, internal defibrillation, complications; cardiac arrest, respiratory arrest. bronchography, local anaesthetics; reactions, treatment.

4. Special procedures in diagnosis Radiology: a). The Gastro intestinal tract : Barium meal, Barium swallow, Small bowel enema, Barium enema. . The renal tract : Intravenous urography, retrograde pyelography, cysto urethrography. The biliary tract. Oral cholecystography, Intravenous cholangiography, operative and post-operative cholangiography, percutaneous transhepatic cholangiography

The respiratory tract ;Bronchography. Gynaecology. Hysterosalpingography. Cardio vascular system .Angiography, aortography-cerebral angiography, Spleno-portovenography.The Lymphatic system. Lymphangiography. Central nervous system. Myelography. Sialography ; Ultrasound + Guided procedures. General preparation, care and CT scan + guided procedures safety measures. MRI

Books for study

Text book

1." Care of patient in diagnostic Radiography" Chesney & Chesney (Blackwell Scientific)

Reference books:

2. " Chesney's Care of the patient in Diagnostic Radiography" Pauline J . Culmer. (Blackwell Scientific)
3. " Aid to Tray and Trolley Setting" Marjorie Houghton (Bacilliere)
4. "First Aid' Haugher & Gardner (Hamlyn.)
- 5."Practical nursing and first- aid" Ross and Wilson (Livingstone

SEMESTER-V

SUBJECT -9 : QUALITY ASSURANCE IN DIAGNOSTIC RADIOLOGY

(Suggested No. of teaching hours 100 including tutorials and practicals).

The provision of high quality health care in the goal of all medical service. Diagnostic radiology provides a valuable input into health care delivery system. Efficient utilization of the technology can be assured only through planned systematic and organized quality assurance procedures. Good diagnostic images would lead to accurate diagnosis and better management of health problem.

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.

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 ; 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.

4. QA Programmed tests: 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.QA of film and image recording devices: Sensitometry ; Characteristic curve ; Film latitude ; Film contrast ; Film speed Resolution, distortion, artifacts of films and image recording

6.Maintenance and care of equipment. Safe operation of equipment -

Routine cleaning of equipment and instruments - Cassette, screen maintenance of automatic processor and manual processing units. Routine maintenance of equipment's, record keeping and log book ; maintenance ; Reject analysis and objectives of reject analysis programme.

Books for study

Text book

1."Quality assurance in Diagnostic Radiology" By: J.M. Mclemore (Year book of Medical publishers)

Reference book

2."Quality Control in diagnostic imaging" By: J.E. GRAY (University Park Press)

3."Processing and Quality Control" By: William, E.J. McKinney (J.B. Lippincott Company)

4."Concepts in Medical Radiographic imaging" By: Marianne Tortoise (W.B. Saunders Company)

5."Quality assurance Management" By: G.E. Hayes (Charger production)

6.Diagnostic Imaging: Quality Assurance By: M.M. Rehani (Jaypee Bros Medical Publishers)

SEMESTER:VI

Subject- 10; RECENT ADVANCES IN DIAGNOSTIC IMAGING

(Suggested No. of teaching hours 100).

This subject enables the student Technologist to learn and understand the advancement in Radio Diagnostic Technology, Imaging equipment and imaging modalities developed in recent years. This subject also enables the student to learn and understand the basic concept of computer applications in diagnostic radiology and imaging.

1. Introduction to computer :History and development of computer-basics-storage and transfer of data- operation of computers-performance of computer systems- computer software and hardware- storage acquisition processing and display of digital images - Care and preventive maintenance of the computer system.

2. Computed tomography: Basic principle-data accumulation-image reconstruction-storing the image-viewing the image-evaluation of image - equipment for tomography-table-gantry-x-ray generator-different generations--image quality-patient exposure-artefacts.

3. Magnetic resonance imaging. Magnetic resonance imaging- basic principle-Instrumentation-Magnetic field gradient coils-Spin echo imaging sequence-multi slice

imaging-multi echo imaging-contrast-multi planar imaging-inversion recovery pulse sequence-signal to noise ratio-fast imaging techniques-safety considerations.

4. Digital radiographic imaging:

History and development ; Theory and Principle Digital fluoroscopy system-digitized image- digital subtraction techniques- digital image processing- future equipment developments- Clinical application - PACS (Picture Archival and Communication System)-Digital Image image quality-: Laser film printers.

5. Interventional procedures. C.T. Guided procedures: Fine needle aspiration cytology ; Fine needle aspiration Biopsy Stereo tactic biopsy ; Radio surgery.

Ultrasound guided procedures: Fine needle aspiration cytology ; Fine needle aspiration -Fine needle aspiration Biopsy.

Fluoroscopy guided procedures: Endoscopic Retrograde choledochopancreatography ; Percutaneous nephrolithotomy ; Percutaneous nephrostomy ; Percutaneous transhepatic biliary drainage ; Angioplasty ; Embolisation -Transjugular liver biopsy

Books for study

Text book

1. "Recent advances in Radiology and Medical Imaging" Lodge & Steiner (Churchill Livingstone)

Reference books

1. "MRI for Technologists" Peggy Woodward & Roger F. Freimark (McGraw Hill)

2. "Imaging for Students" David A. Lisle (Arnold)

3. "Digital subtraction ateriography" Charles, Andrew, Joseph (Year book Medical Publishers)

4. "Atlas of Interventional Radiology" Constantin Cope (J.P. Lipincott.)

5. "Principles of Radiographic Imaging" Richard R. Carlton (Arlene M. Alder)

6. "Radiologic Science for Technologist" Stewart C. Bushong (Mosby)

SEMESTER- VI

SUBJECT-11; RADIATION HAZARDS, CONTROL & SAFETY

(Suggested number of teaching hours 80 including tutorials and demonstrations).

1. Radiation protection; principle, 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. Dose equivalent limits-philosophy-ICRP(60) concepts-AERB guidelines.

3. Planning of radiation installation-protection from 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-thermoluminescent 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 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.

Books for study

Text book

Radiation Protection in Hospitals. Richard F.Mould

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.
4. Radiation Protection. Ronald L. Kathren
5. AERB safety code and manuals,

