HIMALAYAN UNIVERSITY, ARUNACHAL PRADESH

BACHELOR OF SCIENCE

RADIOLOGY & IMAGING TECHNOLOGY

1ST YEAR

1st Semester

S. NO.	SUB. CODE	SUBJECT NAME	MARKS			
			INTERNAL	THEORY	TOTAL	PASS
1	101	General English	30	70	100	40
2	102	Computer Fundamentals	30	70	100	40
3	103	Human Anatomy	30	70	100	40
4	104	Human Physiology	30	70	100	40
5	105	Practical	30	70	100	40

2nd Semester

S. NO.	SUB. CODE	SUBJECT NAME	MARKS			
			INTERNAL	THEORY	TOTAL	PASS
1	201	General Pathology	30	70	100	40
2	202	General Microbiology	30	70	100	40
3	203	General Biochemistry	30	70	100	40
4	204	General Pharmacology	30	70	100	40
5	205	Practical	30	70	100	40

2ND YEAR

3rd Semester

S. NO.	SUB. CODE	SUBJECT NAME	MARKS			
			INTERNAL	THEORY	TOTAL	PASS
1	301	General Physics and Radiation Physics	30	70	100	40
2	302	Radiographic Techniques	30	70	100	40
3	303	Radiographic Photographic and Dark Room Techniques	30	70	100	40
4	304	X-Ray Equipments	30	70	100	40
5	305	Practical	30	70	100	40

4th Semester

S. NO.	SUB. CODE	SUBJECT NAME	MARKS			
			INTERNAL	THEORY	TOTAL	PASS
1	401	Computed Tomography and Magnetic Resonance Imaging and Ultrasonography	30	70	100	40
3	402	Radiotherapy	30	70	100	40
3	403	Nuclear Medicine	30	70	100	40
4	404	Cath Lab	30	70	100	40
5	405	Special Procedures and The Use of Contrast Media	30	70	100	40
6	406	Practical	30	70	100	40

3RD YEAR

5th Semester

S. NO.	SUB. CODE	SUBJECT NAME	MARKS			
			INTERNAL	THEORY	TOTAL	PASS
1	501	Advanced Radiographic Techniques	30	70	100	40
3	502	Interventional and Digital Radiology	30	70	100	40
3	503	Quality Assurance in Diagnostic Radiology	30	70	100	40
4	504	Radiation Hazards Control and Safety	30	70	100	40
5	505	Practical	30	70	100	40

6th Semester

S. NO.	SUB. CODE	SUBJECT NAME	MARKS			
			INTERNAL	THEORY	TOTAL	PASS
1	601	CT Techniques and Equipments	30	70	100	40
2	602	MRI Techniques and Equipments	30	70	100	40
3	603	Ultrasound Techniques and Equipments	30	70	100	40
4	604	Project work	30	70	100	40

HIMALAYAN UNIVERSITY, ARUNACHAL PRADESH

BACHELOR OF SCIENCE

RADIOLOGY & IMAGING TECHNOLOGY

1ST YEAR

1st Semester

General English (101)

1) English, Communication Skill and Public Relations:

2) Writing Skills: Basics of English grammar How to write good and correct English .what is a Sentence? Types of Sentences - simple, compound, complex.

3) Listening Skills: What is listening? Types of Listening Purpose of Listening, Obstacles of listening

4) Reading Skills: Purposes of reading Types of reading - skimming, scanning, extensive reading, intensive reading, Loud and silent reading

5) Rapport Building Interpersonal Response, Traits, Managing Difficult Communication Traits in a hospital, communication in terminal illness

6) Effective Communication - The Ten Commandments The process of communication & different type of communication Communication- Definitions, Meaning, nature of communication, Purpose of communication

7) FORMAL LETTERS: Formal Style of Communication, Formal and Informal Letters, Essentials of a Formal Letter, Mechanics of Writing a Formal Letter, Drafting the Letter, Some Basic Equipment, The Format, Letters of Request, Letters of Complaint, Replying to Letters of Complaint, Letters about Jobs, Applications, Accepting an Offer, Declining an Offer, Letters to Government and Other Organisations, Letters of Complaint, Letters Giving Instructions, Letters of Request,

8)WRITING REPORTS: Different Stages in Writing a Report, Types of Report, Reporting Case History: Informal Reports, Reporting Case History: Formal Reports, Referral Letters, Referral Letters, Reply to Referral Letter

CLINICAL CASE STUDY: Significance of case study method some features, How is clinical case study prepared, Analyzing the case, Documentation and presentation, Conclusions

IMPROVING STUDY SKILLS: How do People Learn, Reading with a Purpose, What are Study Skills, Locating Information, Study Strategies for Better Comprehension: SQ3R, Variations of the SQ3R Approach

WRITING SUMMARIES-I : The technique of summarizing, Let us sum up, Key words

FORMAL CONVERSATION: FACE-TO-FACE: Making Enquiries and Giving Information at Public Offices, Making Enquiries at Hotels and Other Places, Making Enquiries : Taking a Medical History, Giving Advise to Patients. and their Relatives, Arguing with and Persuading People, Describing a Process

INFORMAL CONVERSATIONS: FACE-TO-FACE: Greetings: Enquiries about one's Health, Everyday Situations, Social Life, Other Informal Situations

TELEPHONE CONVERSATIONS: Face-to-Face and Telephone Conversation Compared, Formal Conversation, Emergency Calls, Business Calls, Informal Conversation

INTERVIEWS: Preparation for an Interview, Unfolding the Personality: Specimen Interviews

CASE PRESENTATION: How is a Case Presentation Prepared, Data Collection and Compilation of Material, Audiovisual Aids, Choice and Method of Use, How to Make the Case Presentation, Conclusion

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Computer Fundamentals (102)

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.

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.

Generation of Computers and their Classification Generation of Computers**,** Classification of Computers

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), Advantages & Disadvantages of DBMS, Various Database Structures or database models

Windows Graphical User Interface, Windows, Features of Windows, Control Button of windows, Various Icons on Desktop

Microsoft Word (INTRODUCTION)

Microsoft Excel (INTRODUCTION)

Microsoft PowerPoint (INTRODUCTION)

Internet – Features, Different type of network, Internet,

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

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Human Anatomy (103)

Introduction, subdivisions of anatomy, anatomical nomenculature-in terms of position ,location and fundamental planes

Introduction to bones of human body of:

Bone: definition, composition, functions, classification and features of a long bone.

Cartilage: definition, components and classification.

Joints: definition of joints, classification and function

Upper limb: clavicle, scapula, humerus, radius, ulna, carpus, metacarpus & phalanges,

Lower limb: hipbone, femur, tibia, fibula, tarsus. Metatarsus & phalanges, Skull: name the bone of the skull an sutures between them, Thorax: ribs and their articulation,

Vertebral column: cervical, thoracic, lumbar , sacral and coccygeal

Surface markings of the body: Nine regions of the abdomen, Four quadrants of the hip

Introduction to vital organs:

Respiratory organ Nasopharynx, Oropharynx, Larynx, Trachea, Bronchi, Lungs (and their lobular segments), Thoracic, Pleura and pleural cavity

Circulatory organ Anatomical position of the heart, Pericardium of the heart, Chambers of the heart, Great vessels of the heart, Valves of the heart

Digestive organs Tongue, Teeth, Oral cavity, Pharynx, Esophagus, stomach

Reproductive organs Male and female gonads: testes, epididymis, ovary, fallopian tube, uterus, vagina, Introduction to male genital organs, Introduction to female genital organs

Liver and spleen Introduction, Anatomical position, Gall bladder

Excretory organs Cortex and medulla of kidney, Ureter, Urinary bladder, Urethra (male and female)**,** nephrons.

Nervous System : Basic anatomy of nervous system, Central nervous system, Peripheral nervous system, Autonomic nervous system.

Muscles Introduction, origin and insertion, function.

Human Physiology (104)

Cell: Definition, Structure and functions the cytoplasmic organelles , Reproduction: meiosis, mitosis

The important Physio- chemical laws applied to physiology Diffusion**,** Osmosis**,** Bonding, Filtration**,** Dialysis**,** Surface tension**,** Adsorption**,** Colloid

Fundamentals of different organ system:

Cardiovascular system: Systole, Diastole, Blood circulation, Conduction system of Heart, ECG. Cardiac Output, Cardiac Stroke.

Respiratory system: Functions of Respiratory Tract, Mechanism of Breathing and Respiration, Muscles of Respiration. Common Respiratory Disorders.

Digestive system: Digestion of food in mouth, stomach & small intestines. Absorption of food, function of liver.

Excretory system: Structure & function of kidney and urinary bladder. Mechanism of urine formation. disorders of kidney.

Reproduction system: Male and Female Reproductive organs. Mensuration cycle.

Endocrine system: Functions of various endocrine glands and hormones secreted by them

Lymphatic system: Lymph vessels, lymph nodes and lymphoid organs, their structure & functions.

Blood Definition, Composition, Function

Formation of different types of blood cells Erythrocytes, Leucocytes, Thrombocytes

Mechanism of Blood clotting

Cerebrospinal fluid Formation, Composition, Function

Special senses Hearing, Taste, Smell, Touch, Sight

Practical (105)

1. Study and care of Microscope.

2. Collection of blood samples.

3. Separation of plasma from blood.

4. Demonstration of Vacutainers and its use.

5. Preparation and Examination of blood smear.

6. Histology of Skeletal Muscle.

7. Histology of smooth muscle.

8. Histology of bone.

9. Histology of hyaline cartilage

10. Histology of elastic cartilage

11. Histology of Epithelial tissues: Columnar Epithelium, Squamous Epithelium, Cuboidal Epithelium.

12. Study of Lab Equpiments.

13. Study of lab specimens

English: Job application, Resume writing .Interviews, Group discussions, Essay writing, Formal and informal communication.

Computers: Presentations, using excel sheet, Identification of computer devices,

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2nd Semester

General Pathology (201)

Introduction, Cell Injury ,Cell Death and Cellular Adaptation, Inflammation and types of Inflammation, Infections and types of Infections, Wound Healing and Neoplasia**.**

Pathology of Human Body

Introduction, Atherosclerosis and Other Vascular Diseases.

Morphological Responses of the Cardiovascular System and Ischemic Heart Diseases.

Pathology of Bacterial Pneumonia and Abscess, Tuberculosis.

Kidney and Urinary Tract Diseases.

Chronic Obstructive Pulmonary Diseases,

Pathology of the Esophagus and Stomach,

Pathology of the Small and Large Intestines

General Microbiology (202)

CLASSIFICATION OF MICROORGANISMS.

BACTERIOLOGY Introduction, Structure, Classification & Metabolism of Bacteria **.**Bacterial growth curve, Basis of Antimicrobial Action- .Antibiotics.

Infections by staphylococcus and streptococcus, Infections by Mycobacterium. *tuberculosis*, Infections by E.*coli*, Infections by Salmonella. *typhi* **.**

VIROLOGY Introduction, Structure, Classification and multiplication of viruses, Viral genetics and pathogenesis of Virus, HIV virus, Hepatitis virus, Influenza virus, Herpes Virus .Antiviral drugs

MYCOLOGY General concepts of mycology, Classification of Fungus, Structure of Fungi and disease mechanisms, Diagnosis of Fungal Infections, Treatment of Fungal Infection.

STERILIZATION AND DISINFECTION.STAINING TECHNIQUES.

General Biochemistry (203)

Chemical Bonding Valency, Electrovalent Bonding (Ionic Bonding), Covalent Bonding **Molecular Weight of Compounds**

Solutions Definition and Importance of Solutions**,** Types of Solutions**,** Diffusion, Osmosis and Dialysis

Electrolytes Acids, Bases and Salts**,** Ionization**,** Physiological Importance of Electrolytes**,**

Cell: Eukaryotic Cell, its Structure and function, cell organelles structure and functions. Biological membrane and transport .Passive and Active Transport.

Carbohydrates: classification, glycolysis and its energetic, TCA cycle and its energetics, fate of pyruvate, Regulation of blood glucose by Insulin and Glucagon. Normal Blood Glucose levels.

Lipids: Classification and importance of lipids, Types of Fatty acids, Triacylglycerols ,importance of TAG ,Phospholipids classification and function, prostaglandins and steroids. Digestion and Transportation of Lipids.

Amino acids, Proteins and Enzymes: Classification of amino acids, Importance of amino acids, Classification of Proteins, structure and functions of proteins .Classification of enzymes, Properties of Enzyme, Factors affecting Enzyme action ,Diagnostic Significance of Enzymes.

General Pharmacology (204)

Introduction, Basic concepts of drugs, Factors affecting drug response. Routes of administration of drugs, Effects of Drugs on the body, Prevention of adverse effects to drugs .Drugs and laws, Paramedics Responsibility in Drug Administration, Terminology, drug store, Ethical and Legal Aspects. Antibiotics, Antifungals, Antivirals, Time of Administration, Abbrievations and Symbols used. Antiseptics and Disinfectants,

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Practical (205)

1. Blood collection.
2. TLC
3. DLC
4. Microscopic Urine analysis.
5. Microscopic Stool Examination.
6. Staining techniques: Grams staining, Acid Fast Staining, Negative Staining, Simple Staining.
7. Laboratory instruments: Principle and working of Centrifuge, Incubator, colorimeter.
8. Blood grouping.
9. Type of Stains and their Action: Acidic Stains and Basic Stains .
10. Types of media for Bacterial Culture: Nutrient Agar , Nutrient Broth, Macconkey Agar
11. Bleeding Time and Clotting Time.

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3rd Semester

General Physics and Radiation Physics (301)

PHYSICS

Unites of measurements, Force, Work, Energy, Heat & Energy.
Various methods of transmission of Heat.

MAGNETISM: Classification of Magnets, Properties of Magnets, Magnetic fields & lines of forces, Magnetic fields & their measurements, Electro Magnetism.

ELECTRICITY : Electrostatic-conductor & insulators, Elementary electron theory, Units of electric charged potential. Condensers & capacity of condensers.

CURRENT ELECTRICITY: Ohm's law, various units of current, Voltage & resistance, heating effects of current units of Power & power consumption calculations, Principles & working of Moving coil & moving iron type of meters.

ELECTRO MAGNETIC INDUCTION : Transformers, their losses, rating Induction motors.

DIRECT & ALTERNATING CURRENTS: Impedance, Capacitance & Inductance. Thermoionic emissions & characteristic curves or diode & triode valves Semi conductors.

RADIATION PHYSICS

Rectifications & various circuits.
Structures of Atom, Radioactivity-natural & artificial.
Production & properties of X-rays.
X-ray tube in detail-stationary Anode, Rotating Anode & Radiotherapy tubes.
Interaction of radiation with Matter.
Quantity & quality of radiation & the factors on which it depends H.V.T.
Various radiation units- Rontgen, Rad, REM, RBE etc.
Dosimetry-various radiation measuring instruments.
I.C.R.P. recommendations.

EQUIPMENT

Mains supply, Basic X-ray circuit control & stabilizing equipment Meters, various exposure timers, Control of scattered radiations Fluoroscopy, Tomography, mobile equipment. Photo-fluoroscopy, Memographic equipment.
Image Intensifiers.
Rapid Serial charger equipment.
Care & maintenance of equipment.

Radiographic Techniques (302)

Upper Limb - Fingers individuals & as a whole, hands, carpel tunnel, wrist, fore arm, elbow, head of radius, humerus, shoulder joint, Acromio-clavicular joint, scapular, clavicle, Sternoclavicular joint.

Lower Limb - Tocs, foot, calcaneus, ankle joint, leg, knees, patella, fibula, femur, intercondylar notch.

Hip & Pelvis - Hip-Neck of femur-theatre procedure for hip pinning on reduction, pelvis, sacro-iliac joints, public bones, Acetabulum

Vertebral Column – Curves, Postures, Relative levels, atlanto- occipital region, Adonoid, Cervical spine, Cervico – thoracic spine, dorsal spine, thorac-lumbar spine, lumbe sacral spine, sacrum, coccyx, scoliosis, Kyphosis, flexion & extension.

Bones of thorax – Sternum, ribs.

Skull – Land marks, Planes, cranium, facial bones, maxilla, mandible, zygomata, T.M joints, mastoids, petrous – bones,

Optics foraman, sella turica.

Chest – Chest in teleradiography, Chest supine & portable.

Abdomen – Preparation indication & contra-indication, acute abdomen, pregnancy abdomen for multipley, maturity & Foetal abnormality, pelvimetry

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Radiographic Photographic and Dark Room Techniques (303)

RADIOGRAPHIC PHOTOGRAPHY & DARK ROOM TECHNIQUE

Photographic Process : Light image-Image produced by radiation- Light sensitive materials-Latent image.

Film material : The structure of X-ray films- Resolving power- Graininess of film, Sensitivity of film, speed of film, contrast of photographic films

Sensitivity : Characteristic Curve & its usefulness.

X-ray film storage : Storage of unexposed films.

Screens : Construction of intensifying screens, Choice of Fluoroscent material, Intensifying factor, Detail, Sharpness, Speed screen contact, Care of intensifying screens.

Cassettes : Cassette designs- Care of cassette, Mounting of intensifying screen in the cassette.

Film processing : Constituents of the processing solutions & replenisher. Factors affecting the developer, Types of developer & fixer, Factors affecting the use of the fixer, silver recovery methods.

Film rinsing, washing & drying : Intermediate rinse, Washing Drying.

Film processing equipment : Manual & Automatic processing.

Dark room design : Outlay & material used.

The radiographic image : The sharpness, contrast, Detail, Definition, Viewing conditions.

Administration : Trimming, Identification of films, legends, Relevant papers of the patients, records filling, reports distribution.

X-Ray Equipments (304)

Mains supply, Basic X-ray circuit control & stabilizing equipment meters, various exposure timers, Control of scattered radiations fluoroscopy, tomography, mobile equipment. Photo-fluoroscopy, Memographic equipment.

Image Intensifiers.

Rapid Serial charger equipment.

Care & maintenance of equipment.

Practical (305)

Interpretation of Radiographs:

1. Respiratory system

1. Normal chest Radiograph.
    1. Tuberculosis.
    2. Pneumonia.
    3. Emphysema.
    4. Hydropneumothorax.
    5. Bronchiogenic carcinoma.

2. CVS:
    1. Pericardial effusion.
    2. Pericarditis.
    3. Arterial septal defect.
    4. Aortic stenosis.

3. GIT:
    1. Abdominal radiograph.
    2. Duodenal ulcer.
    3. Colorectal carcinoma.
    4. Ulcerative colitis.
    5. Sprue.
    6. Bowel obstruction.
    7. Colonic polyp.

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4th Semester

Computed Tomography and Magnetic Resonance Imaging and Ultrasonography (401)

Computer Tomography

Basics Principles

1) General principles & definitions
2) Changes & advance
3) Volume & multi-slice scanners
4) Principles of image reconstruction
5) Computer gray scale & CT numbers
6) Slice thickness & table increments
7) Pitch with helical scanners
8) Attenuation & conversion of voxel to pixels
9) Radiographic Anatomy

Magnetic Resonance Imaging

1) Definition & Introduction
2) Physical principles of MRI
3) Comparison with radiography & CT
4) MRI- Components
5) MRI process & clinical applications
6) MRI basic safety

Ultrasonography

1) History
2) Introduction
3) Principles
4) Advantages & limitations
5) Applications
6) USG imaging team

Radiotherapy (402)

Surface dose, air dose, given dose, depth dose & charts.

Isodose charts & isodose charting.

Basic principles in radiotherapy with basic knowledge in Tele & brachy therapy treatment & planning.

- Orthovoltage machines.
- Megavoltage machines
- Cyclotron
- Synchotron.
- Klystron.
- Betatron
- Transformer units.
- Betatron

Nuclear Medicine (403)

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

Cath Lab (404)

Angiography & Interventional Procedures

1) Angiography Procedure
2) Cerebral, Thoracic, Angiocardiography, Abdominal, peripheral Angiocardiography & Lymphography
3) Angiographic Equipment
4) Interventional Imaging Procedures
5) Purpose, Embolization

Percuteneous transluminal Angiography (PTA) & stents implants & DAS

Special Procedures and the Use of Contrast Media (405)

Urinary Tract – K.U.B.I.V.P Retrograde – Cysto- Urethrography

Biliary Tract – Oral Cholecystography, I.V.C, Prans-hepatic percutaneous cholengiography, per-operative,

Cholengiography, T. Tube Cholengiography, ERCP

Gastro- intestinal Tract – Ba-Swallow, Ba-meal, Ba-Meal follow through

Hystero- salphigography – Investigation of uterus & tubes.

Practical (406)

Interpretation of Radiograph:

RENAL SYSTEM:

1. Intravenous Urogram
2. Urolithiasis.
3. Pylonephritis.
4. Renal cyst
5. Renal infarct
6. Pelvic kidney
7. Renal cell carcinoma
8. Bladder calculus.

REPRODUCTIVE SYSTEM:

1. Normal Hysterosalphinography(HSG).
2. Ovarian Dermoid Tumour.
3. Hydrosalpinx.
4. Uterine Fibroid.
5. Conjoined twins
6. Benign Prostatic Hypertrophy.

SKULL:

1. Normal Skull X-RAY
2. Normal CT Scan of Brain
3. Cerebral Abscess.
4. Epidural Haematoma.
5. Subdural Haematoma
6. Cerebral Aneurysm

7. Hypertensive Haemorrhage
8. Pituitary Adenoma.

ORTHOPAEDICS:

1. Normal Bone X-RAY.
2. Metabolic Diseases:
   a) Osteoporosis
   b) Rickets
   c) Osteomalacia
   d) Scurvy
   e) Bone tumours.
   f) Factures
   g) Spina Ventosa

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5th Semester

Advanced Radiographic Techniques (501)

Ultra Sound

1. Principle of Ultra Sound
2. Types of Ultra sound
3. Description of Equipment
4. Indication and clinical Application

CT SCAN

1. Basic principle of CT scan
2. Description of Equipment
3. Conventional CT Scan
4. Indications and Contra Indications

COURSE CONTENTS:

1. Preparation of Patients
2. Contrast Media

3. Indication and Contraindication

4. Clinical application

5. Procedure

6. MR Angiography

Reference Books:

1. Chapman, Radiological Procedure

2. Bhushan L Lakkar, Radiological Procedure

3. Clark, Radiological Procedure

4. Kartikeyan, Step by Step CT Made Easy

5. Khurana, 3D &4D Ultrasound: A Textbook and Atlas

Interventional and Digital Radiology (502)

1-Patient preparation, positioning for Various Interventional and nuclear medicine procedures

2-Radiation protection for patient, occupational workers and public during various Interventional and nuclear medicine procedures

3-Basic physics and working principle of Interventional and NMT equipments

4-Procedure, post processing techniques and evaluation of Image quality and clinical finding.

5-Post procedural care of the patient

Interventional Procedures

Cardiac, Vascular, Nonvascular

References:

1. Cope & Constantine, Current Techniques in Interventional Radiology
2. Anthony W. & Andreas A. Interventional Radiology - A Practical Guide
3. Sorenson, Physics in Nuclear medicine
4. Powsner Physics of Nuclear medicine

Quality Assurance in Diagnostic Radiology (503)

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

Radiation Hazards Control and Safety (504)

1. Radiation protection; principle, history& development-National & international agencies; AERB, BARC, ICRP, WHO, IAEA and their role. Equivalent dose-effective dose-sever-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-ther moluminecent 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-avoidence of unnecessary radiation dose. Radiation emergencies-situation preparedness, safety and prevention-legal requirements recent developments in radiation safety related topics.

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.

Practical (505)

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6th Semester

CT Techniques and Equipments (601)

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

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

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, Remedies

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

References:

1- Euclid S., Computed Tomography- Physical Principle, Clinical application & quality control

2- stewart C. B., Computed Tomography

MRI Techniques and Equipments (602)

1. Introduction and Basic Principle of Magnetic Resonance Imaging

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

2. MRI Hardware

Introduction, Permanent magnets, Electromagnets, Super conducting magnets, Fringe fields, Shim coils, Gradient coils, Radio-frequency coils, the pulse control units, Patient transportation system, Operator interface

3. Encoding, Data collection & Image formation

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

4. Pulse sequences

Introduction To basic pulse sequences. Spin echo sequences, Conventional spin echo, Fast spin echo Inversion recovery, STIR, FLAIR Proton Density Imaging, Gradient echo pulse sequences Conventional gradient echo, The study state, SSFP, Coherent residual transverse magnetization, Incoherent residual transverse magnetization, Ultra- fast imaging, Advanced imaging techniques, EPI

5. MRI parameters & Trade offs

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, Decision making, Volume imaging

6. MRI 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 artefact, Magic angle artifact, Zipper artefact, shading artifact

7. MRI contrast agents

Introduction, Uses and methodology, Review of weighting, Mechanism of action, Dipole-dipole interactions, Magnetic susceptibility, Relaxivity Gadolinium safety, Feridex safety, Current applications of contrast agents

8. Flow Phenomena & MRI angiography

Introduction, The mechanisms of flow, Time of flight phenomenon, Entry slice phenomenon, Intravoxel rephrasing

Flow phenomena compensation

Gradient moment rephrasing, Pre saturation, Even echo rephrasing, MR Angiography

9. 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

References:

1- Stark & Bradley, Fundamentals of MRI
2- Catherine W., MRI in Practice
Stewart C B., MRI Physics & Biological Principle

Ultrasound Techniques and Equipments (603)

Ultra Sound

1. Principle of Ultra Sound

2. Types of Ultra sound

3. Description of Equipment

4. Indication and clinical Application

COURSE CONTENTS:

1. Preparation of Patients

2. Contrast Media

3. Indication and Contraindication

4. Clinical application

5. Procedure

6. MR Angiography

Reference Books:

1. Chapman, Radiological Procedure

2. Bhushan L Lakkar, Radiological Procedure

3. Clark, Radiological Procedure

Project work (604)

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