POST GRADUATE DIPLOMA IN RADIOLOGY & IMAGING TECHNOLOGY

S.No	Course Guideline & Framework	
1	Course Eligibility	B. Sc graduate with a minimum of 50% pass mark in the UG from a recognized university (preference will be given to Radiology & Imaging / CRA / Physics)
2.	Duration of course	1 year
3.	Student intake (Maximum)	>100 beds 20 students
Hospital Facility / Clinical Facility		
4.	X - Ray (Minimum)	300 MA X ray machine – 1 C – Arm X Ray - 1 (Available at the Apollo Group Hospitals where training will take place)
5.	CT Scan (Minimum)	1
6.	MRI , Cardiac Catheterization Lab (Minimum)	1
8.	Own / partnership / tie-up with a specialty hospital	The institution offers training in Nephrology, general medicine, ICU, Orthopedics, General Surgery, Neurology, Neurosurgery, Cardiothoracic surgery and Plastic surgery. The applied use of Radiology, Radio diagnosis and Imaging in these areas
9.	Clinical Facility	Apollo Group Hospitals
Faculty		
10.	Teaching Responsibility	Designated course director, Radiologist -1
11.	Faculty	Part time lecturers: 1 – Radiologist 1 – Neurologist 1 – Nephrologist 1 – Orthopedician 1 – ENT Specialist 1 – Gastroenterologist 1 – OB & G 1- Emergency physician & other relevant specialties
Training Modality		
12.	1st year	Theory on 1st year subjects & Practical's and Log book
13.	Teaching/ Learning methods	LCD projector, Computers, Internet, Discussions & Lectures
14.	Library	Minimum of 200 sq.ft with 200 books
Examinations		
15.	1st year	**Internal Examinations** – Conducted at the end of every 6 months (theory & practical) **Annual Examinations** – University Examination (conducted at the end of 1 year) will include Theory, Practical's

REGULATIONS FOR THE POST GRADUATE DIPLOMA IN RADIOLOGY & IMAGING TECHNOLOGY

1. **SHORT TITLE AND COMMENCEMENT :** These regulations shall be called "THE REGULATIONS FOR THE POST GRADUATE DIPLOMA IN RADIOLOGY & IMAGING TECHNOLOGY

2. **REGISTRATION:** A candidate admitted into Post-Graduate diploma courses in any of the affiliated Institutions of the Tamil Nadu Dr. M.G.R. Medical University, Chennai shall register with the University by remitting the prescribed fees along with the application form for registration duly filled in and forwarded to the Controller of Examinations of this University through the Head of the affiliated institution within the stipulated date. The candidate's name must be registered in the University within 3 months from the date of his/her admission.

3. **ELIGIBILITY:** Candidates for admission to the One year Post-Graduate Diploma course shall be required to possess the following qualifications:
   - ✓ Bachelors with any stream.

4. **RECOGNITION FEE:** Candidates who have passed the Bachelors in University shall remit a recognition fee as prescribed along with the stipulated registration fees.

5. **DURATION OF THE COURSE**: The period of certified study and training for the Post-Graduate Diploma course shall be for **1 year.**

6. **COMMENCEMENT OF THE COURSE:** The academic year for POST GRADUATE DIPLOMA IN RADIOLOGY & IMAGING TECHNOLOGY course will commence from **1st September** of every academic year.

7. **CUT-OFF DATE OF THE COURSE:**
   (I) **30th September of the year concerned.**
   (ii) The candidates admitted upto 0th September of the Academic Year shall be registered to take up the 1st year examination during October of the next year.

8. **COMMENCEMENT OF THE EXAMINATION:**
   15th October
   If the date of commencement of Examination falls on Saturdays/Sundays or declared Public Holidays, the Examination shall being on the next working day.
   (This will be implemented from the Academic Year 2014-15 onwards).

9. **WORKING DAYS IN AN ACADEMIC YEAR. :** The academic year shall consist of not less than **270 working days**.

10. **ATTENDANCE REQUIREMENTS FOR ADMISSION TO EXAMINATIONS:** No candidate shall be permitted to appear for the Examination unless he/she put in 85% attendance during his/her period of study and training in the affiliated institution recognized by this University and produces the necessary certificate of study, attendance and progress from the Head of the Institution by maintaining log book.

11. **MAINTAINENCE OF LOG BOOK**

- ✓ Every Post-graduate Diploma candidate shall maintain a record of skills he has acquired during the one year training period certified by the various Heads of Departments he has undergone training.

- ✓ The candidates should also be required to participate in the teaching and training programme of the institute.
    - ✓ In addition, the Head of the Department shall involve their post-graduate candidates in Seminars, Journal Clubs, Group discussions and conferences.
    - ✓ The Head of the Department shall scrutinize the Log Book once in every three months.
    - ✓ At the end of the course, the candidate should summaries the contents and get the Log Book certified by the Head of the Department.
- ✓ The Log Book should be submitted at the time of practical examination for the scrutiny of the Board of Examiners.

12. **MIGRATION/TRANSFER OF CANDIDATES**

- ✓ A student studying in **POST-GRADUATE DIPLOMA COURSE IN RADIOLOGY & IMAGING TECHNOLOGY** can be allowed to migrate/transfer to another institution of Allied Health Science under the same or another University.
- ✓ Under extraordinary circumstances, the Vice Chancellor shall have the powers to place any migration/transfer he/she deems fit before the Governing Council and get its approval for grant of permission/ratification for Migration/Transfer to the candidates undergoing the course of study in affiliated institutions of this University.

13. **RE-ADMISSION AFTER BREAK OF STUDY:** The regulations for re-admission are as per the University Common Regulation for Re-admission after break of study for all courses.

P.G.DIPLOMA IN

S. No	Name of the Subject	Theory Hours	Practical Hours
	External		
1	Fundamentals of Radiation Physics & Physics of Diagnostic Radiology	130	20
2	Radio Diagnostic Equipments - Instrumentation, Radiation Safety & Quality Control	120	50
3	Clinical Radiography & Dark room Techniques	150	50
4	Contrast & Special Radiographic Procedures	70	80
	Internal		
1	Anatomy & Physiology	60	20
2	English	30	15
3	Computers	30	15
	Total	***590***	***250***
	GRAND TOTAL	***1440***	

PAPER I

Fundamentals of Radiation Physics & Physics of Diagnostic Radiology

Course Hours (Theory):130 hrs

Course Hours (Practicum):20 hrs

Module 1: Basic concepts of Physics

Basic Physical Quantities & Units, Work, Power & Energy, Atomic Structure -Atom models -Neils Bohr - Sommerfield Postulates, Nuclear Model, Various Physical/radiation Quantities used in diagnostic radiology and its units. Electromagnetic spectrum -wave & particle characteristics

Module 2: Electricity

Static Electricity -Coulomb's Law- Electrostatics - Conductors, Insulators- Basic Properties of Charge - Electric Field & Electric Field Intensity, Electric Field due to Point Charge, Electric lines of forces and its properties, Electric Potential-Relation between Electric field & potential, Gauss's Law & Its application, Electrostatic Induction, Capacitance, Principle of a Capacitor, Capacitors in Series and Parallel, Applications of Capacitors.

Current Electricity - Electric Current, Ohm's Law, Resistivity & Conductivity , Classification of Materials based on electrical properties-Superconductivity & its applications, Resistors in Series & Parallel, Kirchoff's Current law & Voltage Law, Heating Effect-Joule's Law & its applications

Module 3: Magnetism & Electromagnetic Induction

Magnetism - Magnetic lines of force, Coulomb's Inverse Square Law, Magnetic Field Intensity, Coulomb's Law, Magnetic Flux, Magnetic moment, Magnetic Properties, Magnetic Effect of Electric Current, Biot-Savart Law / Ampere's Circuital Law, Fleming Left Hand Rule. Solenoid-Right Hand Palm Rule, Moving coil Galvanometer-Voltmeter, Ammeter, Magnetic dipole moment & Gyro magnetic ratio.

Electromagnetic Induction- Induced emf & current - Faraday's Laws, Lenz's Law, Fleming's Right Hand Rule, Self Induction, Mutual Induction, Methods of producing emf,AC generation -Single Phase & Three Phase, Eddy Current and its applications. Transformer, Transformer losses, Autotransformer

Module 4: Atomic Structure and Radioactivity

Nuclear Properties, Mass Defect-Binding Energy,. Properties of Alpha, Beta & Gamma radiation, Modes of Radioactive decay -Alpha, Beta decay -Isomeric Transition & Gamma decay. Laws of Radioactivity, Decay equation, Half Life, Mean life, Transient equilibrium & Secular Equilibrium

Module 5: Physics of X-rays

X-ray Production -Thermionic emission - Bremsstrahlung Spectrum - Characteristic Spectrum, Factors affecting x-ray spectrum, Stationary & Rotating Anode, Space Charge Effect, Anode angle & Focal spot size, Heel Effect, Quality of X-rays, Similar Triangles principle- Magnification & Focal spot blur, Contrast & Spatial resolution

Module 6: Characteristics of X-rays & Interaction with matter

Charged Particle Interactions, Radiative Interactions, Neutron Interactions, X-ray & Gamma interactions, Photo electric effect, Compton Effect Pair Production, Annihilation, Attenuation, Linear Attenuation Coefficient, Mass Attenuation Coefficient, HVL, effective energy, Beam Hardening

Module 7: Principles of Radiation Detection & Measurement

Principles of Radiation detection and measurements – GM Detector, Scintillator detector, Ionisation detector, Thermo luminescence detector, Pocket dosimeter, Radiation survey meter and Gamma Zone monitor.

Module 8: Computed Tomography & Mammography

Physics of computed tomography, Different Generations of CT, Detector Pitch, Collimator Pitch, Slice Thickness, Contrast, Resolution, Hounsfield Unit, Helical Scanning - Interpolation, Image Reconstruction, Windowing & Leveling, Image Quality, Dose Measurement, Dose Considerations, Current Modulation in CT Fluoroscopy, Dual Energy CT, CT Angiography, Gated CT, MDCT, Artifacts in CT Mammography - Principle & design of Mammography units, Tube Output, Focal Spot, Scattered radiation, Screen-Film system -Film Sensitometry, Full field digital Mammography, Factors related to Breast Radiation Dose.

Module 9: Physics of Magnetic Resonance Imaging

Magnetic properties of nuclei, Resonance & Excitation, Free Induction Decay, T1 relaxation, T2 relaxation, Pulse sequences, TR & TE, T1 weighted & T2 weighted images, Image Quality, Localization of Signals, Gradient - Frequency Encoded & Phase Encoded gradients, SNR,K-space, MR Artifacts, Cardiac MRI, MR Elastography, MR Spectroscopy

Module 10: Fluoroscopy, Angiography & Cine Radiography

Fluoroscopy, Real time Imaging, Principle & Production of Fluoroscopy, Field of view/ magnification modes, Contrast Ratio, QDE, Video Cameras - Resolution, Modes of Fluoroscopy, Frame Averaging, Image Quality, C-arm units, Cardiac Catheterization suite- Angiography, Cine Radiography

Module 11: Ultrasound

Properties of Ultrasound, Reflection, Refraction, Attenuation, Snell's Law, Piezoelectric effect, Principle of Ultrasound production, Pulse Echo Concept, Acoustic Impedance, Principle of A-mode, B-mode & M-mode Ultrasound, Doppler effect, Principle of Doppler Ultrasound, Colour Doppler, Echo Cardiography, Elastography -Principles, Image Quality, Artifacts in Ultrasound

Module 12: Nuclear Medicine Imaging

Gamma Camera- Planar Imaging- Static Images, Dynamic Images & Gated Images, SPECT - Image acquisition, Arc of Acquisition, Step & Shoot vs. Continuous Acquisition, Noise Filtering, PET IMAGING - Physics of PET, Advantages of PET, Resolution, Time of Flight, Factors affecting PET imaging, Positron Emission Source, Attenuation Correction, Standard Uptake Value, Combined PET CT Imaging, PET CT cameras, Artifacts in PET CT Imaging

PAPER II

RADIO -DIAGNOSTIC EQUIPMENTS - Instrumentation, Radiation Safety & Quality Control

Course Hours (Theory):120 hrs
Course Hours (Practicum):50 hrs

Module 1: Conventional and Digital Radiography

X-ray Instrumentation - X-ray Generator Circuits, Transformers, Stationary & Rotating anode X-ray tubes, Radiographic Imaging Systems - Conventional Radiography - Films , Screen - Film systems , Intensifying Screens, Computed Radiography, Digital Radiography, Automatic Exposure Control, Detectors - Charged Couple Devices, Flat Panel Detectors

Module 2: Fluoroscopy and Mammography

Conventional Fluoroscopy unit - Imaging Intensifier system, Viewing System in Fluoroscopy, Digital Fluoroscopy - Flat Panel Detectors, C-arm Fluoroscopy Units, Interventional(Catheterization Lab) Fluoroscopy Units, Road Mapping, Automatic Brightness Control, Automatic Exposure Control .Mammography X-ray Tube Design, Target Requirements, Conventional Mammography, Digital Mammography, Detectors, Data Acquisition, Mammography Equipments with Tomosynthesis

Module 3: Computed Tomography

Different Generation of CT Scanner Units - CT Instrumentation, Detectors , Multi Slice CT, Spiral/Helical CT, MDCT - Multi Detector CT, Dual Energy/ Dual Source CT scanners, Gated Cardiac CT, CT fluoroscopy & CT Perfusion

Module 4: Magnetic Resonance Imaging

MRI instrumentation, Magnet, Resistive Magnet, Super Conductive Magnet, Permanent Magnet, RF System, Shim Coils Gradient Coils. Shielding, Eddy Currents, Detector Coil designs, Cardiac MRI, MR spectroscopy, Functional MRI, MR Angiography, MR Artifacts MR Safety

Module 5: Ultrasound

Ultrasound Imaging - Generation & Display, Transducers - Design, Beam Formation, Focusing of Ultrasound Beam, Types & Generation of Ultrasound - Types of Modes -A Mode, B Mode, B - Mode Instrumentation, M Mode, Doppler Ultrasound, Doppler Shift, Colour Doppler, Continuous Wave Doppler, Pulsed Doppler, Micro Bubble Contrast in Ultrasound, Ultrasound in Echo Cardiography

Module 6: Nuclear Medicine

Radionuclide & Radiopharmaceutical production, Generators, Cyclotrons, Reactors, Design of a Gamma Camera unit, Types of Collimators, Design & Operation of SPECT-CT , PET - CT Instrumentation, PET- MRI

Module 7: Fundamentals of Radiation Safety & Regulatory Guidelines

Units & Quantities in Radiation Protection - Exposure, Absorbed Dose, KERMA, Roentgen, Gray, Sievert, Bequerel, curie, Collected Dose, Committed dose, , AERB Guidelines, Radiation Protection Rules, Atomic Energy Act

Module 8: Biological Effects of Radiation

Cells - Cell Cycle & Death, Irradiation of cells - Direct Action in cells, Indirect Action in cells, Type of Radiation Damage - Time Scale & Classification of Radiation Damage. Somatic & Genetic/Hereditary effects, Stochastic & deterministic effects, Acute & Chronic effects, Measurement of Radiation Damage in Tissue, Equivalent Dose, Effective Dose , Tissue Weighting Factor, Radiation Weighting factor, Oxygen Enhancement Ratio(OER), Relative Biological Effectiveness (RBE), Linear Energy Transfer (LET)

Module 9: Planning & Licensing/Certification of X-Ray facilities:

Planning of X-ray facilities - Shielding, Half Value Thickness (HVT), Tenth Value Thickness (TVT), Workload, Use Factor, Occupancy Factor, Layout Guidelines, e-licensing for Radiation applications (elora) requirements

Module 10: Transport, Storage of Radioactive material & Management of Emergency Situations

Transport of Radioactive materials - packaging requirements, Types of Package - Transport Index, Tests for Transport packages, Procurement & Storage of Radioactive materials, Inventory of Radioactive sources, Management of Emergency Situations - Radioactive material spillage - Decontamination Procedure

Module 11: Radiation monitoring

Personal Monitoring, Area Monitoring, TLD Badge, Usage of Tld badges, Film Badge, Ionisation Chamber Survey Meter, GM Counter Survey meter, Contamination Monitor, Semiconductor based Monitoring instruments, Pocket Dosimeter

Module 12: Radiation protection & Quality Control

Philosophy in Radiation Protection, Principles of Radiation Protection, Occupational exposure, Medical Exposure & Public Exposure, Dose limits recommended by AERB, Radiation Protection in Radiography, Fluoroscopy, etc. Quality Assurance - Quality Assurance of Fixed/ Mobile X-ray Units, Quality Assurance of Fluoroscopy units, Quality Assurance in Mammography, Quality Assurance in Computed Tomography, SPECT- CT & PET- CT

RADIO - DIAGNOSTIC EQIPMENTS (Practicum Outline)

The students will be instructed by a Lecturer/ clinical preceptor/ mentor on the various radio - diagnostic equipments. Procedures will include:

1. X-Ray circuits and Identification of X-ray equipment and its parts.
2. Radiographic imaging techniques.
3. Imaging of all kinds of contrast and special radiographic procedures.
4. Congruence of Radiation and optical beam.
5. Calculation of Activity, Attenuation and Inverse square law. Conversion of Radiation units
5. Demonstration of basic procedures of radiation detection instruments.
6. Demonstration of basic procedures of personnel monitoring equipments.

7. Determination of Focal spot size and Accuracy of Central Beam alignment
8. Accuracy of kV test and Linearity of Timer
9. Consistency of Tube current and Radiation Output

Calculation and Graphical representation of total filtration of the X-ray tube.

PAPER III

CLINICAL RADIOGRAPHY AND DARK ROOM TECHNIQUES

1. CLINICAL RADIOGRAPHY TECHNIQUE

Course Hours (Theory):100 hrs

Course Hours (Practicum):25 hrs

CLINICAL RADIOGRAPHY TECHNIQUE (Theory)

Module 1: Preparation of patient and the Room for the procedure

Setting up the equipment- Positioning of the patient(Erect, Sitting, Prone, Lateral, Oblique, Decubitus)- Safety precautions- Explanation of procedure to the patient- Explanation of the use of contrast agents & its administration- Ensure the availability of adequate medical and diagnostic equipments

Module 2: Radiography of the 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.

Module 3: Radiography of the 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

Module 4: Radiography of the Shoulder girdle and thorax

Technique for shoulder joint, scapular, calvicle, 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.

Module 5: Vertebral 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 - Scoliosis - Kyphosis - Spondylolisthesis - disc lesion

Module 6: Pelvic girdle and hip region

Technique for whole pelvis. Ileum, ischium, pubic bones, sacro iliac joint, symphysis pubis, hip joint, acetabulum neck of femur, greater and trochanter.

Supplimentary technique- Congenital dislocation of hips: Epiphysis of femur:-Lateral projections for hip joints to show femoral head and neck relationship.

Module 7: Skeletal Survey

Skeletal survey for metabolic bone diseases metastases, hormonal disorders & renal disorders

Module 8: Skull

Basic projections for cranium, facial bones, nasal bones and mandible. - Technique for-petrous temporals for mastoids - Accessory nasal sinuses- Tempero - mandibular joint - Orbits and optic foramen - Zygomatic arches.- Styloid process. - Pituitary fossa

Module 9: Dental radiography

Technique for intra oral full mouth - Occlusal projections- Extra oral projections

Module 10: Cardiovascular system

Routine projections for heart (without the uses of contrast agent) Supplementary views for above.

Module 11: Upper respiratory system

Lungs and mediasstinum: 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.

Module 12: Abdominal viscera

Technique for plain film examination - Projection for acute abdomen patients - Technique to demonstrate (i). Foreign bodies (ii). Imperforate anus.

Module 13: 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.

CLINICAL RADIOGRAPHY TECHNIQUE (Practicum Outline) will be conducted in the clinical areas:

1. Radiographic positioning of all parts of the body.
2. Determination of low contrast and High contrast resolution.
3. Congruence between table to gantry in CT.
4. Determination of Table position / incrementation in CT.
5. Basic Radiographic Techniques

REFERENCES

1. Radiographic Imaging – Derrick
2. Physics of Photography principles of Medical Radiography – Seeman & Herman
3. Patient care in Diagnostic Radiography – Chesney & Chesney
4. First Aid – Haugher and Gardner
5. Practical Nursing & First Aid – Ross and Wilson
6. Concepts in Medical Radiographic Imaging – Mariamme Tortoice
7. An Atlas of Normal Radiographic anatomy – Richard and Alwin

2. DARK ROOM TECHNIQUES

Course Hours (Theory) 50 hrs

Course Hours (Practicum)25 hrs

DARK ROOM TECHNIQUES (Theory)

Module 1: Basic film structure & Quality

Principles of radiographic Imaging -Choosing film for different studies. Radiographic film – Structure, properties of different parts, handling, film wrapping, Handling of exposed and unexposed films. Types, applications, advantages and limitations, safe light requirements. X-Ray cassettes – structure, function and types.

Module 2: The equipment for processing X-ray images

X-ray Films and X-ray cassettes - Intensifying screens - X-ray films types structure & quality – choosing films for different studies - Dry & wet processing - Uses of intensifying screen, fluorescence and structure of intensifying screens

Module 3: Functions of equipment used for film processing:

Functions of various components -Film roller transport - transport time, film feed system- Care and maintenance (cleaning routine and methods of cleaning).

Module 4: Functions and fundamentals of a Dark Room

Setting up the processing area - Dark room design, construction, illumination, entrance safe lighting - types - Storage, shelving of films - Cleaning and maintenance

Module 5: Techniques and principles of Film Processing

Principles of Acidity, alkalinity, pH, the processing cycle, development, developer solution -Principles of Fixing, fixer solution, washing, drying replenishment, checking and adjusting -Replenishment rates, manual and automatic processing- Silver recovery - Auto and manual chemicals

Module 6: Fundamentals of X-Ray film and Image processing

Composition of single and double coated radiographic films, structure of emulsion, film characteristics (speed, base + fog, gamma, latitude) - effect of grain size on film response to exposure, interpretation of characteristics curve - Latent image formation ; process of film developing (composition of fixer, developer and other processing solution) -Image intensifiers and cassettes (structure and function) - effects of kV and mA on variation of emitted radiation intensity, determination of relative speeds, film contrast, film screen contact -Film storage, handling .

Module 7: Factors affecting Image Quality

Meaning of radiographic image contrast, density, resolution, Characteristic Curve sharpness, magnification and distortion of image, noise and blur - Radiographic illuminators and viewing conditions, visual acuity and resolution.

DARK ROOM TECHNIQUES (Practicum Outline)

The students will be instructed by a Lecturer/ clinical preceptor/ mentor on the various radio - diagnostic equipments. Procedures will include:

1. Radiographic imaging techniques.
2. Imaging of all kinds of contrast and special radiographic procedures.
3. Image processing techniques (including Dark room).
4. Calculation and Graphical representation of total filtration of the X-ray tube.

REFERENCES

1. Radiographic Imaging – Derrick
2. Physics of Photography principles of Medical Radiography – Seeman & Herman
3. Patient care in Diagnostic Radiography – Chesney & Chesney
4. First Aid – Haugher and Gardner
5. Practical Nursing & First Aid – Ross and Wilson
6. Concepts in Medical Radiographic Imaging – Mariamme Tortoice
7. An Atlas of Normal Radiographic anatomy – Richard and Alwin

PAPER IV

CONTRAST & SPECIAL RADIOGRAPHIC PROCEDURES

Course Hours (Theory) 70 hrs

Course Hours (Practicum) 80 hrs

Module 1: Contrast media

Terms used to describe contrast media - Structure of compounds- need for contrast media -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 - Contrast preparantion for CT & MRI. Discuss the records which should be kept regarding contrast media.

Module 2: Emergencies in the Radiology department

Reactions to contrast media - Preventive measures -. Treatment of reaction - Basic emergency equipment and Emergency drugs- Role of radiographer in management of patient with contrast reaction.

Module 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. Sialography.

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

Module 4: Urinary system

Intravenous urography - Retrograde pyelography -- Antegrade pyelography -- Cystography and micturating cystography – Urethrography

Module 5: Female reproductive system

Hysterosalpingography - Mammography.

Module 6: Respiratory system

Nasopharyngography – Layngography - Bronchography.

Module 7: Central nervous system

Myelography -- Cerebral studies.

Module 8: Arthrography & Discogram

Shoulder: hip, knee, elbow.

Module 9: Angiography

Carotid Angiography (4 Vessels angiography)-- Selective studies (Renal; inferior and superior)-Femoral arteriography.

Module 10: Venography

Percutaneous transplenic portal venography -- Peripheral venography -- Inferior and superior venocavography.

CONTRAST & SPECIAL RADIOGRAPHIC PROCEDURES (Practicum outline)

1. Radiographic positioning of all parts of the body.
2. Table top exposure rate measurement in fluoroscopy
3. Radiation leakage test and calculation of workload.
4. Radiation protection survey of X-Ray room installations.
5. Determination of low contrast and High contrast resolution.
6. Congruence between table to gantry in CT.
7. Determination of scan localization light accuracy and gantry tilt in CT
8. Determination of Table position / incrementation in CT.
9. Identification of errors / artifacts in the film.
10. Basic Radiographic Techniques

INTERNAL SUBJECTS

ANATOMY & PHYSIOLOGY
Course Hours (Theory): 60 hrs
Course Hours (Practicum): 20hrs

Module 1: Introduction to anatomy

Scope of Anatomy and Physiology - Definitions and Terms in Anatomy and Physiology- Structure and function of human cell - Elementary tissues of human body- Brief account on Composition of Blood - functions of blood elements - Blood Group and coagulation of blood.

Module 2: Cardio Vascular System

Structure and functions of various parts of the heart, arterial and venous system, brief account on common cardiovascular disorders

Module 3:Respiratory System

various parts of respiratory system and their functions, Physiology of Respiration

Module 4: Digestive System

names and various parts of digestive system-Liver, Spleen, Gall Bladder, Pancreas, Buccal Cavity, Pharynx, Oesophagus, Stomach, intestine etc.-physiology of digestion and absorption

Module 5: Urinary System

various parts of urinary system and its function-structure and function of kidneys- physiology of urine formation - pathophysiology of renal disease and edema

Module 6: Reproductive System

physiology and anatomy of Male & Female reproductive system-Prostate & Uterus & Ovaries etc

Module 7: Musculoskeletal System

Classification of bones & joints, structure of skeleton –structure of skeletal muscle – physiology of muscle contraction

Module 8: Nervous System

various parts of nervous system- Brain and its parts –functions of nervous system – Spinal Cord & Nerves

Module 8: Ear, Nose, Throat and Eye

Elementary knowledge of structure and functions of organs of taste, smell, hearing, vision

Module 9: Endocrine System

Endocrine glands ,their hormones and functions-Thyroid, Parathyroid, Suprarenal, Pituitary, pituitary and Thymus

Module 10: Haemopoietic and Lymphatic System

Name of the blood vessels & lymph gland locations

Module 11: Surface Anatomy & Surface Markings of Human Body

Practicals

- ✓ Study of Human Skeleton parts with skeletal models..
- ✓ Study with charts and models of all organ systems mentioned above.
- ✓ Microscopic slides examination of elementary human tissues, cells.

REFERENCES

1. Solomon. E.A., (2008) Introduction to Human Anatomy and Physiology 3rd Ed, Saunders: St Louis.
2. Chaursia, B.D., & Garg, K., (2012) *Human Anatomy Regional and Applied.* CBS Publications: New Delhi
3. T.S. Ranganathan – *A text book of Human Anatomy*
4. Fattana, Human anatomy (Description and applied) *Saunder's & C P Prism Publishers*, Bangalore – 1991

SPOKEN ENGLISH & COMMUNICATION

Course Hours (Theory):30 hours
Course Hours (Practicum): 15 hrs

COURSE OBJECTIVES: On completion of the course the students will be able to:

1. Improve their fluency in English.
2. Participate in class discussions and question-answer sessions with confidence
3. Improve their vocabulary and utilize English as the only medium of communication.
4. Comprehend the basics of letter writing and formatting of a letter.
5. Understand the various types of letters used for written communication.
6. Effectively write a report using grammatical sentences.

SPOKEN ENGLISH & COMMUNICATION Module 1: Communication

Definition of communication, need for communication its classification and purpose.

Various barriers of communication and major difficulties in communication. The characteristics of successful communication – The seven C's. The human needs and communication "Mind mapping". Information communication. Communication in the health care set up.

Module 2: Comprehension Passage

Reading purposefully **-** Understanding what is read - Drawing conclusion - Finding and analysis

Module 3: Explaining

How to explain clearly - Defining and giving reasons - Explaining differences - Explaining procedures - Giving directions

Module 4: letter writing

Types of letters – Business letters - How to construct correctly - Formal language – Address

– Salutation – Body – Conclusion- Providing information to superiors in written form.

Module 5: Report writing

Reporting an accident - Reporting what happened at a session - Reporting what happened at a meeting

Module 6 : Conversational English Exercises

Self introduction, Explanation of various procedures, Reporting of any mishap, Explaining to a patient, Conversing with the doctor on patient care status.

SPOKEN ENGLISH & COMMUNICATION

Module 1: Communication

Role play / skit as a practical exercise **Module 2: Comprehension Passage**

Comprehension passage as an exercise **Module 3: Writing a letters**

Formulate a business letter and a letter to a friend / family

Module 4: Report writing

Write a report on your recent visit to a place of interest.

REFERENCES

1. English Grammar Collins, Birmingham University, International Language Data Base, Rupa & Co.
2. Wren and Martin - Grammar and Composition, 1989, Chanda & Co, Delhi
3. Letters for all Occasions. A S Myers. Pub - Harper Perennial
4. Spoken English V. Shasikumar and P V Dhanija. Pub. By: Tata Mcgraw Hill, New Delhi

BASICS OF COMPUTER SCIENCE Course Hours (Theory): 30 hours
Course Hours (Practicum): 15 hrs

COURSE OBJECTIVES: On completion of the course the students will be able to

1. Comprehend the parts of a computer and the different operating systems.
2. Utilize the MS word for typing letters and text.
3. Effectively use features in MS word to manipulate text and insert pictures and various fonts.
4. Prepare and use effectively a PowerPoint presentation.
5. Utilize the internet for web searches and e- mail
6. Appreciate the contribution of HIS to the healthcare industry.
7. Describe the uses of the hospital information system.

Basics of Computer

Module 1: Introduction to the Computer

Parts of a computer, I/O devices – memories – RAM and ROM. Networking – LAN, WAN, MAN(only basic ideas)

Module 2: Introduction to Microsoft Word

Typing text in MS word, manipulating text, formatting the text & using different font sizes, bold, italics. Using Bullets and numbering, insertion of pictures, & file insertion. Aligning of the text and justify.

Module 3: Microsoft PowerPoint

Preparing new slides using MS-PowerPoint. Inserting slides, slide transition and animation. Using templates, different text and font sizes. Inserting slides with sounds, inserting clip arts, pictures, tables and graphs. Presentation using wizards

Module 4: Introduction to the Internet

Definition about the World Wide Web & brief history. Using search engine and beginning Google search – Exploring the next using Internet Explorer and Navigator – Uploading and Download of files and images – E-mail ID creation – Sending messages – Attaching files in E-mail

Module 5: Introduction to the Hospital Information System

Definition of Hospital Information system, Architecture of a HIS, aim and uses of HIS, types of HIS Benefits of using a hospital information system.

Basics of Computer (Practicum)

Module 1: Introduction to Microsoft Word

Type a text document, save the document. Align the text with different formats using Microsoft Word. Inserting a table ensuring proper alignment of the table using MS word **Module 2: Microsoft Power Point**

Preparing a slide show with transition, animation and sound effect using MS – Power Point. Customizing the slide show by inserting pictures and tables in the slides using MS – Power Point.

Module 3: Introduction to the Internet

Create an e – mail account. Use the internet to search for a subject of interest.

REFERENCES:

1. Murray H., (2003) Teach yourself basic computer skills, Trans Atlantic publishers.
2. Bennet A., (1996) Computers: Technology, Electronics and Internet, Holy Hail Publishers
3. Prokosh H. U., Dudeck, J., (1995) Hospital Information Systems: Design and Development
Characteristics, Impact and Future Architecture, Elsevier : St Louis.

Scheme of Examination

Paper	Subject	Internal assessment		Theory exam		Practical exam		Viva
		Max	Min	Max	Min	Max	Min	Max
I	Fundamentals of Radiation Physics & Physics of Diagnostic Radiology	50	25	100	50	100	50	50
II	Radio Diagnostic Equipments - Instrumentation, Radiation Safety & Quality Control	50	25	100	50	-	-	-
III	Clinical Radiography & Dark room Techniques	50	25	100	50	100	50	50
IV	Contrast & Special Radiographic Procedures	50	25	100	50	100	50	50

Distribution of the theory Marks

Type of Questions	Distribution of marks	Total Marks
Long Essays	2 x 20 = 40	
Short Notes	10 X 6 = 60	100