



NIMS UNIVERSITY

SYLLABUS

OF

MASTER OF RADIATION TECHNOLOGY – MRT

VERSION 1.2

DIRECTORATE OF DISTANCE EDUCATION

Shobha Nagar, Jaipur-Delhi Highway (NH-11C), Jaipur- 303121
Rajasthan, India

MASTER OF RADIATION TECHNOLOGY – MRT

Eligibility	:	Graduate in related field
Programme Duration	:	2 Years
Programme Objectives	:	Our Master program in Radiation Technology combines both theoretical and clinical instructions covering topics such as physiology, anatomy, radiation physics, radiation imaging, radiation protection, positioning of patients, radiographic techniques, medical terminology and patient care procedures. Using new imaging techniques, alongside doctors and nurses, you will help in quicker and more accurate diagnosis of illness. We are one of the few premium institutes in India to offer this program.
Job Prospects	:	After the completion of MRT, you will find a challenging career in hospitals, trauma centers and private laboratories. You can also explore a career in nuclear imaging . As it's a very demanding profession, candidates seek career in various specializations, under radiology where the remunerations are high. Common job profiles of students after completing MRT include: Diagnostic Imaging Technologist, Radiation Therapist, Nuclear Medicine Technologist, Sonographer, Magnetic Resonance Imaging Technologist, Academics in Radiation technology

YEAR I

Course Code	Course Title	Theory/ Practical	Continuous Assessment (Internals)	Credits
ANT16101	Human Anatomy & Physiology	70	30	4
PAT16102	Pathology & Terminology	70	30	4
RAD16101	Image Production & Evaluation	70	30	4
RAD16102	Equipment Operation and Quality Control	70	30	4
RAD16103	Radio Diagnosis & Radio Graphic Procedures	70	30	4
BOX16101	Biostatistics & Hospital Management	70	30	3
PCE16101	Patient Care & Evaluation	70	30	4
RAD16104	Radiation Hazards, Prevention and Safety	70	30	4
RAD16105P	Radio Imaging & Diagnosis-I	35	15	1
			Total	32

YEAR II

Course Code	Course Title	Theory/ Practical	Continuous Assessment (Internals)	Credits
RAD16201	Radiation Protection & Advanced Diagnostic Techniques	70	30	5
RAD16202	Ultrasound and Computerized Tomography	70	30	5
RAD16203	Radiography & Photography	70	30	5
RAD16204	Special Investigation & Technology	70	30	5
RAD16205	MRI and Nuclear Medicine Imaging	70	30	5
RAD16206	Recent Advancements in Modern Imaging Technology	70	30	5
RAD16207P	Radio Imaging & Diagnosis-II	35	15	1
DSR16201	Dissertation	200		1
			Total	32

DETAILED SYLLABUS

INSTRUCTIONAL METHOD: Personal contact programmes, Lectures (virtual and in-person), Assignments, Labs and Discussions, Learning projects, Industrial Training Programmes and Dissertation.

YEAR I

HUMAN ANATOMY & PHYSIOLOGY- ANT16101

UNIT	CONTENTS
1	<p>Introduction: Overview of the structure Organization of the human body Anatomical terminology as a communicative device.</p> <p>Cell- Cell morphology and diversity Introduction to ultra structure and function of cell organelles and cell inclusions.</p> <p>Tissues- Macroscopic and microscopic studies of epithelial tissue, general connective tissue, cartilaginous tissue, bone tissue, muscle tissue, nervous tissue and the integument, major functional advantages of each tissue type.</p> <p>Skeletal Muscles- Major skeletal muscles of the head, Neck, Thorax, Abdomen and upper and lower limbs.</p> <p>General Osteology- General morphology of bones Structural classification of bones Identification and naming of individual bones of the skeleton Development and growth of skeletal tissue and bones.</p> <p>General Astrology- Structural and functional classification of joints General morphology of a synovial joint and associated structures Movements made available by synovial joints Detailed Osteology and Astrology- Naming and identification of osteological features of individual human bones Naming, Identification and application of classifications to the major joints of the human body Examples of variability in the human skeleton.</p>
2	<p>Cardiovascular System: Macroscopic features, function and location of the adult and foetal heart and the location of major arteries and veins Macroscopic features of blood vessels including arteries, veins and capillaries; morphological features of the cellular components of blood.</p> <p>Lymphatic System- Macroscopic features, Major function and location of the lymphatic vascular structures, Lymph nodes, Tonsils and other mucosa-associated lymphatic tissue, Spleen and thymus; Microscopic anatomy of lymph nodes.</p>

	<p>Nervous System- Macroscopic features and major functions of the brain and spinal cord Morphological features and major functions of the contents of the peripheral nervous system and autonomic nervous system.</p> <p>Respiratory System- Macroscopic features and major functions of the nasal cavity Paranasal sinuses Pharynx, Larynx, Trachea, Bronchi, Lungs and Thoracic wall including the thoracoabdominal diaphragm General microscopic anatomy of the epithelium of the respiratory tract and the lungs.</p> <p>Digestive System- Macroscopic features and major functions of the Mouth, Salivary glands, Pharynx, esophagus, stomach, small and large intestines, liver pancreas, biliary system and peritoneal cavity; general microscopic anatomy of the esophagus, stomach, small intestine, pancreas and liver.</p>
3	<p>Urinary System: Macroscopic features, Major functions and location of the kidneys, Ureters, Urinary bladder and the urethra; Microscopic anatomy of the kidney.</p> <p>Endocrine System – Macroscopic features Location and basic function of the hypothesis cerebri Thyroid gland Parathyroid glands Suprarenal glands Pineal gland and organs with a minor endocrine function Microscopic anatomy of the hypothesis cerebri Thyroid gland, Bulbourethral glands.</p> <p>Male Reproductive System- Macroscopic features, Major functions and location of the scrotum, Testes, Epididymis, Ductus deferens, Inguinal canal, Seminal vesicles, Prostate gland, Bulbourethral gland and penis; Microscopic anatomy of the testis.</p> <p>Female Reproductive System- Macroscopic features Major functions and location of the ovaries Uterine tubes, Uterus, Vagina and external genitalia; Microscopic anatomy of the ovary.</p> <p>Special Senses- Macroscopic features and major functions of the contents of the orbital cavity, The eyeball, Lacrimal apparatus, and external, Middle and internal ear; Microscopic anatomy of the photosensitive retina.</p>
4	<p>Upper Limb: Relevant osteology Detailed plain radiographic anatomy of skeletally mature and immature individuals Regional and surface anatomy of the shoulder, axilla, and upper limb with and emphasis on blood and lymphatic vessels MRI and axial sectional anatomy of the glen humeral joint.</p> <p>Lower Limb- Relevant osteology Detailed plain radiographic anatomy of skeletally mature and immature individuals Regional and surface anatomy of the hip, thigh, crus and pes, with an emphasis on blood and lymphatic vessels</p>

	<p>MRI of the knee joints; angiography of the lower limb.</p> <p>Head and Neck- Relevant osteology of the skull and cervical vertebrae, Surface anatomy, Lymphatics, Major blood vessels and nerves of the head and neck</p> <p>Regional anatomy of the brain and its meanings- Axial, Coronal and Sagittal sectional anatomy of the head and axial sectional anatomy of the neck Plain radiographic anatomy Computerized tomography MRI and angiography of the head and neck.</p>
5	<p>Cross sectional anatomy of body: Radiographic anatomy of different radiographs in various projections Surface anatomy and applied anatomy pertaining to Radiology.</p>
6	<p>General Physiology: Structure of cell membrane. Transport across cell membrane and Homeostasis Blood- A B O System & mismatch-transfusion WBC plasma protein Erythrocytes Hemoglobin. Normal values of Blood (composition & function) Nerve Neuron AHC- Structure, Classification & Properties R.M.P., Action potential Propagation of nerve impulse Degeneration & regeneration Reaction of degeneration. Muscle- Structure -properties -classification -excitation/contraction coupling, Motor, EMG - factors affecting muscle transmission, Neuromuscular transmission.</p>
7	<p>C.N.S. & P.N.S. - Receptor Physiology: Classification & properties Synapse structure Properties, & transmission Reflexes-structure, properties, & transmission Sensory & Motor Tracts -effect of transaction (Complete & Incomplete) at various levels Physiology of Touch , Pain, Temperature & Perception Physiology of Muscle Tone (muscle spindle), Stretch, Vestibular Apparatus mainly organ Anatomy, Function of Basal ganglia, Thalamus, Hypo-Thalamus, Pre-Frontal lobe, P.A.S., Sensory / motor cortex, Sensory / motor cortex, Limbic System, Learning , memory & condition reflex, Physiology of Voluntary movement.</p>
8	<p>Excretory System Kidneys-(short note) -structure & function, urine formation Maturation - neural control- neurogenic bladder, Temperature Regulation, Circulation of the skin-body fluid-electrolyte balance, Endocrine, Secretion -regulation & function of Pituitary-thyroid-parathyroid Pancreas</p> <p>Reproductive System- Functions of Estrogen Progesterone & Testosterone Puberty & Menopause Special senses Eye-Errors of refraction-accommodation-reflexes-dark & light Adaptation photosensitivity Ear, skin.</p> <p>Respiratory System- Introduction General organization Mechanics of respiration Pulmonary Volumes & capacities Anatomical &Physiological Dead space- ventilation/perfusion ratio</p>

	<p>Alveolar ventilation Transport of respiratory gases Nervous & Chemical control of respiration Pulmonary function tests-Direct & indirect method of measurement Physiological changes with altitude & acclimatization</p> <p>Cardiovascular System- Structure & properties of cardiac muscle Cardiac cycle Heart rate regulation-factors affecting Heart Rate</p> <p>Blood pressure- Definition -regulation-factors affecting</p> <p>Cardiac output- Regulation & function affecting Peripheral resistance Venous return Regional circulation-coronary-muscular Cerebral, Normal ECG</p>
--	---

LEARNING SOURCE: Self Learning Materials

ADDITIONAL READINGS:

- A. Anatomy and Physiology for Radiographers-C.A. Warrick
- B. Gray's anatomy Descriptive and applied –T.B. Johnston.
- C. Foundation of Anatomy and Physiology-Ross and Wilson
- D. An Atlas of Normal Radiographic Anatomy-Richard & Alvin

PATHOLOGY & TERMINOLOGY- PAT16102

UNIT	CONTENTS
1	<p>Introductory Pathology: Cellular adaptation and cell death Inflammation and repair; infection; circulatory disorders; immune defense Genetics of disease Neoplasia Cell injury and adaptation- Atrophy, Hypertrophy, Metaplasia, Hyperplasia</p> <p>Classification of tumors, Premalignant lesion Types of inflammation & system manifestations of inflammation Disorders of vascular flow & shock (Brief introduction) Oedema, Hyperemia or congestion, Thromboses, Embolism, Infarction shock, Ischemia, Over hydration, Dehydration The Response to infection Categories of infectious agents, Host barriers to infection</p> <p>How disease is caused Inflammatory response to infectious agents</p>

	Hematopoietic and Lymphoid System- Hemorrhage, Various type of Anemia, Leucopenia, Leukocytosis, Bleeding disorders coagulation mechanism.
2	Fundamentals of Medical Terminology: Word Roots, Prefix, Suffix, Abbreviations & Symbols Introduction to Anatomy & Physiology Organs & Systems Gastro intestinal, Respiratory, Circulatory, Renal, Reproductive, Nervous, Common Diseases & Procedures, Gastro intestinal, Cholecystitis, Cholelithiasis, Appendicitis, Intestinal Obstruction, Peritonitis Gastro copy- Endoscopy, Laparotomy, laparoscopy, Common Diseases & Procedures, Respiratory, Tuberculosis, Bronchial Asthma, Respiratory Failure, Pulmonary Emboli son, Pneumonia, Bronchoscopy, Pulmonary Function test, Cardio-Pulmonary, Resuscitation.
3	Fundamentals of Medical Terminology-II: Circulatory ,Hypertension ,Coronary Artery Disease ,Arrhythmias, Cardiac Arrest ,Shock, Deep Vein thrombosis (DVT) , ECG,2D Echo Cardiogram, Coronary Angiography, Cardiac Catheterization, Stress test, Pacemaker, Renal, Nephrotic Syndrome ,Urinary Tract Infection Renal /Bladder Stones Intravenous Pyelography, Cystoscopy, Urinalysis, Haemodialysis, Peritoneal Dialysis ,Reproductive, Female - breast cancer /Self Examination, Menstrual Disorders, Dysmenorrheal, Premenstrual Syndrome (PMS), Menorrhagia Ovarian, Cyst, Fibroids, Malignancy, Infertility Mammography, Ultra Sound, Laparoscopy, IV F, Tubectomy, D& C, Male - Prostate Enlargement, Hydrocele, Impotence, T transurethral Research of Prostate, Nervous Stroke (Cerebro Vascular Accident), Brain Tumor, Brain Injuries, Spinal Cord Injuries, Lumbar Puncture, Myelography, CT Scan, MRI, EEG, EMG, Oncology, Investigations, Tumor markers, RECIST Criteria for response evolution

LEARNING SOURCE: Self Learning Materials

ADDITIONAL READINGS:

- A. Robbins Basic Pathology
- B. Robbins and Cotran Pathologic
- C. Basis of Disease Medical Terminology for Health Professions

IMAGE PRODUCTION & EVALUTION- RAD16101

UNIT	CONTENTS
1	Factors affecting recorded detail: Density Distortion and contrast The relationship among density, distortion, contrast, and recorded detail Factors that govern the selection of films, screens and grids The relationship between films and screens The effect of factors influencing exposure control such as the nature of the radiographic procedure, films, screens, and grids selected; power setting used; and beam limitation and scatter Exposure calculations for various radiographic procedures Advantages and disadvantage associated with automatic exposure control.
2	Factor affecting the decision to use automatic exposure controls: Simulated radiographic procedure, Use, Technique, Charts to select exposure factors, Film storage Considerations

	Radiographic identification procedures Periodic maintenance for automatic film processors Procedures for loading and unloading Computed radiography systems.
3	Digital Image: The effects of frequency, Contrast, and noise on digital image quality Function of digital image window level and width controls Picture archival and communication systems (PACS) Film archival, Diagnostic quality of radiographs.

LEARNING SOURCE: Self Learning Materials

ADDITIONAL READINGS:

- A. Mosby's Comprehensive Review of Radiography

EQUIPMENT OPERATION AND QUALITY CONTROL- RAD16102

UNIT	CONTENTS
1	Various Radiographic equipment and accessories: Component parts labeling Equipments used for Sonography Computed radiography CT technology MRI technology and digital radiography Differences in various types and models of portable radiographic equipment Differences in portable and non-portable radiographic equipment.
2	X-Ray Tube: Theory of operation of an X-ray tube Construction and function of an X-ray tube Determine the maximum allowable exposure factor for various radiographic procedures using an X-ray tube rating chart Simulations of radiographic exposures and anode and tube housing cooling charts Determine the rate of anode and tube housing cooling X-ray tube warm-up procedures for radiographic equipment from various manufactures.
3	Safety checks of radiographic equipment: Safety checks of radiographic equipment and accessories such as lead aprons and gloves and collimator accuracy Identify symptoms of malfunctions in radiographic equipment Procedures for malfunctions of radiographic equipment Detailed of Sonography CT scan & MRI

LEARNING SOURCE: Self Learning Materials

ADDITIONAL READINGS:

- A. Essentials of Radiologic Science Workbook Robert A. Fosbinder
- B. Textbook of Radiographic Positioning and Related operation and quality control

RADIO DIAGNOSIS & RADIOGRAPHIC PROCEDURES- RAD16103

UNIT	CONTENTS
1	Positioning Terminology: Types and functions of immobilization and positioning devices, Radiographic procedure, Appropriate breathing instruction for patient Positioning and technique variations for various radiographic procedures Procedures for patient preparation.
2	Types of Contract Media: Contract media with radiographic procedures Specific contract medium Indications, Contraindications and the adverse reactions associated with its use. Routine and special radiographic procedures Steps for patient preparation and patient positioning Routine and special radiographic procedures Equipments needed and the exposure setting that are consistent with A.R.R.T. specifications.
3	Different Radiographic Procedures: Learning & system of Sonography Different means of Sonography and diagnostic procedures Learning regarding advancement and new technology in the field of radio diagnosis Learning regarding CT scan, complete functioning CT scan a way of diagnostic procedures Learning in MRI Techniques and its usefulness in different diagnostic procedures Learning of different aspects of digital radiology, CR System and DSA.

LEARNING SOURCE: Self Learning Materials

ADDITIONAL READINGS:

- A. A Guide to Radiological Procedures by Stephen Chapman

BIO STATICS AND HOSPITAL MANAGEMENT- BOX16101

UNIT	CONTENTS
1	Introduction and Some Basic Concepts: Sample and population. Statistical definitions. Random sampling. Testing of hypothesis. Statistical tools for collection, presentation and analysis of data relating to causes and incidence of diseases. Measurement of central tendency. Measures of variation. Frequency distribution.
2	Concept of Probability: Laws of Probability. Probability Distribution Binomial, Normal and Chi-square distribution Commonly used procedures and test of significance and estimation Correlation and regression Test of significance namely Z test, T test, Chi square test, F test

	Analysis of variance.
3	Research Statistics: Research Statistics pertaining to medical laboratory technology Testing the efficacy of manufacturing drugs Medicines and injections for curbing and controlling specific diseases Statistical analysis of instrumental data and comparison of various biological techniques used in hospitals.
4	Health care – an overview: Functions of Hospital administration Modern techniques in Hospital management Challenges and strategies of Hospital management Administrative Functions– Planning, Organizing, Staffing, Leading and Controlling Organizational Structure, Motivation and leadership. Designing health care organization.
5	Hospital Management: Medical record, House-keeping services. Laboratory performance. Management of biomedical waste. Total patient care – indoor and outdoor. Nursing and ambulance resources. Evaluation of hospital services. Quality assurance. Record reviews and medical audit.

LEARNING SOURCE: Self Learning Materials

ADDITIONAL READINGS:

- A. Methods in Bio-Statistics for medical students, Mahajan, B.K., Jaypee Brothers Medical Publishers, New Delhi.

PATIENT CARE & EVALUATION- PCE16101

UNIT	CONTENTS
1	Patient Care: Principles of body mechanics applicable to patient care Procedures for patient transfer such as table to table, table to wheelchair, wheelchair to bed, bed to stretcher, the three-man lift, and draw sheet lift Procedures for turning patients who have severe trauma, Unconsciousness, Disorientation, or Amputated limbs Radiographic procedures Patient preparation stamps.
2	Radiographic Procedures: Radiographic procedures using contract agents Appropriate contrast agent for each procedure Discuss patient preparation in terms of procedures Indications, Contraindications and symptoms of treatment for adverse reactions to contrast agents Disinfection and sterilization procedures in terms of types and methods used- Procedures for scrubbing, Donning gowns and gloves, Removing gowns and gloves, and handling sterile instruments

	Procedures for handling and disposing of infectious wastes Isolation techniques-, function, purpose and procedures.
3	Management of infectious patients: Psychological considerations for the management of infectious patients The vital signs used to assess patient condition Measurements of temperature, pulse, blood pressure, and respiration Clinical measurement and recording of temperature, pulse, blood pressure and respiration. Symptoms of cardiac arrest, anaphylactic shock, convulsion, seizure, hemorrhage, apnea, emesis, aspiration, fractures and diabetic coma/insulin reaction Acute care procedures for cardiac arrest, Anaphylactic shock, Convulsion, Seizure, Hemorrhage, Apnea, Emesis, Aspiration, Fractures, and diabetic coma/insulin reaction Use of medical equipment and supplies in treating medical emergencies.

LEARNING SOURCE: Self Learning Materials

ADDITIONAL READINGS:

- A. Principles and Techniques of Patient Care
- B. Pierson and Fairchild's Principles & Techniques of Patient Care

RADIATION HAZARDS, PREVENTION & SAFETY- RAD16104

UNIT	CONTENTS
1	Radiation Protection: Principles History & development-National & international agencies, AERB, BARC, ICRP, WHO,IAEA and their role Equivalent dose, effective dose sievert-rem Sources of radiation-natural man made & internal exposures
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 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-Thermo luminescent 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 examination: Medical research X-ray avoidance of unnecessary radiation dose
7	Radiation Emergencies: Situation preparedness, safety and prevention-legal requirements Recent developments in radiation safety related topics

LEARNING SOURCE: Self Learning Materials

ADDITIONAL READINGS:

- A. Radiation Protection in Hospital. Richard F. Mould
- B. Basic radiological physics, Jaypee brothers pvt. Ltd New Delhi
- C. An Introduction to Radiation Protection Allen Martin “& Samuel
- D. Radiation safety in Medical practice. M.M. Rechami

RADIO IMAGING & DIAGNOSIS–I RAD16105P

UNIT	CONTENTS
1	Practical I- Radiographic positioning of various parts Immobilization technique in pediatrics radiography Selection of contrast media & its application Its indication and contraindication, management of reaction/ side effects Application of conventional radiography , USG, CT & MRI techniques Systematised use of CR ,DR,DSA etc. Recent radiological techniques
2	Practical II- Practice of statistical data of radiological patients Demand and expenditure of consumable items in radiology Repeat film analysis, Film fog analysis Film processing chemical audit Justification of Radiological procedure & its importance in various ailments. Preparing of charts and statistics of radiological procedure showing their use and advantage Patient identity Care of critical ill patient Emergency patient Management of unconscious patient's radiological investigation Various techniques of shifting the patient on x - ray couch and off the couch Measuring of BP, PULSE, application of oxygen, IV lines Sterilization of apparatus/equipments/accessories required in radiological procedures

	Psychological and sympathetically treatment & dignity of pt
3	Practical III- Radiation hazards & protection of worker patient and gen. Public Use of protective devices Use of ionisation chamber Use of TLD badges Management and care of radiation injuries
4	Practical IV- Identification & thorough knowledge of human body's anatomy and physiology Reorganization of all radiological anatomy on imaging film Knowledge of body systems and their function and practical demonstration Physiological exercises acute & chronic muscle strength power Practice of physical rehabilitation Benign and malignant pathological specimens identification, oncology division (Med. Surg. & Radiation) Practice of image development manually and automatically and dry film processing Chemistry Laser printers, Laser camera, Combination of film screen cassette I.P. exposure selection for particular radiological procedure, Anatomical landmarks for field selection during radiological investigation Dark room design & selection Loading /unloading of cassettes ,Dry and wet area in dark room AEC, CRR, DR, PACS
5	Practical V- Diagrams of body parts radiographic equipments X-ray tube, models Use of portable radiography machines Detail practical of CT, MRI & USG

LEARNING SOURCE: Self Learning Materials

ADDITIONAL READINGS:

- A. A Guide to Radiological Procedures by Stephen Chapman

**RADIATION PROTECTION & ADVANCED DIAGNOSTIC
TECHNIQUES- RAD16201**

UNIT	CONTENTS
1	<p>Beam Restricting Devices: Describe the use and function of beam limiting devices Beam filtration and shielding devices Relationship between exposure factors and patient dosage Nature and function of the ten-day rule Screen and exposure setting combination that will minimize the radiation dosage that patients receive.</p>
2	<p>Radiographic Procedures: Methods to avoid repeat radiographs Purpose of primary and secondary radiation barriers and room construction and Design in terms of personnel protection Radio diagnosis & radiographic equipments and techniques used to reduce personnel exposure during radiographic Fluoroscopic, mobile, and surgical procedures.</p>
3	<p>Radiographic Devices: Types and purposes of personnel protective devices used during radiographic, fluoroscopic, mobile, and surgical procedures Types, uses, and purpose of patient restraint devices for reducing personnel radiation exposure Personnel monitoring devices in terms of purposes, types, characteristics, advantages and disadvantage.</p>
4	<p>Introduction to computer: History and development of computer Basics storage and transfer of data- operation of computer, Performance of computer systems Computer software and hardware Storage acquisition processing and display of digital images- Care and preventive maintenance of the computer system.</p>
5	<p>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 generation-Image quality Patient exposure-artifacts 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.</p>
6	<p>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 and image quality:- Laser film printers.</p>

7	<p>Interventional Procedures: C.T. Guide procedures Fine needle aspiration cytology Fine needle aspiration Biopsy Stereo tactic biopsy- Radio surgery</p> <p>Ultrasound Guided Procedures- Fine needle aspiration Cytology Fine needle aspiration Biopsy Fluoroscopy guided procedure Endoscopic Retrograde Choledoch Pancreatography Percutaneous Nephrolithotomy- Percutaneous Nephrostomy, Percutaneous transhepatic biliary drainage, Angioplasty- Embolisation- Transjugular liver biopsy.</p>
---	--

LEARNING SOURCE: Self Learning Materials

ADDITIONAL READINGS:

- A. Fundamentals of Diagnostic Radiology William E. Brant, Clyde A. Helms

ULTRASOUND AND COMPUTERIZED TOMOGRAPHY- RAD16202

UNIT	CONTENTS
1	<p>Measures to Control Scatter Radiation: Recent developments in x-ray tube technology Advancements in H.T. generators Measure to control scatter radiation including- Beam centering devices Collimator cone diaphragms and grids Fluoroscopy and IITV systems- Cine radiography with various recording devices Tomography principles, various types and its applications</p>
2	<p>Computed Tomography: Principle, Data acquisition, Concepts, Image reconstruction, Instrumentation, Image manipulation Historical developments-Variou generators, Spiral/helical, Single slice Multi slice CT, Electron beam CT, Mobile CT, Advance volume scanning, Continuous sub second scanning, Real time CT Fluoroscopy Interventional guidance tool 3D CT Angiography Virtual reality imaging Including image quality and quality control in CT scanners Computer Tomography Various imaging protocols and technique</p>
3	<p>Basic principles of U.S. Various types of transducer Mechanism of image formations of Abdominal organ and pelvic organ (Aorta IV, C Liver,</p>

	Gall bladder, Pancreas, Spleen, Kidney, Urethras, Urinary bladder etc) various advancement, Doppler and image artifacts, Physical aspects of ultra sonography including Doppler color Doppler flow imaging Power Doppler Clinical application of U.S. including use of contrast media in U.S.
--	---

LEARNING SOURCE: Self Learning Materials

ADDITIONAL READINGS:

- A. Fundamentals of Diagnostic Radiology William E. Brant, Clyde A. Helms

RADIOGRAPHY & PHOTOGRAPHY- RAD16203

UNIT	CONTENTS
1	<p>Photographic Process: Radiographic film Image processing Manual as well as automatic, Sensitometer, Intensifying screens Film/screen combinations/analyzing the image</p> <p>Establishing image standards- Professional imaging standards, The analytical process, Acceptance limits</p> <p>Radiographic Quality- Density: contrast, Recorded detail, distortion</p> <p>The art of films critique- Implementing imaging standers, Identifying an image problem.</p>
2	<p>Quality Management: Quality assurance and quality control Comparing exposure systems Developing exposure charts Fixed kilovoltage system, Variable kilovoltage system Other exposure systems Automatic exposure controls</p>
3	<p>Exposure conversion problems: Planning of a processing room as well as of a radiology department Day light processing system Image recording devices- Video recorder, Multi format camera, Laser camera, Dry camera etc. Photo fluoroscopy Special imaging processes- Copying, radiography, Xero-radiography, Subtraction technique.</p>

LEARNING SOURCE: Self Learning Materials

ADDITIONAL READINGS:

- A. Medical Radiographic Technique and Dark Room Practices Krishnamurthy

SPECIAL INVESTIGATION & TECHNOLOGY- RAD16204

UNIT	CONTENTS
1	Special Investigation: Soft tissue radiography, High KV techniques, Macro Radiography, Mammography Foreign body localization.
2	Types of Radiography: Operation theater radiography Trauma and ward radiography Pediatric radiography Special procedures: HSG, Myelography, Orthography, DCG
3	Interventional procedures: PTC, ERCP, PCN and FNAC: Fluoroscopy/ US/CT guided. Angiographic procedures Vascular/non –vascular MRI-Various imaging protocols and techniques Digital imaging , applications and advancements
4	Use and function of beam limiting devices: Beam filtration, and shielding devices. Relationship between exposure factors and patient dosage Nature and function of the ten-day rule Screen and exposure setting combination that will minimize the radiation dosage that patients receive.
5	Methods to avoid repeat radiographs: Purpose of primary and secondary radiation barriers Room construction and design in terms of personnel protection Radio diagnosis, Radiographic equipments and techniques used to reduce personnel exposure during radiographic, fluoroscopic, mobile, and surgical procedures.
6	Types and purposes of personnel protective devices: Types and purposes of personnel protective devices used during radiographic, fluoroscopic, mobile, and surgical procedures Types, uses, and purpose of patient restraint devices for reducing personnel radiation exposure Personnel monitoring devices in terms of purposes, types, characteristics, advantages, and disadvantage.

LEARNING SOURCE: Self Learning Materials

ADDITIONAL READINGS:

- A. Introduction to the Principles of Medical Imaging Chris Guy , Dominic Fitches

MRI AND NUCLEAR MEDICINE IMAGING- RAD16205

UNIT	CONTENTS
1	MRI: Basic principles of MRI Complete imaging equipment and various requirements Basic principles of MRI T1 and T2 Relaxation Behaviors of tissues T1T2 and proton density images Spiral localization of images Types of imaging sequences (Spin echo, fast spin echo, flash, inversion recovery, gradient echo etc.) MR spectroscopy, principles and techniques Contrast agents in MRI, image quality Image artifacts and its compensators NMR hazard and safety Advances in MRI.
2	NMI: Radionuclide scanning including thyroid up takes measurement Rectilinear scanner Gamma camera, PET,SPECT-their principles working applications and advancements
3	Radiography: Computerized radiography, Digital radiography including DSA, principles, working applications and advancements

LEARNING SOURCE: Self Learning Materials

ADDITIONAL READINGS:

- A. Introduction to the Principles of Medical Imaging Chris Guy , Dominic Fitches

RECENT ADVANCEMENTS IN MODERN IMAGING TECHNOLOGY- RAD16206

UNIT	CONTENTS
1	Special Techniques: Special Techniques of the following- Radiographic techniques of whole upper limb & shoulder girdle Radiographic techniques of whole lower limb and pelvic girdle Radiographic techniques of whole vertebral column, skull, cranial bones and facial bones Dental radiography, Intra oral, Extraoral as well as occlusal radiograph.
2	Radiographic Technique: Radiographic technique of whole thorax including Lungs, Mediastinal, Heart, Ribs, Diaphragms Special Procedure For Liver, Pancreas, Spleen, Biliary system, GI tract and Genitourinary

	tract Radiographic techniques for Obstetrics and Gynecology studies, Radiographic techniques for cardio-vascular system Radiographic techniques for lymphatic system
3	Recent Advances: Recent advances in Ultrasound, Probe designing, High frequency probes and contrast sonography
4	Recent Advances in CT: Recent advances in CT, MDCT, Multi tube CT, Electron beam CT and latest detector systems
5	Recent Advances in MRI: Recent advances in MRI, newer sequences, MRS, functional MRI and Cardiac MRI
6	Recent Advances: Recent advances in PET-CT, newer isotopes other than FDG, PET MRI

LEARNING SOURCE: Self Learning Materials

ADDITIONAL READINGS:

- A. Introduction to the Principles of Medical Imaging Chris Guy , Dominic Ffytche

RADIO IMAGING & DIAGNOSIS –II- RAD16207P

UNIT	CONTENTS
1	Practical I- Practical knowledge of mammography OT techniques Use of C-Arm IITV Pediatric radiography Special radiography HSG, Orthography, Interventional procedure, PTC, ERCP, US/CT guided FNAC, DSA, DEXA MRI protocols & application of T1 * T2 Wt relaxation time image MRCP
2	Practical II- Knowledge of Radiation protection devices & AERB rules Safety codes Planning of X – Ray room Dimensions Wall thickness Shielding devices

LEARNING SOURCE: Self Learning Materials

ADDITIONAL READINGS:

- A. Introduction to the Principles of Medical Imaging Chris Guy , Dominic Ffytche