

# NIMS UNIVERSITY, JAIPUR



## SYLLABUS

# MASTER OF RADIATION TECHNOLOGY

**MASTER OF RADIATION TECHNOLOGY**

Sl. No.	Subject Code and Subject Name	Theory	Practical
<b>YEAR - I</b>			
1.	ANATOMY & PHYSIOLOGY	100	100
2.	PATHOLOGY & TERMINOLOGY	100	100
3.	IMAGE PRODUCTION AND EVALUATION	100	50
4.	RADIODIAGNOSIS & RADIOGRAPHIC PROCEDURE	100	50
5.	EQUIPMENT OPERATION AND QUALITY CONTROL	100	-
6.	RADIATION PROTECTION	100	-
7.	PATIENT CARE AND EDUCATION	100	-

Sl. No.	Subject Code and Subject Name	Theory	Practical
<b>YEAR - II</b>			
1.	LEARNING REGARDING RADIOTHERAPY	100	-
2.	BIOSTATISTICS	100	-
3.	ULTRASOUND AND COMPUTERIZED TOMOGRAPHY	100	-
4.	MODERN IMAGING TECHNIQUES	100	50
5.	RADIOGRAPHIC PHOTOGRAPHY	100	50
6.	SPECIAL INVESTIGATION AND TECHNOLOGY	100	50
7.	MRI AND NUCLEAR MEDICINE IMAGING	100	50

## ANATOMY & PHYSIOLOGY

<b>UNIT 1</b>	<p><i>Introduction:</i> Overview of the structural organisation of the human body; anatomical terminology as a communicative device.</p> <p><i>Cells:</i> Cell morphology and diversity; introduction to ultrastructure and function of cell organelles and cell inclusions.</p> <p><i>Tissues:</i> 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><i>Skeletal Muscles:</i> Major skeletal muscles of the head, neck, thorax, abdomen and upper and lower limbs.</p> <ul style="list-style-type: none"> <li>□ <i>General Osteology:</i> 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.</li> <li>□ <i>General Arthrology:</i> Structural and functional classification of joints; general morphology of a synovial joint and associated structures; movements made available by synovial joints</li> <li>□ <i>Detailed Osteology and Arthrology:</i> 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.</li> </ul>
<b>UNIT 2</b>	<p><i>Cardiovascular System:</i> Macroscopic features, function and location of the adult and foetal heart and the location of major arteries and veins; microscopic features of blood vessels including arteries, veins and capillaries; morphological features of the cellular components of blood.</p> <ul style="list-style-type: none"> <li>□ <i>Lymphatic System:</i> 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.</li> <li>□ <i>Nervous System:</i> 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.</li> <li>□ <i>Respiratory System:</i> 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.</li> <li>□ <i>Digestive System:</i> Macroscopic features and major functions of the mouth, salivary glands, pharynx, oesophagus, stomach, small and large intestines, liver, pancreas, biliary system and peritoneal cavity; general microscopic anatomy of the oesophagus, stomach, small intestine, pancreas and liver.</li> </ul>
<b>UNIT 3</b>	<ul style="list-style-type: none"> <li>□ <i>Urinary System:</i> Macroscopic features, major functions and location of the kidneys, ureters, urinary bladder and the urethra; microscopic anatomy of the kidney.</li> <li>□ <i>Endocrine System:</i> Macroscopic features, location and basic function of the</li> </ul>

	<p>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 and suprarenal glands.</p> <ul style="list-style-type: none"> <li>□ <i>Male Reproductive System:</i> 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.</li> <li>□ <i>Female Reproductive System:</i> Macroscopic features, major functions and location of the ovaries, uterine tubes, uterus, vagina and external genitalia; microscopic anatomy of the ovary.</li> <li>□ <i>Special Senses:</i> 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.</li> </ul>
<b>UNIT 4</b>	<ul style="list-style-type: none"> <li>□ 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 an emphasis on blood and lymphatic vessels; MRI and axial sectional anatomy of the glen humeral joint.</li> <li>□ 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; MRI of the knee joints; angiography of the lower limb.</li> <li>□ Head and Neck: relevant osteology of the skull and cervical vertebrae; surface anatomy, lymphatics, major blood vessels and nerves of the head and neck; regional anatomy of the brain and its meninges; axial, coronal and sagittal sectional anatomy of the head and axial sectional anatomy of the neck; plain radiographic anatomy, computerised tomography, MRI and angiography of the head and neck.</li> </ul>

## PHYSIOLOGY

<b>UNIT 1</b>	<ol style="list-style-type: none"> <li>1. General Physiology Structure of cell membrane. Transport across cell membrane and Homeostasis (only short notes)</li> <li>2. <b>Blood:</b> Rh- A B O system &amp; mismatch-transfusion WBC plasma protein Eryt hrocytes. Haemoglobin. Normal values of Blood (composition &amp; function)</li> <li>3. <b>Nerve Neuron AHC</b> <ol style="list-style-type: none"> <li>i) Structure, classification &amp; Properties;</li> <li>ii) R.M.P.</li> <li>iii) action potential;</li> <li>iv) Propagation of nerve impulse;</li> <li>v) degeneration &amp; regeneration</li> <li>vi) Reaction of degeneration (retrograde)</li> </ol> </li> <li>4. <b>Muscle</b> <ol style="list-style-type: none"> <li>i) Structure- properties-classification-excitation/contraction coupling</li> </ol> </li> </ol>
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	<ul style="list-style-type: none"> <li>ii) Motor unit- E.M.G.- factors affecting muscle transmission</li> <li>iii) Neuro-muscular transmission</li> </ul>
<b>UNIT 2</b>	<p><b>C.N.S. &amp; P.N.S.</b></p> <ul style="list-style-type: none"> <li>i) Receptor physiology-classification &amp; properties-;</li> <li>ii) Synapse-structure, properties, &amp; transmission;</li> <li>iii) Reflexes-classification &amp; properties;</li> <li>iv) Sensory &amp; Motor Tracts-effect of transaction (complete &amp; incomplete) at various levels</li> <li>v) Physiology of Touch, Pain, Temperature &amp; Proprioception;</li> <li>vi) Physiology of Muscle Tone (muscle spindle); Stretch</li> <li>vii) Vestibular Appralus mainly ottolyth organ Anatomy</li> <li>viii) Function of Basal Ganglia, Thalamus, Hypo-Thalamus, Pre- frontal lobe, P.A.S.,</li> <li>ix) Sensory / motor cortex;</li> <li>x) Limbic system;</li> <li>xi) Learning, memory &amp; condition reflex,</li> <li>xii) Physiology of Voluntary movement</li> </ul>
<b>UNIT 3</b>	<p><b>Excretory system</b></p> <ul style="list-style-type: none"> <li>i) Kidneys- (short note)- structure &amp; function;</li> <li>ii) urine formation;</li> <li>iii) Micturition- neural control – neuroqenic bladder</li> </ul> <p><b>Temperature Regulation</b></p> <ul style="list-style-type: none"> <li>i) circulation of the skin- body fluid- electrolyte balance</li> </ul> <p><b>Endocrine</b></p> <ul style="list-style-type: none"> <li>i) secretion- regulation &amp; function of Pituitary-thyroid-adrenal-parathyroidpancreas</li> </ul> <p><b>Reproductive system</b></p> <ul style="list-style-type: none"> <li>i) Functions of Estrogen, Progesterone &amp; Testosterone</li> <li>ii) Puberty &amp; Menopause</li> </ul> <p><b>Special senses</b></p> <ul style="list-style-type: none"> <li>i) Eye-Errors of refraction-accommodation-reflexes-dark &amp; light adaptation photosensitivity Ear, Skin</li> </ul>
	<p><b>Respiratory system</b></p> <ul style="list-style-type: none"> <li>i) Introduction, general organization;</li> <li>ii) Mechanics of respiration;</li> <li>iii) Pulmonary Volumes &amp; capacities;</li> <li>iv) Anatomical &amp; Physiological Dead space-ventilation/perfusion ratio, alveolar</li> </ul>

	<p>ventilation</p> <ul style="list-style-type: none"> <li>v) Transport of respiratory gases</li> <li>vi) Nervous &amp; Chemical control of respiration</li> <li>vii) Pulmonary function tests-Direct &amp; indirect method of measurement;</li> <li>viii) Physiological changes with altitude &amp; acclimatization</li> </ul> <p><b>Cardio-Vascular</b></p> <ul style="list-style-type: none"> <li>i) structure &amp; properties of cardiac muscle;</li> <li>ii) Cardiac cycle;</li> <li>iii) Heart rate regulation-factors affecting;</li> <li>iv) Blood pressure- definition-regulation-factors affecting;</li> <li>v) cardiac output-regulation &amp; function affecting;</li> <li>vi) Peripheral resistance, venous return</li> <li>vii) Regional circulation-coronary-muscular, cerebral</li> <li>viii) Normal ECG.</li> </ul>
	<p><b>Exercise physiology</b></p> <ul style="list-style-type: none"> <li>i) Effects of acute &amp; chronic exercises;</li> <li>ii) oxygen / CO<sub>2</sub> transport-O<sub>2</sub> debt</li> <li>iii) effects of exercise on muscle strength, power, endurance, B.M.R., R.Q.-hormonal &amp; metabolic effects-respiratory &amp; cardiac conditioning</li> <li>iv) AGING</li> <li>v) Training-fatigue- &amp; recovery;</li> <li>vi) Fitness-related to age, gender, &amp; body type</li> </ul> <p><b>A.N.S.</b></p> <p>Sympathetic / parasympathetic system-adrenal medulla-functions-Neuro Transmitters-role in the function of pelvic floor-(micturation, defecation labour)</p>

### PATHOLOGY & TERMINOLOGY

<b>UNIT 1</b>	<p>Introductory <i>Pathology</i>: 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, classification of tumors, premalignant lesion, Types of inflammation &amp; system manifestations of inflammation Disorders of vascular flow &amp; shock (Brief Introduction): Oedema, hyperemia or congestion, thrombosis, embolism, Infarction shock, Ischemia, Over hydration, Dehydration, The Response to infection: Categories of infectious agents, host barriers to infection, how disease is caused, inflammatory response to infectious agents Haematopoietic and Lymphoid System: Haemorrhage, various type of Anaemia, leucopenia, leucocytosis, bleeding disorders coagulation mechanism</p>
<b>UNIT 2</b>	<p><b>Fundamentals of Medical Terminology:</b></p> <ul style="list-style-type: none"> <li>· Word Roots</li> <li>· Prefix</li> <li>· Suffix</li> <li>· Abbreviations &amp; Symbols</li> </ul> <p><b>Introduction to Anatomy &amp; Physiology</b></p> <p><b>Organs &amp; Systems</b></p> <ol style="list-style-type: none"> <li>1. Gastro Intestinal</li> <li>2. Respiratory</li> <li>3. Circulatory</li> <li>4. Renal</li> <li>5. Reproductive</li> <li>6. Nervous</li> </ol> <p><b>Common Diseases &amp; Procedures</b></p> <ul style="list-style-type: none"> <li>· Gastro Intestinal</li> <li>· Cholecystitis</li> </ul>

	<ul style="list-style-type: none"> <li>· Cholelithiasis</li> <li>· Appendicitis</li> <li>· Intestinal Obstruction</li> <li>· Hernia</li> <li>· Peritonitis</li> </ul> <p>Gastroscopy : Endoscopy , Laparotomy, Laparoscopy.</p> <p><b>Common Diseases &amp; Procedures</b></p> <ul style="list-style-type: none"> <li>· Respiratory</li> <li>· Tuberculosis</li> <li>· Bronchial Asthma</li> <li>· Respiratory Failure</li> <li>· Pulmonary Embolism</li> <li>· Pneumonia</li> </ul> <p>Branchoscopy, Pulmonary Function Test, Cardio-Pulmonary Resuscitation.</p>
<b>UNIT 3</b>	<p><b>Circulatory</b></p> <ul style="list-style-type: none"> <li>· Hypertension</li> <li>· Coronary Artery Disease</li> <li>· Arrhythmias</li> <li>· Cardiac Arrest</li> <li>· Shock. Deep Vein Thrombosis (DVT), ECG, , 2D Echo Cardiogram, Coronary Angiography, Cardiac Catheterization, Stress Test, Pacemaker.</li> </ul> <p><b>Renal</b></p> <ul style="list-style-type: none"> <li>· Nephrotic Syndrome</li> <li>· Urinary Tract Infection</li> <li>· Renal Failure</li> <li>· Renal / Bladder Stones</li> </ul> <p>Intravenous Pyelography, Cystoscopy, Urinalysis , Hoemodialis, Peritoneal Dialysis.</p> <p><b>Reproductive</b></p> <ul style="list-style-type: none"> <li>· Female – Breast Cancer/Self Examination</li> </ul> <p>Menstrual Disorders, Dysmenorrhoea, Premenstrual Syndrome (PMS), Menorrhagia Ovarian Cyst, Fibroids, Malignancy, Infertility Mammography, Ultra Sound, Laparoscopy, IVF, Tubectomy, D &amp; C.</p> <ul style="list-style-type: none"> <li>· Male - Prostate Enlargement, Hydrocele, Impotence, Transurethral Resection of Prostate (TURP)</li> </ul> <p><b>Nervous</b></p> <ul style="list-style-type: none"> <li>· Stroke ( Cerebro Vascular Accident)</li> <li>· Brain Tumor</li> <li>· Brain Injuries</li> <li>· Spinal Cord Injuries</li> </ul> <p>Lumbar Puncture, Myelography, CT Scan, MRI, EEG, EMG</p> <p><b>Oncology</b></p>

	· Investigations
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### IMAGE PRODUCTION & EVALUATION

<b>UNIT I</b>	<ul style="list-style-type: none"> <li>• Review factors affecting recorded detail, density, distortion, and contrast.</li> <li>• Discuss the relationships among density, distortion, contrast, and recorded detail.</li> <li>• Review factors that govern the selection of films, screens, and grids.</li> <li>• Discuss the relationship between films and screens.</li> <li>• Review 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.</li> <li>• Perform exposure calculations for various radiographic procedures.</li> <li>• Describe the advantages and disadvantages associated with automatic exposure control.</li> </ul>
<b>UNIT II</b>	<ul style="list-style-type: none"> <li>• Discuss factors affecting the decision to use automatic exposure controls.</li> <li>• Given a simulated radiographic procedure, use technique charts to select exposure factors.</li> <li>• Review film storage considerations.</li> <li>• Review radiographic identification procedures.</li> <li>• Discuss the daily and periodic maintenance for automatic film processors.</li> <li>• Discuss the procedures for loading and unloading.</li> <li>• Discuss the exposure of computed radiography systems.</li> </ul>
<b>UNIT III</b>	<ul style="list-style-type: none"> <li>• Describe the effects of frequency, contrast, and noise on digital image quality.</li> <li>• Discuss the function of digital image window level and width controls.</li> <li>• Describe picture archival and communication systems (PACS).</li> <li>• Discuss film archival.</li> <li>• Discuss the criteria used to evaluate the diagnostic quality of radiographs.</li> <li>• List the possible causes of poor radiograph quality.</li> </ul>

### RADIODIAGNOSIS & RADIOGRAPHIC PROCEDURE

<b>UNIT I</b>	<ul style="list-style-type: none"> <li>• Review positioning terminology.</li> <li>• Describe types and functions of immobilization and positioning devices.</li> <li>• Given a radiographic procedure, state the appropriate breathing instructions for the</li> </ul>
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	<p>patient.</p> <ul style="list-style-type: none"> <li>• Discuss positioning and technique variations for various radiographic procedures.</li> <li>• Given various radiographic procedures, describe the requisite procedures for patient preparation.</li> <li>• .</li> </ul>
<b>UNIT II</b>	<ul style="list-style-type: none"> <li>• List the types of contrast media.</li> <li>• Match contrast media with radiographic procedures.</li> <li>• Given a specific contrast medium, list the indications, contraindications, and the adverse reactions associated with its use.</li> <li>• Given a list of routine and special radiographic procedures, list the steps for patient preparation and patient positioning.</li> <li>• Given a list of routine and special radiographic procedures, select the equipment needed and the exposure settings that are consistent with A.R.R.T. specifications.</li> </ul>
<b>UNIT III</b>	<ul style="list-style-type: none"> <li>• Given training/learning regarding different radiographic procedures.</li> <li>• Given a training/learning &amp; system of sonography and different means of sonographically diagnostic procedures.</li> <li>• Given a training/learning regarding advancement and new technology in the field of radio diagnosis.</li> <li>• Given a training/learning regarding CT scan, its complete functioning and to learn CT scan a way of diagnostic procedure.</li> <li>• Given a training/learning in MRI techniques and its usefulness in different diagnostic procedures.</li> </ul> <p>Given a training/learning of different aspects of digital radiology</p>

### EQUIPMENT OPERATION AND QUALITY CONTROL

<b>UNIT 1</b>	<ul style="list-style-type: none"> <li>• Given diagrams of various radiographic equipment and accessories, label the component parts.</li> <li>• Describe equipment used for sonography, computed radiography, CT technology, MRI technology and digital radiography.</li> <li>• Discuss the differences in various types and models of portable radiographic equipment.</li> <li>• Discuss the differences in portable and non-portable radiographic equipment.</li> <li>•</li> </ul>
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<b>UNIT II</b>	<ul style="list-style-type: none"> <li>• Describe the theory of operation of an X-ray tube.</li> <li>• Describe the construction and function of an X-ray tube.</li> <li>• Determine the maximum allowable exposure factor for various radiographic procedures using an X-ray tube rating chart.</li> <li>• Given simulations of radiographic exposures and anode and tube housing cooling charts, determine the rate of anode and tube housing cooling.</li> <li>• Review X-ray tube warm-up procedures for radiographic equipment from various manufacturers.</li> </ul>
<b>UNIT III</b>	<ul style="list-style-type: none"> <li>• Perform safety checks of radiographic equipment and accessories such as lead aprons and gloves and collimator accuracy.</li> <li>• Identify symptoms of malfunctions in radiographic equipment.</li> <li>• Discuss reporting procedures for malfunctions of radiographic equipment.</li> <li>• Detailed experience of sonography, CT scan &amp; MRI.</li> </ul>

### RADIATION PROTECTION

<b>UNIT I</b>	<ul style="list-style-type: none"> <li>• Describe the use and function of beam limiting devices, beam filtration, and shielding devices.</li> <li>• Describe the relationship between exposure factors and patient dosage.</li> <li>• Describe the nature and function of the ten-day rule.</li> <li>• Given various radiographic procedures, determine the film, screen, and exposure setting combination that will minimize the radiation dosage that patients receive.</li> </ul>
<b>UNIT II</b>	<ul style="list-style-type: none"> <li>• Discuss methods to avoid repeat radiographs.</li> <li>• Describe the purpose of primary and secondary radiation barriers and room construction and design in terms of personnel protection.</li> <li>• Describe the radio diagnosis &amp; radiographic equipments and techniques used to reduce personnel exposure during radiographic, fluoroscopic, mobile, and surgical procedures.</li> </ul>
<b>UNIT III</b>	<ul style="list-style-type: none"> <li>• Discuss the types and purposes of personnel protective devices used during radiographic, fluoroscopic, mobile, and surgical procedures.</li> <li>• Describe the types, uses, and purposes of patient restraint devices for reducing personnel radiation exposure.</li> <li>• Describe personnel monitoring devices in terms of purposes, types, characteristics, advantages, and disadvantages.</li> </ul>

### PATIENT CARE AND EDUCATION

<b>UNIT I</b>	<ul style="list-style-type: none"> <li>• Verify the patient's identity by asking the patient and/or by checking the wrist band.</li> <li>• Verify the radiographic procedure requested by checking the procedure requisition form.</li> <li>• Review the principles of body mechanics applicable to patient care.</li> <li>• Demonstrate procedures for patient transfer such as table to table, table to wheelchair, wheelchair to bed, bed to stretcher, the three-man lift, and drawsheet lift.</li> <li>• Describe the procedures for turning patients who have severe trauma, unconsciousness, disorientation, or amputated limbs.</li> <li>• Given various radiographic procedures, list the patient preparation steps.</li> <li>• Given various radiographic procedures, state the appropriate instructions to be given to the patient.</li> </ul>
<b>UNIT II</b>	<ul style="list-style-type: none"> <li>• Given radiographic procedures using contrast agents, list the appropriate contrast agent for each procedure.</li> <li>• Given various radiographic procedures, discuss patient preparation in terms of procedures, indications, contraindications, and symptoms of and treatment for adverse reactions to contrast agents.</li> <li>• Given various radiographic procedures and patient information, describe the disinfection and sterilization procedures in terms of types and methods used.</li> <li>• Demonstrate the procedures for scrubbing, donning gowns and gloves, removing gowns and gloves, and handling sterile instruments.</li> <li>• Discuss procedures for handling and disposing of infectious wastes.</li> <li>• Given a list of isolation techniques, describe the function, purpose, and procedures for each.</li> </ul>
<b>UNIT III</b>	<ul style="list-style-type: none"> <li>• Discuss the psychological considerations for the management of infectious patients.</li> <li>• Describe the vital signs used to assess patient condition.</li> <li>• Identify normal values for measurements of temperature, pulse, blood pressure, and respiration.</li> <li>• Demonstrate the clinical measurement and recording of temperature, pulse, blood pressure, and respiration.</li> <li>• Describe the symptoms of cardiac arrest, anaphylactic shock, convulsion, seizure, hemorrhage, apnea, emesis, aspiration, fractures, and diabetic coma/insulin reaction.</li> <li>• Describe the acute care procedures for cardiac arrest, anaphylactic shock, convulsion, seizure, hemorrhage, apnea, emesis, aspiration, fractures, and diabetic coma/insulin reaction.</li> <li>• Describe the use of medical equipment and supplies in treating medical</li> </ul>

	emergencies.
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## SECOND YEAR

### LEARNING REGARDING RADIOTHERAPY

- Details & different techniques of radiotherapy.
- Doses of radiotherapy in different diseases.
- Different procedures of radiotherapy.
- Details of radiotherapy equipments & evaluation of patients before, during & after radiation therapy.

## BIostatISTICS

<b>UNIT 1</b>	<b>Introduction</b> Meaning, definition, characteristics of statistics. Importance of the study of statistics. Branches of statistics. Statistics and health science including nursing. Parameters and estimates. Descriptive and inferential statistics. Variables and their types.
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	Measurement scales
<b>UNIT 2</b>	<p><b>Tabulation of Data</b>  Raw data, the array, frequency distribution.  Basic principles of graphical representation.  Types of diagrams - histograms, frequency polygons, smooth frequency polygon, commulative frequency curve, ogive.  Normal probability curve. <b>Measure of Central Tendency</b>  Need for measures of central tendency  Definition and calculation of mean - ungrouped and grouped  Meaning, interpretation and calculation of median ungrouped and grouped.  Meaning and calculation of mode.  Comparison of the mean, and mode.  Guidelines for the use of various measures of central tendency.</p>
<b>UNIT 3</b>	<p><b>Measure of Variability</b>  Need for measure of dispersion.  The range, the average deviation.  The variance and standard deviation.  Calculation of variance and standard deviation ungrouped and grouped.  Properties and uses of variance and SO  <b>Probability and Standard Distributions.</b>  Meaning of probability of standard distribution.  The Binominal distribution  The normal distribution.  Divergence from normality - skewness, kurtosis.</p>
	<p><b>Samling Techniques</b>  Need for sampling - Criteria for good samples.  Application of sampling in Community.  Procedures of sampling and sampling designs errors.  Sampling variation and tests of significance.  <b>Health Indicator</b>  Importance of health Indicator.  Indicators of population, morbidity, mortality, health services.  Calculation of rates and rations of health.</p>

**ULTRASOUND AND COMPUTERIZED TOMOGRAPHY**

<b>UNIT 1</b>	Recent developments in x-ray tube technology Advancements in H.T. generators Measure to control scatter radiation including – beam centering devices, collimators, cone diaphragms and grids Fluoroscopy and IITV systems including cine radiography with various recording devices. Tomography principle, various types and its applications
<b>UNIT 2</b>	<b>Computed tomography:</b> Principle, data acquisition concepts, image reconstruction, instrumentation, image manipulation, historical developments-various generators, spiral / helical, single slice. Multislice, CT , electron beam CT, mobile CT advances in volume scanning , continuous, sub second scanning , Real time CT fluoroscopy , interventional guidance tool, 3D CT, CT angiography , virtual reality imaging , including image quality and quality control in CT scanners . Computed tomography , various imaging protocols and techniques
<b>UNIT 3</b>	<b>US:-</b> Basic principles of US, various types of transducers, mechanism of image formations of Abdominal organ and pelvic organ ( Aorta, IVC, Liver, Gall bladder,pancreas,Spleen,kidneys, ureters,urinary bladder etc.) various advancement including Doppler and image artifacts, Physical aspects of ultrasonography including Doppler, color Doppler, flow imaging, power Doppler. Clinical application of U.S. including use of contrast media in U.S.

**MODERN IMAGING TECHNIQUES**

<b>UNIT 1</b>	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 , extra oral as well as occlusal radiography
<b>UNIT 2</b>	Radiographic technique of whole thorax including lungs, mediastinal , heart , ribs , diaphragms SPECIAL PROCEDURE FOR for liver , pancreas , spleen , biliary system , GI tract and genito-urinary tract .

	<p>Radiographic techniques for obstetrics and gynecology studies.</p> <p>Radiographic techniques for cardio-vascular system</p> <p>Radiographic techniques for lymphatic system.</p>
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### RADIOGRAPHIC PHOTOGRAPHY

<b>UNIT 1</b>	<p>Photographic process: radiographic film, image processing , manual as well as automatic , sensitometer, intensifying screens, film/ screen combinations / analyzing the image 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, etc.</p>
<b>UNIT 2</b>	<p>Quality management: - Quality assurance and quality control</p> <p>Comparing exposure systems</p> <p>Developing exposure charts</p> <p>Fixed kilovolt age system</p> <p>Variable kilovolt age system</p> <p>Other exposure systems</p> <p>Automatic exposure controls</p>
<b>UNIT 3</b>	<p>Exposure conversion problems</p> <p>Planning of a processing room as well as of a radiology department</p> <p>Day light processing system</p> <p>Image recording devices, video recorder, multi format camera, laser camera, dry camera etc. photo fluoroscopy</p> <p>Special imaging processes: - copying radiography, xero-radiography, subtraction technique etc.</p>

### SPECIAL INVESTIGATION AND TECHNOLOGY

<b>UNIT 1</b>	<ol style="list-style-type: none"> <li>1. Soft tissue radiography</li> <li>2. High KV techniques</li> <li>3. Macro Radiography</li> <li>4. Mammography</li> <li>5. Foreign body localization</li> </ol>
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<b>UNIT 2</b>	<ol style="list-style-type: none"> <li>1. Operation theater radiography</li> <li>2. Trauma and ward radiography</li> <li>3. Pediatric radiography</li> <li>4. Special procedures: HSG, Myelography, orthography, DCG etc.</li> </ol>
<b>UNIT 3</b>	<ol style="list-style-type: none"> <li>1. Interventional procedures: PTC, ERCP, PCN, And FNAC: Fluoroscopy / US/ CT guided.</li> <li>2. Angiographic procedures: Vascular / non – vascular</li> <li>3. MRI – Various imaging protocols and techniques</li> <li>4. Digital imaging , applications and advancements</li> </ol>

### MRI AND NUCLEAR MEDICINE IMAGING

<b>UNIT 1</b>	<p><b>MRI</b></p> <p>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</p>
<b>UNIT 2</b>	<p><u>NMI</u></p> <p>Radionuclide scanning including thyroid up takes measurement, rectilinear scanner, gamma camera, PET, SPECT, their principles, working, applications and advancements.</p> <p>COMPUTERIZED RADIOGRAPHY</p> <p>Digital radiography including DSA, principles, working applications and advancements.</p>