

**YEAR I**

<b>CourseCode</b>	<b>CourseTitle</b>	<b>Theory/ Practical</b>	<b>Continuous Assessment (Internals)</b>	<b>Credits</b>
ANT12203	HumanAnatomyandPhysiology -I	70	30	4
RAD12204	RadiationPhysics andPhysics ofDiagnosticRadiology	70	30	4
RAD12205	DarkRoomTechniques	70	30	4
RAD12206	RadioDiagnosticEquipments	70	30	3
HHM12201	General PrinciplesofHospitalPracticea ndPatientCare	70	30	3
ANT12203P	HumanAnatomyandPhysiology -I(P)	35	15	3
RAD12204P	RadiationPhysics andPhysics ofDiagnosticRadiology(P)	35	15	3
RAD12205P	DarkRoomTechniques (P)	35	15	3
RAD12206P	RadioDiagnosticEquipments(P)	35	15	3
<b>TOTAL</b>		<b>700</b>		<b>30</b>

**YEARII**

<b>CourseCode</b>	<b>CourseTitle</b>	<b>Theory/ Practical</b>	<b>Continuous Assessment (Internals)</b>	<b>Credits</b>
ANT12302	HumanAnatomyandPhysiology -II	70	30	4
RAD12304	ClinicalRadiographyTechniques	70	30	4
RAD12305	Contrast and NpecialRadiographicPro cedures	70	30	4
RAD12306	Radiation Nafety andQualityControl	70	30	4
RIN12301	Basics ofMedicalImagingInformat ion	70	30	4
ANT12302P	HumanAnatomyandPhysiology -II(P)	35	15	2

RAD12304P	ClinicalRadiographyTechniques(P)	35	15	2
RAD12305P	Contrast and NpecialRadiographicProced ures(P)	35	15	2
RAD12306P	Radiation Nafety andQualityControl(P)	35	15	2
TRN12301	HospitalTraining	100		2
<b>TOTAL</b>		<b>800</b>		<b>30</b>

YEAR I

**HUMAN ANATOMY AND PHYSIOLOGY – I – ANT12203**

UNIT	CONTENT
1	<b>General Anatomy:</b> Organization of Organisms; Cell-Structure and Function; Tissue Classification and Function; Human Anatomy- Introduction; Subdivisions of anatomy; Anatomical nomenclature- Terms of position, location and fundamental planes, Clinical terms; General Histology- Definition and meaning; Slide preparation- Fixing, Chemical fixation with formaldehyde or other chemicals; Processing-
2	<b>Skin and Connective Tissue:</b> Skin Definition of Skin; Layers of skin; Types of skin; Functions; Dermatome; Connective tissue- Definition; Brief discussion on Types: Connective tissue proper (general and specific), General Definition- Bone, Cartilage and Blood, Embryonic connective tissue-
3	<b>The Skeletal System:</b> Brief discussion over skeletal system; Classification of skeleton- axial and Appendicular; brief discussion over bone structure, bone cells, bone marrow, bone growth, ossification, parts of a long bone; Major components of skeletal system: a) Bone- definition, synonym, Composition, special features & Function, Classification, features of a long bone, Bone marrow; b) Cartilage- definition; Components and classification- Overview of Osteology of bones of: i) Upper limb- Clavicle, Scapula, Humerus, Radius & Ulna and carpals; ii) Lower limb- Femur, Patella, Tibia & Fibula and tarsals; iii) Thorax (sternum & ribs); iv) Abdomen- Pelvis; v) Skull bones- Cranial bones (Frontal, Parietal, Temporal, Occipital); Facial bones- (Maxilla and Mandible)- their position, orientation, sidedetermination & ligaments attached- Joints- Definition of Joints, Functions, Classification of Joints based on- Structure and Function.
4	<b>The Muscular System:</b> Brief introduction of muscular system; muscle tissue types; General review of skeletal muscles- Brief knowledge of Appendicular muscles & Axial muscles.
5	<b>The Circulatory System:</b> Brief discussion about basics of circulatory system; The Heart- General features of Heart, Shape and Size of Heart, Position of heart, General overview on- mediastinum and relations of heart, Pericardium, Layers of heart- epicardium, myocardium and endocardium, Cardiac muscles, Chambers of heart and associated blood vessels, Valves of heart, Blood supply of Heart, vessels related to heart, Conduction system of heart, Functions of heart; Lymphatic system- Introduction to lymphatic system, brief overview of lymph nodes & lymphatic organs.
6	<b>The Respiratory System:</b> General discussion of respiratory system- Cellular respiration, Brief knowledge of classification of respiratory system; upper conducting part & lower respiratory part; Brief discussion over anatomy of- Larynx, trachea and bronchial tree; Lungs- Anatomical position, relations, lobes, fissures, broncho-pulmonary segments, Pleura- Layers of pleura and Pleural cavities; Microscopic anatomy of Trachea & Lungs.
7	<b>General Physiology:</b> Introduction to Physiology- Meaning, Homeostasis, Cell, Body fluid, Transport through cell membrane- Passive Processes; The Principle of Diffusion; Simple diffusion; Facilitated diffusion Osmosis; Active Processes- Active Transport; Transport in Vesicles; The Primary Tissue; Organs and systems.
8	<b>Blood:</b> Red blood cells- Erythropoiesis, stages, differentiation, Functions, Blood cell count, variations; Hemoglobin- Structure, function, concentration, physiological variation, Methods of estimation of Hb; White blood cell

	Platelets–Origin,normalcount,morphology,functions,Coagulation,Coagulants&anti-coagulants;Bloodgroups-A,B,Osystem,Bloodgroupingandtyping,Cross-matching,Rhsystem,Rhfactor,Rhincrossmatching;Bloodtransfusion–indication,universaldonorandrecipient concept;Nelection criteriaof blooddonor;Disordersofwhitebloodcells,PlateletsandClotting.
9	<b>GastrointestinalSystem:</b> PhysiologicalanatomyofGIT;Digestionoffoodinthemouth(mastication),stomach,andintestine;Absorptionofnutrientsfromdigestedfood;Roleofbileinthedigestiveprocess.
10	<b>RespiratorySystem:</b> Respiratorysystemphysiology;Introduction;measurementsofrespiratoryratesandvolumes;gaslaws;gasexchange;oxygenandcarbondioxidetransportintheblood.
11	<b>NervemusclePhysiology:</b> Restingmembranepotential;ActionPotential-Physiologyofnervesandneuromuscularjunction,Neuromusculartransmission;Overviewofmuscularsystem-MusclePhysiology,Musclefiber,Musclecontraction,theslidingfilamentmodelofmusclecontraction;I
12	<b>CardiovascularandLymphaticSystem:</b> Introduction;Cardiacmuscle;thecardiacconductingsystem;Theelectrocardiogram-ECGandappliedphysiology;Cardiacoutput;Bloodpressure-Control,fluidvolumeandbloodpressure;Coronarycirculationandappliedphysiology;Introductiontothelymphaticsystem -lymph,lymphaticcirculation,andfunctionslymph.

## **HUMANANATOMYANDPHYSIOLOGY–I(P)–ANT12203P**

### 1. Histology

- a) Histotechniques
- b) Microscope
- c) Histology of Nkeletal muscle
- d) HistologyofCardiacmuscle
- e) Histologyof Nsmoothmuscle
- f) HistologyofBone
- g) HistologyofHyalinecartilage
- h) HistologyofElasticcartilage
- i) HistologyofFibrocartilage
- j) Histologyofartery

- k) Histology of Vein
  - l) Histology of Lung
  - m) Histology of Trachea
2. Osteology
    - a) Appendicular skeleton
    - b) Axial skeleton
  3. Specimen
    - a) Heart
    - b) Lungs
    - c) Larynx
    - d) Skin
  4. Study and care of microscope.
  5. Collection of blood samples.
  6. Hemocytometer.
  7. Determination of Erythrocyte Sedimentation Rate (ENR) and Packed Cell Volume (PCV).
  8. Estimation of Hemoglobin concentration.
  9. Total RBC count.
  10. Determination of red blood cell indices.
  11. Total Leukocyte count.
  12. Preparation and examination of blood smear & Differential Leukocyte Count (DLC).

## **Radiation Physics and Physics of Diagnostic Radiology – RAD12204**

UNIT	CONTENT
1	<b>Basic Concepts of Physics:</b> Work- Units of Work; Power- Units of Power, Another Formula for Power; Energy- Units of Energy, Forms of Energy, Mechanical Energy, Sources of Energy, Law of Conservation of Energy; Electricity- Charge (Q), Net Charge (Q), Current (I), Ampere, Small Quantity of Electric Current, Ammeter, Electric Circuit, Electric Potential Difference, One Volt, Voltmeter, Symbols for Some Commonly Used Instruments in Circuit Diagrams, Electric Current; Magnetism – Magnet, Non-Magnetic Substances, Ferromagnetic Substances, Magnetic Field; Units and Measurements-
2	<b>Basic Concepts of Radiation Quantities:</b> Radiation Quantity; Radiation Units- Conventional Units, SI Units, Specific Quantities and their Associated Units, Photons, Photon Concentration (Image Quality), Energy; Exposure- Air Kerma, Surface Integral Exposure, Dose Area Product, Computed Tomography Dose Index, Mammography Mean Glandular Dose, Integral Dose, Computed Tomography Dose Length Product; Unit of Radiography – kVp, mA, mAs; Heat; Radiation Exposure- Types of Radiation Exposure, External Irradiation, Contamination, Incorporation; Radiation Dose- Ways to Measure Dose of Radiation, Types of Radiation Doses, Absorbed Dose, Equivalent Dose, Effectived
3	<b>Electricity:</b> Electricity- Static Electricity, Current Electricity; Conductors; Insulators; Electric Charge- The Law of Conservation of Charge; Coulomb's Law; Electric Field-

	-Capacitors- Dielectric, Types of Capacitor, Dielectrics, Capacitor in Series and Parallel Combination, Charging and Discharging of Capacitors; Capacitors Used in Diagnostic Radiology- X-Ray Equipment.
4	<b>Electrical Circuits and Their Principles:</b> Electric Circuit; Resistances in Electrical Circuits- Variable Resistance—Rheostat, Length of Conductor, Area of Cross Section, The NI Unit of Resistivity, Resistance of Resistors in Series, Resistance of Resistors in Parallel, Measuring Electrical Resistance, Resistors, Resistance in the Circuit; Specific Resistances—Three-phase Circuits—Specific Resistance, Three-phase Circuit, Star Connection, Delta Connection; X-Ray Generators- Where the Electrons Come From, Electrons need to be Accelerated, Function of the Target Material, The Cathode, The Anode, Importance of the Density of the Target Material, The High Voltage Power Supply, Transformers, The Control Unit, Current Control, Voltage Control, Time Control; Electrical Measuring Instruments - Electric Power, Electric Power Calculation, Power of AC Circuits, Real Power, Reactive Power, Apparent Power, Real/Reactive/Apparent Powers Relation, Electric Energy, How an Electric
5	<b>Magnetism and Electromagnetic Induction:</b> DC Circuit; Ohm's Law; Ampere's Law- The Nolenoid; Resistivity; Series and Parallel in Combination; Electromotive Force; Kirchhoff's Law; Heating Effect of Electric Current- Cause of Heating Effect of Electric Current, Joule's Law of Heating, Ammeter, Galvanometer, Voltmeter.
6	<b>Magnetism:</b> Magnetism—Attraction, Repulsion; Magnets; Magnetic Field- Names of Poles, Magnetic Field Lines; Force on an Electric Current and Charge in a Magnetic Field- Force on a Current Carrying Conductor in a Magnetic Field, Fleming's Left-Hand Rule, Force on a Current in a Magnetic Field, Direction of Motion when Field and Current are at Right Angle, The Force between Two Parallel Wires; Magnetic Field due to a Straight and Parallel Wires- Magnetic Field due to Current in a Straight Wire, Determination of the Direction of the Field, Magnetic Field due to Parallel Wires, The Force between Two Parallel Wires; Nolenoids; Generator and Dynamo—Principle, Construction, Working; Alternating Current Generator—Principle; Direct Current Generator- Principle of DC Generator, Single Loop DC Generator, Concept of Single Loop Generator, Working Principle of DC Generator; Electric Motor- Principle of Electric Motor, Construction and Parts of a DC Motor, Working of a DC Motor; Induction Coil.
7	<b>Basic Laws of Electric and Magnetic Fields:</b> Induced EMF; Faraday's Law- Faraday's First Law, Faraday's Second Law, How to Increase EMF Induced in a Coil, Applications of Faraday's Law; Lenz's Law- Application of Lenz's Law; EMF Induced in a Moving Conductor; Magnetic Flux- Properties of Magnetic Flux or Magnetic Lines of Force; Transformer- Working Principle of Transformer, Basic Theory of Transformer, Main Constructional Parts of Transformer, How a Transformer Works; Inductance- Inductance of a Coil; Resonance in AC Circuit- Series Resonance, Parallel Resonance; Einstein's Formula.
8	<b>Atomic Structure:</b> Structure of Atom- Bohr's Model of Atom, Distribution of Electrons in Orbit or Shell; Atomic Number- Mass Number or Atomic Mass, Arrangement of Electrons in an Atom— Electronic Configuration, Rules to Write the Electronic Configuration of an Atom, Valency, Isotopes, Isobars; Structure and Property of Nucleus; Nuclear Forces- Strong Nuclear Force, Strong Nuclear Force Examples, Weak Nuclear Force, Weak Nuclear Force E
9	<b>Radioactivity:</b> Radioactivity- Radioactivity Unit; Laws of Radioactivity- Laws of Radioactive Disintegration; Decay Equations- Alpha Decay, Beta Decay, Gamma Decay, Radioactive Decay Equation, Applications; Half-life and Mean-life- Half-life, Mean-life; X-Ray Production- Characteristic X-ray Generation, Bremsstrahlung/Braking X-ray Generation, The X-ray Spectrum; Properties of X-Ray; Qualities of X-Rays; Factors Affecting Quality and Intensity of X-rays- The Intensity of X-rays; Measurement of X-rays; Absorption Coefficient- Nuclear Photoelectric Effect; Half Value Layer; Alpha, Beta, Positron and Gamma Emission of Radiation- Alpha Particles, Beta Particles, Positron, Gamma Rays and X-Rays; Characteristic Radiation- Properties of Characteristic Radiation; Inverse Square Law.
10	<b>Ionization and Excitation:</b> Ionizing and Excitation Radiation; Interaction of Ionizing Radiation with Matter— Ionization and Excitation— Ionization, Excitation, Directly

	<p>Ionizing Radiation, Indirectly Ionizing Radiation, Difference between Ionization and Excitation; Types of Interaction of Radiation, Photon Interactions, Photoelectric Interactions, Compton Interactions, Coherent Scatter, Pair Production, Electron Interactions, Electron Range, Linear Energy Transfer, Positron Interactions; X and Gamma Radiation- Characteristics of Gamma Radiation and X-Rays; Photoelectric and Compton Effect- Photoelectric Effect, Einstein's Equations for the Photoelectric Effect, Compton Effect; Bremsstrahlung; Pair Production and Annihilation Radiation- Pair Production, Annihilation Radiation; Ionization Chamber Measurements; Measuring Device Using Presently- Geiger Counter, Proportional Counter.</p>
11	<p><b>Characteristics of X-Rays:</b> Exponential Attenuation; Half Value Thickness; Tenth Value Thickness; Inverse Square Law; Dependence on Energy and Atomic Number; Radiation Intensity and Exposure- Radiation Intensity, Exposure; Photon Flux and Energy Flux Density- Photon Flux, Energy Flux Density; Characteristic X-Rays and Factors affecting Quality and Intensity of X-Rays- Characteristic X-Rays, X-Ray Fluorescence— Intensity; Heel Effect- Anode Heel Effect; Soft and Hard X-Rays; Added and Inherent Filtration— Filtration, Inherent Filtration, Added Filtration; Reflection and Transmission of Targets-</p>
12	<p><b>X-ray Machinery Components:</b> Construction of X-Ray Tubes; X-Ray Tube Design; Tube Voltage of X-ray Machine; Current of X-ray Machine; Space Charge Tube Rating of X-ray Machine; X-Ray Production Efficiency of X-ray Machine; Stationary and Rotating Anode Types of X-ray Machine- Stationary Anode Tube, Rotating Anode Tube; Grids and its types of X-ray Machine— History, Types of GRID, Construction, Basic Principles of Grid; Contrast Reduction— Collimation, Air Gap; Filters— Types and Working Principle of X-ray Machine- X-ray Filters; Effectiveness of Grids and Filters of X-ray Machine— Grid, Filter; Intensifying Screens of X-ray Machine- Screen Functions: X-Ray Absorption, Light Production, Exposure Reduction, Receptor Sensitivity; Use of Cones and Diaphragm Beam Limiting Devices- Different Types of Beam</p>
13	<p><b>X-Ray Generator Circuits:</b> Half and Full Wave Rectifier- Half-wave Rectifier, Full Wave Rectifier, Full Wave Rectifier Circuit; X-ray Transformers; Junction Transistor; Control of kV and mA circuit- Effect of Kilovoltage, Kilovoltage Selector, Milliammeter and Milliampere Control, Effect of Milliampere, Milliammeter and Milliampere Selector; Exposure Switches and Meters and their Functions- Exposure Switch, mA/mAs and Exposure Time Meter, Hand-Held Radiation Survey Meters, and General-purpose Geiger Counters, PM1405 General Purpose Survey Meter, Inspector Hand-held Radiation Detector, RadAlert 100 Hand-held Radiation Detector, CRM100 Hand-held Radiation Detector, PM1912 RadFlash II UNB Gamma Detector, Terra-PC Compact Geiger Counter, PM1208 MWristwatch Gamma Monitor; Exposure Timers— Electronic Timer- Exposure Timer, Electronic Timer; Automatic Exposure Control- Important Principles; X-Ray Tube Overload Protection Circuits; Interlocking Circuits; Regulating and Safety Devices- Safety Precautions, Shielding, Eye Protection, Tube Status Indicators, Safety Devices—</p>
14	<p><b>Principles of Radiation Detection and Measurements:</b> Principles of Radiation Detection and Measurements- Principles of Radiation Detection, Principles of Radiation Measurement, Terminology and Units, Radiation Detectors; G-M Detector- Principle of Operation; Scintillation Detector; Ionization Detector- Ionization Chamber, Principle of Operation; Thermoluminescence Detector- How TLD works; Pocket Dosimeter- Direct Reading Pocket Dosimeter; Radiation Survey Meter and Gamma Zone Monitor-</p>
15	<p><b>Fluoroscopy:</b> Fluoroscopy— Image Intensifier Design- Fluoroscopy Basics, History of Fluoroscopy, Equipment, Common Fluoroscopy Procedures; Television Camera; Monitor; Image Recorders; Cinefluorography and Artifacts— Cinefluorography, Artifacts; Benefits/Risks of Fluoroscopy.</p>
16	<p><b>Body Section Radiography:</b> Basic Method of Tomography- Computed Tomography (CT),</p>



	<p>HowaCTNsystemWorks,AdvancesinTechnologyandClinicalPractice;Terminology-GeneralRadiography,Fluoroscopy,MagneticResonanceImaging(MRI),Ultrasound,NuclearMedicine,Lithotripsy,PET/CT;Blurring-BlurNize,BlurNhape,BlurProfile,EquivalentBlur;NectonThickness-EndometrialThickness,RadiographicAssessment,Values,TreatmentandPrognosis;BasicMethodofNarrowandWideAngleTomography-NarrowAngleTomography,WideAngleTomography;TomographicMotions;PhantomImages;TomographicAngle;Phantomography;Ntereoscopy;PhysiologyofDepthPerceptioninNtereoscopy-Ntereopsis,MonocularCues,BinocularCues,ConnectingBinocularDisparityandDepthPerception,TheOrganizationoftheRetinaandVisualNystem,Emmert'sLaw;NtereoscopicFilming-</p>
17	<p><b>BasicPhysics of CT:</b> Basic Physics of CT; HowaCT Image is Produced; Hounsfield Unit or CT number; Window Level (WL) and Window Width (WW); Pitch; To Improve Image-capture Times and Resolution; X-Ray Detection; Tomographic Imaging; Image Reconstruction-Multiplanar Reformatting; Dual-modality Imaging-Positron Emission Tomography (PET)/CT; Advantages and Disadvantages of CT-Advantages, Disadvantages.</p>
18	<p><b>Basic Physics of MRI:</b> Basic Physics of MRI- Echo Time, Repetition Time, Bo, Ferromagnetic, Paramagnetic, Nuperparamagnetic, Diamagnetism; Larmor Frequency; Net Magnetization Vector; Resonance and Radiofrequency; Relaxation-T1 Relaxation, T2 Relaxation, T2* Decay; MR Hardware- Magnets, Permanent MRIMagnets, Resistive (aircore) MRIMagnets, Nuperconductive MRIMagnets; Quenching; Radiofrequency Coils; Gradient Coils; MRI Electronics and Data Processing; Nigna l Processing-Fourier Transform; K Npace; Npatial Resolution MRI; Acquisition Time; Zero Filling Interpolation; Advantages</p>
19	<p><b>Angiography and Cineradiography:</b> Angiography Radiography- Risks of Angiography, Benefits of Angiography; Cineradiography; DNANubtraction Process- What will happen during Test; X-Ray Equipment- The X-Ray Machine, Contrast Media, Radiation Hazards of Analytical X-Ray Equipment, Ncattered Radiation, Hazards Associated with X-Ray Exposure, Nkin Burns, Target Nize, Eye Damage, Intensity of the Primary X-Ray Beam, Ncattered Radiation; Injection Pump; Nerial Imaging Devices-</p>

## **Radiation Physics and Physics of Diagnostic Radiology (P) – RAD12204P**

1. Write about radiation units.
2. What are the properties of x-rays?
3. Write about radiation detectors.



4. How a CT system works?
5. Define Fluoroscopy.
6. Write about the principle of CT and MRI.
7. Write about physics of MRI.

### **Dark Room Techniques – RAD12205**

UNIT	CONTENT
1	<b>Basic Film Structure and Quality:</b> Principles of Radiographic Imaging-Theory of X-ray attenuation, Radiographic Digital Imaging; Radiographic Film-Structure and Properties of Different Parts, Handling, Film Wrapping, Handling of Exposed and Unexposed Films, Types, Application, Advantage and Limitations, Safe Light Requirements; Latitude of Exposure; Variation in Exposure Time; X-Ray Cassettes-Structure and working, Functions, Types of X-ray Cassettes, Pass Box.
2	<b>The Equipment for Processing X-Ray Image:</b> X-ray Films; X-ray Cassettes; Care of Cassettes; Construction of Intensifying Screen-Components of the Intensifying Screen; Choice of Fluorescent Materials-None Activators of Fluorescence, Fluorescence in Natural Compounds, Common Materials that Fluoresce; Intensifying Factors –Screens, Screen Materials, Cassettes, Screen/film Speed, Speeds of Intensifying Screens; Sharpness Speed; Care of Intensifying Screens and Rate Earth Screens-Effect of Damage on the Screen, Causes of Damage, Causes of Contamination, Cleaning of Screens; X-ray Films Types Structure and Quality -Screen Films; Choosing Films for Different Studies; Dry and Wet Processing- The 'Dry' side, The 'Wet' Side, Processing Tanks used in wet film Processing; Use of Intensifying Screen –Advantages, Construction of intensifying screen; Fluorescence and
3	<b>Functions of Equipment Used in Film Processing:</b> Manual and Automatic Film Processors-Processor systems, Major components of automatic film processors; Film Roller Transport-Transport time, Film feed system; Care and Maintenance.
4	<b>Functions and Fundamentals of a Dark Room:</b> Requisites of a Dark room; Netting up the Processing Area- Wet Area, Dry Area; Dark room Design, Construction, Illumination, and Entrance Safe Lighting- Loading Dark room (Dry Area), Processing Dark room (Wet Area), Essentials of Dark room Design; Types of Films; Storage, Shelving of Films; Cleaning a
5	<b>Techniques and Principles of Film Processing:</b> Principles of Acidity, Alkalinity and pH; Principle of Fixing, Fixer Solution, Washing, Drying Replenishment, Checking and Adjusting –Washing, Drying, Checking and Adjusting; Replenishment Rate, Manual and Automatic Processing ; Silver Recovery; Auto and Manual Chemicals.
6	<b>Fundamentals of X-ray Films:</b> X-Ray Imaging Techniques; Structure of Emulsion –Components, Manufacture; Film Characteristics (Speed, Base + Fog, Gamma, Latitude) –Speed, Base + Fog, Gamma, Latitude; Effect of Grain Size on Film Response to Exposure- Film Grain, Dye Clouds in Colour Film, Grain Size Variability; Interpretation of Characteristics Curve.
7	<b>Fundamentals of Film Processing:</b> Latent Image Formation; Process of Film Developing (Composition of Fixer, Developer and Other Processing Solutions); Image Intensifiers and Cassettes-Structure and Functions of Image Intensifier, Structure and Functions of Cassettes; Effect of kV and mA on Variation of Emitted Radiation Intensity- kV Effect on Spectrum, kV Control; Determination of Relative Speed; Film Contrast- Contrast Transfer, Contrast Curve; Film Screen Contact.
8	<b>Film Storage and Handling:</b> Characteristics of Film Storage and Handling; Storage and Care of X-ray Films; Storage and Handling of Raw and Exposed Film; Storage and

	Handling of Processed Film; Storage Room.
9	<b>Factors Affecting Image Quality:</b> Meaning of Radiographic Image Contrast- Subject Contrast, Film Contrast, Physical Determinants of Image Contrast; Density; Characteristic Curve- Film Characteristic Curves, Adjusting the Exposure to Produce a Different Film Density, Adjusting the Exposure to Allow Use of a Different Film Type; Sharpness; Magnification and Distortion of Image- Image Magnification, Image Distortion; Image Noise- Quantum Noise, Grain and Structure
10	<b>Visibility of Image:</b> Radiographic Illuminators and Viewing Conditions- Object Contrast, Background Brightness, Object Size, Viewing Distance, Glare, Background Structure, Effect of Blur on Image Contrast; Visual Acuity and Resolution- Definition, Physiology, Expression; Quality Assurance of the Related Equipment and Its Benefits with Respect to Visual Assessment.
11	<b>X-Ray Darkroom:</b> Size of X-ray Darkroom; Light Proof Entrance; Hatches; Construction of Walls for Protection against Chemicals and Radiations; Ceiling; Colour Scheme; Water Proofing of Floors; Loading Bench Design; Disposition of Processing and Accessory Equipment for Efficient Work; Arrangement of Drying Cabinets in Darkroom or in Adjacent Rooms; Darkroom Illumination and Testing for Safety; Ventilation.
12	<b>Accessories for Darkroom:</b> Viewing Boxes; Spotlight- Types and Uses of Spotlight; Illuminators; Hangers - Care of Hangers; Projectors and Viewing Screens for Miniature and Cine-radiography; Magnifiers; Film Identification; Lead Letters and Numbers; Actinic Marker; Embossing

### **Dark Room Techniques(P) – RAD12205P**

1. How will you do the storage of chemicals in Dark Room?
2. Perform the safe light test.
3. Perform the preparation of developer and fixer and its chemistry.
4. How will you design the darkroom?
5. How will you perform the processing of exposed films?
6. Perform the developing of the X-ray films.

## RadioDiagnosticEquipments–RAD12206

UNIT	CONTENT
1	<b>Mammography:</b> Tube; Compression- Npot Compression, Need of Breast Compression; Grids- Types of Grids, Grid Ratio, Use of Grid; Automatic Exposure Control; Interventional Accessories; Biopsy Equipment Procedures; Portable and Mobile X-ray Unit
2	<b>Computed Tomography:</b> Generations- First Generation, Necond Generation, Third Generation of CT, Fourth Generation Ncanners; Different Parts of a CT Ncanner- CT Tube, Collimator, Detector; Multiplanar Reformation-
3	<b>Image Reconstruction Techniques:</b> Image Reconstruction Technology- Iterative Reconstructive Technique (IRT), Algebraic Reconstruction Technique (ART); N simultaneous Iterative Reconstructive Technique (NIRT); N simultaneous Algebraic Reconstruction Technique (NART); Analytic Method- Fourier Transform, Nimple Back-projection, Back-projection Filtering, Filtered Back-projection.
4	<b>Special Imaging Techniques:</b> CT Number or Hounsfield Units; Npatial Resolution; Contrast and Noise; Plain and Contrast Nudies; Advantages and Disadvantages of CT; CT Dose Measurement; Nupplies and Materials Required for Taking CT; Advancement in CT Technology; CT Performance Parameters.
5	<b>Magnetic Resonance Imaging:</b> Ntatic Magnetic Field- Natural and Occupational Exposure, Biological Effects; Gradient Magnetic Field; Radiofrequency Fields; Quenching; Alignment; Net Magnetization Vector; Precession; Resonance; Nignal Creation and Detection; Relaxation of the NMV; Pulse Timing Parameters; Nupplies and Materials Required for MRI.
6	<b>Contrast Studies:</b> Image Contrast- Contrast Mechanism, T1 Contrast, T2 Contrast, PD Contrast; Image Weighting - T1 Weighting, T2 Weighting, PD Weighting; Pulse Nequences - Npin Echo/Fast Npin (Turbo) Echo, Inversion Recovery Nequence, Gradient Echo Nequences, Grad
7	<b>Spatial Encoding:</b> Gradient Coils; Nlice Nelection Gradient; Frequency Encoding Gradient; Phase Encoding Gradient; Nampling; Fourier Transform- Introduction to Fourier Transform, Definition of Fourier Transform, Applications
8	<b>K-Space:</b> Manipulating K- Npace; Partial/Fractional Echo- Characteristics of Partial/Fractional Echo, Motivation for Partial K-space Reconstruction; Partial Fourier Imaging; Rectangular FOV- Characteristics of Rectangular FOV, What is the Field of View?
9	<b>SNR and Spatial Resolution:</b> Coil Types- The Gradient Coils, RFCoil; Proton Density; TR, TE and Flip Angle; Voxel Volume- Rendering, Voxel Data, Uses, Voxel Editors; Reducing the Bandwidth;
10	<b>Ultrasound:</b> Physical Characteristics of Nound- Transducer Nensors and Actuators, Combining Transducers, Efficiency; Characteristics of Ultrasound Beam; Interaction of Ultrasound and Matter- Absorption and Attenuation, Reflection, Refraction; Quarter Wave Matching; Ultrasonic Display- How Ultrasound Machines Work; Imaging Principles- Ultrasound Modes, Pulse Echo, Image Resolution, Image Creation, Doppler Mode, Contrast Enhanced Ultrasound Imaging; Doppler Techniques; Real Time Ultrasound; Ultrasound Instrumentation; B OIEffects and Nafety Considerations-
11	<b>Scintigraphy:</b> Role of Ncintigraphy; Radionuclides- Origin, Uses, Common Example, Dangers, Nummary Table for Classes of Nuclides, "Ntable and Radioactive", List of Commercially Available Radionuclides; Equipment; Examination Procedure; Patient Preparation and Position.
12	<b>Operating Radiologic Equipment:</b> General Radiographic Equipment- Photon Nources, Neutron Nources; Advanced Imaging Equipment Including CT & MRI- Magnetic Resonance Imaging (MRI), Computed Tomography (CT), Nuclear Medicine, Radiograph

<p>Ultrasound, Elastography, Tactile Imaging, Photoacoustic Imaging, Thermography, Tomography, Echocardiography; Quality Control Procedure for all Radiographic Equipment; Factors Essential for Operation of CT Machine; Factors Essential for Operation of MRI Machine.</p>
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### **Radio Diagnostic Equipments (P) – RAD12206P**

1. Define Mammography Tube and need of Mammography.
2. What are Grids, its uses and types?
3. Write about different generation of CT.
4. What are MRI Artifacts?
5. What are the advantages and disadvantages of CT?
6. Write about mobile x-ray unit and dental x-ray unit.
7. What are T1 and T2 weighted Images?

### **GENERAL PRINCIPLES OF HOSPITAL PRACTICE AND PATIENT CARE – HHM12201**

UNIT	CONTENT
1	<p><b>Hospital Structure and Organization:</b> Overview of hospital structure, hospital procedure, professional qualities; Communication and relational skills – development of appropriate communication skills with patients, verbal and non-verbal communication, appearance and behavior; Professional attitude of the technologist to patients and other members of the staff; Records and reports – records relating to patients and departmental statistics; Minimizing waiting time out-patient and follow-up clinics, stock-</p>
2	<p><b>Care of Patient:</b> Contact with the patient and family members in the respective department; Communication with the patient and family members; Patient transfer technique; Restraint techniques – consideration to be taken for the geriatric, paediatric, trauma, emotionally disturbed, and anaesthetized patients; Specific patient conditions – essentials of care of</p>

	patientsonventilator, tracheostomy, tubesandcatheters, nasogastrictubes, chesttubes, intravenousline s, oxygen&casts; Basicsonhygieneandmaintenanceofhygiene; Essentialcareofpatientwithacolosto my, providingbedpansandurinals; Basicsofnursingcare–measurementofvitalsigns –steriledressing.
3	<b>FirstAidandBasicLifeSupport:</b> Aimsandobjectivesoffirstaid; woundsandbleeding, dressingandb andages; pressureandsplints, supportsetc. shock; insensibility; asphyxia; convulsion; resuscitation, use of suctionapparatus, drugreactions; prophylacticmeasures; administrationofoxygen; electricshock; b urns; scalds; haemorrhage; pressurepoints; compressionband. Fractures; splints, bandaging; dressing, f oreignbodies; poisons. IntroductiontoBLN, indicationsforBLN, andtheprocessofBLN. Recoverypos ition.
4	<b>InfectionControlPractices:</b> Definition–introductiontothetypesofmicro-organisms–Bacteria– theirnatureandappearance–spreadofinfections–auto- infectionorcrossinfection; asepsisandantiseptics; Infectionpathogens; Communicablediseasescrossin fectionandprevention, patienthygiene, personalhygiene, departmentalhygiene, handlingofinfectious patientsinthedepartment; Applicationofasepsis, inflammationandinfectionprocess; Hospitalacquire dinfection; Universalprecautionsandbiomedicalwastemanagement.
5	<b>PrincipleofAsepsis:</b> Nterilization– methodsofsterilization; useofcentralsterilesupplydepartmentofinstruments, surgicaldressingincom monuseincludingfilamenteds wabs, elementaryoperatingtheatreprocedure, generalabdominalprepar
6	<b>MaintenanceofMedicationsintheDepartment:</b> Nstorage: classification; labelingandchecking, regu lationsregardingdangerousandotherdrugs; unitsofmeasurements, specialdrugs, anti-depressive, anti- hypertensiveetc.
7	<b>SpecializedInvestigations:</b> Careofpatients-patientscareduringinvestigation; GItract, renaltract, biliarytract, respiratorytract, gynecology, cardiovascular, lymphaticsystem, CNN.
8	<b>Medico–LegalIssues:</b> Medico–Legalconsiderations– clinicalandethicalresponsibilities, ethicallawandprofessionaletiquettesappliedtomembersofprofess ionassociatedwithmedicine, misconductandmalpractice; Handlingfemalepatients, practiceinpregna ncy–decisionmaking.
9	<b>Nursing, HandlingandCareofPatients:</b> Hospitalanddevelopmentalprocedure; Hospitalstaffingan dorganization, recordsanddepartmentalstatistics, appoints, stocktakingandstockkeeping, reception, e lementaryhygiene.

**HUMAN ANATOMY AND PHYSIOLOGY -II- ANT12302**

UNIT	CONTENT
<b>SECTION A (HUMAN ANATOMY)</b>	
1	<b>The Digestive System:</b> The Digestive system – Overview of digestive system, functions of digestive system; The alimentary canal or GI tract (gastrointestinal tract) – Mouth, Pharynx, Esophagus, Stomach, Small intestine, Large intestine & Rectum and Anus; Accessory digestive organs – Tongue, Teeth, Salivary glands, Liver, Gallbladder, and Pancreas; Histology –
2	<b>The Uro-Genital System:</b> Kidney – Nephron, histology of kidney; Ureters; Urinary bladder, urethra; The Genital System – brief discussion and anatomy; Male reproductive system – primary reproductive organs, secondary or accessory reproductive organs; Female reproductive system – primary reproductive organs, secondary or accessory reproductive organs; Histology – Testis, and Ovary.
3	<b>The Nervous System:</b> Broad classification of nervous system; neurons and glial cells; central nervous system – brain, spinal cord; Peripheral nervous system – cranial nerves, spinal nerves; Histology – spinal cord, and cerebrum.
4	<b>The Endocrine System:</b> Anatomy of pituitary gland – hormones of the pituitary gland; Anatomy of thyroid – Hormones of thyroid; Parathyroid gland – parathyroid hormone; Adrenal gland – hormones of the adrenal glands.
5	<b>The Special Senses:</b> Overview of special senses; chemical senses – olfaction, taste; physical senses – vision, ear; Anatomical overview of sense organs – eye, ear, nose, and tongue.
6	<b>Radiological Anatomy:</b> Properties of X-rays; Radiographic views and procedures – Fluoroscopy, CT scanning, Ultrasound, and MRI (Magnetic Resonance Imaging); X-rays of skeleton; Drugs used in radiology; Radiographic Examination – Alimentary tract, kidney and gallbladder.
<b>SECTION B (PHYSIOLOGY)</b>	
7	<b>Excretory System:</b> Body fluid compartments – Intracellular fluids, Extracellular fluids, interstitial fluid and edema; Urine formation by the kidney – Renal blood flow, Tubular processing; Diuretics and kidney diseases; Micturition – Cystometrogram; Excretory functions of skin.
8	<b>Fluids, Electrolytes and Acid-base Balance:</b> Regulation of ECF osmolarity and sodium concentration; Renal regulation of ECF and blood volume; Renal regulation of potassium, calcium, phosphate, and magnesium – Regulation of potassium balance, Regulation of calcium balance, regulation of phosphate, regulation of magnesium; Acid base balance – Proximal tubular mechanism, and distal tubular mechanism.
9	<b>Endocrine System:</b> Endocrine glands and their mechanism of hormonal function; The hypothalamus; Pituitary gland; Adrenal glands; Thyroid gland; Parathyroid gland; Pancreas; Testis and Ovary.
10	<b>Reproductive System:</b> Physiology of male reproductive system – Seminal fluid, spermatogenesis; Physiology of female reproductive system; Oogenesis; The ovarian cycle and the menstrual cycle; Gestation – Pregnancy tests and contraceptives; Lactation – composition of milk, advantages of breastfeeding.
11	<b>Nervous System:</b> Functional anatomy of nervous system – neurons, neuroglia, nerves, and flow of information from neuron to neuron; Cerebrospinal fluid (CSF) – functions of CSF, formation and flow of CSF, significance of CSF analysis; Physiology of spinal cord – Reflexes; Functions of brain; functions of autonomic nervous system.
12	<b>Special Senses:</b> Physiology of sense organ; Traditional senses – Hearing, Taste, Smell, Touch, and Vision; Other senses –

**HUMAN ANATOMY AND PHYSIOLOGY -II (P) – ANT12302P**

1. Histology

- a) Histology of Esophagus
- b) Histology of Stomach (Fundus)
- c) Histology of Duodenum
- d) Histology of Ileum
- e) Histology of Appendix
- f) Histology of Pancreas
- g) Histology of Testis
- h) Histology of Ovary
- i) Histology of Cerebrum
- j) Histology of Cerebellum
- k) Histology of Spinal Cord
- l) Histology of Kidney
- m) Histology of Thyroid Gland
- n) Histology of Cornea

## 2. Specimen

- a) Stomach
- b) Liver
- c) Pancreas
- d) Tongue
- e) Kidney
- f) Brain
- g) Eye

## 3. Radiological Anatomy

- a) Chest X-ray



- b) KUB
- c) X-ray of Shoulder joint
- d) X-ray of Knee joint
4. Perimetry (Charting the Field of Vision).
5. Examination of Visual Acuity.
6. Examination of Color Vision.
7. Tuning-Fork Tests of Hearing.
8. Determination of sensation of Taste.
9. Determination of sensation of Smell.
10. EEG.
11. Electroneurodiagnostic Tests.

### **Clinical Radiography Techniques – RAD12304**

UNIT	CONTENT
1	<b>Preparation of Patient and the Room for the Procedure:</b> Introduction; General Layout and Preparation of the Operating Room - Layout of the Operating Room, Preparation of the Operating Room; Netting Up the Equipment - Equipment and Materials; The Positioning of the Patient - Erect Positioning, Nitting Positioning, Prone Positioning, Lateral Positioning, Oblique Positioning, Decubitus Positioning; Nafety Precautions; Procedure to the Patient; The Use of Contrast Agents and Its Administration - Availability of Adequate Medical and Diagnostic Equipment.
2	<b>Radiography of the Upper Limb:</b> Radiographic Techniques for Upper Limbs - Hands, Fingers, Thumb, Wrist Joint or Carpal Bones, Forearm, Elbow Joint, Radioulnar Joints, Humerus; Nupplementary Radiographic - Techniques for Upper Limbs, Carpal Tunnel View, Ulnar Groove, Head of the Radius, and Nupracond
3	<b>Radiography of the Lower Limb:</b> Radiographic Techniques for Lower Limbs - Foot, Toes, Great Toe, Tarsal Bones, Calcaneum, Ankle Joint, Lower Leg, Knee, Patella & Femur; Nupplementary Radiographic Techniques for Lower Limbs - Ntress View for Torn Ligaments, Nubtalar Joint or Talocalcaneal Joint, Intercondylar Projection of the Knee, Tibial Tubercle, and Length Measurement Technique.
4	<b>Radiography of the Shoulder Girdle and Thorax:</b> Indications for the X-ray Examination; Right Nshoulder in External Rotation Anteroposterior Radiograph Technique for Nshoulder Joint - Ncapula, Clavicle, Acromioclavicular Joints, Nternum, Ribs, Nternoclavicular Joint; Nupplementary Projections and Technique - Recurrent dislocation of Nshoulder, Traumatic dislocation
5	<b>Vertebral Column:</b> Technique for Atlanto-occipital Joint - Cervical Npine, Cervico Thoracic Npine, Thoracic Npine, Thoraco - Lumbar Npine, Lumbosacral Npine, Nacrum and Coccyx; Nupplementary Technique to Demonstrate - Ncoliosis, Kyphosis, Npodylolisthesis, disclesion, Union of Npinal Graft; Adaptation of Technique
6	<b>Pelvic Girdle and Hip Region:</b> Technique for Whole Pelvis - Ileum, Ischium, Pubic Bones, Nacroiliac Joint, Nymphysis Pubis, Hip Joint, Acetabulum Neck of Femur, Greater and Lesser Trochanter; Nupplementary Technique - Congenital Dislocation of Hips, Epiphysis of Femur; Lateral Projections for - Hip Joint to Nhow Femoral Head and Neck Relationship.
7	<b>Skeletal Survey:</b> Introduction; Nkeletal Nurvey for Metabolic Bone Diseases Metastases;

	Hormonal Disorders and Renal Disorders.
8	<b>Skull:</b> Introduction; Basic Projections for Cranium, Facial Bones, Nasal Bones and Mandible; Technique for Petrous Temporal for Mastoids - Internal Auditory Canal, Accessory Nasal Sinuses, Temporal Mandibular Joint, Orbits and Optic Foramen, Zygomatic Arches, Styloid Process, Pituitary Fossa, Jugular Foramen.
9	<b>Dental Radiography:</b> Introduction; Technique for Intraoral Full Mouth; Occlusal View; Extraoral Near Parallel Technique; Extraoral Supplementary View.
10	<b>Cardiovascular System:</b> Cardiovascular System; Components of the Circulatory/ Cardiovascular System; Routine Projections for Heart and Vessels (without the uses of contrast agent); A Full Inspiratory Effort Pulls the Diaphragm down as far as Possible.
11	<b>Upper Respiratory System:</b> Upper Respiratory Tract; Technique for Post Nasal Air Ways - Larynx, Trachea, Thoracic Inlet, Thyroid Gland, Valsalva Manoeuvres - Phonation; Lungs and Mediastinum; Technique for Routine Projections; Supplementary Projections; - Anteroposterior, 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, Noft Tissue Radiography of Neck and Breast, etc.
12	<b>Abdominal Viscera:</b> Abdominal Viscera; Technique for Plain Film Examination; Projection for Acute Abdomen Patients; Technique to Demonstrate (i) Foreign Bodies (ii) Imperforate Anus - Foreign Bodies, and Imperforate Anus.
13	<b>Using Mobile X-ray Unit:</b> Radiography Using Mobile X-ray Unit; Radiography in the Ward; Radiography in the Specialized Unit, e.g. - Intensive Care Unit - Coronary Care. - Neonatal Unit: Intensive Care Unit, Coronary Care, Radiography in Neonatal Unit; Radiography

**LEARNING SOURCE:** Self Learning Materials

**ADDITIONAL READINGS:**

- A. Haas A, Pinedo H, Haas F, et al: Pulmonary Therapy and Rehabilitation: Principles and Practice. Baltimore, MD, Williams & Wilkins, 1979, pp 123-140.
- B. Gaskell DV, Webber BA: The Brompton Hospital Guide to Chest Physiotherapy, ed 4. Oxford, England, Blackwell Scientific Publications Ltd, 1980, pp 13-30.
- C. Trudel C: La distribution de la ventilation et de la perfusion pulmonaire chez le sujet normal et obstructif chronique. Physiotherapy Canada 32:344-351, 1980.

**WEBLINKS:**

- A. [www.en.wikipedia.org/wiki/Operating\\_room\\_management](http://www.en.wikipedia.org/wiki/Operating_room_management)
- B. [www.cpii-medical.com/medicalxraygenerators](http://www.cpii-medical.com/medicalxraygenerators)
- C. [www.radiology.ucla.edu/body.cfm?id=62](http://www.radiology.ucla.edu/body.cfm?id=62).

**Clinical Radiography Techniques (P) – RAD12304P**

1. How will you perform radiography using Mobile X-ray unit in a ward?
2. How will you take a teleroentgenography and what precautions will you take? Write about its procedure.
3. What is the technique for performing radiograph of whole pelvis?

4. Write about the preparation of patient and the room for the procedure of radiograph.
5. How will you take radiograph of L.N.N spine?
6. Write about the procedure of taking radiograph of KUB and the preparation of the patient.
7. Write about taking radiograph of upper limb in hand, wrist and elbow.

## **Contrast and Special Radiographic Procedures – RAD12305**

UNIT	CONTENT
1	<p><b>Contrast Media:</b> Terms Used to Describe The Contrast Media-            Structure of Compounds, Need for Contrast Media, Types of Contrast Media; General Principles Governing the Use of Contrast Agents-            Strength and Quantity of Contrast Agents, Methods of Introduction of the Contrast Agents; Contrast Preparation for CT and MRINcans-            Patient Preparation Guidelines, Magnetic Resonance Imaging (MRI/MRA); Records that should be</p>
2	<p><b>Emergencies in the Radiology Department:</b> Reaction to Contrast Media; Preventive Measures and Treatment of Reaction-            Preventive Measures in Patients at Risk, Treatment of Reaction; Basic Emergency Equipment and Emergency Drugs-            Basic Emergency Equipment, Basic Emergency Drugs; Role of a Radiographer in Management of Pa</p>
3	<p><b>Gastrointestinal Tract:</b> Fluoroscopy- General Consideration of Fluoroscopy, Responsibility of Radiographers; Barium N wallow- Pharynx and Oesophagus, Barium Meal and Follow through-            Hypotonic Duodenography; N small Bowel Enema-            Barium Enema Routine Projection for Colon and Rectum, Colon Activators; Double Contrast N studies-            Colostomy, N special Techniques for N specific Disease to be Examined; Water N soluble Contrast Media-            Gastrograftin N studies, Nialography; Biliary N system-            Plain Film Radiography, Oral Cholecystography, Intravenous Cholangiography, Percutaneous Cholangiography, Endoscopic Retrograde Cholangiopancreatography (ERCP), Operative Cholangiog</p>
4	<p><b>Iodine Preparation:</b> Iodine: Organic Compounds- Water-            Soluble Group, N significance of Iodine Content, Proprietary Preparations; Iodized Oil-            Application of Various N systems of Human Body, Volume, Contraindications and Side Effects, Methods of Administration and Route, N sensitivity Test, N side-            Effect Management, Elimination from the Body; Gases- Air- Oxygen, Carbon dioxide, Application</p>
5	<p><b>Urinary System and Female Reproductive System:</b> Problems Related to Urinary N system-            Intravenous Urography, Retrograde Pyelography, Antegrade Pyelography, Cystography and Micturating Cystography, Urethrography, Renal Puncture, Vesiculography, Cavernosography; Female Reproductive N system-            Hysterosalpingography, Mammography, Cyst Puncture, Mammary Duct Injection.</p>
6	<p><b>Respiratory System and Central Nervous System:</b> Respiratory N system-            Nasopharyngography, Laryngography, Bronchography; Central Nervous N system-            Myelography, Cerebral N studies, Ventriculography, Encephalography.</p>
7	<p><b>Arthrography, Discogram and Angiography:</b> Arthrography-            N shoulder, Hip, Knee, Elbow; Discogram Techniques and Procedures-            History and Physical Examination, Initial Preparation for the Discogram            Procedure, Administration of Local Anesthesia, Pressurizing the Discs-            the Diagnostic Portion of the Discogram Procedure; Angiography-            Carotid Angiography (4 Vessels angiography), Thoracic and Arch Aortography, N elective N studies (Renal; inferior and superior), Coeliac Axis, Vertebral Angiography, Femoral Arteriography, Angioc</p>

8	<b>Venography, Lymphatic System, Dacryocystography and Sinusography:</b> Venography; Lymphatic System- Techniques for Routine Projection, Noft Tissues Differentiation for Region Concerned, Lymphography; Dacryocystography-
9	<b>Tomography and Subtraction:</b> Tomography- General Principles, Estimation and Nelection of Depth of Layer, Types and Advantages of Various Movements, Choice of Tomographic Movement, Nequential, Horizontal and Multi-section Tomography, Application of Tomography to Npecific Regions; Nubtraction- Photographic Nubtraction, Colour Nubtraction, Electronic Nubtraction.
10	<b>Soft Tissue Radiography:</b> High and Low Kilo Voltage Technique; Non-screen Technique; Nimultaneous Nscreen and Non-screen Technique; Difference between Nimultaneous Nscreen and Non-screen Technology; Differential Filtration; Multiple Radiography; Uses of Noft Tissue Radiography
11	<b>High kV Radiography:</b> General Principles- Relation to Patient Dose; Change in Radiographic Contrast; Ncatter Elimination- Beam Collimation, Grid Ratio and Npeed and Type of Grid Movement; Radiographic Factor-
12	<b>Localization of Foreign Bodies:</b> General Location Principles, Ingested, Inhaled, Inserted; Embedded Foreign Bodies- Clinical Presentation; Foreign Bodies in Eye; Localization and Confirmation of Diagnosis- Preparation of the Area to be Investigated; Appropriate Projection for all Regions-

### **Contrast and Special Radiographic Procedures(P)–RAD12305P**

1. Write about the types and need of contrast media.
2. Write about I. V. P.
3. How will you perform Barium Meal?
4. How will you perform M. C. V. and R. G. V.?
5. Write about Myelography.
6. How will you perform sensitivity test and why?
7. Demonstrate the procedure of Cholangiography.

## Radiation Safety and Quality Control – RAD12306

UNIT	CONTENT
1	<p><b>Radiation Hazards:</b> Radiation- Radiation Hazards, Radiation Hazards Throughout Radiography and Fluoroscopy; Role of Atomic Energy Regulatory Board; AERB Safety Requirements; ICRP, IAEA, and NCRP, BARC &amp; AERB Guidelines; Radiation Protection Rules in Radiology and Nuclear Medicine; Instruments of Radiation Protection of GonadNshield- Installed Instruments, Portable Instruments, GonadalNshield, Occupational and Public Exposure; Planning of X-Ray Rooms, Dark Rooms, Installation and Inspection of X-Ray Equipments.</p>
2	<p><b>Radiation Protection:</b> Radiation Protection Survey in Diagnostic X-Ray Installations and Evaluation of Workload- General Procedures, Survey report, New x-ray equipment, Existing x-ray equipment; Radiation Protection Devices; LeadNshield, Lead Chair, Lead Apron, Lead Goggles</p>
3	<p><b>Taking Care of Radiological Equipment:</b> Procedures and Policies on Safety Precautions to be Taken When Operating Radiological Equipment's; Mandatory Regulations on Safety and Risk Mitigation When Operating Radiological Equipments; Routine Basic Maintenance Procedure for Radiological Equipments; Contacting Vendors and Suppliers For Maintenance and Repair of Radiological Equipment and Ordering of New Supplies; Inventory Policy of the Organization With Regard to Radiological Supplies.</p>
4	<p><b>Biological Effects of Radiation:</b> Absorbed Dose- Radiological Protection, Other uses, Computation, Radiation-related quantities; Equivalent Dose; Effective Dose; Collective Dose; Natural and Artificial Background Radiation; Stochastic, Deterministic and Hereditary Effects - Direct and Indirect Effect.</p>
5	<p><b>Measurement of Radiation:</b> Radiation Weighting Factor <math>W_r</math>; Roentgen, Curie, Radium, Radium Equivalent, Becquerel; Work Load, Use Factor and Occupancy Factor; OER, RBE, LET, Lethal Damage, Potentially Lethal Damage, Nucleon Lethal Damage; Dose Equivalent Limits Philosophy; ICRP (60) Concepts and AERB Guidelines.</p>
6	<p><b>Planning of X-Ray Rooms:</b> Protection from primary, Leakage and scattered Radiation; Barrier Design- Barrier Materials- Concrete, Brick &amp; Lead- Primary &amp; Secondary Barrier Design Calculations; Design of Doors, Control of Radiation- Effects of time, Distance and Shielding; Types and Usage of Protection Accessories; Radiation Warning Signs Used in Radiology and Nuclear Medicine, Classification of Area; Room Construction, Protection</p>
7	<p><b>Personnel Monitoring Systems:</b> Radiation Detectors- Principle and Objective- Survey Meters, Film Badge, Audible Alarm Rate Meters and Digital Electronic Dosimeters, Thermoluminescent dosimeter Badge, Pocket Dosimeter; Area Monitoring, Radiation Survey and Practical Use of Survey Meter; Zone Monitors and Phantoms; Survey in X-Ray, Fluoroscopy and CT Scan Units; Technical Standards of Radiation Protection, ALARA, Patient dose Factors.</p>
8	<p><b>Patient Protection:</b> Safe Work Practice in Diagnostic Radiology; Radiation Absorbed Dose from General, Dental, Fluoroscopy- General, Dental, Fluoroscopy; X-Ray and CT Examinations- X-ray Examinations during Pregnancy, X-ray Examinations Associated with Illness, X-ray Examinations not Associated with Illness, Medico-legal or Insurance Purpose of x-ray Examinations, Medical Research X-Ray, Avoidance of Unnecessary Radiation Dose; Radiation Emergencies- Situation Preparedness, Safety and Prevention, Legal Requirements, CRP, Recommendations on Medical Exposure, International Recommendations and Current Code of Practice for the Protection of Persons against Ionizing Radiation from Medical Use.</p>
9	<p><b>Preventive Maintenance:</b> General Care- Maintenance of Log Book, Practical Precautions, Brakes and Locks, HT Cable Care, Care of Meters &amp; Controls, Care of Tubes and Tracks, Care of Accessory Equipment, Functional Tests for any Faults, Failure of X-ray Tubes; Common Trouble-Shooting &amp; Remedies.</p>
10	<p><b>Quality Assurance Checks:</b> Quality Assurance- The Physics Report, Quality Control of</p>

	Radiographic Units; General Care-Mechanical Characteristics; Display Indicators of All Diagnostic Equipment.
11	<b>Quality Control in Radiology:</b> Quality Control; Quality Control Procedure in Radiology as Per Nabh; Biological Effect of Radiation- Mechanisms of Radiation Damage, Determinants of Biological Effects, Pattern of Biological Effects, Short-Term Effects, Long-Term Effects; Radiation Dose- Radiation Dose Chart, The Dose-Response Curve; Basic Radiation Safety Procedures- Effects of Time, Distance and Shielding, Personnel and Area Monitoring, Planning of X-Ray Rooms, Dark Rooms; Evaluation of
12	<b>Radiation Safety:</b> Radiation Safety Instruments- Radiation Detection and Measurement Instruments, Methods of Detection; ICRP / AERB Recommendations- The Regulatory Bodies, Regulatory Board, Objectives of Radiation Safety, Radiation Safety Act in India, Role of AERB (India), Principles of Radiation Safety, AERB Guidelines for Personal Safety.

### **Radiation Safety and Quality Control (P) – RAD12306P**

1. Elaborate and write about term – ICRP, AERB and BARC.
2. Write about planning of x-ray rooms and dark rooms.
3. Write about the radiation protection methods and devices.
4. What are the AERB guidelines for radiation protection?
5. What are the personnel monitoring system?
6. What are the radiation warning signs and radiation control methods used in radiology and nuclear medicine?
7. Write about dental radiography.

### **Basics of Medical Imaging Informatics – RIN12301**

UNIT	CONTENT
1	<b>Information Technology and Informatics:</b> Computer Science- Computer Technology, Importance of Computer Technology in The Medical Field; Information Technology; Information Science; Basics of Informatics- Public Health Informatics, Clinical



	Informatics, Imaging Informatics, Biomedical Informatics, PACN With IHE.
2	<b>Digital Biomedicine/Medicine:</b> Biomedicine and Medicine – Biomedicine, Medicine, Modern Medicine, Alternative Medicine, Conventional/Traditional Medicine, Biomedicine Vs. Medicine; Research In Biomedical Science; Digitalization in Biomedicine and Medicine – Challenges to be Faced For Digitalization, Data Standards for Digitalization, Digital Image Processing
3	<b>Healthcare Information Technology:</b> About Healthcare Information Technology (HIT) – Concepts and Definitions, Implementation of HIT; Types of Technology – Electronic Health Record (EHR), Clinical Point of Care Technology, Clinical Efficiency Measures – Time and Length of Stay, Evidence-Based Practice Implications, Use of BCMA for Medication Administration.
4	<b>Ontological Description in Medical Imaging Informatics:</b> Medical Information Expression, Processing and Representation – Representation Techniques; Ontological Data Entity Classification and Abstraction – Relations, Restrictions and Inheritance, Ontology Construction, Types of Ontologies; Ontological Domain Mapping, Modelling and Data Structure; Ontological Description of Terminology in Medical Imaging Informatics – Terminologies in Radiology, Interoperability, Application Areas of Ontologies in Radiology, Clinical Practice Guidelines, Order Entry, Structured Reporting, Diagnostic Decision Support Systems, DICOM – Structured Reporting, Notification and Reminder, Semantic Image Retrieval.
5	<b>Medical Image Data:</b> Medical Image, Image Quality and Data Formats – Medical Imaging, Image Quality, Data Formats; Medical Imaging Modalities – X-Ray Technology, Diagnostic Ultrasound, Magnetic Resonance Imaging (MRI), Computed Tomography (CT), Positron Emission Tomography (PET), PET-CT, Nuclear Imaging; Medical Image Digitalization and Acquisition Gateway – Acquisition Gateway, DICOM – Compliant Image Acquisition Gateway, DICOM
6	<b>Workflow in Radiology:</b> Genetic Workflow in Radiology and PACN Workflow – PACN Workflow; Integrating The Healthcare Enterprise Workflow Model; Key Steps Radiology Workflow and Its Analysis.
7	<b>Basic Medical Image Processing and Analysis:</b> Quality Evaluation, Statistical Analysis and Information Entropy – Image Quality Evaluation – ROC Method; Coding and Decoding; Stable and Unstable Signal Processing; Transformations – Negatives, Log Transformations, Power-Law Transformations, Piecewise-Linear Transformation Functions, Contrast Stretching.
8	<b>Pre-Medical Image Processing:</b> Image Reconstruction; Background Removal – Advantages; Noise Removal; Image Compression – Coding Redundancy, Spatial, Temporal and Bit-Depth Redundancy, Psychovisual Redundancy, General Image Compression Algorithm, Basic Co
9	<b>Post-Medical Image Processing:</b> Filtering; Contrast and Enhancement; Registration; Classification, Texturing and Segmentation.
10	<b>Medical Image Displaying, Visualization, and Representation:</b> Image Displaying – Display Workstations and Other Tools, Types of Image Workstation, Window and Level; 2D and 3D Displaying Algorithms; 3D Volume Rendering and Ray-Tracing; Virtual Reality Technology – Human Simulation Software, Virtual Reality Diagnostics, Virtual Robotic Surgery.
11	<b>Multi-Dimension Image Representations:</b> Static 2D and 3D Temporal – Spatial Image Representations; Dynamic 2D and 3D Temporal – Spatial Image Representations; High-Dimensional Image Representations.
12	<b>Multi-Scale Modelling in Medical Imaging Informatics:</b> Multi-Scale in Medical Imaging Informatics; Architectures in Future Healthcare Systems –



**HOSPITAL TRAINING-TRN12301**