NIMS UNIVERSITY

SYLLABUS

OF

DIPLOMA IN RADIATION TECHNOLOGY - DRT10

VERSION 1.2

DIRECTORATE OF DISTANCE EDUCATION

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

DIPLOMA IN RADIATION TECHNOLOGY - DRT10

Eligibility	:	10^{th}
Programme Duration	:	3 Years
Programme Objectives	:	Radiography is the art and science of producing medical images using x-radiation. Technologists produce images for the radiologist's interpretation to aid in medical diagnoses. The program prepares you, under the direction of a medical specialist (radiologist), to work in the hospital medical imaging department, at the patient's bedside, in the operating room or Emergency or in private imaging clinics. Our Diploma program in Radiography Technology has been designed to integrate the academic environment with the clinical setting. We are one of the few premium institutes in India to offer this program.
Job Prospects	:	Upon successful completion of the Diploma you can explore a career as a radiologist technician. You will find ample opportunities in Hospitals, Clinics and Doctors' offices. You may further pursue a bachelor's degree to continue your education and specialize. Common job profiles of students after completing DRT include: Technician in Hospitals, Nursing Homes and Diagnostic Labs

YEAR I

Course Code	Course Title	Theory/ Practical	Continuous Assessment (Internals)	Credits
ENG12101	Communication For Professionals	70	30	4
ANT12101	Basic Anatomy & Physiology	70	30	5
BCH12101	Basic Biochemistry	70	30	5
MBL12101	Basic Microbiology	70	30	5
RAD12101	Basics of Radiation Physics	70	30	5
ANT12101P	Basic Anatomy & Physiology	35	15	1
MBL12101P	Basic Microbiology	35	15	1
RAD12101P	Basics of Radiation Physics	35	15	1
TRN12101	Hospital Training-I	200		1
			TOTAL	28

YEAR II

Course Code	Course Title	Theory/ Practical	Continuous Assessment (Internals)	Credits
CSC12207	Fundamentals of Computer Science	70	30	4
RAD12201	Patient Care Relevant to Diagnostic Radiology	70	30	5
RAD12202	Radiation Physics and Modern Imaging Techniques-I	70	30	5
RAD12203	Radiography and Dark Room Techniques	70	30	5
ANT12201	Human Anatomy & Physiology	70	30	5
RAD12202P	Radiation Physics and Modern Imaging Techniques-I	35	15	1
RAD12203P	Radiography and Dark Room Techniques	35	15	1
RAD12201P	Patient Care Relevant to Diagnostic Radiology	35	15	1
TRN12201	Hospital Training-II	200		1
			TOTAL	28

YEAR III

Course Code	Course Title	Theory/ Practical	Continuous Assessment (Internals)	Credits
WCM12301	Environmental & Biomedical Waste Management	70	30	4
RAD12301	Radiation Physics and Modern Imaging Techniques-II	70	30	5
RAD12302	Quality Assurance in Diagnostic Radiology	70	30	5
RAD12303	Radiation Hazards, Prevention and Safety	70	30	5
HHM12301	General Principles of Hospital Practice and Patient Care	70	30	5
RAD12301P	Radiation Physics and Modern Imaging Techniques-II	35	15	1
RAD12302P	Quality Assurance in Diagnostic Radiology	35	15	1
RAD12303P	Radiation Hazards, Prevention and Safety	35	15	1
TRN12301	Hospital Training-III	200		1
			TOTAL	28

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

COMMUNICATION FOR PROFESSIONALS- ENG12101

UNIT	CONTENTS
1.	**Parts of Speech:** Definition of all the sight parts along with examples and their use in language. **Definite and Indefinite articles:** A, an, and, the, Definition and its uses along with examples. **Types of Pronouns:** Personal, Reflexive, Emphatic, Demonstrative, Relative, Indefinite, Interrogative and Distributive pronouns. **Noun:** Defining noun along with types and categories, Gender, Number case **Adjective:** Adjective, Comparison, Adjective used as nouns, Positions of the Adjective and Correct use of Adjectives. **Verb:** Definition, its forms, Verbs of incomplete predication, Phrases (defining it along with examples). Adjective, Adverb and Noun phrase. **Clauses:** Defining it along with examples: Adverb, Adjective and Noun Clauses. **Sentence and its Types:** Simple, Compound and Complex, Subject and Predicate (parts of a sentence), Transformation of Sentences. Active and Passive voice, Mood and Narration (Direct and Indirect speeches).
2.	**Words and Phrases:** Word formation (prefix, suffix), Idioms, Synonyms and antonyms, Phonetics, Speech sound, The phoneme, The syllable and IPA transcription.
3.	**Business Correspondence I**: Paragraph writing, Introductory remarks, Principles, Writing of single paragraphs and precise writing, Letter writing, Quotations, Orders and tenders, Inviting and sending quotations, Placing orders and inviting tenders.
4.	**Business Correspondence II:** Notices, Agenda and Minutes, Application letter, Importance and function, Drafting the application, Elements structure, Preparing CV's.
5.	**Applied Grammar:** Correct usage of Grammar, Structure of sentences, Structure of paragraphs, Enlargements of

	vocabulary.
6.	**Business Writing:** Written composition, Precise writing and summarizing, Writing of Bibliography, and Enlargement of vocabulary.

LEARNING SOURCE: Self Learning Materials

ADDITIONAL READINGS:

A. English Grammar and Composition Wren and Martin. S. Chand & Company Ltd.

B. Intermediate English Grammar; Raymond Murphy Pub: Foundation Books, New Delhi

C. Eng. Grammar usage and Composition; Tickoo & Subramanian Pub: S. Chand and Co.

D. Living Eng. Structure; Standard Alien.

BASIC ANATOMY & PHYSIOLOGY- ANT12101

UNIT	CONTENTS
1.	**The Human Body:** Definitions, sub-divisions of Anatomy, Terms of Location and Position, Fundamental Planes, Vertebrate structure of man, Organization of the body cells, Tissues.
2.	**The Skeletal System:** Types of bones, Structure and growth of bones, Division of the skeleton Appendicle skeleton, Axial skeleton, Name of all the bones and their parts. Joints classification, Types of movements with examples.
3.	**Anatomy of Circulatory System:** Heart Size, Position coverings, Chambers, Blood supply, Nerve supply, Blood vessels. General plan of circulation, Pulmonary Circulation, Names of Arteries and Veins and their position. Lymphatic system general plan.
4.	**Anatomy of the Respiratory System:** Organs of respiratory system, Larynx, Trachea, Bronchial tree, Respiratory portion, Pleurae and Lungs. Brief knowledge of parts and position.
5.	**Anatomy of the Digestive System:** Components of Digestive System, Alimentary tube, Anatomy of organs of Digestive Tube, Mouth, Tongue, Tooth, Salivary Glands, Liver, Bleary Apparatus, Pancreas, Names, Position and brief functions.
6.	**Anatomy of the Nervous System:** Central nervous system, The Brain, Hind brain, Midbrain, Forebrain, Brief Structure, Locations, and Peripheral nervous system, Spiral card, Anatomy, Functions, Reflex – Arc, ménages. Injuries to spinal card and brain.
7.	**Anatomy of the Endocrine System:** Name of all Endocrine glands, their position. Hormones and their functions– Pituitary, Thyroid, parathyroid, adrenal glands, gonads & islets of pancreas.
8.	**Anatomy of Excretory System and Reproductive System:** Kidneys location, Gross structure, Excretory ducts, Urethras, Urinary Bladder, Urethra, Male Reproductive system, Testis, Duct system, Female reproductive system, Ovaries Duct

	system, accessory organs.
9.	**Blood:** Definitions, composition, properties and function of Blood, Haemogram (RBC, WBC, Platelet count, HB concentrations), Function of plasma proteins Haemopoiesis, Blood Group – ABO and RH grouping, Coagulation & Anticoagulants, Anemia causes effects & treatment, Body fluid compartments, composition, Immunity Lymphoid tissue, Clotting factors, mechanism of blood clotting, Disorders of white blood cells, Disorders of platelets, Disorders of clotting.
10.	**Cardio Vascular System:** Function of cardiovascular system, Structure of cardiovascular system, Cardiac cycle, functional tissue of heart & their function, Cardiac output, E.C.G., blood pressure, Heart Rate.
11.	**Respiratory System:** Function of Respiratory System, Functional (physiological) Anatomy of Respiratory system, Mechanism of Respiration, Lung volumes & capacities, Transport of Respiratory Gases.
12.	**Digestive System:** Function of digestive system, Functional Anatomy of Digestive System, Composition and functions of all digestive juices, Movements of Digestive System (intestine), Digestion & absorption of Carbohydrate, Proteins & Fats.
13.	**Muscle Nerve Physiology:** Type of muscle, Structure of skeletal muscle, Sarcomere, Neuromuscular junction & transmission, Excitation and contraction coupling (Mechanism of contraction).
14.	**Structure and Functions of Skin:** Body Temperature, Fever, Regulation of Temperature.
15.	**Excretory System:** Excretory organs, Kidneys-function, Nephron, Juxta Glomerular Apparatus, Renal Circulation, Mechanism of Urine Formation, Mechanism of Micturition, Cystometrogram, Diuretics, Artificial Kidney.

LEARNING SOURCE: Self Learning Materials

ADDITIONAL READINGS:

A. Text books of Physiology. Author : Guyton (Arthor C). Prism publishers Bangalore.

B. Human Physiology. Author : Chaterjee (cc). Medical allied agency

C. Concise Medical physiology. Author : Choudhary (Sujit km.). New central books Kolkata.

D. Review Medical physiology. Author : Ganang. Application and Lange.

BASIC BIOCHEMISTRY- BCH12101

UNIT	CONTENTS
1.	**Introduction to Medical Lab Technology:** General Introduction, Role of Medical Lab Technologist's ethics, Responsibility, Safety measures and First Aid, Cleaning and care of general laboratory glassware and equipments.
2.	**Distilled Water:** Types of Distilled Water, Plants preparation & storages.
3.	**Analytical Balance:** Principle & Maintenance, Preparation of reagents.
4.	**Standard Solutions:** Various std. solutions used preparation & storage of chemicals.
5.	**Units of Measurements:** S.I. units, Definitions, Conversions, Measurement of volume, Strength, Normality. Molarity, Molality: volumetric apparatus, calibration of volumetric apparatus.
6.	**Carbohydrate:** Definition, classification, functions, properties and osazone formation.
7.	**Proteins and Amino Acids:** Definition, classification, functions and chemical reactions.
8.	**Nucleic Acids:** Definition types and functions.
9.	**Lipids:** Definition, Classification, function of lipids and lipoproteins.
10.	**Enzyme:** Definition, classification, factors affecting enzyme action, inhibition Diagnostic importance of enzymes and isoenzymes.
11.	**Carbohydrate Metabolism:** Definition and importance of Glycolysis, Glycogeniesis, Glycogenolysis, Gluconeogenesis, Kreb's cycle, Cori's Cycle.
12.	**Blood Glucose Regulation:** Glycosuria, Glucose tolerance tests, Protein Metabolism.
13.	**Urea:** Deamination, Transamination and Urea formation.
14.	**Introduction to Medical Lab Technology:** General Introduction, Role of Medical Lab Technologist's ethics, Responsibility, Safety measures and First Aid, Cleaning and care of general laboratory glassware and equipments.

LEARNING SOURCE: Self Learning Materials

ADDITIONAL READINGS:

A. Biochemistry – Stryer.
B. Text Book of Medical Biochemistry – Chatterjee and Shinde

BASIC MICROBIOLOGY- MBL12101

UNIT	CONTENTS
1.	**Introduction and Brief History of Microbiology:** Definition History and relationship of micro org. to man Safety measures in microbiology.
2.	**Culture Media:** Preparation of various media, Standardization and use of Sterilization, Definition, Different methods and principles-Moist heat dry heat Radiation & filtration, Autoclave-its structure functioning control & indicators.
3.	**Antiseptics and Disinfectants:** Definition types, mode of action & properties, uses of disinfectant & antiseptics, testing efficiency.
4.	**Glassware:** Description of glassware its use handling and care.
5.	**Staining:** Principle of Grams & AFB staining.
6.	**Culture Methods:** Aerobic and Anaerobic Culture Methods.
7.	**Antigen and Antibodies:** General characters and nature of antigen and antibody, Principle of antigen antibody reaction.
8.	**Clinical Samples:** Collection, Transportation and processing of Clinical Samples for Microbiological Investigations.
9.	**Laboratory Organization:** Management, Recording of results and quality control in microbiology.
10.	**Viruses:** Introduction to Virology, Physiochemical characteristics of Viruses.
11.	**Protozoa:** General characters and classification of Protozoa of Medical importance.
12.	**Systemic Microbiology:** Identification of Bacteria Micrococci, Staphylococci, Pneumococci, Corynebacteria, Escherichia coli, Klebseilla, Enterobacter, Proteus, Providencia Salmonella, Shigella, Arizona, Citrobactor, Yesinia, Pseudomonas, Vibrio Cholera, Haemophilus, Mycobacteria, Buccella, Bordetella, Bacillus, Clostridia, Anaerobic Cocci, Neisseria, Treponema, Borrelia Leptospria, Mycoplasma, Rickettsia, Chlamydia, Tric agents.

LEARNING SOURCE: Self Learning Materials

ADDITIONAL READINGS:

A. Ananthanarayanan R. and C. K. Jayaram Paniker (1997) Text of microbiology, Orient Longman.

B. Stanier RY, Ingraham JL, Wheelis, ML Painter PR (1986).General Microbiology

BASICS OF RADIATION PHYSICS-RAD12101

UNIT	CONTENTS
1	**Dosimeter and Radiation Biology:** Radiation units, Exposure Coulombs/kg, Air Kerma-gray-absorbed dose-gray(Gy), equivalent dose-sievert, Effective dose-sievert Interaction mechanisms Ionization excitation free radicals Introduction to concept of linear energy transfer (LET).
2	**Interactions:** Interactions of charged particles Interaction of electromagnetic radiation Neutron interactions Introduction to Thermography, Microwave equipment and interactions Optical interaction Ultra sound interactions.
3	**Basic Concepts of Electromagnetic Radiation:** Electromagnetic Waves Relationship between frequency and wavelength The electromagnetic spectrum, Sources of Electromagnetic radiation Risks from occupational exposure-public Occupational exposure of pregnant women Diagnostic reference levels (DRL)
4	**Basics of NMR and MRI:** Basic Nuclear Magnetic Resonance (NMR) Nuclear magnetic moments-effect of external magnetic field Nuclear precession Equilibrium magnetization Significance of Radio frequency (RF) Pulse OIMR) Microwave (EPR) Equipment Resonance and Larmor frequency Free induction Decay (FID)
5	**Radiation Detectors** Radiation protection-biological aspects Measurement of detriment ICRP frame work of radiological protection.
6	**Nuclear Medicine:** Nuclear medicine-In vitro and In vivo Testing gamma rays for imaging radio pharmaceuticals Preparation and quality control Chemistry and radio pharmacology of radionuclide’s gamma Camera SPECT, PET
7	**Ultrasound in Medicine:** Ultrasound Image Generation and detection of Ultrasound propagation Choice of frequency

	A-scan, B-scan M-mode imaging and Echo Cardiography Use of Doppler techniques for blood flow etc.

LEARNING SOURCE: Self Learning Materials

ADDITIONAL READINGS:

A. First year Physics for Radiographer-Hay & Hughes.

B. Fundamental of X-ray and Radium Physics-Joseph Selman

C. Basic Medical Radiation Physics-Stanton

D. Christensen's Physics of Diagnostic Radiology-Christensen.

BASIC ANATOMY & PHYSIOLOGY- ANT12101P

UNIT	CONTENTS
1	**Practical Anatomy:** Practical's related to anatomy & physiology such as knowledge of surface anatomy of human body, Identification of bones and parts on x-ray film as radiological anatomy.
2	**Charts and Identification:** Preparing charts of human anatomy systems & structures of human body, Identification and knowledge of pathological specimens, Visit of Anatomy & Pathology museum.

LEARNING SOURCE: Self Learning Materials

ADDITIONAL READINGS:

A. Text books of Anatomy. Author: Guyton (Arthor C). Prism publishers Bangalore.

B. Human Physiology. Author: Chaterjee (cc). Medical allied agency

BASIC MICROBIOLOGY– MBL12101P

UNIT	CONTENTS
1.	**Instrument:** Compound Microscope.
2.	**Demonstration and Sterilization of Equipments:** Hot Air oven, Autoclave, Bacterial filters.
3.	**Demonstration:** Demonstration of commonly used culture media, Nutrient Broth, Nutrient Agar, Blood Agar,
4.	**Growth Media:** Chocolate agar, MacConkey medium, LJ media, Robertson Cooked meat media, Potassium Telluride media with growth, MacConkey medium with LF & NLF, NA with staph.

5.	**Tests:** Antibiotic Susceptibility Test, Demonstration of common serological tests – Widal, VRDL, ELISA.
6.	**Staining:** Grams Staining, Acid Fast Staining
7.	**Stool Exam:** Stool exam for Helminth ova
8.	**Hospital Visit:** Visit to hospital for demonstration of biomedical waste management.
9.	**Culture:** Anaerobic Culture Methods.

LEARNING SOURCE: Self Learning Materials

ADDITIONAL READINGS:

A. http://www.cuteri.eu/microbiologia/manuale_microbiologia_pratica.pdf

B. Practical Microbiology by Vasanthakumari,BI Publications Pvt Ltd, 2009

BASICS OF RADIATION PHYSICS- RAD12101P

HOSPITAL TRAINING-I-TRN12101

YEAR II

FUNDAMENTALS OF COMPUTER SCIENCE- CSC12207

UNIT	CONTENTS
1.	**Computer Application:** Characteristic of computers, Input, output, storage units, CPU, Computers system.
2.	**Computers Organization:** Central Processing Unit, Control Unit, Arithmetic Unit, Instruction Set, Register, Processor Speed.
3.	**Memory:** Main Memory, Storage Evaluation Criteria, Memory Organization, Memory Capacity, Random Access Memories, Read Only Memory, Secondary Storage Devices, Magnetic Disk, Floppy and Hard Disk, Optical Disks CD-ROM, Mass Storages Devices.
4.	**Input Devices:** Keyboard, Mouse, Trackball, Joystick, Scanner, Optical Mark Reader, Bar-code reader, Magnetic ink character reader, Digitizer, Card reader, Voice recognition, Web cam, Video

	Cameras.
5.	**Output Devices:** Monitors, Printers, Dot Matrix Printers, Inkjet Printers, Laser Printers, Plotters, Computers Output Micro Files (Com), Multimedia Projector.
6.	**Operating System:** Microsoft Windows, An overview of different version of windows, Basic windows elements, File managements through windows, Using essential accessories: System tools Disk cleanup Disk defragmenter, Entertainments, Games, Calculator, Imagine-Fax, Notepad, paint, Word Pad, Recycle bin, windows Explorer, Creating folders icons.
7.	**Word Processing:** Word processing concepts, Saving, closing opening and existing documents, Selecting text, edition text, Finding and replacing text, Printing documents, Creating and printing merged documents, Mail merge, Character and paragraph formatting, Page designs and Layout, Editing and proofing tools checking and correcting spelling, Handling graphics, Creating tables and charts, Documents templates and wizards.
8.	**Presentation Package:** Creating opening and saving presentations, Creating the look of your presentation, Working in different views working with slides, Adding and formatting text, formatting paragraphs, Checking spelling and correcting typing mistakes, Making notes pages and handouts, Drawing and working with objectives, Adding clip art and other pictures, Designing slides shows, Running and controlling a slid show, Printing Presentations.
9.	**Internet and Email:** Use of Internet and Email, Internet, Websites (Internet Sites), The Mail protocol suite.
10.	**Hospital Management System:** Types and Uses, Hospital Management & System Package, Advanced Hospital Management System, X O Hospital Management System, LCS Hospital Management Information System, NVISH Hospital Management System, CSPM-Hospital Management System.

LEARNING SOURCE: Self Learning Materials

ADDITIONAL READINGS:

A. Foundations of computing first edition, 2002: P.K. Sinha and P. Sinha.

B. Microsoft office 2000 for window, second Indian Print, person education S. Sagman.

PATIENT CARE RELEVANT TO DIAGNOSTIC RADIOLOGY-RAD12201

UNIT	CONTENTS
1	**Radiological Contrast Agents:** Opaque agents and gases- Relationship of x-ray transmission to density and atomic number of the elements of contrast medium.

	Types of Barium Sulphate Solutions, Concentration and its particular uses, Flavouring agents.
2	**Iodine Preparation:** Organic compounds, Water - soluble group; Significance of iodine content, Proprietary preparations, Iodised oil, Application of various systems of human body , Volume, Contra-indications, Methods of administration and route.
3	**Iodine Preparation II:** Sensitivity test, Side effects and management, Elimination from the body. Gases- Air, Oxygen and Carbon dioxide application and dangers.
4	**Emergencies in the X-ray Department and Management:** External defibrillation, Direct cardiac massage, Internal defibrillation Complications- Cardiac arrest, Respiratory arrest. Bronchography Local anaesthetics- Reactions, Treatment.
5	**Special Procedures in Diagnosis Radiology:** The Gastro intestinal tract- Barium meal, Barium swallow, Small bowel enema, Barium enema The Renal tract- Intravenous urography, Intravenous cholangiography, Operative and post operative cholangiography, Percutaneous transhepatic cholangiography.
6	**Special Procedures in Diagnosis Radiology-II:** The Respiratory tract- Bronchography, Gynecology, Hysterosalpingography Cardio Vascular System- Angiography, Aortography, Cerebral angiography, Splenoportovenography The Lymphatic System- Lymphangiography Central Nervous System- Myelography, Sialography Ultrasound +Guided procedures General preparation, Care CT scan+guided procedures Safety measures MRI.

LEARNING SOURCE: Self Learning Materials

ADDITIONAL READINGS:

A. Care of patient in diagnostic Radiography Chesney & Chesney (Blackwell Scientific)
B. Chesney's Care of the patent in Diagnostic Radiography Pauline J Clumer (Black well Scientific)
C. Aid to Tray and Trolley Setting Marjorie Hougton (Bacilliere)
D. First Aid Haugher & Gardner (Hamlyn)

RADIATION PHYSICS AND MODERN IMAGING TECHNIQUES-I
RAD12202

UNIT	CONTENTS
1	**Radiography:** Primary radiological image produced by Contrast Media Attenuation Linear and Mass Attenuation Coefficient factors affecting attenuation Application in radiology Filters- Inherent and Added Filters, Heavy metal filters X-ray beam restrictor aperture diaphragm cones and cylinder collimators Function of restrictors.
2	**Scattered Radiation:** Significance of Scatter Grid principle- design and type Evaluation of grid performance lead content Grid cut off Moving grids Grid selection Air gap technique.
3	**Fluoroscopy Equipment:** Direct fluoroscope Image intensifier design Brightness gain Imaging characteristics Multi field image intensifiers Close circuit television scanning- Television image quality Fluoroscopic image recorder TV image records.
4	**Radiographic Image:** Image clarity contract Factors affecting contrast Image quality Mottle sharpness and resolution Line spread function, Modulation transfer function Noise and wiener spectrum Magnification Distortion penumbra unsharpness Inverse square law Evaluation of resolution Quantum mottle patient exposure.
5	**Body Section Radiography:** Basic methods of Tomography, Terminology, Blurring section thickness, Narrow and Wide angle Tomography, Circular Tomography. Topographic motions Phantom Image Tomography Angel Determination.

LEARNING SOURCE: Self Learning Materials

ADDITIONAL READINGS:

A. Physics for Radiographer-Hay & Hughes.

B. Fundamental of X-ray and Radium Physics-Joseph Selman

C. Basic Medical Radiation Physics-Stanton

D. rsstudents.files.wordpress.com/2008/03/fluoroscopy.ppt

RADIOGRAPHY AND DARK ROOM TECHNIQUES- RAD12203

UNIT	CONTENTS
1	**X-ray Materials:** Types of emulsion-characteristic and control Screen and non-screen films Dental films X-ray paper Under and Over exposure speed contrast.
2	**Intensifying Screens:** Fluorescence Application of fluorescence in Radiography Types of Intensifying screens and Intensifying factors Cleaning and general care of screen-after glow.
3	**X-ray Cassettes** Testing and proving good screen Contract, General care.
4	**X-ray Developers:** Characteristics, Details and contrast Freedom from chemical fog and staining Function and constituent of developer Standardization by time and temperature Exhaustion of developer
5	**Replenishes:** Powder and liquid solution - Radium and high contrast developer Ultra rapid development methods Automatic processing.
6	**X-ray Fixers and Fixing:** Fixing agent's Acid and preservative in fixer Inclusion of hardener Time of fixation Silver recovery.

7	**Rinsing, Washing and Drying:** Objects Methods employed Methods of drying films
8	**Processing:** Preparation of solution Suitable water supply Nature of mixing vessels Order mixing solutions Filtrations Making of stock solutions Storage of dry chemical Storage of solution.
9	**Processing Apparatus:** Processing units Hanger's, Care of hanger's, Refrigeration and use of ice.
10	**OT Processing:** Operation theatre processing, Dish units.
11	**Technical and Processing faults:** Chemical reduction Chemistry and characteristics of Farmer's reducer Local and general application.
12	**X-Ray Dark Room:** Size, Light proof entrance, Hatches, Construction of walls of protection against chemical and Radiation, Ceiling, Colour Schemes, Waterproofing of floors, Loading bench design, Disposition of processing and accessory, Equipment for efficient working, Arrangement of drying cabinets in Dark Room or in adjacent room, Dark Room illumination and testing for safety, Ventilation.
13	**The Radiographic Image:** Radiographic factors affecting image contrast and sharpness Variation in exposure time in accordance with quality of Radiation filters, Distance, Intensifying screens, Grids, Film Speed, Developer and Development.
14	**Presentation of Radiograph:** Identification of films Aspect for direct and stereo (univeraprimatic) viewing Mounting dental films Accessories- Viewing boxes, Spot light illuminator, Projectors and viewing screens for miniature and cine radiography, magnifiers, Film identification, Lead letters and numbers, Actinic marker embossing machine, Film trimmers, Corner cutters, Dental mounts and cutter, Filling units.
15	**Dark Room Procedures and Techniques:** Dark room adaptation techniques Safe light test, Preparation of developer Fixer And its chemistry Design and planning of dark room, processing of exposed films, care of intensifying screens, storage of unexposed films Accessories of dark room- AFP tech. Dry camera and presentation of films etc. Manual and automatic processing, AFP tech. and presentation of films etc.

LEARNING SOURCE: Self Learning Materials

ADDITIONAL READINGS:

A. Physics for Radiographer-Hay & Hughes.

B. Fundamental of X-ray and Radium Physics-Joseph Selman

C. Basic Medical Radiation Physics-Stanton

HUMAN ANATOMY & PHYSIOLOGY- ANT12201

UNIT	CONTENTS
1.	**The Human Body:** Definitions, sub-divisions of Anatomy, Terms of location and position, Fundamental planes, Vertebrate structure of man, Organization of the body cells, Tissues.
2.	**The Skeletal System:** Types of bones, Structure and growth of bones, Name of all the bones and their parts. Joints classification, Types of movements with examples. **Division of the Skeleton**- Appendicle Skeleton, Axial Skeleton.
3.	**Anatomy of Circulatory System:** Heart Size, Position coverings, Chambers, Blood supply, Nerve supply, Blood vessels. General plan of circulation, Pulmonary circulation Names of Arteries and Veins, Their position. Lymphatic System General Plan.
4.	**Anatomy of the Respiratory System:** Organs of respiratory, Larynx, Trachea, Bronchial Tree, Respiratory portion, Pleurae and Lungs, Brief knowledge of parts and position.
5.	**Anatomy of the Digestive System:** Components of Digestive system, Alimentary tube, Anatomy of organs of Digestive tube, Mouth, Tongue, Tooth, Salivary glands, Liver, Bleary apparatus, Pancreas, Names and position and brief functions.
6.	**Anatomy of the Nervous System:** Central nervous system, The Brain, hind brain, midbrain, forebrain, brief structure, locations, and peripheral nervous system, Spiral card, Anatomy, functions, reflex – Arc, ménages. Injuries to spinal card and brain.
7.	**Anatomy of the Endocrine System:** Name of all endocrine glands their position, hormones, and their functions– pituitary, thyroid, parathyroid, adrenal glands, gonads & islets of pancreas.
8.	**Anatomy of Excretory System and Reproductive System:** Kidneys location, gross structure, excretory ducts, urethras, urinary bladder, urethra, Male reproductive system, Testis, duct system, Female reproductive system, Ovaries Duct system, accessory organs.
9.	**Blood:** Definitions, Composition, Properties and function of Blood, Haemogram (RBC, WBC, Platelet count, HB concentrations), Function of plasma proteins, Haemopoiesis. **Blood Group**–ABO and RH grouping, Coagulation & Anticoagulants. **Anemia-** Anemia causes effects & treatment, Body fluid compartments, composition, Immunity **Clotting-** Lymphoid tissue, Clotting factors, Mechanism of blood clotting, Disorders of white blood cells, Disorders of platelets, Disorders of clotting.
10.	**Cardio Vascular System:** Function of cardiovascular system, Structure of cardiovascular system, Cardiac cycle,

	Functional tissue of heart & their function, Cardiac output, E.C.G., blood pressure, Heart Rate.
11.	**Respiratory System:** Function of Respiratory System, Functional (physiological), Anatomy of Respiratory system, Mechanism of respiration, Lung volumes & capacities, Transport of respiratory gases.
12.	**Digestive System:** Function of digestive system, Functional Anatomy of Digestive System, Composition and functions of all digestive juices, Movements of Digestive System (intestine), Digestion & absorption of carbohydrate, proteins & fats.
13.	**Functions of Nervous System:** Neuron – Conduction of impulses, Factors effecting, Synapse – Transmission, Reception, Reflexes, Ascending tracts, Descending tracts, Functions of various parts of the Brain, Cerebro Spinal Fluid (CSF), Composition, Functions & Circulation, Lumbar Puncture, Autonomic Nervous System – and its types, Functions of (ANS).
14.	**Special Senses:** Vision – Structure of Eye, function of different parts Refractive errors of and correction. Visual pathways, color vision & tests for color blindness. Hearing, structure and function of ear, mechanism of hearing, test for hearing (deafness).
15.	**Muscle Nerve Physiology:** Type of muscle, Structure of skeletal muscle, Sarcomee, Neuromuscular junction & transmission, Excitation & contraction coupling (mechanism of contraction).
16.	**Structure and Function of Skin:** Body temperature, Fever, Regulation of temperature.
17.	**Excretory System:** Excretory organs, Kidneys, Function, Nephron, Juxta Glomerular Apparatus, Renal Circulation, Mechanism of Urine Formation, Mechanism of Micturition, Cystomatrogram, Diuretics, Artificial Kidney.
18.	**Structure and Function of Reproductive System:** Male reproductive system, Spermatogenesis, Testosterone, Female reproductive system, Ovulation, Menstrual cycle cogenesis, Tests for ovulation, Estrogen & progesterone, Pregnancy test, Parturition, Contraceptive, Lactation, Composition of milk, Advantages of breast feeding.

LEARNING SOURCE: Self Learning Materials

ADDITIONAL READINGS:

A. Text books of Physiology. Author: Guyton (Arthor C). Prism publishers Bangalore.
B. Human Physiology. Author: Chaterjee (cc). Medical allied agency
C. Concise Medical physiology. Author: Choudhary (Sujit km.). New central books Kolkata.
D. Review Medical physiology. Author: Ganang. Application and Lange.

RADIATION PHYSICS AND MODERN IMAGING TECHNIQUES–I RAD12202P

UNIT	CONTENTS
1	Practical I-

	Practical of measuring instruments Ionisation chamber TLD measuring technique-Focal spot measurement, KV measurement Linearity of mA station Tube centering Radiographic tech. of whole body, all sp. Investigations imaging, etc. Table top dose measurement in fluoroscopy Image distortion of IITV Leakage of radiation through lead flaps Radiation level measurement during tube, Above table and Below table Removal of grids.

LEARNING SOURCE: Self Learning Materials

ADDITIONAL READINGS:

A. Physics for Radiographer-Hay & Hughes.

B. Fundamental of X-ray and Radium Physics-Joseph Selman

C. Basic Medical Radiation Physics-Stanton

RADIOGRAPHY AND DARK ROOM TECHNIQUES – RAD12203P

UNIT	CONTENTS
1	Practical I- Dark room adaptation techniques Safe light test, Preparation of developer Fixer And its chemistry Design and planning of dark room, processing of exposed films, care of intensifying screens, storage of unexposed films Accessories of dark room- AFP tech. Dry camera and presentation of films etc. Manual and automatic processing, AFP tech. and presentation of films etc.

LEARNING SOURCE: Self Learning Materials

ADDITIONAL READINGS:

A. Physics for Radiographer-Hay & Hughes.

B. Fundamental of X-ray and Radium Physics-Joseph Selman

C. Basic Medical Radiation Physics-Stanton

PATIENT CARE RELEVANT TO DIAGNOSTIC RADIOLOGY-RAD12201P

UNIT	CONTENTS
1	Practical I- Practical knowledge of patient care Measuring of pulse, Measuring of BP Preparation for radiological investigations, Contrast media application, reaction management, allergy test Care of Anaesthetic patient Knowledge of catheterization Oxygen administration, Biopsy Method, Sympathetic and behavioral treatment Care of ambulatory patients Care of pregnant patient Non cooperating child Dignity of patient etc.

LEARNING SOURCE: Self Learning Materials

ADDITIONAL READINGS:

A. Care of patient in diagnostic Radiography Chesney & Chesney (Blackwell Scientific)

B. Chesney's Care of the patent in Diagnostic Radiography Pauline J clumer (Black well Scientific)

C. Aid to Tray and Trolley Setting Marjorie Hougton (Bacilliere)

HOSPITAL TRAINING-II-TRN12201

ENVIRONMENTAL & BIOMEDICAL WASTE MANAGEMENT-WCM12301

UNIT	CONTENTS
1	**Environment Introduction:** Biotic and Abiotic environment, Adverse effects of Environmental Pollution, Control Strategies, Various Acts and Regulation.
2	**Water Pollution:** Water Quality Standards for potable water, Surface and underground water sources, Impurities in water and their removal, Denomination, Adverse effects of domestic waste water and industrial effluent to surface water sources, Eutrophication of lakes, Self purification of steams.
3	**Air Pollution:** Sources of air contaminations, Adverse effects on human health, Measurement of air quality standards and their permissible limits, Measure to check air pollution, Greenhouse effect, Global warming, Acid rain, Ozone depletion.
4	**Bio Medical Waste Management:** Introduction to Bio-Medical Waste, Types of Bio-Medical Waste, Collection of Bio-Medical Waste, Treatment and safe disposal of Bio-Medical Waste.
5	**Solid Waste Management:** Introduction to Solid Waste, Its collection and disposal, Recovery of resources, Sanitary land-filling, Vermin-composting, Hazardous waste management.
6	**Land Pollution:** Soil Conservation, Land Erosion, Aforestation, Ecology Business of Species, Biodiversity, Population Dynamics, Energy flow, Ecosystems
7	**Social Issues and the Environment:** Sustainable development and life style, Urban problems related to energy, Resettlement and rehabilitating of people, Environmental ethics, Consumerism and waste products, Water Harvesting and Rural Sanitation- Water harvesting techniques, Different schemes of Rural Water Supply in Rajasthan, Rural Sanitation, Septic Tank, Collection and disposal of wastes, Bio-gas, Community Awareness and participation, Miscellaneous, Non-Conventional (Renewable) sources of energy, Solar energy, Wind energy, Bio-mass energy, Hydrogen energy.

LEARNING SOURCE: Self Learning Materials

ADDITIONAL READINGS:

A. Paryavaran Shiksha. Author : Dr. A.N. Mathur, Dr. N.S. Rathore, Dr. V.K. Vijay.

B. Paryavaran Adhyayan. Author : Dr. Ram Kumar Gujar, Dr. B.C. Jat

C. Parayavaran Avabodh. Author : Dr. D.D. Ojha.

D. Environmental Chemistry and Pollution Control. Author : S.S. Dora

E. Ecology concepts and application. Author : Manuel C. Muller.

RADIATION PHYSICS AND MODERN IMAGING TECHNIQUES-II
RAD12301

UNIT	CONTENTS
1	**Radiography:** Primary radiological image produced by Contrast Media Attenuation Linear and Mass Attenuation coefficient Factors affecting attenuation Application in radiology Filters- Inherent and Added Filters, Heavy metal filters X-ray beam restrictor aperture diaphragm cones and cylinder collimators Function of restrictors.
2	**Scattered Radiation:** Significance of Scatter Grid principle- design and type Evaluation of grid performance lead content Grid cut off Moving grids Grid selection Air gap technique.
3	**Fluoroscopy Equipment:** Direct fluoroscope Image intensifier design Brightness gain Imaging characteristics Multi field image intensifiers Close circuit television scanning- Television image quality Fluoroscopic image recorder TV image records.
4	**Radiographic Image:** Image clarity contract Factors affecting contrast Image quality Mottle sharpness and resolution Line spread function, Modulation transfer function Noise and wiener spectrum Magnification Distortion penumbra unsharpness Inverse square law Evaluation of resolution Quantum mottle patient exposure.
5	**Body Section Radiography:** Basic methods of Tomography, Terminology, Blurring section thickness, Narrow and Wide angle Tomography, Circular Tomography. Topographic motions Phantom Image Tomography Angel Determination.
6	**Mammography:** Technical aspects of Mammography Generator x-ray tubes, Accessories, Resolutions and quality control Application and role in medicine.

7	**Ultrasound:** Physical characteristics of sound transducer Characteristics of ultrasound Beam interaction of Ultrasound with Matter Quarter wave matching Ultrasonic display imaging principles Doppler technique Ultrasound instrumentation, Bio effect and Safety consideration.

LEARNING SOURCE: Self Learning Materials

ADDITIONAL READINGS:

A. Physics for Radiographer-Hay & Hughes.

B. Fundamental of X-ray and Radium Physics-Joseph Selman

C. Basic Medical Radiation Physics-Stanton

QUALITY ASSURANCE IN DIAGNOSTIC RADIOLOGY-RAD12302

UNIT	CONTENTS
1.	**QA Activities:** Equipment selection phase, Equipment installation and acceptance phase, Operational phase, Preventive maintenance.
2.	**QA Programme at Radiological Faculty Level:** Responsibility, Purchase, Specifications, Acceptance's Routine testing, Evaluation of results of routine testing, Record keeping Quality assurance practical exercise in the X ray generator and tube, Image receptors from processing, Radiographs equipments Fluoroscopic equipments, Mammographic equipments, Conventional tomography, Computed tomography, Film processing, Manual and automatic, Consideration for storage of film and chemicals, Faults tracing Accuracy of imaging- Image distortion for digital imaging devices.
3.	**QA Programmed Test:** Light beam alignment, X-ray out-put and beam quality check KVp check, Focal spot size and angle measurement, Timer check, MAs test, Grid alignment test, High and low contrast resolutions, Mechanical and electrical checks, Test, Field alignment test for fluoroscopic device, Resolution test. Phantom measurements-CT, US and MRI.
4.	**QA of Film and Image Recording Devices:** Sensitometry, Characteristic curve, Film latitude, Film contrast, Film speed Resolution, Distortion, Artifacts of films and image recording Maintenance and care of equipment: Safe operation of equipment-

	Routine cleaning of equipment and instruments- Cassette, Screen maintenance of automatic processor and manual processing units, Routine maintenance of equipments, Records keeping and log book, Maintenance, Reject analysis and objective of reject analysis programme.

LEARNING SOURCE: Self Learning Materials

ADDITIONAL READINGS:

A. Quality assurance in Diagnostic Radiology By J.M. Mcolemore (Year book of Medical Publishers)
B. Quality Control in diagnostic imagine" By J.E. Gray (University Park Press)
C. Processing and Quality Control " By: William E.J. Mckinney (J.B. Lippincott Company)
D. Reading 4 - Concepts in Medical Radiographic imagine" By: Marianne Tortoic (W.B. Saunders Company)

RADIATION HAZARDS, PREVENTION & SAFETY-RAD12303

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	**Patient Protection II:** 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 bothers pvt. Ltd New Delhi
C. An Introduction to Radiation Protection Allen Martin "& Samuel
D. Radiation safety in Medical practice. M.M. Rechami

GENERAL PRINCIPLES OF HOSPITAL PRACTICE AND PATIENT CARE- HHM12301

UNIT	CONTENTS
1	**Hospital Procedure:** Hospital staffing and organization, Records relating to patients and departmental statistics, Professional attitude of the technologist to patient and other members of the staff, Medico legal aspects, Accident in the department, Appointment, Organization, Minimizing waiting time, Outpatient and follow ups to clinics, Stock taking and Stock keeping.
2	**Care of the Patient:** First contact with patients in the department, Management of chair and stretcher, Patients and aids for this, Management for the unconscious patient, Elementary hygiene, Personal cleanliness, Hygiene in relation to patient (for example clean linen and receptacles), Nursing care, Temperature, Pulse and Respiration, Essential care of the patient who has a Tracheotomy, Essential care of the patient who has Colostomy, Bedpans and Urinals, Simple application of a Sterile Dressing.
3	**Aims and Objective of First Aids:** Wounds and bleeding, Dressing and bandages, Pressure and splints, Supports etc., Shock

	insensibility, Asphyxia, Convulsions, Resuscitation. Use of suction apparatus, Drug reactions, Prophylactic measures, Administration of oxygen, Electric shock, Burns, Scalds, Hemorrhage, Pressure points, Compression Band, Fracture, Splints, Bandaging, Dressing, Foreign bodies poisons.
4	**Infection:** Bacteria their nature and appearance, Spread of infections, Auto infection or Cross infection, The inflammatory process, Local tissue reaction, General body reaction, Ulceration aspects and Antisepsis.
5	**Principles of Asepsis:** Sterilization, Methods of sterilization, Use of central sterile supply, Departmental care and Identification of Instruments, Surgical dressings in common use including Filament Swabs, Elementary Operating Theatre procedure, Setting of trays and trolleys in the Radiotherapy Department.
6	**Departmental Procedures:** Department staffing and organization, Records relating to patients and departmental statistic, Professional attitude of the technologist to patient and other members of the staff, Medico legal aspects, Accidents in the department, Appointment, Organization, Minimizing waiting time, Outpatient and follow ups to Clinic, Stock taking and Stock keeping.
7	**Drugs in the Department:** Storage, Classification, Labeling and checking, Regulations regarding dangerous and other drugs, Units of measurement, Special drugs, Anti Depressive and Antihypertensive etc.

LEARNING SOURCE: Self Learning Materials

ADDITIONAL READINGS:

A. Deeley-A guide to Radiotherapy nursing Living stone

B. Care of patient in diagnostic Radiography Chesney & Chesney

C. Chesney's Care of the patient in Diagnostic Radiography Pauline J.Culmer.

D. Aid to Tray and Trolley Setting Marjorie Hougton

QUALITY ASSURANCE IN DIAGNOSTIC RADIOLOGY- RAD12302P

UNIT	CONTENTS
1	Practical I- Practical of QA & QC Knowledge of QA & QC test equipments Various parameters of acceptance test of machine—KV, MA , time, x-ray output etc. Inventory of machines X– ray tubes, cassettes, films etc. AMC/ CMC records and review Performance of machines as far as image quality Grid test, Fluoroscopy device test, Phantom test, Sensitivity test, LBD test etc. Resolution test of CT, MRI and USG Use of Sensitometer and Densitometer.

LEARNING SOURCE: Self Learning Materials

ADDITIONAL READINGS:

A. Quality assurance in Diagnostic Radiology" By J.M. Mcolemore (Year book of Medical Publishers)

B. Quality Control in diagnostic imagine" By J.E. Gray (University Park Press)

C. Processing and Quality Control " By: William E.J. McKinney (J.B. Lippincott Company)

D. Concepts in Medical Radiographic imagine" By: Marianne Tortoic (W.B. Saunders Company)

RADIATION HAZARDS, PREVENTION AND SAFETY- RAD12303P

UNIT	CONTENTS
1	Practical I- Practicals based on Radiation Hazards & control safety Knowledge of all hazards Education of general public by posters and seminars Safety of women and children , Pregnant women, Safety of patient attendants Non radiation workers hospital staff Checking of lead aprons Leakage radiation from tube head Radiation survey in and around X – ray installation Use of TLD film badges and use of protective devices etc Keeping of dose records of radiation workers Steps after high exposure report and investigations.

LEARNING SOURCE: Self Learning Materials

ADDITIONAL READINGS:

A. Radiation Protection in Hospital. Richard F. Mould Reference book

B. Basic radiological physics. Jaypee bothers pvt. Ltd New Delhi

C. An Introduction to Radiation Protection Allen Martin "& Samuel

D. Radiation safety in Medical practice. M.M. Rechami

RADIATION PHYSICS AND MODERN IMAGING TECHNIQUES-II– RAD12301P

UNIT	CONTENTS
1	Practical I-

	Practical of measuring instruments Ionisation chamber TLD measuring technique-Focal spot measurement, KV measurement Linearity of mA station Tube centering Radiographic tech. of whole body, all sp. Investigations imaging, etc. Table top dose measurement in fluoroscopy Image distortion of IITV Leakage of radiation through lead flaps Radiation level measurement during tube, Above table and Below table Removal of grids.

LEARNING SOURCE: Self Learning Materials

ADDITIONAL READINGS:

A. Physics for Radiographer-Hay & Hughes.

B. Fundamental of X-ray and Radium Physics-Joseph Selman

C. Basic Medical Radiation Physics-Stanton

HOSPITAL TRAINING-III-TRN12301