



NIMS UNIVERSITY

SYLLABUS
OF

BACHELOR OF RADIATION TECHNOLOGY– BRT

VERSION 1.2

DIRECTORATE OF DISTANCE EDUCATION

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

BACHELOR OF RADIATION TECHNOLOGY– BRT

Eligibility	:	10+2 with PCB/PCM
Programme Duration	:	3 years
Programme Objectives	:	<p>Our bachelor's program in Radiation Technology combines both theoretical and clinical instructions covering topics such as physiology, anatomy, radiation physics, radiation imaging, radiation protection, positioning of patients, radiographic techniques, medical terminology and patient care procedures. Using new imaging techniques, alongside doctors and nurses, you will help in quicker and more accurate diagnosis of illness. We are one of the few premium institutes in India to offer this program.</p>
Job Prospects	:	<p>After the completion of BRT, you will find a challenging career in hospitals, trauma centers and private laboratories. You can also explore a career in nuclear imaging. As it's a very demanding profession, candidates seek career in various specializations under radiology where the remunerations are high. Common job profiles of students after completing BRT include: Diagnostic Imaging General Technologist, Radiation Therapist, Nuclear Medicine Technologist, Sonographer, Magnetic Resonance Imager (MRI), Trainee Nuclear Medicine Technologist, Trainee Sonographer, Trainee Magnetic Resonance Imaging Technologist.</p>

YEAR I

Course Code	Course Title	Theory/ Practical	Continuous Assessment (Internals)	Credits
ENG14101	Communication For Professionals	70	30	5
BOX14101	Bio Statics and Hospital Management	70	30	5
RAD14101	Basics of Radiation Physics	70	30	6
RAD14102	Radiation Physics and Modern Imaging Techniques	70	30	6
RAD14103	Radiography and Dark Room Techniques	70	30	6
RAD14101P	Basics of Radiation Physics	35	15	1
RAD14102P	Radiation Physics and Modern Imaging Techniques	35	15	1
RAD14103P	Radiography and Dark Room Techniques	35	15	1
TRN14101	Hospital Training-I	200		1
			TOTAL	32

YEAR II

Course Code	Course Title	Theory/ Practical	Continuous Assessment (Internals)	Credits
CSC14207	Fundamentals of Computer Sciences	70	30	5
RAD14201	Patient Care Relevant to Diagnostic Radiology	70	30	6
RAD14202	Quality Assurance in Diagnostic Radiology	70	30	6
RAD14203	Radiation Hazards ,Prevention and Safety	70	30	6
HHM14201	General Principles of Hospital Practice and Patient Care	70	30	5
RAD14201P	Patient Care Relevant to Diagnostic Radiology	35	15	1
RAD14202P	Quality Assurance in Diagnostic Radiology	35	15	1
RAD14203P	Radiation Hazards, Prevention and Safety	35	15	1
TRN14201	Hospital Training-II	200		1
			TOTAL	32

YEAR III

Course Code	Course Title	Theory/ Practical	Continuous Assessment (Internals)	Credits
RAD14301	Applied Imaging Technology I & II	70	30	6
RAD14302	Advanced Diagnostic Techniques and Radiation Hazards	70	30	6
RAD14303	Ultrasound and Computerized Tomography	70	30	6
RAD14304	Image Production and Evaluation	70	30	5
RAD14305	Special Investigation Techniques	70	30	5
RAD14301P	Applied Imaging Technology I & II	35	15	1
RAD14302P	Advanced Diagnostic Techniques & Radiation Hazards	35	15	1
RAD14303P	Ultrasound and Computerized Tomography	35	15	1
TRN14301	Hospital Training-III	200		1
			TOTAL	32

DETAILED SYLLABUS

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

YEAR- I

COMMUNICATION FOR PROFESSIONALS- ENG14101

UNIT	CONTENTS
1	<p>Parts of speech: Definition of all the sight parts along with examples and their use in language.</p> <p>Definite and Indefinite articles: A, an, and, the, Definition and its uses along with examples.</p> <p>Types of Pronouns: Personal, Reflexive, Emphatic, Demonstrative, Relative, Indefinite, Interrogative and Distributive pronouns.</p> <p>Noun: Defining noun along with types and categories, Gender, Number case</p> <p>Adjective: Adjective, Comparison, Adjective used as nouns, Positions of the Adjective and Correct use of Adjectives.</p> <p>Verb: Definition, its forms, Verbs of incomplete predication, P</p>

6	Business Writing: Written composition, Precise writing and summarizing, Writing of Bibliography, and Enlargement of vocabulary.
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LEARNING SOURCE: Self Learning Materials

ADDITIONAL READINGS:

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

BIO STATICS AND HOSPITAL MANAGEMENT- BOX14101

UNIT	CONTENTS
1	Introduction: Meaning, Definition, Characteristics of statistics, Importance of the study of statistics, Branches of statistics, Statistics and health science including nursing Parameters and estimates, Descriptive and inferential statistics Variables and their types, Measurement scales.
2	Data: Tabulation of Data Raw data The array Frequency distribution Basic principles of graphical representation Types of diagrams-histograms Frequency polygons Smooth frequency Polygon Cumulative frequency curve Normal probability curve Measure of Central Tendency Need for measures of central tendency Definition and calculation of mean- ungrouped and grouped, Meaning, Interpretation and calculation of median Ungrouped and grouped Meaning and calculation of mode Comparison of the mean, and mode Guidelines for the use of various measures of central tendency.
3	Measure of Variability: Need for measure of dispersion, The range, The average deviation, The variance and standard deviation Calculation of variance and standard deviation Ungrouped and grouped Properties and uses of variance and SO Probability and Standard Distributions

	Meaning of probability of standard distribution The Binominal distribution The normal distribution Divergence from normality - skewness, kurtosis Practice on computer to prepare the data of investigations positive and negative To produce the authenticity of radiological examination Practical for demand of future requirement of man power and machines etc.
4	Health care – an overview: Functions of hospital administration Modern techniques in hospital management Challenges and strategies of hospital management Administrative functions–Planning, Organizing, Staffing Leading and controlling organizational structure Motivation and leadership Designing health care organization Medical record House-keeping services Laboratory performance Management of biomedical waste Total patient care – indoor and outdoor Nursing and ambulance resources Evaluation of hospital services Quality assurance. Record reviews and medical audit.

LEARNING SOURCE: Self Learning Materials

ADDITIONAL READINGS:

1. Medical Biostatistics Chapman & Hall/CRC Biostatistics Abhaya Indrayan , S.B. Sarmukaddam

BASICS OF RADIATION PHYSICS- RAD14101

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	<p>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)</p>
4	<p>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)</p>
5	<p>Radiation Detectors: Radiation protection-biological aspects Measurement of detriment ICRP frame work of radiological protection.</p>
6	<p>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</p>
7	<p>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.</p>
8	<p>Basic Physics & Radiation Physics: Basic concepts-Units and measurements-Force work power and energy Temperature and heat SI Units of above parameter Atomic structure atom model Nucleus- Electronic configuration- periodic table Isotopes-Ionization-excitation-Binding energy electron volt, Electromagnetic radiation- Quantum nature of radiation- mass energy equivalence- Fluorescent-electromagnetic spectrum Electricity and magnetism: Electric charges, Coulomb's law, Unit of charge- Electric potential Unit of potential Electric induction capacitance and capacitors Series and parallel connection Electric current unit Resistance Ohm's law Electric power Joule's law Magnetism: Magnetic induction</p>

	<p>Magnetic properties Hysteresis- Magnetic effect of current- Electrical instruments, Galvanometer, Voltmeter, Ammeter and Multimeter Electromagnetic Induction-Induced electro motive force Faradays Experiments-law of electromagnetic induction.</p>
9	<p>Self and Mutual induction: Alternation current– Ac generator Peak and RMS values, Ac circuits with resistance capacitance and inductance Choke coil- Eddy current Transformer-theory, Design, Losses-Auto transformer-High voltage transformer-electric power transmission X-rays: Discovery of x-rays-properties, Production–x-ray spectrum-bremsstrahlung and characteristic X-rays tube: Coolidge tube design, line focus principle-space charge effect, tube cooling, Modern x-ray tubes, Stationary anode, Rotating anode, Grid controlled x-ray tubes Heel effect of focus radiation Tube insert and housing-Tube rating Quality and intensity of x-rays-factors influencing them X-ray generator circuits: Vacuum tube, Diodes-Semi conductor diodes-transistor-rectification. Half and Full wave self rectification X-ray generator filament circuit, Kilo voltage circuit, Single phase generator, Three phase generator, Constant potential generator, Fuses switches and interlocks, Exposure switching and timers-HT cables-ear thing.</p>
10	<p>Radioactivity: Discovery of radioactivity, Natural radioactivity , Units Radium, Thorium and Uranium series Alpha, Beta decay and Gamma rays Radioactive disintegration Exponential decay Half life period decay Constant, Artificial radioactivity Production of radioisotopes Cyclotron, Neutron fission and fusion- Chain reaction, Atom bomb, Nuclear reactor Interaction of X and gamma rays- Transmission through matter Law of exponential attenuation Half value layer, Linear Attenuation Coefficient Coherent scattering Photoelectric effect Compton scattering pair production Photonuclear disintegration-Particle interactions, Interactions of x and gamma rays in the body fat, Soft tissue, Bone contrast media, Total attenuation coefficient, Relative clinical importance Radiation quantities and units- Radiation Immensity Exposure roentgen Its limitations Kerma and absorbed Electronic equilibrium read Gray conversion factor for roentgen to RAD RBD-LET Quality factor Dose equivalent-rem, sievert Radiation detection and measurements- Principle of radiation detection</p>

	Ionization chamber Proportional counter- GM tubes Scintillation detectors Semiconductor detector Gamma ray spectrometer Measuring system Free ionization chamber, Thimble ion chamber, Condenser chamber Victoreen electrometer, Secondary standard dosimeter, Film dosimeter, Chemical dosimeter, Thermoluminescent dosimeter, Pocket dosimeter, Radiation survey meter, Zone monitor, Contamination monitors-their functions, use and maintenance.
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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.

RADIOGRAPHY AND DARK ROOM TECHNIQUES- RAD14102

UNIT	CONTENTS
1	<p>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.</p> <p>Intensifying Screens- Fluorescence Application of fluorescence in Radiography Types of Intensifying screens and Intensifying factors Cleaning and general care of screen-after glow.</p> <p>X-ray Cassettes- Testing and proving good screen Contract, General care</p> <p>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</p>
2	Replenishes:

	<p>Types- Powder and liquid solution - Radium and high contrast developer Ultra rapid development methods Automatic processing.</p> <p>X-ray fixers and fixing- Fixing agent's Acid and preservative in fixer Inclusion of hardener Time of fixation Silver recovery.</p> <p>Rinsing washing and drying- Objects Methods employed Methods of drying films</p> <p>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.</p>
3	<p>Processing Apparatus: Processing units Hanger's, Care of hanger's, Refrigeration and use of ice.</p> <p>OT Processing- Operation theatre processing Dish units. Technical and processing faults- Chemical reduction. Chemistry and characteristics of Farmer's reducer Local and general application.</p> <p>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.</p>
4	<p>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.</p> <p>Presentation of Radiograph- Identification of films Aspect for direct and stereo (univeraprimatic) viewing Mounting dental films</p>

5	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.
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LEARNING SOURCE: Self Learning Materials

ADDITIONAL READINGS:

- A. Medical Radiographic Technique and Dark Room Practices Krishnamurthy

RADIATION PHYSICS AND MODERN IMAGING TECHNIQUES-
RAD14103

UNIT	CONTENTS
1	Absorption of radiation: The exponential attenuation Linear & mass attenuation co-efficient Half value layer Energy transfer and energy absorption coefficient Total absorption coefficient Relative importance of different types of absorption Interaction of radiation- Introduction Photo electric effect Compton scattering Thomson scattering and pair production Energy distribution and relative importance of the different attenuation processes Measuring Instrument- Dose build up and electronic Bragg Gray Cavity theory Determination of dose in an extended medium by ionization chamber measurement Direct measurement of absorbed dose Relation among exposure dose and Kerma.
2	Measuring instruments: Ionization chamber Proportional counter GM counter scintillation detector Semi conductor detector Film dosimeter system Chemical dosimeter system TLD calibration measurement techniques and protocols of radiation dissymmetric system Radiation protection- Unit and quantities Dose limits for personal and public Recommendations of various advisory groups and regulatory bodies i.e. Protection of patient staff and public Various Safety measure devices and ALARA principles including radiological installation planning.
3	Quality Assurance & Quality control: Quality Assurance & Quality control related to radiography/fluoroscopy x-ray unit CT,

	<p>MRI, US and DSA units Modern Imaging Techniques Radiographic techniques of whole upper limb & shoulder girdle Radiographic technique of whole lower limb and pelvic girdle Radiographic techniques of whole vertebral column, Skull cranial bones and Facial bones Dental radiology intra oral extra oral as occlusal radiography Radiography technique of whole thorax including Lung, Mediastinal, Heart, Ribs, Diaphragms Special procedure for Liver, Pancreas, Spleen, Biliary system, GI tract and Genitor urinary tract Radiographic technique for obstetrics and gynecology studies Radiographic techniques for cardio vascular system.</p>
4	<p>Radiographic technique for lymphatic system, Radiography: Primary radiological image produced by contrast media Attenuation Linear and mass attenuation coefficient Factors affecting attenuation Application in radiology</p> <p>Filters inherent and added filters- Heavy metal filters, X-ray beam restrictor aperture diaphragm cones and cylinder collimators Function of restrictors</p> <p>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.</p> <p>Fluoroscopy- 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.</p>
5	<p>Radiographic Image: Image clarity contrast 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.</p> <p>Body section radiography- Basic methods of Tomography, Terminology, Blurring section thickness, Narrow and Wide angle Tomography, Circular Tomography.</p>

	<p>Topographic motions Phantom Image Tomography Angel Determination.</p> <p>Mammography- Technical aspects of Mammography Generator x-ray tubes, Accessories, Resolutions and quality control Application and role in medicine</p> <p>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.</p>
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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

BASICS OF RADIATION PHYSICS- RAD14101P

UNIT	CONTENTS
1	Practical I- Practical concerning with radiation physics Practical knowledge of x-ray tube, Anode, Cathode, Rotor, Filter, Generators, USG modes transducers, Charts diagrams, Three phase, Single phase, Control panel switches and functions, Cassettes, Film hangers, Intensifying screens, Cones.
2	Practical II- Congruency of radiation and optical field Radiation leakage, measurements Practical knowledge of Tube rating charts, Grids and function of Potter Bucky, Equipment knowledge of NMR, Gamma rays Radio pharmaceuticals application.

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.

RADIATION PHYSICS AND MODERN IMAGING TECHNIQUES – RAD14102P

UNIT	CONTENTS
1	Practical I- Practical Rad. Physics & Modern Imaging Technology- Practical of measuring instruments Ionization chamber TLD measuring technique Focal spot measurement KV measurement Linearity of mA station Tube centering.
2	Practical II- Radiographic tech. of whole body all sp. Investigations imaging 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. 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

RADIOGRAPHY AND DARK ROOM TECHNIQUES- RAD14103P

UNIT	CONTENTS
1	Practical I- Dark room procedures technique 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.
2	Practical II- Accessories of dark room AFP tech. Dry camera and presentation of films etc. Chemistry for processing of exposed films Manual and automatic processing Care of intensifying screens Storage of unexposed films

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

HOSPITAL TRAINING-I- TRN14101

YEAR-II

FUNDAMENTALS OF COMPUTER SCIENCE- CSC14207

UNIT	CONTENTS
1	<p>Computer Application: Characteristic of computers, Input, output, storage units, CPU, Computers system.</p> <p>Computers Organization- Central Processing Unit, Control Unit, Arithmetic Unit, Instruction Set, Register, Processor Speed</p> <p>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.</p>
2	<p>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</p> <p>Output Devices: Monitors, Printers, Dot Matrix Printers, Inkjet Printers, Laser Printers, Plotters, Computer</p>

	Output Micro Files, Multimedia Projector.
3	<p>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</p> <p>Word Processing- Word Processing concepts, Saving, Closing and Opening an Existing document, 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.</p>
4	<p>Documents, Templates and Wizards Presentation Package: Creating Opening and Saving Presentations Creating the look of your Presentation Working in Different Views and 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 Use of Internet and Email, Internet, Websites (Internet Sites), The Mail protocol suite.</p>
5	<p>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.</p>

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-
RAD14201

UNIT	CONTENTS
1	<p>Preparation of patients for general radiological procedures: Departmental instruction to out patients or ward Staff use of aperients enemas and colonic irrigations Flatulence and flatus causes and methods of relief Principles of catheterization and intubation pre medication, its uses and methods</p>

	<p>Anaesthetized patients nursing care before and after special x-ray Examination (for example in neurological vascular and respiratory conditions) Diabetic patient special attention to food hazards of trauma Radiological contrast agents: Opaque agents and gases.</p>
2	<p>Radiological Contrast Agents: 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.</p> <p>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.</p> <p>Iodine Preparation II- Sensitivity test, Side effects and management, Elimination from the body. Gases- Air, Oxygen and Carbon dioxide application and dangers</p> <p>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.</p>
3	<p>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.</p> <p>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.</p>

LEARNING SOURCE: Self Learning Materials

ADDITIONAL READINGS:

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

- B. Chesney's Care of the patient in Diagnostic Radiography Pauline J clumer (Black well Scientific)
- C. Aid to Tray and Trolley Setting Marjorie Houghton (Bacilliere)
- D. First Aid Haugher & Gardner (Hamlyn)

QUALITY ASSURANCE IN DIAGNOSTIC RADIOLOGY- RAD14202

UNIT	CONTENTS
1	<p>Objectives: Improve the quality of image thereby increasing the diagnostic value To reduce the radiation exposure Reducation of film wastage and repeat examination Maintain various diagnostic and imaging units at their optimal performance activities Equipment selection phase Equipment installation and acceptance phase Operational phase Preventive maintenance Programme at radiological faculty level: Responsibility, Purchase, Specifications, Acceptance's Routine testing: Evaluation of results of routine testing.</p>
2	<p>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 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 of film and image recording devices.</p>
3	<p>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.</p>

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 & SAFETY- RAD14203

UNIT	CONTENTS
1	<p>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</p>
2	<p>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.</p> <p>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.</p> <p>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.</p> <p>AERB safety code and ethics- Built in safety specification for diagnostic x-ray, fluoroscopy and CT units Specification for radiation protection devices-room layout.</p>
3	<p>Operational Safety: Radiation protection programme- Personnel requirements and responsibilities-regulatory controls</p>

	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 Radiation emergencies-situation preparedness, safety and prevention-legal requirements Recent developments in radiation safety related topics.
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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

GENERAL PRINCIPLES OF HOSPITAL PRACTICE AND PATIENT CARE- HHM14201

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. 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.
5	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. 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 Houghton

**PATIENT CARE RELEVANT TO DIAGNOSTIC RADIOLOGY-
RAD14201P**

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 patient in Diagnostic Radiography Pauline J clumer (Black well Scientific)
- C. Aid to Tray and Trolley Setting Marjorie Houghton (Bacilliere)

QUALITY ASSURANCE IN DIAGNOSTIC RADIOLOGY- RAD14202P

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- RAD14203P

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

HOSPITAL TRAINING-II-TRN14201**YEAR-III****APPLIED IMAGING TECHNOLOGY I & II- RAD14301**

UNIT	CONTENTS
1	Diagnostic and Digital Radiology: Introduction to Diagnostic radiology I and II Introduction to Diagnostic Radiology III Digital Radiology I Digital Radiology II and III.
2	X-Ray: Production of X-ray Bremsstrahlung and characteristic radiation The x-ray spectrum The intensity of X-ray Beams X-ray tubes X-ray generators Transformers X-ray Generator Types Effect of waveform on Radiation output Exposure switches and Timings.
3	Interaction: Interactions between X-ray and Matter Attenuation interaction process Relative importance of different types of interactions Scatter radiation Contrast media filtration Grids and Air gap technique.
4	Screen /Film Systems: Luminescent screens General Principles Absorption of quantum Physical characteristics of X-ray film and film processing Structure of X-ray film Latent image formation by light (or) X-rays Automatic film processing.
5	Image Quality in Radiology: Radiographic (or) image contrast Radiographic Mottle (noise) Blur Modulation Transfer function Geometry of the Radiographic Image

	Mammography an introduction and description.
6	Basic Concepts: Introduction to MRI and NMR Physics of proton NMR Probing chemical structure, chemical shielding (NMR) The g-value (EPR) through bond J coupling and through space dipole-dipole coupling (NMR).
7	NMR: Chemical shift Relaxation general mechanism Longitudinal (Tr) relaxation time Transverse (T2) relaxation time effect of field in homogeneities T2 Standard sequence ultra fast sequences Pulse sequence Inversion recovery and STIR Spin echo Gradient sequences MR Angiography.
8	MRI: Fields The Fourier transform and The FID 2D-Fourier transform reconstruction methods Imaging Technique Gradient Magnetic Inter leaved Multi Imaging 3D Fourier Transform reconstruction methods.
9	MRI 2: Imaging Quality Effects of flow Instrumentation Safety and contraindication MRI in practice One-dimensional imaging: Frequency encoding using magnetic field gradient Two dimensional imaging: phase encoding slice selection (3D to 2D) gradient echoes.
10	Spectroscopy: Introduction to in Vivo/MR-Spectroscopy Single-Voxel MRS Introduced to spectroscopic Imaging (CSI) Processing MRS data Flow and Angiography Advanced pulse sequences and techniques, Clinical.

LEARNING SOURCE: Self Learning Materials

ADDITIONAL READINGS:

- A. Applied Imaging Technology John C. P. Heggie, Neil A. Liddell, Kieran P. Maher

**ADVANCED DIAGNOSTIC TECHNIQUES AND RADIATION
HAZARDS- RAD14302**

UNIT	CONTENTS
1	Radiation Hazards Control & Safety: 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	<p>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.</p> <p>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. Personnel Monitoring System- 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</p>
3	<p>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.</p> <p>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.</p> <p>Radiation emergencies-situation preparedness, Safety and prevention-legal requirements Recent developments in radiation safety related topics.</p>

LEARNING SOURCE: Self Learning Materials

ADDITIONAL READINGS:

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

ULTRASOUND AND COMPUTERIZED TOMOGRAPHY- RAD14303

UNIT	CONTENTS
1	<p>Measures to Control Scatter Radiation: Beam centering devices Collimator cone diaphragms and grids Fluoroscopy and IITV systems-</p>

	<p>Cine radiography with various recording devices Tomography principles, various types and its applications Computerized Tomography- Principle data acquisition Concepts, Image reconstruction, Instrumentation, Image manipulation, Historical development Various generator spiral helical single.</p>
2	<p>Computerized Tomography: Multi slice CT, Electron beam CT, Mobile CT, Advance volume scanning, Continuous sub second scanning, Real time CT Fluoroscopy Interventional guidance tool 3D CT Angiography Virtual reality imaging Including image quality and quality control in CT scanners Computer Tomography Various imaging protocols and technique Basic principles of U.S. Various types of transducer Mechanism of image formations of Abdominal organ and pelvic organ (Aorta IV, C Liver, Gall bladder, Pancreas, Spleen, Kidney, Ureters, Urinary bladder etc) various advancement, Doppler and image artifacts, Physical aspects of ultra sonography including Doppler color Doppler flow imaging Power Doppler Clinical application of U.S. including use of contrast media in U.S.</p>

LEARNING SOURCE: Self Learning Materials

ADDITIONAL READINGS:

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

IMAGE PRODUCTION AND EVALUATION- RAD14304

UNIT	CONTENTS
1	<p>Image Production and Evaluation I: Review factors affecting recorded detail Density Distortion and contrast Discuss the relationship among density Distortion Contrast, and recorded detail Review factors that govern the selection of films Screens and grids Discuss the relationship between films and screens Review the effect of factors influencing exposure control such as the nature of the radiographic procedure, films, screens, and grids selected, power setting used, and beam limitation and scatter Perform exposure calculations for various radiographic procedures, Describe the advantages and disadvantage associated with automatic exposure control.</p>

2	<p>Image Production and Evaluation II: Factors affecting the decision to use automatic exposure controls Simulated radiographic procedure Use Technique charts to select exposure factors Review film storage Considerations Review radiographic identification procedures Discuss the daily and periodic maintenance for automatic film processors Discuss the procedures for loading and unloading Discuss the exposure of computed radiography systems.</p>
3	<p>Image Production and Evaluation III: Describe the effects the effects of frequency Contract, and noise on digital image quality Discuss the function of digital image window level and width controls Describe picture archival and communication systems (PACS), Discuss film archival Discuss the criteria used to evaluate the diagnostic quality of radiographs List the possible causes of poor radiograph quality.</p>

LEARNING SOURCE: Self Learning Materials

ADDITIONAL READINGS:

1. Radiobiology for the radiologist Eric J. Hall, Amato J. Giaccia

SPECIAL INVESTIGATION TECHNIQUES- RAD14305

UNIT	CONTENTS
1	<p>Pathology: Definition Cell growth-cell deformities-cell damage defense mechanism cell repair Neoplasia- Benign & malignant including its mode of growth and metastasis Causes of Disease Congenital- Traumatic metabolic and deficiency-infection immunization Blood disease, Leukemia's Anemia's Radiotherapy- Radiation treatment method, External radiation use and application of radiation, Radiotherapy technique for Skin disease in system, Respiratory, Alimentary, Urinary reproductive (including Breast, endocrine, nervous), Special procedural and related contrast media.</p>
2	<p>Contrast Media: Emergencies in radiology department Urinary tract I.V.P. Retrograde pyelography – cystourethrography Biliary tract- Oral cholecystography Hepatic percutaneous cholangiography Pre-operative cholangiography</p>

	T-tube cholangiography E.R.C.P., Gastrointestinal tract: Ba---swallow---Ba---meal, upper GIT Ba. Meal following through B.a. enema Ba double contrast enema Female genital tract- Hysterosalpingography and pelvimetry. Angiography- Carotid angiography Femoral arteriogrphahy Aortagraphy Selective angiography Cardiac catheterization CNS Ventriculography Myelography Pneumoencephalography & Shuntography Tomography- Principle Equipment and types of movement in tomography Venography, Lymphangiography.
3	Mammography: Radiculography, Dacrocystography, Sialography, Sinography, Nasopharyngography, Laryngography, Bronchography, Arthrography, Disography Introduction to Ultrasonography Computerized tomography Scanning and magnetic resonance Imaging Radiography special investigation & Radiography.

LEARNING SOURCE: Self Learning Materials

ADDITIONAL READINGS:

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

APPLIED IMAGING TECHNOLOGY I & II- RAD14301P

UNIT	CONTENTS
1	Practical I- Particles based theory Part of Applied imaging Technology Use of x-ray tube generator High frequency generator Selection of screen cassette, AFP, IP, application of mammography, MRI planning, safety of patients in MRI.

LEARNING SOURCE: Self Learning Materials

ADDITIONAL READINGS:

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

**ADVANCED DIAGNOSTIC TECHNIQUES & RADIATION
HAZARDS- RAD14302P**

UNIT	CONTENTS
1	Practical I- Practical on advanced diagnostic tech. & radiation hazards Use of USG, Doppler, CT Spiral, MDCT, DSA, PACS, OPG, CR and DR and cameras Practical for radiation safety of patient and worker etc.

LEARNING SOURCE: Self Learning Materials

ADDITIONAL READINGS:

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

ULTRASOUND AND COMPUTERIZED TOMOGRAPHY- RAD14303P

UNIT	CONTENTS
1	Practical I- Practical on USG & CT- Principal and application of different type of CT, different CT protocols Tomogram and selection of anatomical area for scan as per prescription Patient and attendant Care in CT Image processing Patient setup on CT table Application of Sonography Care of transducers Preparation of patient Patient privacy handling of machine Color Doppler and clinical application of U.S.

LEARNING SOURCE: Self Learning Materials

ADDITIONAL READINGS:

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

HOSPITAL TRAINING-III-TRN14301