

GURU KASHI UNIVERSITY



Bachelor of Medical Radiology & Imaging Technology (BMRIT)

Session: 2026-27
Faculty of Allied & Healthcare

Graduate Attributes of the Program:

Bachelor of Medical Radiology and Imaging Technology (BMRIT) program is to provide students with a high quality, well-rounded educational experience which results in graduates who possess the knowledge, skills and abilities to enter the field of diagnostic imaging as entry-level MRITs. Graduates of the BMRIT program will be able to demonstrate the necessary skills to integrate the theoretical knowledge and essential clinical skills to perform radiography, radiological and imaging procedures including interventional procedures with utmost radiation safety measures as well as to provide exemplary patient care in a variety of healthcare settings with diverse patient populations.

The objectives of the program are to:

1. Provide the profession and community with trained qualified MRITs.
2. Provide education a comprehensive program that promotes problem solving, critical thinking and communication skills in the clinical environment.
3. Students will demonstrate quality patient care skills including professionalism and ethical behaviors as specified in the code of ethics.
4. Provide graduate students with specific skills necessary making them to be competent at entry level.

Element of the Descriptor	Program learning outcomes relating to Bachelor's Degree
The graduates should be able to demonstrate the acquisition of:	
Knowledge and understanding	Acquire comprehensive knowledge of anatomy, physiology, pathology, microbiology, biochemistry, and radiation physics.
	Understand principles of radiography, imaging modalities (X-ray, CT, MRI, USG), and interventional procedures.
	Gain knowledge of radiation safety, quality assurance, and regulatory requirements.
	Understand patient care principles, medical ethics, and professional responsibilities.
	Develop understanding of image processing and evaluation of diagnostic quality.
General, technical and professional skills required to perform and accomplish tasks	Perform radiological and imaging procedures independently or as a team member.
	Handle and maintain radiological equipment such as X-ray, CT, MRI, ultrasound, and DSA units.
	Demonstrate skills in image acquisition, processing, and quality evaluation.

	Apply radiation protection and safety measures effectively.
	Communicate effectively with patients and healthcare professionals.
	Maintain professionalism, ethical conduct, and proper documentation of patient data.
Application of knowledge and skills	Apply theoretical knowledge in clinical radiography and imaging procedures.
	Perform patient positioning and imaging techniques in real clinical settings.
	Manage emergency situations in radiology departments.
	Use computer systems for image processing, storage, and reporting.
	Ensure quality patient care while performing diagnostic procedures.
Generic learning outcomes	Develop critical thinking, problem-solving, and decision-making abilities.
	Enhance communication skills and teamwork in clinical environments.
	Demonstrate ability for lifelong learning and professional growth.
	Integrate theoretical knowledge with practical and clinical exposure.
Constitutional, humanistic, ethical, and moral values	Practice ethical behavior as per medical code of conduct.
	Respect patient dignity, privacy, and cultural diversity.
	Show empathy, compassion, and professionalism in patient care.
	Uphold integrity, honesty, and responsibility in professional duties.
Employability and job-ready skills, and entrepreneurship skills and capabilities/qualities and mindset	Develop competencies required for employment in hospitals, diagnostic centers, and healthcare institutions.
	Demonstrate leadership, initiative, and teamwork skills.
	Build confidence to work independently in radiology departments.
	Acquire entrepreneurial mindset for managing diagnostic services or imaging centers.
	Adapt to technological advancements and continuous professional development.

Credit requirements	Total credits: 170 credits • Foundation courses: 12 credits • Core courses: 109 credits • Programme courses: 9 credits • Internship: 40 credits Distribution of Credits: • L – Lectures- 1 hour: 1 credit • T – Tutorial- 1 hour: 1 credit • P – Practical- 2 hours: 1 credit • Clinical (Studentship)- 3 hours: 1 credit
Entry requirements	Must have passed 10+2 (Higher Secondary) with Physics, Chemistry, Biology, and English.
	Minimum age: 17 years.
	Admission based on merit and/or entrance exam (e.g., NEET).
	Must provide medical fitness certificate and character references.

SEMESTER: 1st											
S.No.	Course Code	Course Title	L	T	P	No. of Credits	Internal Examination		External Examination		Total Marks
							Theory	Practical	Theory	Practical	
1.	BMRI101	Human Anatomy	3	0	0	3	30	-	70	-	100
2.	BMRI102	Physiology	3	0	0	3	30	-	70	-	100
3.	BMRI103	Basics of Radiation Physics	2	0	6	5	30	30	70	70	200
4.	BMRI104	Introduction to Healthcare	1	0	0	1	30	-	70*	-	-
5.	BMRI105	Medical Terminology and Record Keeping	1	0	0	1	30	-	70*	-	-
6.	BMRI106	Basics Computers and Information Science	1	0	0	1	30	-	70*	-	-
7.	BMRI107	Medical Law and Ethics	1	0	0	1	30	-	70*	-	-
8.	BMRI108	Professionalism and Values	1	0	0	1	30	-	70*	-	-
9.	BMRI109	Principals of Management	1	0	0	1	30	-	70*	-	-
10.	BMRI110	English & Communication skills	1	0	0	1	30	-	70*	-	-
11.	BMRI111	Clinical Education-I	0	0	15	5	-	-	-	-	-
	Grand Total		15	0	21	23	300	30	700	70	400

***Note (only for 1 Credit subjects):** Institute level exam only: The Institute level examination will be held before the commencement of the University examinations. A Pass in the subject with a minimum of 50 marks (50% of the total 100 marks) is compulsory in order to be eligible for the award of degree. These marks will not be considered for the award of class. Supplementary examination shall be conducted by the Institute for the benefit of unsuccessful candidates. Supplementary examinations will be conducted within six weeks/six months from the date of announcement of result

SEMESTER: 2nd											
S.No.	Course Code	Course Title	L	T	P	No. of Credits	Internal Examination		External Examination		Total Marks
							Theory	Practical	Theory	Practical	
1.	BMRI201	Basics of Microbiology	2	0	0	2	30	-	70	-	100
2.	BMRI202	Basics of Biochemistry	2	0	0	2	30	-	70	-	100
3.	BMRI203	Conventional Radiography and Equipment	4	0	2	5	30	-	70	-	100
4.	BMRI204	Clinical Radiography Positioning-I	4	1	6	8	30	30	70	70	200
5.	BMRI205	Clinical Education-II	0	0	15	5	-	-	-	-	-
	Grand Total		12	1	23	22	120	30	280	70	500

SEMESTER: 3rd											
S.No.	Course Code	Course Title	L	T	P	No. of Credits	Internal Examination		External Examination		Total Marks
							Theory	Practical	Theory	Practical	
1.	BMRI301	Pathology	2	0	0	2	30	-	70	-	100
2.	BMRI302	Clinical Radiography Positioning-II	2	1	6	6	30	30	70	70	200
3.	BMRI303	Radiography and Image Processing Techniques	2	0	2	3	30	-	70	-	100
4.	BMRI304	Contrast Media & Special Radiological procedures	2	1	6	3	30	30	70	70	200
5.	BMRI305	Clinical Education-III	0	0	12	4	-	-	-	-	-
		Grand Total	8	2	26	21	120	60	280	140	600

SEMESTER: 4th											
S.No.	Course Code	Course Title	L	T	P	No. of Credits	Internal Examination		External Examination		Total Marks
							Theory	Practical	Theory	Practical	
1.	BMRI401	Cross sectional anatomy	2	0	6	5	-	30	-	70	100
2.	BMRI402	Modern Radiological Imaging Equipment and Physics	2	1	2	4	30	-	70	-	100
3.	BMRI403	Interventional Radiology Techniques	2	1	4	5	30	30	70	70	200
4.	BMRI404	Patient Care in Radiology	1	1	4	4	30	30	70	70	200
5.	BMRI405	Clinical Education-IV	0	0	12	4	-	-	-	-	-
	Grand Total		7	3	26	22	90	90	210	210	600

SEMESTER: 5th											
S.No.	Course Code	Course Title	L	T	P	No. of Credits	Internal Examination		External Examination		Total Marks
							Theory	Practical	Theory	Practical	
1.	BMRI501	Basics Techniques in CT Technology	4	1	8	9	30	30	70	70	200
2.	BMRI502	Radiation Safety in Diagnostic Radiology	2	1	4	5	30	30	70	70	200
3.	BMRI503	Quality Assurance in Diagnostic Radiology and Regulatory Requirements	1	1	2	3	30	-	70	-	100
4.	BMRI504	Clinical Education-V	0	0	12	4	-	-	-	-	-
	Grand Total		7	3	26	21	90	60	210	140	500

SEMESTER: 6th											
S.No.	Course Code	Course Title	L	T	P	No. of Credits	Internal Examination		External Examination		Total Marks
							Theory	Practical	Theory	Practical	
1.	BMRI601	Basics Techniques in MRI Technology	3	1	8	8	30	30	70	70	200
2.	BMRI602	Introduction to Nuclear Medicine Techniques	1	1	2	3	30	-	70	-	100
3.	BMRI603	Ultrasound Techniques	2	1	0	3	30	-	70	-	100
4.	BMRI604	Biostatistics and Research Methodology	1	1	0	2	30	-	70*	-	
5.	BMRI605	Clinical Education-VI	0	0	15	5	-	-	-	-	-
	Grand Total		7	4	25	22	120	30	280	70	400

***Note (only for 2 Credit subjects) (Biostatistics and Research Methodology):** Institute level exam only: The Institute level examination will be held before the commencement of the University examinations. A Pass in the subject with a minimum of 50 marks (50% of the total 100 marks) is compulsory in order to be eligible for the award of degree. These marks will not be considered for the award of class. Supplementary examination shall be conducted by the Institute for the benefit of unsuccessful candidates. Supplementary examinations will be conducted within six weeks/six months from the date of announcement of results.

SEMESTER: 7th											
S.No.	Course Code	Course Title	L	T	P	No. of Credits	Internal Examination		External Examination		Total Marks
							Theory	Practical	Theory	Practical	
1.	BMRI701	Internship-I	-	-	-	20	-	100	-	100	200
	Grand Total		-	-	-	20	-	-	-	-	200

SEMESTER: 8th											
S.No.	Course Code	Course Title	L	T	P	No. of Credits	Internal Examination		External Examination		Total Marks
							Theory	Practical	Theory	Practical	
1.	BMRI801	Internship-II	-	-	-	20	-	100	-	100	200
	Grand Total		-	-	-	20	-	-	-	-	200

Note: ESE* will be conducted immediate after end of the 7th & 8th semester at the institutional level.

Every candidate after passing all semesters examination is required to undergo compulsory internship to the satisfaction of the college authorities and University for a period of 1 year as to be eligible for the award of the degree. The internship is partial fulfillment of the requirements for the graduation and no candidate shall be declared to have completed the program otherwise. The internship shall be completed within 18 months of the date of passing final examination.

1ST SEMESTER

Course Title: Human Anatomy	L	T	P	Cr.
Course Code: BMRI101	3	0	0	3

Total Hours 48 hrs**Course Outcomes:** At the end of the course students will be able to...

1. Describe the general anatomy of human body.
2. Explain normal disposition of various structures and organs in the body and its clinical correlation.
3. Describe the microscopic structure of various tissues.
4. Determine the topography of various structures on the surface of the body.
5. Identify and locate structures of the body.
6. Identify organs and tissues under microscope.
7. Point out various features of appearance of normal body in skiagrams.

COURSE CONTENTS**UNIT-I****08 Hours****Introduction: Human Body as a Whole**

Definition of anatomy and its subdivisions, terms of location, positions and planes, cell and its organelles, epithelium: definition, classification, describe with examples, functions, glands: classification, describe serous and mucous glands with examples, basic tissues: classification with examples.

UNIT-II**08 Hours****Locomotion and Support**

Cartilage: types, examples and histology. Bone: classification, examples and histology. Parts of long bone, names of all bones, vertebral column and intervertebral disc. Fontanel of fetal skull. Joints: classification of joints with examples, typical synovial joint in detail. Muscular system: classification of muscular tissue and histology.

Important muscles of the body: Sternocleidomastoid, trapezius, muscles of tongue, deltoid, biceps brachii, intercostal muscles, thoracic diaphragm, rectus abdominis, external oblique, internal oblique, transversus abdominis,

pelvic diaphragm, gluteus maximus, gluteus medius, gluteus minimus, quadriceps femoris and soleus.

UNIT-III

08 Hours

Cardiovascular System

Heart: size, location, chambers, exterior and interior, blood supply of heart, pericardium, systemic and pulmonary circulation, branches of aorta: common carotid artery, subclavian artery, axillary artery, brachial artery, radial artery, superficial palmar arch, femoral artery, popliteal artery and dorsalis pedis artery. Peripheral pulse, inferior vena cava, portal vein, portosystemic anastomosis, great saphenous vein, median cubital vein, dural venous sinuses. Lymphatic system: cisterna chyli and thoracic duct, lymphatic tissues and its histology, regional lymph nodes: cervical, axillary and inguinal lymph nodes.

Respiratory System

Parts of respiratory system: nose, nasal cavity, paranasal air sinuses, larynx, trachea, lungs, pleura and bronchopulmonary segments. Histology of trachea and lungs.

UNIT-IV

08 Hours

Gastro-Intestinal System Theory

Parts of GIT: oral cavity (lip, cheek, tongue, salivary glands, palate, dentition), pharynx (Waldeyer's ring), oesophagus, stomach, small and large intestine and appendix, liver, gall bladder, pancreas and spleen. Histology of oesophagus, stomach, small and large intestine, liver, gall bladder and pancreas.

Peritoneum

Description of reflections, folds and pouches in brief.

UNIT-V

08 Hours

Urinary System

Kidney, ureter, urinary bladder, male and female urethra. Histology of kidney, ureter and urinary bladder.

Reproductive System

Parts of male reproductive system: testis, vas deferens, epididymis and prostate. Parts of female reproductive system: uterus, fallopian tubes, ovary and mammary gland. Histology of testis, vas deferens, epididymis, prostate, uterus, fallopian tube and ovary.

Endocrine Glands

Names of all endocrine glands. Describe in detail the pituitary gland, thyroid gland, parathyroid gland and suprarenal gland. Histology of pituitary, thyroid, parathyroid and suprarenal glands.

UNIT-VI

08 Hours

Nervous System

Neuron, classification of nervous system, cerebrum, cerebellum, brain stem, spinal cord and spinal nerve, meninges, ventricles and cerebrospinal fluid, blood supply of the brain, cranial nerves in brief, nerve plexus (brachial and lumbar).

Sensory Organs

Skin and its appendages. Eye: parts of eyeball and lacrimal apparatus, extraocular muscles, histology of cornea and retina. Ear: parts of ear, external, middle and inner ear and their contents.

Embryology

Spermatogenesis and oogenesis, ovulation, fertilization and placenta.

SUGGESTED PRACTICALS/DEMONSTRATION (6 Hours)

- Demonstration of Histology of types of epithelium, Histology of serous, mucous and mixed salivary gland, Surface marking of the body region wise.
- Demonstration of Histology of hyaline, elastic and fibrocartilage,
- Demonstration of all bones showing parts, radiographs of normal bones and joints, Histology of compact bone (TS and LS), Demonstration of all muscles of the body, Histology of skeletal, smooth and cardiac muscle.
- Demonstration of heart, pericardium and vessels of the body, Histology of large artery, medium sized artery and large vein, Histology of lymph node, spleen, tonsil and thymus, Normal chest radiograph showing

heart shadows, Normal angiograms. Demonstration of parts of respiratory system, Normal radiographs of chest, Histology of lung and trachea.

- Demonstration of parts of GIT, liver, gall bladder, pancreas and spleen, Histology of tongue, salivary glands, oesophagus, stomach, small and large intestine, liver, gall bladder, pancreas and spleen, Radiographs of abdomen plain and contrast. Demonstrations of reflections, folds and pouches.
- Demonstration of parts of urinary system, Histology of kidney, ureter, urinary bladder, Radiographs of abdomen – IVP, retrograde cystogram. Demonstration of section of male and female pelvis with organs in situ, Histology of testis, vas deferens, epididymis, prostate, uterus, fallopian tube and ovary, Radiographs of pelvis – Hysterosalpingogram. Demonstration of the glands, Histology of pituitary, thyroid, parathyroid, suprarenal glands.
- Demonstration of Histology of peripheral nerve and optic nerve, Demonstration of major nerves in the body,
- Demonstration of cranial cavity and parts of brain, Histology of cerebrum, cerebellum, spinal cord
- Demonstration of Histology of thin and thick skin,
- Demonstration of histology of cornea and retina.

TRANSACTIONAL MODES

Lecture, Tutorial, Problem based learning, small group teaching and learning, Continuous interactive learning, Case-based, Project based, Seminars, Clinical conferences, E-learning, Skills laboratory, Industrial visit

SUGGESTED READING

- *Human Anatomy, Vol.1, 2 & 3, 5th edition, 2010, B.D. Chaurasia CBS publishers & distributors Pvt. Ltd.*
- *Physiology & Anatomy with Practical Considerations Ester. M. Grishcimer J. P. Lippincott. Philadelphia*
- *Manipal Manual of Anatomy, 2nd edition, 2012 Sampath Madhyastha CBS publishers & distributors Pvt. Ltd*
- *Text Book of General Anatomy, 2nd edition, 2013 Shobha Rawlani and Shiwlal Rawlani Jaypee brothers*
- *Langman's Medical Embryology, 11th edition, 2009 T.W Sadler Wolters Kluwer.*

Course Title: Physiology	L	T	P	Cr.
Course Code: BMRI102	3	0	0	3

Total Hours 54 hrs

Course Outcomes: At the end of the course students will be able to...

1. Explain the normal functioning of organs and systems.
2. Understand the interrelationships and interactions among various organs and systems for maintaining homeostasis.
3. Assess the relative contribution of each organ systems toward the maintenance of constant internal environment
4. Differentiate between normal and abnormal functioning of organs and systems,
5. Understand physiological basis of pathogenesis and treatment of diseases and disorders.
6. Apply the physiological basis in the field of allied health care

COURSE CONTENTS

UNIT-I

10 Hours

General physiology

Introduction to Physiology, Concept of Homeostasis, cell – Morphology – Functions of organelles and Cell membrane, Transport mechanisms, Body fluid compartments.

Muscle nerve physiology

Neurons: Morphology, Action Potential, Neuroglia: Types & functions, Muscles: Types, structure of sarcomere. Neuromuscular junction, sliding filament mechanism of contraction.

Blood

Composition, properties, functions. Plasma proteins: Concentrations and functions, RBC: Morphology, functions, count, physiological variations and life span Erythropoiesis – stages, essential factors, regulation of Erythropoiesis, Haemoglobin: Functions, concentration, physiological variations. Fate of Haemoglobin – Jaundice, types, Color index, MCH, MCV, MCHC, PCV – normal values, WBC: Morphology, functions of all types including T & B lymphocytes, total and differential counts, physiological variations, Platelets: Morphology, count, functions, thrombocytopenia & bleeding time, Blood groups: Basis of blood grouping. Landsteiner's laws, ABO system, determination of blood groups, blood transfusion, complications of

incompatible blood transfusion, Rh group, erythroblastosis foetalis, prevention and treatment, Blood bank.

Haemostasis: Mechanisms. Clotting mechanism: factors, intrinsic and extrinsic pathways.

Disorders of clotting – haemophilia, vitamin K deficiency. Anticoagulants – mechanism of action and their uses, Anaemia: Classification – Morphological and Etiological, Blood volume: normal values.

UNIT-II

10 Hours

Cardiovascular system

Organization of cardiovascular system, greater and lesser circulation, Physiological anatomy of the heart, nerve supply, Junctional tissues of heart (pacemaker), Cardiac cycle: Mechanical events, Heart sounds, causes, characteristics and significance, Normal ECG, clinical significance of ECG, Heart rate – Physiological variations, Cardiac output: Definitions, normal values, physiological variations, Arterial blood pressure: Definitions, normal values, physiological variations, factors maintaining blood pressure. Role of baroreceptors in regulation of blood pressure.

UNIT-III

08 Hours

Respiratory system

Respiratory and non-respiratory function of respiratory system. Physiological anatomy of respiratory system Functions of respiratory tract. Respiratory membrane. Respiratory muscles.

Surfactant: functions, respiratory distress syndrome.

Definitions of terms used in respiratory physiology: Eupnea, Hyperpnoea, Tachypnea, Apnea, Dyspnea.

Mechanics of breathing – intrapulmonary and Intrapleural pressure changes during a respiratory cycle.

Spirometry – Lung volumes and capacities. Vital capacity.

Oxygen transport: Role of haemoglobin, factors affecting, oxygen carrying capacity. Carbon dioxide transport: forms, chloride shift (Hamburger's phenomenon).

Respiratory centers. Role of chemo receptors in regulation of respiration. Pulmonary ventilation and alveolar ventilation. Partial pressure of gases, Calculation of partial pressure of gasses in mixture. Arterial and venous blood gas concentrations and contents.

Hypoxia: Types and effects Cyanosis, Asphyxia, Periodic Breathing, Acclimatization.

Hyperbaric O₂ therapy, Artificial respiration and Ventilators.

UNIT-IV

04 Hours

Excretory system

Functions of kidneys. Nephrons – Juxta glomerular apparatus – functions, Steps in Urine formation – Ultrafiltration, Tubular Reabsorption, Tubular Secretion, GFR.

Definition, normal values, factors affecting GFR, measurement of GFR, Renal threshold for glucose, tubular load for glucose, Role of aldosterone and ADH in urine formation, Micturition, Innervation of bladder. Diuresis, Renal functions tests – Based on analysis of urine and analysis of blood, Skin: Functions of skin. Sweat glands.

UNIT-V

04 Hours

Digestive system

Introduction, structure of alimentary canal, Saliva: Composition, functions, Stomach: Functions. Gastric Juice: composition, functions, Pancreatic Juice: Composition and functions, Liver: Functions, Bile: composition, functions, Gall bladder: functions, Succus entericus: Composition, functions. Functions of large intestine, Movements of small intestines, Deglutition.

UNIT-VI

08 Hours

Endocrine system

Major endocrine glands- Hormone: Definition, Anterior pituitary: hormones and their functions, disorders – Gigantism, acromegaly, dwarfism, Posterior pituitary:

Hormones – diabetes insipidus, Thyroid: Hormones, normal values, functions, role of TSH. Disorders: simple goitre, myxoedema, cretinism, Grave's disease, Adrenal cortex: hormones, functions of cortisol and aldosterone. Addison's disease, Cushing's syndrome, Adrenal medulla: actions of adrenaline and noradrenaline, Endocrine pancreas: Insulin & glucagon, functions, Regulation of blood glucose level, diabetes mellitus, Parathyroid: Functions of PTH.

Nervous system

Synapse: Types, Transmission, Sensory receptors: Definition, Classification Organization of spinal cord, Functions of Dorsal column and Spinothalamic tract,

Functions of Corticospinal tract, Reflex Action: Definition, reflex arc, Functions of Cerebellum, Basal ganglia, Thalamus, Hypothalamus, Cerebral cortex:

Lobes & functions. EEG – Definition and uses, Autonomic nervous system: Organization & functions, Cerebrospinal fluid: Composition and function.

UNIT-VII

10 Hours

Special senses

Vision: Physiological anatomy of eye ball, rods & cones, Refractive errors: Myopia, hypermetropia, presbyopia & astigmatism, Audition: Functions of outer, middle & inner ear, cochlea, Deafness – types, Taste: Taste buds, primary taste sensation, Smell: Receptors, modalities of smell

Reproductive system

Male reproductive system: functions of testes, puberty, spermatogenesis functions of testosterone, semen, Female reproductive system: Ovarian hormones functions – Menstrual cycle, Hormonal basis of changes in menstrual cycle, Family Planning.

SUGGESTED PRACTICALS/DEMONSTRATION (8 Hours)

- Study of Microscope and its uses
- Collection of blood and study of haemocytometer
- Haemoglobinometry
- Determination of RBC count

- Determination of WBC count
- Determination of blood groups
- Determination of bleeding time
- Determination of clotting time
- Recording of Arterial Blood Pressure,
- Clinical examination of Radial pulse
- Recording of spirogram and determination of vital capacity
- Artificial respiration, CPR
- Demonstration of ECG recording

TRANSACTIONAL MODES

Lecture, Tutorial, Problem based learning, small group teaching and learning, Continuous interactive learning, Case-based, Project based, Seminars, Clinical conferences, E-learning, Skills laboratory, Industrial visit

SUGGESTED READING

- *Foundation of Anatomy and Physiology*, Ross Wilson, Churchill Livingstone.
- *Physiology & Anatomy with Practical Considerations*, Ester. M. Grishcimer, J.P. Lippincott. Philadelphia
- *Text Book of Physiology*, A. P. Krishna, Suman Publication
- *Text Book of Physiology*, A.K. Jain, Avichal Publishing Company

Course Title: Basics of Radiation Physics	L	T	P	Cr.
Course Code: BMRI103	2	0	6	5

Total Hours 36 hrs

Course Outcomes: At the end of the course students will be able to...

1. Describe general physics related to imaging
2. Differentiate between within general radiation
3. Identify construction of radiology equipment's
4. Interpret quality of control of radiology equipment's
5. Differentiate between x-ray equipment's and other radiology related equipment's
6. Describe production of x-rays
7. Describe circuit system of radiology equipment's

COURSE CONTENTS

UNIT-I

05 Hours

Basic concepts: Units and measurements-Force, work, power and energy-Temperature and heat-SI units of above parameters. 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-Fluorescence-electromagnetic spectrum.

UNIT-II

06 Hours

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. Varying currents-Growth and decay of current in LR circuit time constant, charge and discharge of a Capacitor through a resistance and inductance. Oscillations in an LC circuit. Alternating currents: Peak and RMS values and current and voltage, circuit containing LR, CR and LCR-Power factor, series and parallel LCR circuits, DC circuit, Ohm's law, resistivity, series and parallel combination, EMF, Kirchhoff's law, heating effect of current.

Electromagnetic waves: Introduction, Maxwell's equation, electromagnetic waves, energy density and intensity, momentum, electromagnetic spectrum and radiation in Atmosphere.

UNIT-III**05 Hours****Electronics**

Semiconductors; Conduction in crystals, Energy bands. Intrinsic and Extrinsic semiconductors n-type and p-type semiconductors, majority and minority carriers.

Semiconductor diodes: p-n junction-properties forward and reverse bias, characteristics of p-n junction Rectifiers-Half-wave and full wave, ripple factor, Efficiency of HW and FW rectifiers. Filter circuits; Zener diode, regulated power supply.

Transistors-Symbols, Transistor connections and characteristics, Transistor as an amplifier, load line analysis, operating point, types of amplifiers-voltage and power amplifiers. Feedback-negative feedback in amplifiers.

UNIT-IV**05 Hours**

Discovery of x-rays-X-ray production and properties: Bremsstrahlung Radiations-Characteristics X-Rays, factors affecting X-ray emission spectra, X-ray quality and quantity, HVL measurements, heel effect, soft and hard X-Rays, added and inherent filtration, reflection and transmission targets.

UNIT-V**04 Hours****Heat**

Definition of heat, temperature, Heat capacity, specific heat capacity, Heat transfer-conduction, convection, radiation, thermal conductivity, equation for thermal conductivity (k), the value of k of various material of interest in radiology, thermal expansion, Newton's law of cooling, Heat radiation, perfect black body, Stefan law, application in Diagnostic Radiology (Heat dissipation in both stationary and rotating X-ray tubes).

UNIT-VI**05 Hours**

Interaction of ionizing radiation with matter: Types of interactions of X- and gamma radiation, Photoelectric & Compton, Pair production, annihilation radiation.

Interaction of X and gamma rays: Transmission through matter, law of exponential attenuation, half value layer and linear attenuation coefficient-coherent scattering-photonuclear disintegration-Particle interactions. Interactions of X rays and Gamma rays in the body; fat soft tissue-bone-contrast media-total attenuation coefficient-relative clinical importance.

UNIT-VII

06 Hours

Exponential attenuation (linear/mass attenuation coefficients), Half Value Thickness (HVT), Tenth Value Thickness (TVT), dependence on energy and atomic number.

Radiation intensity and exposure, photon flux and energy flux density. f. LET, range of energy relationship for alpha, beta particles with X-Rays.

Physical quantity, its unit and measurement: Fundamental and derived quantity, SI unit, various physical/radiation quantity used in Diagnostic Radiology and its unit (for example, KVp, mA, mAS, Heat unit).

SUGGESTED PRACTICALS/DEMONSTRATION (108 Hours)

- Basic concepts
- Electricity and magnetism, Electromagnetic waves
- Electronics
- Discovery of x-rays-X-ray production and properties
- Heat
- Interaction of ionizing radiation with matter
- Exponential attenuation, Physical quantity, its unit and measurement

TRANSACTIONAL MODES

Lecture, Tutorial, Problem based learning, small group teaching and learning, Continuous interactive learning, Case-based, Project based, Seminars, Clinical conferences, E-learning, Skills laboratory, Industrial visit

SUGGESTED READING

- *Basic radiological physics, K. Thayalan, Jaypee Brothers Medical Publishers (P) Limited, 2003*

- *Christensen's physics of diagnostic radiology, Curry and Dowdey, Wolters Kluwer*
- *X-Ray Equipment for Student, D.N. And M.O. Chesney, Blackwell Science Ltd*
- *A Textbook of Radiation Physics for Radiologic Technology, Surendra Maharjan, Suraj Sah, Samiksha Publications*
- *A Concise Guide on Basic Radiographic Physics Darkroom Procedures, Radiographic Positioning & Techniques, Lalit Agarwal, JBD Publications*

Course Title: Introduction to Healthcare*	L	T	P	Cr.
Course Code: BMRI104	1	0	0	1

Total Hours 18 hrs

Course Outcomes: At the end of the course students will be able to...

1. Explain the concept of health, its determinants, health indicators in India, the health team approach, and the objectives of national health and family welfare programmes.
2. Describe the fundamental principles of nursing, interpersonal relationships, and the role of nursing in patient care.
3. Demonstrate basic nursing procedures, including bandaging, patient positioning, bed making, and measures to promote patient comfort, rest, and sleep.
4. Apply safe techniques for lifting, transferring, and transporting patients using wheelchairs and stretchers.
5. Explain bedside management procedures, including bedpan use, observation of body secretions, catheter care, and enema administration.
6. Describe methods of providing nourishment, including oral feeding, tube feeding, intravenous drips, and blood transfusion under appropriate supervision.
7. Demonstrate the techniques for measuring, monitoring, and recording vital signs accurately.
8. Explain and apply basic aseptic techniques, sterilization, and disinfection to prevent healthcare-associated infections.
9. Identify and observe surgical dressings and explain the basic principles of wound care and infection prevention.
10. Describe the principles of first aid and demonstrate appropriate initial care for common emergencies within their level of training.

COURSE CONTENTS

Introduction to Health:

- Definition of Health, Determinants of Health, Health indicators of India, Health team concept
- National Health Policy National Health Programs (Brief objectives and scope)
- Family welfare programs in India

Introduction to Nursing:

- Nursing and Nursing principles, Interpersonal relationships, Bandaging basic turns, Bandaging extremities, Triangular bandages and their applications
- Nursing position, bed making, prone, lateral, dorsal, dorsal recumbent, Fowler's position, comfort measures, Aids, rest and sleep
- Lifting and transporting patients, transferring patients to wheel chair, transferring from bed to stretcher

Bedside Management:

- Proper usage of bedpan, Observation of stools, urine, sputum. Understand the use and care of catheters. Enema procedures

Method of giving nourishment:

- Feeding, tube feeding, drips, transfusion Monitoring and recording of vitals
- Simple aseptic techniques, sterilization and disinfection
- Observation of surgical dressings
- Concepts of First Aid

TRANSACTIONAL MODES

Lecture, Tutorial, Problem based learning, small group teaching and learning, Continuous interactive learning, Case-based, Project based, Seminars, Clinical conferences, E-learning, Skills laboratory, Industrial visit

SUGGESTED READING

- *Principles and Practice of Nursing Management and Administration, Jogindra Vati, Jaypee Brothers Ltd*
- *Textbook of Preventive and Social Medicine, K Park, Banarsidas Bhanot Publishers*
- *Introduction to Healthcare, Dakota Mitchell and Lee Haroun, Delmar*
- *Introduction to Healthcare and Careers, Roxann Delaet, Joanes and Bartlett Learning*

Course Title: Medical Terminologies and Record Keeping*	L	T	P	Cr.
Course Code: BMRI105	1	0	0	1

Total Hours 18 hrs

Course Outcomes: At the end of the course students will be able to...

1. Explain the basic concepts of medical terminology and the derivation of medical terms.
2. Identify and differentiate word roots, prefixes, suffixes, and combining forms used in medical terminology.
3. Apply the conventions of combining medical word elements and forming plural medical terms.
4. Construct and interpret basic medical terms using appropriate roots, prefixes, suffixes, and combining forms.
5. Interpret commonly used medical abbreviations, symbols, and terminology in healthcare settings.
6. Identify and interpret diagnostic, surgical, and procedural terms related to the integumentary, musculoskeletal, respiratory, cardiovascular, nervous, and endocrine systems.
7. Interpret basic medical orders, clinical reports, and healthcare documentation using appropriate medical terminology.
8. Demonstrate basic skills in data entry, documentation, and management of patient information using electronic health record systems.

COURSE CONTENTS

- Derivation of medical terms.
- Define word roots, prefixes and suffixes.
- Conventions for combined morphemes and the formation of plurals.
- Basic medical terms.
- Form medical terms utilizing roots, suffixes, prefixes and combining roots.
- Interpret basic medical abbreviations/symbols.
- Utilize diagnostic, surgical and procedural terms and abbreviations related to the integumentary system, musculoskeletal system, respiratory system, cardiovascular system, nervous system and endocrine system.
- Interpret medical orders/reports.
- Data entry and management on electronic health record system.

TRANSACTIONAL MODES

Lecture, Tutorial, Problem based learning, small group teaching and learning, Continuous interactive learning, Case-based, Project based, Seminars, Clinical conferences, E-learning, Skills laboratory, Industrial visit

SUGGESTED READING

- *Medical Terminology, Documentation, and Coding, Anne P. Stich, Routledge Publisher*
- *Medical Terminology for Health Professions, Ann Ehrlich, Carol L. Schroeder, Cengage Learning*
- *Medical Terminology, M.Mastenbjörk M.D. S. Meloni M.D. Medical Creation David Andersson, Medical Creations*
- *Medical Records: Organization and Management, GD Mogli (Author), Jaypee Brothers Medical Publishers*

Course Title: Basic Computers and Information Science*	L	T	P	Cr.
Course Code: BMRI106	1	0	0	1

Total Hours 18 hrs

Course Outcomes: At the end of the course students will be able to...

1. Explain the basic concepts, characteristics, generations, components, and languages of computers.
2. Identify and describe various input devices, output devices, processors, memory units, and storage devices.
3. Demonstrate basic operations of the Windows operating system, including file management, folder creation, and desktop navigation.
4. Create, edit, format, save, and print documents using MS Word, including tables and mail merge.
5. Use MS Excel to enter and organize data, format worksheets, perform basic calculations, and create graphs.
6. Develop and deliver presentations using MS PowerPoint with appropriate formatting, layouts, and graphical elements.
7. Describe the functions and types of operating systems, computer networks, network topologies, and network components.
8. Explain the basic concepts of the Internet, email, web browsers, and other Internet services.
9. Describe the applications of computers in clinical and healthcare settings, including electronic patient data management.
10. Demonstrate practical computer skills, including the use of MS Office applications, software installation, and accurate data entry.

COURSE CONTENTS

- **Introduction to computer:** Introduction, characteristics of computer, block diagram of computer, generations of computer, computer languages.
- **Input output devices:** Input devices (keyboard, point and draw devices, data scanning devices, digitizer, electronic card reader, voice recognition devices, vision-input devices), output devices (monitors, pointers, plotters, screen image projector, voice response systems).
- **Processor and memory:** The Central Processing Unit (CPU), main memory.
- **Storage Devices:** Sequential and direct access devices, magnetic tape, magnetic disk, optical disk, mass storage devices.
- **Introduction of windows:** History, features, desktop, taskbar, icons on the desktop, operation with folder, creating shortcuts, operation with

windows (opening, closing, moving, resizing, minimizing and maximizing, etc.).

- **Introduction to MS-Word:** introduction, components of a word window, creating, opening and inserting files, editing a document file, page setting and formatting the text, saving the document, spell checking, printing the document file, creating and editing of table, mail merge.
- **Introduction to Excel:** introduction, about worksheet, entering information, saving workbooks and formatting, printing the worksheet, creating graphs.
- **Introduction to power-point:** introduction, creating and manipulating presentation, views, formatting and enhancing text, slide with graphs.
- **Introduction of Operating System:** introduction, operating system concepts, types of operating system.
- **Computer networks:** introduction, types of network (LAN, MAN, WAN, Internet, Intranet), network topologies (star, ring, bus, mesh, tree, hybrid), components of network.
- **Internet and its Applications:** definition, brief history, basic services (E-Mail, File Transfer Protocol, telnet, the World Wide Web (WWW)), www browsers, use of the internet.
- Application of Computers in clinical settings.

Practical on fundamentals of computers –

- Learning to use MS office: MS word, MS PowerPoint, MS Excel.
- To install different software.
- Data entry efficiency

TRANSACTIONAL MODES

Lecture, Tutorial, Problem based learning, small group teaching and learning, Continuous interactive learning, Case-based, Project based, Seminars, Clinical conferences, E-learning, Skills laboratory, Industrial visit

SUGGESTED READING

- *Basic of Computer and Information Technology*, Ashok Arora, Vikas
- *Computer and Information Science*, Roger Lee (editor), Springer
- *Computer and Information Sciences*, Tadeusz Czachórski, Erol Gelenbe, Krzysztof Grochla, Ricardo Lent (Editor, Springer
- *Information science and computer basics: An introduction*, Mitchell, Ruth K, Clive Bingley

Course Title: Medical law and ethics*	L	T	P	Cr.
Course Code: BMRI107	1	0	0	1

Total Hours 18 hrs

Course Outcomes: At the end of the course students will be able to...

1. Explain the definition, goals, scope, and fundamental principles of medical ethics and professional codes of conduct.
2. Describe the principles of confidentiality, patient autonomy, informed consent, and patients' rights in healthcare settings.
3. Identify medical malpractice and negligence, differentiate rational and irrational drug therapy, and explain professional accountability.
4. Explain the ethical and legal considerations related to the care of terminally ill patients, euthanasia, and organ transplantation.
5. Describe the medico-legal aspects of medical records, medico-legal cases, documentation, ownership, confidentiality, disclosure, and record retention.
6. Explain the purpose and importance of professional indemnity insurance in healthcare practice.
7. Describe standardized protocols for preventing near-miss incidents and sentinel events and improving patient safety.
8. Demonstrate an understanding of the procedures for obtaining valid informed consent and maintaining ethical standards in patient care.

COURSE CONTENTS

- Medical ethics - Definition - Goal - Scope
- Introduction to Code of conduct
- Basic principles of medical ethics – Confidentiality
- Malpractice and negligence - Rational and irrational drug therapy
- Autonomy and informed consent - Right of patients
- Care of the terminally ill- Euthanasia
- Organ transplantation
- Medico legal aspects of medical records – Medico legal case and type- Records and document related to MLC - ownership of medical records - Confidentiality Privilege communication - Release of medical information - Unauthorized disclosure - retention of medical records - other various aspects.
- Professional Indemnity insurance policy
- Development of standardized protocol to avoid near miss or sentinel events
- Obtaining an informed consent.
- Medical ethics - Definition - Goal - Scope

- Introduction to Code of conduct
- Basic principles of medical ethics – Confidentiality
- Malpractice and negligence - Rational and irrational drug therapy
- Autonomy and informed consent - Right of patients
- Care of the terminally ill- Euthanasia
- Organ transplantation
- Medico legal aspects of medical records – Medico legal case and type- Records and document related to MLC - ownership of medical records - Confidentiality Privilege communication - Release of medical information - Unauthorized disclosure - retention of medical records - other various aspects.
- Professional Indemnity insurance policy
- Development of standardized protocol to avoid near miss or sentinel events
- Obtaining an informed consent

TRANSACTIONAL MODES

Lecture, Tutorial, Problem based learning, small group teaching and learning, Continuous interactive learning, Case-based, Project based, Seminars, Clinical conferences, E-learning, Skills laboratory, Industrial visit

SUGGESTED READING

- *Medical Law and Ethics, Bonnie F. Fremgen, Pearson*
- *Medical Law and Ethics, Jonathan Herring, OUP UK*
- *Medical Law and Ethics, Purosottam Behera, Mittal Publications*
- *Reflections on Medical Law and Ethics in India, Bismi Gopalakrishnan, Mercy Khaute, B. Sandeepa Bhat, Eastern Law House*

Course Title: Professionalism and Values*	L	T	P	Cr.
Course Code: BMRI108	1	0	0	1

Total Hours 18 hrs

Course Outcomes: At the end of the course students will be able to...

1. Explain the importance of professional values, including integrity, objectivity, professional competence, due care, and confidentiality in healthcare practice.
2. Identify personal, ethical, and moral values and understand their role in professional decision-making.
3. Demonstrate appropriate professional attitudes and behavior while treating patients, colleagues, and other individuals with equality, dignity, and respect.
4. Explain professional codes of conduct, accountability, responsibility, and the consequences of professional misconduct.
5. Differentiate the roles and responsibilities of various healthcare professionals and recognize the importance of teamwork and interprofessional collaboration.
6. Identify cultural issues in healthcare settings and demonstrate cultural sensitivity while providing respectful, inclusive, and patient-centered care.

COURSE CONTENTS

- Professional values- Integrity, Objectivity, Professional competence and due care, Confidentiality
- Personal values- ethical or moral values
- Attitude and behavior- professional behavior, treating people equally
- Code of conduct, professional accountability and responsibility, misconduct
- Differences between professions and importance of team efforts
- Cultural issues in the healthcare environment

TRANSACTIONAL MODES

Lecture, Tutorial, Problem based learning, small group teaching and learning, Continuous interactive learning, Case-based, Project based, Seminars, Clinical conferences, E-learning, Skills laboratory, Industrial visit

SUGGESTED READING

- *Textbook of Medical Ethics, Erich H Loewy, Springer*
- *Professionalism, Professional Values and Ethics in Nursing, Suresh K Sharma, Asha P Shetty, Jaypee Brothers Medical Publishers*
- *Essentials of Professionalism, Professional Values & Ethics for BSc Nursing Students, Varinder Kaur, CBS Publishers and Distributors Pvt. Ltd*
- *Textbook of Professional Ethics and Human Values, R S Naagarazan, New age International Publishers*

Course Title: Principals of Management*	L	T	P	Cr.
Course Code: BMRI109	1	0	0	1

Total Hours 18 hrs

Course Outcomes: At the end of the course students will be able to...

1. Explain the basic concepts, principles, functions, and importance of management in organizations.
2. Describe the principles of strategic management and their role in achieving organizational goals.
3. Apply the fundamentals of planning to establish objectives and prepare effective action plans.
4. Identify and apply appropriate planning tools and techniques for organizing and managing tasks.
5. Explain decision-making processes and apply basic techniques for managing conflicts and workplace stress.
6. Describe organizational change and identify strategies to encourage innovation and continuous improvement.
7. Explain group dynamics and demonstrate effective teamwork and collaboration skills.
8. Describe different leadership styles and their application in managing individuals and teams.
9. Apply time-management techniques to prioritize tasks and improve productivity.
10. Explain cost control, resource utilization, and operational efficiency in organizational settings.

COURSE CONTENTS

- Introduction to management
- Strategic Management
- Foundations of Planning
- Planning Tools and Techniques
- Decision Making, conflict and stress management
- Managing Change and Innovation
- Understanding Groups and Teams
- Leadership
- Time Management
- Cost and efficiency

TRANSACTIONAL MODES

Lecture, Tutorial, Problem based learning, small group teaching and learning, Continuous interactive learning, Case-based, Project based, Seminars, Clinical conferences, E-learning, Skills laboratory, Industrial visit

SUGGESTED READING

- *Essentials of Professionalism, Professional Values & Ethics for BSc Nursing Students, Varinder Kaur, CBS Publishers and Distributors Pvt. Ltd*
- *Professionalism Professional Values and Ethics in Nursing, Suresh K Sharma, Jaypee Brothers*
- *Professionalism, Professional Values & Ethics, Shama Lohumi, CBS publishers and Distributors PVT Ltd*

Course Title: English and Communication skills*	L	T	P	Cr.
Course Code: BMRI110	1	0	0	1

Total Hours 18 hrs

Course Outcomes: At the end of the course students will be able to...

1. Demonstrate an understanding of basic English grammar, including parts of speech, tenses, number, gender, and vocabulary development.
2. Read, comprehend, summarize, and interpret prescribed texts and other English reading materials.
3. Develop effective written communication skills through letter writing, note-taking, précis writing, diary writing, essays, and report writing.
4. Prepare official correspondence, including applications, circulars, notices, charge memos, summaries, and observation reports.
5. Demonstrate effective spoken English skills through formal and informal conversations, debates, interviews, telephone conversations, and public speaking.
6. Apply appropriate communication techniques to express opinions, agree or disagree politely, emphasize points, and participate effectively in discussions.
7. Demonstrate effective listening skills by identifying key points, understanding spoken information, and interpreting lectures, speeches, audio, and video materials.
8. Apply English communication skills in academic, professional, and healthcare settings through appropriate verbal, written, and listening practices.

COURSE CONTENTS

Language-Basic

Content: Review of grammar, Remedial study of grammar, building vocabulary Introduction

Parts of speech

Exercise on use of grammar Tense,

Number, Gender

Assessment methods: Objective type, Fill in the blanks.

Content: Read and comprehend prescribed course books Reading, Summarizing, Comprehension

Assessment methods: Fill in the blanks and one-mark questions

Content: Various Forms of Composition Letter writing

Note taking

Precise

writings Diary

writing

Reports on health problem etc. Official

correspondence:

Outgoing correspondence, replying incoming correspondence, writing circulars, notices, charge memos, note taking, writing summaries, observation reports. Teaching learning activities: Exercise on writing: Letter writing, resume/CV Essay writing.

Assessment methods: Applications, short reports to be written.

Content: English- Spoken mode, Debates, Telephonic conversation, formal & informal conversation: Agreeing emphasizing, interrupting, politely, opinions, interviews, visual presentation.

Teaching learning activities: Participating in seminar, Telephonic conversation, conversation in different situations, practice in public speaking

Assessment methods: Assessment of the skills based on the checklist.

Content: Listening to comprehension media, audio, video, speeches, definition of listening, types of listening, purposes of listening, obstacles for listening, contexts of listening, to be a good listener, listening to a lecture etc.

Teaching learning activities: Listening to audio, video tapes and identify the key points.

Assessment methods: Practical test of listening and filling out the blanks, essay type.

TRANSACTIONAL MODES

Lecture, Tutorial, Problem based learning, small group teaching and learning, Continuous interactive learning, Case-based, Project based, Seminars, Clinical conferences, E-learning, Skills laboratory, Industrial visit

SUGGESTED READING

- *Communicative English for General Nursing Students*, Tom Koorkkakala, K.J. Publications
- *How to write and speak Better, Reader's*, John Ellison Kahn, Reader's Digest Association
- *Communication and Soft Skill Development*, Ashwini Deshpande, Career Publications

Course Title: Clinical Education I	L	T	P	Cr.
Course Code: BMRI111	0	0	15	5

Students will gain additional skills in clinical procedures, interaction with patients and professional personnel. Students apply knowledge from previous clinical learning experience under the supervision of a senior technologist. Students are tested on intermediate clinical radio diagnosis skills.

Studentship or observership must include:

- A minimum of 14 hours per week is considered as studentship in every semester.
- Provide simulation and skill labs for practicing skills specific to the program in the initial years of observership/studentship.
- Every semester must have seminars/workshops on new developments/technologies. Check annexure for marking criteria.
- If the clinical facility is not within the same campus, transportation should be provided to the students and interns.
- All practical skills must be supervised and recorded in a Logbook and skills to be evaluated after the completion of the internship.

2ND SEMESTER

Course Title: Basic of Microbiology	L	T	P	Cr.
Course Code: BMRI201	2	0	0	2

Total Hours 36 hrs**Course Outcomes:** At the end of the course students will be able to...

1. Describe the structure, classification, morphology and growth of bacteria
2. Describe the methods sterilization and disinfection and its applications
3. Explain the concepts of immunity, hypersensitivity and immunization
4. Describe Nosocomial infections and methods for prevention of Hospital acquired infections
5. Describe the management of biomedical waste
6. List the common fungi and viruses and explain their importance

COURSE CONTENTS**UNIT-I****09 Hours**

Morphology of Bacteria: (Structure, size, shape, arrangement cell wall, flagella, spore, capsule, fimbria)

Physiology of Bacteria: (Bacterial growth curve, Temp, O₂, Co₂, micro and macro nutrient growth requirements)

Culture Media

Culture Methods

Antimicrobial sensitivity tests

Sterilization and Disinfections: Definition, Dry heat Sterilization, Moist heat Sterilization, Chemical disinfectants, Gaseous disinfection, Test for disinfection

Sterilization control

UNIT-II**08 Hours**

Infection: Classification, Sources of infection, Modes of transmission
 Nosocomial infection including biomedical waste management: Definition, Classification, Significance, Prevention and control

Biomedical waste management

UNIT-III

05 Hours

Immunology: Immunity, Antigen, Antibody, Hypersensitivity

UNIT-IV

07 Hours

General Properties of fungi. (General characters, classification, Morphology, Reproduction)

General Properties of Viruses. (General character, classification based on Genome, Capsid, Envelope & replication and cultivation of virus).

UNIT-V

07 Hours

Applied Microbiology: Pyrexia of unknown origin, Meningitis, Zoonotic infections, Hepatitis, HIV infection and AIDS, Food poisoning, Diarrhea, Urinary tract infections, Pulmonary Tuberculosis

TRANSACTIONAL MODES

Lecture, Tutorial, Problem based learning, small group teaching and learning, Continuous interactive learning, Case-based, Project based, Seminars, Clinical conferences, E-learning, Skills laboratory, Industrial visit

SUGGESTED READING

- *Text book of Microbiology, Ananthnarayana&Panikar, University Press*
- *Text book of Microbiology, Baveja, Arya Publications*
- *Text book of Microbiology, Sathish Gupte, JPB*
- *Text book of Microbiology, Dr Arora, CBS Publishers & Distributors Pvt. Ltd*

Course Title: Basic of Biochemistry	L	T	P	Cr.
Course Code: BMRI202	2	0	0	2

Total Hours 36 hrs

Course Outcomes: At the end of the course students will be able to...

1. Understand the responsibility of health care personals and hazards faced in the clinical laboratory
2. Explain the different types, use, care and maintenance of laboratory apparatus and instruments.
3. Understand the fundamental chemistry and knowledge of different solutions
4. Understand what acids, bases, salts and indicators are and also know about acid base balance
5. Describe the sample collection procedure to analyse various biochemical parameters
6. Describe assimilation of nutrients and consequences of malnutrition
7. Understand the different functional tests like LFT (Liver function test), RFT (Renal function test)
8. Understand the overview of tumor markers, cardiac markers, blood sugar and GTT, lipid profile and diagnostic enzymology
9. Describe the applications of radioisotopes

COURSE CONTENTS

UNIT-I

09 Hours

Nutrition

Calorific value

Nitrogen Balance

Respiratory quotient

BMR

Nutritional importance of carbohydrate, lipids, proteins, vitamins and minerals

Emphasis on parenteral nutrition

UNIT-II

09 Hours

Acid-Base Balance

Henderson Hassel Bach equation

Buffers of the body fluids

Ph regulation

Disturbance in acid base balance

Anion gap

Basic principles & estimation of blood gases and ph.

Water & Electrolyte balance

Over view of water and electrolyte balance

Basic principles in estimation of Electrolyte

Normal values and interpretation

UNIT-III**09 Hours****Clinical chemistry****Brief over view of normal values and interpretation of results**

Renal function tests

Liver function tests

Tumor markers

Cardiac markers

Diagnostic Enzymology

Lipid profile

Blood sugar and GTT

Normal & Abnormal urine analysis

UNIT-IV**09 Hours**

Radioisotopes: Definition, Application & Hazards Normal and abnormal urine analysis

Clinical charts on LFT, RFT, and diagnostic enzymology

TRANSACTIONAL MODES

Lecture, Tutorial, Problem based learning, small group teaching and learning, Continuous interactive learning, Case-based, Project based, Seminars, Clinical conferences, E-learning, Skills laboratory, Industrial visit

SUGGESTED READING

- *Text Book of biochemistry for dental students, Vasudevan, Sreekumari, Kannan Vaidyanathan, Jaypee Brothers*
- *Biochemistry for Physiotherapy and allied health sciences students., Nandini M, Beena V Shetty, Vinitha Ramanath Rai, Jaypee Brothers Medical Publisher (India)*
- *Clinical chemistry, Varley, CBS Publishers & Distributors*
- *Textbook of biochemistry for paramedical students, P Ramamoorthy, Jaypee Brothers Medical Publishers*

Course Title: Conventional Radiography Equipment	L	T	P	Cr.
Course Code: BMRI203	4	0	2	5

Total Hours 72 hrs

Course Outcomes: At the end of the course students will be able to...

1. Describe the structure and working of x-ray tube, production of x-rays
2. Describe the types of x-ray tube and heat dissipation methods
3. Explain the x-ray generator circuits CO004: Describe the different circuit types
4. Describe the meters and exposure timers
5. List the control of scattered radiation
6. Describes about the fluoroscopy
7. Explains about the care and maintenance of x-ray equipment's

COURSE CONTENTS

UNIT-I

10 Hours

X-ray tube: historical aspects, construction of X-ray tubes, requirements for X ray production(Electron source, target and anode material), tube voltage, current, space charge, early X-ray tubes(Coolidge tubes, tube envelop and housing) cathode assembly, X-ray production efficiency, advances in X-ray tubes, anode angulation and rotating tubes-line focus principle-space charge effect, tube cooling-Modern X-ray tubes-stationary anode, rotating anode, grid controlled X ray tubes, heel effect, off focus radiation, tube insert and housing-Tube rating Quality and intensity of x-rays-factors influencing them.

Production of x-rays: X-ray tube, gas filled x-ray tube, construction working and limitations; stationary anode x - ray tube; construction, working, methods of cooling the anode, rating chart and cooling chart;

UNIT-II

10 Hours

Rotating anode x - ray tube: construction, working rating chart, speed of anode rotation, angle of anode inclination, dual focus and practical consideration in choice of focus, anode heel effect, grid-controlled x - ray tube; effect of variation of anode voltage and filament temperature; continuous and characteristics spectrum of x - rays, inherent filter and added filter, their effect on quality of the spectrum.

Grid controlled and high-speed tubes, focal spot size, speed of anode rotation, target angle, inherent filtration, radiation leakage and scattered radiation). Interlocking and X-ray tube overload protection.

Heat dissipation methods, tube rating, heat units, operating conditions and maintenance and Q.A procedures.

UNIT-III

10 Hours

Filament current and voltage, X-ray circuits (primary circuit, auto transformer), types of exposure switch and timers, principle of automatic exposure control (AEC) and practical operation, filament circuit, high voltage circuits, half wave, full wave rectification, three phase circuits. Types of generators, 3 phase, 6 and 12 pulse circuits-high frequency generators-falling load generators, Capacitors discharge and grid control systems.

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-earthing.

UNIT-IV

10 Hours

High tension circuits: H.T. generator for x-ray machines, three phase rectifier circuits, three phase six rectifier circuit, three phase 12 rectifier circuit, high and medium frequency circuits; capacitance filter control and stabilizing equipment; mains voltage compensator, mains resistance compensator, compensation for frequency variation, control of tube voltage, kV compensator; high tension selector switch, filament circuit, control of tube current, space charge compensation.

Interlocking circuits: Relays: description and working, use of relays in diagnostic machines for over load protection, circuit diagram; simplified circuit and block diagrams illustrating sequence of events from mains supply to controlled emission of x-rays.

UNIT-V

10 Hours

Meters and exposure timers: Moving coil galvanometer: construction and working/conversion to millimeter, ammeter and voltmeter, meters commonly

used in diagnostic x-ray machines, pre reading kV meter and millimeter, digital panel meters. Clockwork timers, synchronous motor timer, electronic timers, photo metric timers (fluorescent and photoelectric effect as applied in timers), ion chamber-based timers, integrated timer.

UNIT-VI

08 Hours

Control of scattered radiation: Beam limiting devices: cones, diaphragms, light beam collimator, beam centering device, methods to verify beam centering and field alignment; **Filters-** inherent filters, added filters, heavy metal filters, grids; design and control of scattered radiation, grid ratio, grid cut-off, parallel grid, focused grid, crossed grid, grided cassettes, stationary and moving grid potter bucky diaphragms, various types of grid movements; single stroke movement, oscillatory movement and reciprocatory movement.

UNIT-VII

08 Hours

Fluoroscopy: Fluorescence and phosphorescence - description, fluorescent materials used in fluoroscopic screens, construction of fluoroscopic screen and related accessories, tilting table, dark adaptation. Image intensifier - Construction and working, advantages over fluoroscopic device, principles and methods of visualising intensified image, basic principles of closed circuit television camera and picture tube. Vidicon camera, CCD. Automatic brightness control, automatic exposure control, chamber selection during fluoroscopy. Serial radiography: Manual cassette changer, rapid automatic film changer, basic principles of cine fluoroscopy and angiography use of grid controlled x-ray tube.

UNIT-VIII

06 Hours

Care and Maintenance of X-ray equipment;

General care; functional tests; testing the performance of exposure timers, assessing the MA settings, testing the available KV, measurement of focal spot of an x-ray tube, testing the light beam diaphragm, practical precautions pertaining to Brakes and locks, H.T. cables, meters and controls, tube stands and tracks as well as accessory equipment.

SUGGESTED PRACTICALS/DEMONSTRATION (36 Hours)

- X-ray tube; Production of x-rays
- Rotating anode x - ray tube; Grid controlled and high speed tubes; Heat dissipation methods
- Filament current and voltage; X-ray generator circuits
- High tension circuits; Interlocking circuits; Relays
- Meters and exposure timers
- Control of scattered radiation: Beam limiting devices
- Fluoroscopy
- Care and Maintenance of X-ray equipment

TRANSACTIONAL MODES

Lecture, Tutorial, Problem based learning, small group teaching and learning, Continuous interactive learning, Case-based, Project based, Seminars, Clinical conferences, E-learning, Skills laboratory, Industrial visit

SUGGESTED READING

- *Radiographic Imaging (Cbs) I.C.R.P., D.N. Chesney & M.O Chesney, CBS Publishers & Distributors*
- *An Introduction Of Physics to Diagnostic Radiography, Christensen, Curry & Dowdey, Lea & Febiger*
- *Radiological Science for technologists, Stewart C Bushong, Mosby*
- *Equipment for Diagnostic Radiography, E. Forster Springer Dordrecht*
- *The Physics Of Radiology And Imaging, K Thayalan, Jaypee*

Course Title: Clinical Radiography Positioning I	L	T	P	Cr.
Course Code: BMRI204	4	1	6	8

Total Hours 72 hrs

Course Outcomes: At the end of the course students will be able to...

1. Understand the basic patient positioning during radiographic investigation.
2. Apply special positioning skills for different pathological and physical conditions.
3. Application of equipments while working in radiology departments.
4. Choose proper position during radiography.
5. Explain relative positions of x-ray tube and patient relevant exposure factors during radiography.
6. Explain the use of accessories.
7. Explain the anatomic and physiological basis of the procedure to be undertaken.
8. Explain the radiographic appearances of both normal and common abnormal conditions.

COURSE CONTENTS

UNIT-I

08 Hours

Principles of Radiography:

Preparation of the Room, Apparatus and Instruments Positions of the Patient: Erect, Sitting, Supine, Prone, Lateral, Oblique, Decubitus Etc. Relative position of X-Ray tube and patient, relevant exposure factors. Use of accessories such as radiographic cones, grid and positioning aids. Anatomic and Physiological basis of the procedure, Association with theory with practical work. Radiographic appearances, both normal and common abnormal conditions where elementary knowledge of the pathology involved will ensure the application of the appropriate radiographic technique. Modifications in technique for various disabilities and types of subject. Radiation protection, use of gonad shield, practical methods of reducing radiation dose to the patient.

UNIT-II

10 Hours

Upper limb:

Routine projections for the whole hand, fingers, wrist joint, forearm, elbow joint and humerus.

Supplementary projections for Scaphoid, Carpal tunnel, Ball Catchers projections, Head of the Radius, Supracondylar fracture and Olecranon process

UNIT-III

10 Hours

Lower limb:

Routine projections for the whole foot, toes, calcaneum, ankle joint, leg, knee-joint, patella and femurs.

Supplementary projections for Talo-Calcaneal joint, Forced projections for torn ligaments, Flat Feet, Club Feet, Intercondylar projections for loose bodies in the knee, Axial projection for Patella.

UNIT-IV

10 Hours

Shoulder Girdle and Thorax:

Routine projections for the shoulder joint, Scapula, Acromio-Clavicular joint, Clavicle, Sternoclavicular joint, Sternum and Ribs.

Supplementary projections for the axial projection of Clavicle, Bicipital groove, Coracoid process.

UNIT-V

12 Hours

Vertebral Column:

Routine projections for Atlanto -Occipital joint, cervical spine, Cervico-thoracic Junction, thoracic Spine, lumbar Spine, Lumbo Sacral Region, Sacrum and Coccyx.

Supplementary projections for the intervertebral foramina, posterior arch of Atlas, Flexion and Extension of Cervical Spine, Scoliosis and Kyphosis, Sacro Iliac Joint.

UNIT-VI

12 Hours

Skull:

Routine projections for cranium and facial bones;

Supplementary projections for trauma, Towne's method, Sellaturcica, Optic foramina, Jugular foramina, Temporal bones, Mastoids, Petrous bone, Zygomatic arches, Orbits, Maxillae, Nasal bones, Mandible, Temporomandibular joints.

Nasal Sinuses: Techniques for Frontal, Maxillary, Ethmoidal and Sphenoid Sinuses, erect and horizontal projections for fluid levels.

UNIT-VII**10 Hours****Pelvic girdle and hip region:**

Routine projections for the whole pelvis, Sacro-Ileac joints, hip joint and Neck of Femur.

Supplementary projections for the greater and lesser trochanters of Femur. Frog leg projection, Ischeum, Symphysis Pubis, Ileum, Acetabulum and Congenital Dislocation of Hip, Arthrodesis.

Skeletal survey: Skeletal survey for metabolic bone disease, metastases, hormonal disorder, renal disorders.

SUGGESTED PRACTICALS/DEMONSTRATION (108 Hours)

- Principles of Radiography
- Upper limb
- Lower limb
- Shoulder Girdle and Thorax
- Vertebral Column
- Skull
- Pelvic girdle and hip region, Skeletal survey

TRANSACTIONAL MODES

Lecture, Tutorial, Problem based learning, small group teaching and learning, Continuous interactive learning, Case-based, Project based, Seminars, Clinical conferences, E-learning, Skills laboratory, Industrial visit

SUGGESTED READING

- *Atlas of Radiographic Positioning and Radiological Procedures, Philip W Ballinger, Eugene D. Frank, Mosby*
- *Clarks Positioning In Radiography, Ra Swallow, E Naylor, Lippincott Williams and Wilkins*
- *Merrill's Atlas of Radiographic Positioning and Procedures, Bruce W. Long & Jeannean Hall Rollins & Barbara J. Smith, Mosby*
- *Bontrager's Textbook Of Radiographic Positioning And Related Anatomy, Leslie E Kendrick, Elsevier Science*
- *Radiology Of Positioning And Applied Anatomy For Students And Practitioners, Garkal Gs, Jaypee Brothers Medical Publishers*
- *A Guide on Special Radiographic Investigations & Techniques, Lalit Agarwal, JBD Publications*

Course Title: Clinical Education II	L	T	P	Cr.
Course Code: BMRI205	0	0	15	5

Students will gain additional skills in clinical procedures, interaction with patients and professional personnel. Students apply knowledge from previous clinical learning experience under the supervision of a senior technologist. Students are tested on intermediate clinical radio diagnosis skills.

Studentship or observership must include:

- A minimum of 14 hours per week is considered as studentship in every semester.
- Provide simulation and skill labs for practicing skills specific to the program in the initial years of observership/studentship.
- Every semester must have seminars/workshops on new developments/technologies. Check annexure for marking criteria.
- If the clinical facility is not within the same campus, transportation should be provided to the students and interns.
- All practical skills must be supervised and recorded in a Logbook and skills to be evaluated after the completion of the internship.

3RD SEMESTER

Course Title: Pathology	L	T	P	Cr.
Course Code: BMRI301	2	0	0	2

Total Hours 36 hrs**Course Outcomes:** At the end of the course students will be able to...

1. Define the term “Disease” or concepts of Diseases.
2. Define, classify diseases and the medical terms used.
3. Describe the cause and mechanism of a few common diseases they come across during their routine work.
4. Common changes seen in these diseased persons in different organs/tissues/bodyfluids.
5. Names of the common laboratory tests done to diagnose the diseases like examination of urine, blood, other body fluids and tissues.
6. Enumerate the proper methods of collection, preservation and delivery of the samples to the respective laboratories.
7. Describe the procedures of procuring the whole blood or blood components from blood bank and the complications of blood transfusion.

COURSE CONTENTS**UNIT-I****07 Hours**

Introduction to Pathology, Cell membrane, Cytoplasm, contents and nucleus
 Various injuries – Cell changes – Reversible changes, fatty liver, hydropic changes and Irreversible changes

Irreversible changes – Necrosis. Types with examples. Apoptosis Pigments – Classification. Bilirubin, melanin, pathological calcification

Inflammation – Definition, classification, signs, vascular & cellular events in acute inflammation

Repair and wound healing, fracture healing, complications, factors influencing healing

Infectious diseases – Tuberculosis, leprosy, fungal diseases, malaria

UNIT-II**08 Hours**

Oedema – Definition, classification, causes, pathogenesis. Pulmonary oedema, cardiac oedema, Renal oedema, Lymphedema

Thrombosis – Definition, classification, pathogenesis, venous and arterial thrombosis, fate of thrombus

Embolism – Definition, classification and clinical manifestations – Infarction, gangrene

Cellular adaptations and Growth disorders: Atrophy, hypertrophy, hyperplasia, metaplasia, dysplasia and neoplasia

Neoplasia (Tumors) – Definition, nomenclature, differences between benign and malignant tumors metastasis

Causes (carcinogens), clinical features and lab diagnosis of cancers

Genetics – Genetic diseases, cause, Common cytogenic diseases – Klinefelter, Downs and Turners syndrome.

Complete urine examination – physical, chemical, microscopy of sediment
Liver function tests, Renal function tests

Cytology, FNAC, Surgical pathology, biopsy, resected specimen preservation, fixation and filling of request forms

UNIT-III

07 Hours

Blood collection for investigations, anticoagulant. Sample collection, labeling, transportation to labs

Common hematological tests – Peripheral blood smear, Haemoglobin, Packed cell volume, WBC count – variation of total and differential leukocyte count, Platelet count

Bone marrow Aspiration and biopsy; Indications, procedure, contraindications and complications

Anemias – Definition, classification, Iron deficiency anemia, causes, clinical features and lab diagnosis

Megaloblastic anemia – cause, classification, diagnosis. Briefly hemolytic anemia Leukemia – Definition, classification, lab diagnosis of Acute Leukemias (AML & ALL) and Chronic Leukemias (CML & CLL)

Bleeding disorders – Classification, Vascular, Platelet and coagulation factors contribution in clotting.

Common Platelet disorders Common coagulation disorders (Hemophilia, DIC).
BT, CT, Prothrombin time and APTT for diagnosis

Blood grouping, cross matching, collection of blood from blood donors.
Mandatory tests done in blood bank, blood components, complications of
blood transfusion and its evaluation

UNIT-IV

07 Hours

Osteomyelitis – Acute and chronic, Tubercular, causes, pathology & its complications

Diseases of joints – Osteoarthritis and Rheumatoid arthritis – causes, aetiopathogenesis, pathology, complications Metabolic disease of bones – Osteoporosis, Osteomalacia, Rickets

Cardiovascular diseases – Introduction, Atherosclerosis – definition, risk factors, sites/ organs, pathology manifestations, complications. Aneurysms – types, causes and complications

Ischemic heart disease (IHD) – Types, Pathogenesis of Angina, Myocardial infarctions and its complications Rheumatic heart disease – etiology, pathogenesis and morphology of the heart Hypertension – definition, causes, complications

Heart failure – Causes, pathophysiology, clinical manifestations and complications

UNIT-V

07 Hours

Respiratory diseases – Chronic obstructive pulmonary airway diseases – causes, pathology and complications of each (asthma, chronic bronchitis, emphysema, Bronchiectasis in brief).

Pneumonia – classification, clinical features and morphology

Pulmonary tuberculosis – classification/ types, primary, complex, miliary TB and cavitary TB, complications Pleural effusion – definition, causes, clinical features and diagnosis

Renal system; Glomerulonephritis, nephritic and nephrotic syndrome. Tubulointerstitial diseases, Renal failure – Acute and chronic

Pyelonephritis – Types, causes, organ changes and complications.

Renal stones – Causes, pathogenesis, clinical features. Hydronephrosis – causes, clinical features and diagnosis

SUGGESTED PRACTICALS/DEMONSTRATION (6 Hours)

- Fatty liver – Gross & Microscopy
- T.B. Lymphadenitis – Gross & Microscopy
- Acute Appendicitis – Gross & Microscopy
- Granulation tissue – Microscopy
- Mechanism of thrombosis, Sites & complications and clinical features (effects)
- Atrophy & Hypertrophy (Heart).
- Benign tumors - Squamous papilloma – Gross & Microscopy, Adenoma Colon
 - Gross & Microscopy, Leiomyoma uterus – Gross & Microscopy;
- Malignant tumors - Squamous cell carcinoma – Gross & Microscopy, Adenocarcinoma colon – Gross & Microscopy, Malignant melanoma skin – Gross & Microscopy, Osteosarcoma bone – Gross & Microscopy
- Metastasis – Lung, liver, lymph nodes (specimens)
- Blood collections – Containers, Anticoagulants Hb%, PCV, ESR, Peripheral smear and Bone marrow aspiration
- Cytology – Body fluids, FNAC.
- Histopathology – Specimens, biopsies, fixatives. Request form writing.
- Blood grouping, Transfusion complications, components.
- Anemias – Microcytic hypochromic, Megaloblastic (slides)
- Leukemia – AML & CML (Slides)
- Atherosclerosis, MI, Rheumatic valvular lesions
- Renal stones, hydronephrosis, chronic pyelonephritis (specimens)
- Lung – Pneumonias, pulmonary tuberculosis cavitary lung abscess (specimens).

TRANSACTIONAL MODES

Lecture, Tutorial, Problem based learning, small group teaching and learning, Continuous interactive learning, Case-based, Project based, Seminars, Clinical conferences, E-learning, Skills laboratory, Industrial visit

SUGGESTED READING

- *Textbook of Pathology with Pathology, Harsh Mohan, Jaypee Brothers Medical Publishers (P) Ltd*
- *Pathology Basis of Disease, Robbins and Cotran, Saunders Elsevier*
- *Text book on Pathology for DMLT & Paramedical Courses, Dr. I Clement, Emmess medical publishers*
- *Text book of Pathology & Microbiology for Paramedical Students, Aruna Singh, Notion Press*

Course Title: Clinical Radiography Positioning II	L	T	P	Cr.
Course Code: BMRI302	2	1	6	6

Total Hours 36 hrs

Course Outcomes: At the end of the course students will be able to...

1. Prepare management and positioning of patients
2. Correlate of indications, contraindications of the patient
3. Understand the patient preparations needed before any radiological examination.
4. Generalize knowledge of post procedural care.
5. Students will be able position the patients for radiological procedures.
6. Knowledge of image quality in radiological images.
7. Management of patients in radiology department for various procedures.
8. Ability to handle emergency situations in radiology department.

COURSE CONTENTS

UNIT-I

05 Hours

Dental Radiography

Technique for intra oral full mouth. - Occlusal projections. - Extra oral projections including orthopantomography. - Supplementary techniques.

Upper respiratory system

Technique for postnasal airways, larynx, trachea, thoracic inlet, Valsalva maneuver. - Phonation.

UNIT-II

06 Hours

Lung and Mediastinum:

Supplementary projections: Antero-posterior, obliques, lordotic, apical projection, use of penetrated postero-anterior projection. - Expiration technique. - Technique for pleural fluid levels and adhesions.

Abdominal viscera-

Technique for plain film examination. - Projection for acute abdomen patients. - Technique to demonstrate: Foreign bodies, Imperforate anus.

UNIT-III**05 Hours****Radiography using mobile X-ray equipment- Radiography in the ward:**

Radiography in the specialized unit, such as: Intensive care unit, Coronary care, Neonatal unit Radiography in the operating theatre.

Mammography: Basic views, special views, wire localization.

Localization of foreign bodies. Various techniques

UNIT-IV**05 Hours****Ward / mobile radiography –**

electrical supply, radiation protection, equipment and instructions to be followed for portable/ward radiography.

Operation theatre techniques:

General precautions, Asepsis in techniques - Checking of mains supply and functions of equipment, selection of exposure factors, explosion risk, radiation protection and rapid processing techniques.

Trauma radiography/Emergency radiography**UNIT-V****05 Hours****Neonatal and Pediatric Radiography,****Forensic Radiography****Microradiography:**

General principles, Requirement, Equipment, Technique.

UNIT-VI**05 Hours****Soft Tissue Radiography:**

High and low kilo voltage technique; differential filtration. Non - screen technique - simultaneous screen and non -screen technique.

Multiple radiography.

Uses of soft tissue radiography.

High kV Radiography:

General principles

Relation to patient dose

Change in radiographic contrast.

Scatter elimination; beam collimation; grid ratio.

Speed and type of grid movement.

Radiographic factor; application and uses.

UNIT-VII**05 Hours****Localization of foreign bodies:**

General location principles.

Ingested; inhaled; inserted; embedded foreign bodies.

Foreign bodies in eye.

Preparation of the area to be investigated.

Appropriate projection for all Techniques to locate non-opaque foreign body.

SUGGESTED PRACTICALS/DEMONSTRATION (108 Hours)

- Dental Radiography; Upper respiratory system
- Lungs and Mediastinum; Abdominal viscera
- Radiography in the ward; Mammography
- Operation theatre techniques; C-arm
- Neonatal and Paediatric Radiography; Forensic Radiography
Microradiography
- Soft Tissue Radiography Multiple radiography High kV Radiography
Scatter elimination; beam collimation; grid ratio Speed and type of
grid movement Radiographic factor; application and uses
- Localization of foreign bodies

TRANSACTIONAL MODES

Lecture, Tutorial, Problem based learning, small group teaching and learning, Continuous interactive learning, Case-based, Project based, Seminars, Clinical conferences, E-learning, Skills laboratory, Industrial visit

SUGGESTED READING

- *Radiological positioning, Merils, Mosby*
- *A guide to radiological positioning, Clarks, CBS publishers and distributors pvt. Ltd,*
- *Radiology Of Positioning And Applied Anatomy For Students And Practitioners, GarkalGs, Jaypee Brothers Medical Publishers*
- *Bontrager's Textbook of Radiographic Positioning and Related Anatomy, John Lampignano), Leslie E. Kendrick, Mosby*
- *A Concise Guide on Basic Radiographic Physics Darkroom Procedures, Radiographic Positioning & Techniques, Lalit Agarwal, JBD Publications*

Course Title: Radiography and Image Processing Techniques	L	T	P	Cr.
Course Code: BMRI303	2	0	2	3

Total Hours 36 hrs

Course Outcomes: At the end of the course students will be able to...

1. Know basic physics of radiography processing system
2. Describe construction and working of film, intensifying screen, cassette, dark room and automatic processor
3. Explain radiographic film Processing chemistry
4. Discuss the factors affecting image quality in radiographic image and their application
5. Operate the workflow in x-ray imaging
6. Apply knowledge for the use of radiation factors
7. Demonstrate process the radiographic film in different systems
8. Prepare care and maintenance of radiographic films, cassettes, intensifying screens, darkroom accessories and X-ray equipment

COURSE CONTENTS

UNIT-I

09 Hours

Photographic Principles:

Radiographic film- construction and types; Photographic effect and latent image formation; Film density and log relative exposure; Characteristic curve – its formation and features; Spectral response; Film faults and Artifacts

Intensifying Screens: Luminescence-fluorescence and phosphorescence; Construction and types of Intensifying Screens; Intensification Factor, quantum detection and conversion efficiency; Film screen matching; Resolving power of Intensifying Screens; Speed of intensifying screen; Screen film contact tests; Advantages and limitations of Intensifying Screens

X-ray Cassette: Construction of X-ray cassettes; Types of cassettes; Mounting Intensifying Screens on cassettes; Care and maintenance of cassettes

UNIT-II

07 Hours

Dark Room – Planning & Construction: Planning for a small & large Hospital; Location of Dark Room; Construction of Dark Room; Ventilation;

Wall Protection; Entrance to Dark Room - Single Door, Double Door, Labyrinth

Dark Room Accessories: Dry bench; Hopper, Drawer, Cupboard; Loading and unloading cassettes; Hangers, types of hangers and storage of hangers; Wet bench; Cleanliness, control of dust, dark room sinks; Hatches; Drier; Safe Lights-types and uses, factors affecting safelight performance, safelight Tests; Viewing room, Film dispensing

UNIT-III

07 Hours

Film Processing: Photochemistry;

Developer; Rinsing; Fixer; Washing and drying;

Preparation of processing solutions; Manual processing apparatus; Effect of temperature in processing; Rapid processing

Automatic processor: Principle of working and features, thermal regulation and replenishment system; Care and maintenance of automatic processor; Advantages and limitations of automatic processor

UNIT-IV

05 Hours

Day Light Film handling; Xeroradiography, Stereoscopy

UNIT-V

08 Hours

The Radiographic Image:

The emergent beam related to densities on film contrast – objective and subjective Radiation contrast, film contrast and Radiographic contrast- Density, Sharpness, Unsharpness

Resolution: Factors affecting resolution, choice of Kilovolt age and Mill amperage, Choice of Short Focus and Broad Focus, selection of Focus to Film Distance and Object to Film Distance selection of cassettes, Avoiding scatter radiation, magnification, distortion, penumbra

Reproduction of Radiographs: Copying Radiographs, Magnification and Minification Radiography

Imaging Communication: Hospital Information System, Radiology Information System, PACS, DICOM

SUGGESTED PRACTICALS/DEMONSTRATION (36 Hours)

- Radiographic film; Intensifying Screens; X-ray Cassette
- Dark Room – Planning & Construction
- Film Processing; Photochemistry;
- The emergent beam related to densities on film contrast – objective and subjective Radiation contrast, film contrast and Radiographic contrast- Density, Sharpness, Unsharpness; Factors affecting resolution; Reproduction of Radiographs

TRANSACTIONAL MODES

Lecture, Tutorial, Problem based learning, small group teaching and learning, Continuous interactive learning, Case-based, Project based, Seminars, Clinical conferences, E-learning, Skills laboratory, Industrial visit

SUGGESTED READING

- *Radiographic Imaging (Cbs) I.C.R.P., D.N. Chesney & M.O Chesney, Blackwell Scientific*
- *An Introduction Of Physics to Diagnostic Radiography, Christensen, Curry & Dowdey, Lea & Febiger*
- *Radiological Science for technologists, Stewart C. Bushong, Mosby*
- *A Concise Guide on Basic Radiographic Physics Darkroom Procedures, Radiographic Positioning & Techniques, Lalit Agarwal, JBD Publications*

Course Title: Contrast and Special Radiological Procedures	L	T	P	Cr.
Course Code: BMRI304	2	1	6	6

Total Hours 36 hrs

Course Outcomes: At the end of the course students will be able to...

1. Prepare management and positioning of patients while performing radiological procedures.
2. Correlate of indications, contraindications, contrast media, radiation dose, exposure timing and radiation safety measures for different radiological procedures.
3. Understand the patient preparations needed before any radiological examination.
4. Generalize knowledge of post procedural care.
5. Students will be able position the patients for radiological procedures.
6. Knowledge of image quality in radiological images.
7. Management of patients in radiology department for various procedures
8. Ability to handle emergency situations in radiology department.
9. Precautions and care required in interventional suits.

COURSE CONTENTS

UNIT-I

08 Hours

Introduction: General approach to Special Radiographic procedures, Responsibility of Radiology Technologist during radiological procedures, Preparation of patient for different procedures, Room layout in interventional radiology and fluoroscopy.

Contrast Media: Positive and Negative, Ionic & Non-Ionic, Adverse Reactions to contrast media and patient management.

Emergency Equipment in the Radiology Department

UNIT-II

10 Hours

Gastro Intestinal Tract: Barium Swallow; Barium Meal - Single and Double Contrast; Barium Meal Follow Through; Small Bowel Enema (Enteroclysis); Barium Enema - Gastrograffin Enema; Loopogram

Biliary Tract: Oral & Intravenous Cholecystography; Percutaneous Transhepatic Cholangiography; Percutaneous Transhepatic Biliary Drainage; Endoscopic Retrograde Cholangiopancreatography

UNIT-III**08 Hours**

Urinary System: IVU (Intravenous Urography), Retrograde Pyeloureterography (RGU), Micturating Cysto Urethrography, Ascending Urethrography

Reproductive System: HysteroSalpingogram, FTR (Fallopian Tube Recanalization)

UNIT-IV**10 Hours**

Central Nervous System: Cervical Myelography - Cisternal Puncture and Lateral Cervical Puncture, Lumbar Myelography, Myelography with water soluble and oily contrast media

Respiratory System: Bronchography, Percutaneous Lung Biopsy Other procedures in radiology: Arthrography, Sialography, Lymphography, Sinography & Fistulography, Dacryocystography, Embolization & embolic agents

SUGGESTED PRACTICALS/DEMONSTRATION (108 Hours)

- General approach to special radiographic procedures, responsibility of radiology technologist during radiological procedures Contrast media and their adverse reactions to contrast media and patient management
- Procedures for gastrointestinal tract including barium studies Procedures for biliary tract
- Procedures for urinary system and reproductive system
- Procedures for central nervous system and respiratory system

TRANSACTIONAL MODES

Lecture, Tutorial, Problem based learning, small group teaching and learning, Continuous interactive learning, Case-based, Project based, Seminars, Clinical conferences, E-learning, Skills laboratory, Industrial visit

SUGGESTED READING

- *Radiographic Imaging (Cbs)I.C.R.P., Bhushan and Lakkhar, Arya Publications*
- *A guide to radiological procedures, Chapman, Elsevier*

Course Title: Clinical Education III	L	T	P	Cr.
Course Code: BMRI305	0	0	12	4

Students will gain additional skills in clinical procedures, interaction with patients and professional personnel. Students apply knowledge from previous clinical learning experience under the supervision of a senior technologist. Students are tested on intermediate clinical radio diagnosis skills.

Studentship or observership must include:

- A minimum of 14 hours per week is considered as studentship in every semester.
- Provide simulation and skill labs for practicing skills specific to the program in the initial years of observership/studentship.
- Every semester must have seminars/workshops on new developments/technologies. Check annexure for marking criteria.
- If the clinical facility is not within the same campus, transportation should be provided to the students and interns.
- All practical skills must be supervised and recorded in a Logbook and skills to be evaluated after the completion of the internship.

4TH SEMESTER

Course Title: Cross Sectional Anatomy	L	T	P	Cr.
Course Code: BMRI401	2	0	6	5

Total Hours 36 hrs**Course Outcomes:** At the end of the course students will be able to...

1. Identify cross-sectional anatomy in sagittal, coronal and axial planes on CT and MR images.
2. Describe anatomical structural relationships.
3. Recognize normal anatomy and develop a personal resource system for future study.
4. Locate and identify cerebral, upper thoracic, mid-thoracic and abdominal anatomy.
5. Identify anatomical structures of the body and head on CT and MR images.
6. Distinguish arterial and venous anatomy throughout the body's vascular system.
7. Classify anatomical sections and their associated structures.

COURSE CONTENTS**UNIT-I****12 Hours**

Introduction to sectional anatomy and terminology: sectional planes and anatomical relationships/terminology.

Anatomy of the upper thorax: surface anatomy and relationships, bony structures, muscles and blood vessels.

Divisions of the mid-thorax: lungs, heart, great vessels and esophagus.

UNIT-II**12 Hours**

CT/MRI images of the thorax: normal and abnormal imaging.

Anatomy of the abdomen: major organs and accessory organs; abdominal blood vessels.

CT/MR images of the abdomen.

Normal and pathological anatomy of the pelvis: bony structures and associated muscles, digestive and urinary systems.

Reproductive organs: normal and abnormal imaging.

UNIT-III

12 Hours

CT/MR Images of the Male/Female Pelvis- Normal and pathologic

Neuro Anatomy-Scan planes

Brain –Cerebral hemispheres, Sinuses, Ventricles, Brainstem and associated parts, Arterial/venous systems, Basal ganglia, Cranial nerves

Spine- Vertebra and disc, Spinal cord and meninges

Neck-Arterial/venous systems, Muscles, Glands and pharynx

SUGGESTED PRACTICALS/DEMONSTRATION (108 Hours)

- Introduction to sectional anatomy and terminology; sectional planes; anatomical relationships; upper thoracic surface anatomy, bones, muscles and blood vessels; mid-thoracic anatomy including lungs, heart, great vessels and esophagus
- CT/MRI images of the thorax; abdominal organs and vessels; CT/MR images of the abdomen; pelvic bones, muscles, digestive and urinary systems; reproductive organs and normal/abnormal imaging
- CT/MR images of the male and female pelvis; neuroanatomical scan planes; brain structures and vascular anatomy; spine, spinal cord and meninges; neck vessels, muscles, glands and pharynx

TRANSACTIONAL MODES

Lecture, Tutorial, Problem based learning, small group teaching and learning, Continuous interactive learning, Case-based, Project based, Seminars, Clinical conferences, E-learning, Skills laboratory, Industrial visit

SUGGESTED READING

- *G. Bhavin Jhankaria. Cross Sectional Anatomy CT & MR. Jaypee Brothers Medical Publishers.*
- *D. Karthikeyan. Step by Step Cross-sectional Anatomy. Jaypee Brothers Medical Publishers.*

- *David J. Jackowe. Atlas of Cross-Sectional Anatomy and Radiological Imaging. Anshan Ltd.*
- *Denise L. Lazo. Fundamentals of Sectional Anatomy: An Imaging Approach. Cengage Learning.*

Course Title: Modern Radiological Imaging Equipment and Physics	L	T	P	Cr.
Course Code: BMRI402	2	1	2	4

Total Hours 36 hrs

Course Outcomes: At the end of the course students will be able to...

1. Describe special radiological equipment.
2. Describe computed radiography and digital radiography.
3. Describe PACS, RIS and HIS.

COURSE CONTENTS

UNIT-I

09 Hours

Modern x-ray tube. Digital Mammography and Tomosynthesis, Stitch radiography, Dual energy x-ray absorptionometry (DEXA) scan.

UNIT-II

09 Hours

Computed radiography: its principle, physics & equipment. Digital Radiography: its principle, physics & equipment. Flat panel digital fluoroscopy and radiography system, Direct and indirect digital radiography and fluoroscopy systems. Digital radiography and Computed radiography its advantages, disadvantages and applications. Digital Portable and mobile x-ray units.

UNIT-III

09 Hours

Modern dental equipment; cone-beam dental CT.

UNIT-IV

09 Hours

Picture archiving and communication system (PACS), RIS and HIS.

SUGGESTED PRACTICALS/DEMONSTRATION (36 Hours)

- Modern x-ray tube. Digital Mammography and Tomosynthesis, Stich radiography, Dual energy x-ray absorptionometry (DEXA) scan.

- Computed radiography: its principle, physics & equipment. Digital Radiography: its principle, physics & equipment. Flat panel digital fluoroscopy and radiography system, Direct and indirect digital radiography and fluoroscopy systems. Digital radiography and Computed radiography its advantages, disadvantages and applications. Digital Portable and mobile x-ray units.
- Modern dental equipments. Cone beam dental CT.
- Picture archiving and communication system (PACS), RIS and HIS.

TRANSACTIONAL MODES

Lecture, Tutorial, Problem based learning, small group teaching and learning, Continuous interactive learning, Case-based, Project based, Seminars, Clinical conferences, E-learning, Skills laboratory, Industrial visit

SUGGESTED READING

- *Amol Sasane, Hariqbal Singh and Roshan Lodha. Textbook of Radiology: Physics. Jaypee Brothers Medical Publishers.*
- *K. Thayalan. The Physics of Radiology and Imaging. Jaypee Brothers Medical Publishers.*
- *Thomas S. Curry, James E. Dowdey and Robert E. Murry. Christensen's Physics of Diagnostic Radiology. Lea & Febiger.*
- *S. K. Bhargava. Textbook of Radiology for Residents and Technicians. CBS Publishers.*
- *Lalit Agarwal and K. B. Gehlot. Concise Text Book on Imaging Modalities & Recent Advances in Diagnostic Radiology. JBD Publications.*

Course Title: Interventional Radiology Techniques	L	T	P	Cr.
Course Code: BMRI403	2	1	4	5

Total Hours 36 hrs

Course Outcomes: At the end of the course students will be able to...

1. Know the basic principle and physics of interventional equipment.
2. Know the management and positioning of patients while performing interventional radiological procedure.
3. Have knowledge about the indications, contraindications, contrast media, radiation dose, exposure timing and radiation safety measures for the different interventional radiological procedure.
4. Understand the patient preparation needed before any interventional radiological procedures.
5. Have knowledge about the post procedural care and safety.

COURSE CONTENTS

UNIT-I

06 Hours

Introduction to interventional procedures

DSA: basic principles and types

Equipment: Basics of angiographic equipment, single and biplane angiographic equipments, angiographic table, image intensifier, flat panel detectors, recording systems, pulse oximetry, cardiac resuscitation measure-ECG, pressure injector, catheters, needle and other tools, 3D rotational angiography, image processing, patient monitor, CO2 angiography

UNIT-II

09 Hours

Interventional procedures: Catheter- classification, types and applications, Guide wire- classification, types and applications, Pressure Injector and Accessories, Percutaneous catheterization, Digital Subtraction Angiography, Catheterization Sites, Asepsis

UNIT-III

09 Hours

Arteriography: Head and Neck Arteriography, Pulmonary Arteriography, Coronary Arteriography, Ascending Aortography, Trans Lumbar Aortography, Renal Arteriography, Trans Femoral Arteriography

Venography: Peripheral Venography- Lower Limb, Upper Limb, Central Venography, Superior Venacavography, Inferior Venacavography, Pelvic Venography

UNIT-IV

06 Hours

Safety considerations in angiography room; room design, protective devices, radiation monitoring

UNIT-V

06 Hours

Care and maintenance tests: General care, functional test

Quality assurance program: Acceptable limits of variation, corrective action

SUGGESTED PRACTICALS/DEMONSTRATION (72 Hours)

- Basics of angiographic equipments
- Catheter and guide wires
- Arteriography and venography procedures
- Safety considerations in angiography room

TRANSACTIONAL MODES

Lecture, Tutorial, Problem based learning, small group teaching and learning, Continuous interactive learning, Case-based, Project based, Seminars, Clinical conferences, E-learning, Skills laboratory, Industrial visit

SUGGESTED READING

- *Karim Valji. The Practice of Interventional Radiology.*
- *David Kessel and Iain Robertson. Interventional Radiology: A Survival Guide. Elsevier Health Sciences.*
- *Krishna Kandarpa, Lindsay Machan and Janette Durham. Handbook of Interventional Radiologic Procedures. Lippincott Williams & Wilkins.*
- *Lalit Agarwal. A Guide on Special Radiographic Investigations & Techniques. JBD Publications.*

Course Title: Patient Care in Radiology	L	T	P	Cr.
Course Code: BMRI404	1	1	4	4

Total Hours 18 hrs

Course Outcomes: At the end of the course students will be able to...

1. Understand the responsibility of the imaging technologist and other health care facility.
2. Understand the management and care of patient during different procedures and emergency situations.
3. Know about different patient transfer techniques and to restrain the uncooperative patients during radiological examination
4. Differentiate the types of consent forms
5. Know about infection control, infection source and isolation techniques
6. Describe sterilization techniques
7. Understand the radiation safety and protection

COURSE CONTENTS

UNIT-I

02 Hours

Introduction to Patient Care: Responsibilities of Medical Imaging Technologist, Obtaining Consents and history for different radiological examinations, Patient transfer and Restraining techniques, Obtaining vital signs, Ergonomics and body mechanism

Communication: Patient education, Communication with the patient, Professional role and behavior

UNIT-II

02 Hours

Hospital procedure: Hospital staffing and organization; records relating to patients and departmental statistics; professional attitude of the technologist to patients and other members of the staff; medico- legal aspects; accidents in the departments, appointments, organization; minimizing waiting time; out-patient and follow-up clinics; stock-taking and stock keeping.

UNIT-III

03 Hours

Care of the patient: FIRST contact with patients in the department; management of chair and stretcher patients and aids for this, management of

the unconscious patient; elementary hygiene; personal cleanliness; hygiene in relation to patients.

UNIT-IV

03 Hours

Nursing procedures in Radiology: Injection- methods and their routes of administration, Clothing of patient, Administering rectal enema.

First aid: Aims and objectives of first aid; 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. Fractures; splints, bandaging; dressing, foreign bodies; poisons.

UNIT-V

03 Hours

Infection: Bacteria, their nature and appearance; spread of infections; auto-infection or cross-infection; the inflammatory process; local tissue reaction, general body reaction; ulceration; asepsis and antisepsis. Universal precautions, hospital acquired infections- HIV, Hepatitis B, C, and MRSA etc.

Principles of asepsis: Sterilization - methods of sterilization; use of central sterile supply department; care of identification of instruments, surgical dressings in common use, including filamented swabs, elementary operating theatre procedure; setting of trays and trolleys in the radio imaging department (for study by radio imaging students only)

UNIT-VI

02 Hours

Patient care in following investigations: GIT, Respiratory system, Cardiovascular system, CNS; Sterilization; Infection control

Departmental procedures: Department staffing and organizations; records relating to patients and departmental statistics; professional attitudes of the technologist to patients and other members of the staff, medico-legal aspects accidents in the department; appointments; organisations; minimizing waiting time; out-patient and follow-up clinics; stock taking and stock keeping.

UNIT-VII**03 Hours**

Drugs in the department and Storage: classification; labelling and checking, regulations regarding dangerous and other drugs; units of measurement, special drugs, anti-depressive, anti-hypertensive etc. crash cart.

Medical ethics and records: Medico legal implication of MLC cases, Importance of consent, Consent in detail, Precaution while dealing with female patient, Medical records

SUGGESTED PRACTICALS/DEMONSTRATION (72 Hours)

- Introduction to Patient Care and Communication
- Hospital staffing and organization; records relating to patients and departmental statistics; professional attitude of the technologist to patients and other members of the staff; medico- legal aspects; accidents in the departments, appointments, organization; minimizing waiting time; out patient and follow-up clinics; stock-taking and stock keeping.
- Care of the patient
- Nursing procedures in Radiology and first aid
- Infection and Principles of asepsis
- Patient care in following investigations: GIT, Respiratory system, Cardiovascular system, CNS; Sterilization; Infection control.
- Drugs in the department and Storage and medical ethics and records

TRANSACTIONAL MODES

Lecture, Tutorial, Problem based learning, small group teaching and learning, Continuous interactive learning, Case-based, Project based, Seminars, Clinical conferences, E-learning, Skills laboratory, Industrial visit

SUGGESTED READING

- *Ruth Ann Ehrlich and Dawn M. Coakes. Patient Care in Radiography. Mosby.*
- *N. K. Kardam and Lalit Agarwal. Concise Textbook on Hospital Management & Patient Care in Diagnostic Radiology. JBD Publications.*
- *Ruth Ann Ehrlich and Joan A. Daly. Patient Care in Radiography: With an Introduction to Medical Imaging. Mosby Elsevier.*
- *A. M. Adler. Introduction to Radiologic and Imaging Sciences*

Course Title: Clinical Education IV	L	T	P	Cr.
Course Code: BMRI405	0	0	12	4

Students will gain additional skills in clinical procedures, interaction with patients and professional personnel. Students apply knowledge from previous clinical learning experience under the supervision of a senior technologist. Students are tested on intermediate clinical radio diagnosis skills.

Studentship or observership must include:

- A minimum of 14 hours per week is considered as studentship in every semester.
- Provide simulation and skill labs for practicing skills specific to the program in the initial years of observership/studentship.
- Every semester must have seminars/workshops on new developments/technologies. Check annexure for marking criteria.
- If the clinical facility is not within the same campus, transportation should be provided to the students and interns.
- All practical skills must be supervised and recorded in a Logbook and skills to be evaluated after the completion of the internship.

5TH SEMESTER

Course Title: Basics Techniques in CT Technology	L	T	P	Cr.
Course Code: BMRI501	4	1	8	9

Total Hours 72 hrs**Course Outcomes:** At the end of the course students will be able to...

1. Define basic principle and physics of Computed Tomography scan
2. Recognize protocols needed for Computed Tomography examination
3. Prepare and positioning for Computed Tomography examination
4. Interpret post processing of raw Computed Tomography images
5. Prepare and position the patients for Computed Tomography examination
6. Categorize knowledge of improving image quality in Computed Tomography images
7. Plan of scanning with various Computed Tomography protocols for better representation of images
8. Systematize post processing for Computed Tomography scan
9. Management of patient for any post contrast reactions

COURSE CONTENTS**UNIT-I****15 Hours****Introduction and history,**

CT principle, CT generations, CT Instrumentation, CT detectors, Axial & Helical CT – Slip ring technology

UNIT-II**14 Hours****Data acquisition, Image preprocessing/reconstruction techniques,**

Algorithms for image reconstruction, Image display, Image post-processing techniques, CT artifacts, Image quality

UNIT-III**14 Hours****CT Protocols for different body parts & Dental scan,**

CT Protocols for Angiography & Perfusion, CT contrast media and administration, CT guided interventional procedures

UNIT-IV

15 Hours

Multi-detector CT

Isotropic imaging, Cardiac CT, Flash CT, Advanced CT scanners, Dual energy & Dual Source Scanners, CT- fluoroscopy

UNIT-V

14 Hours

Safety consideration,

Documentation in CT, Role of Medical Imaging technologist in CT scan procedures, Quality assurance in CT

SUGGESTED PRACTICALS/DEMONSTRATION (144 Hours)

- Introduction and history, CT principle, CT generations, CT Instrumentation, CT detectors, Axial & Helical CT – Slip ring technology
- Image post-processing techniques, CT artifacts
- CT Protocols for different body parts & Dental scan, CT Protocols for Angiography & Perfusion, CT contrast media and administration, CT guided interventional procedures
- Multi-detector CT
- Safety consideration, Documentation in CT, Role of Medical Imaging technologist in CT scan procedures, Quality assurance in CT

TRANSACTIONAL MODES

Lecture, Tutorial, Problem based learning, small group teaching and learning, Continuous interactive learning, Case-based, Project based, Seminars, Clinical conferences, E-learning, Skills laboratory, Industrial visit

SUGGESTED READING

- *Euclid Seeram. Computed Tomography: Physical Principles, Clinical Applications, and Quality Control. Saunders.*

- *Lois Romans. Computed Tomography for Technologists: A Comprehensive Text. Lippincott Williams & Wilkins.*
- *Euclid Seeram. Computed Tomography: Physics and Technology: A Self Assessment Guide. Wiley-Blackwell.*
- *Timothy P. Szczekutowicz. The CT Handbook: Optimizing Protocols for Today's Feature-Rich Scanners. Medical Physics Publishing Corporation.*
- *Manjot Kaur and Maajid Mohi Ud Din Malik. CT Protocols. JBD Publications.*

Course Title: Radiation Safety in Diagnostic Radiology	L	T	P	Cr.
Course Code: BMRI502	2	1	4	5

Total Hours 36 hrs

Course Outcomes: At the end of the course students will be able to...

1. Aim and need of radiation protection
2. Introduction to Radiation units and quantities
3. Understanding of various Radiation protection regulations and the dose limits
4. Radiation protection to patients, occupational workers and general public in Diagnostic Radiology
5. Layout of Radiology department
6. Use of protective devices and awareness of radiation with radiation signages
7. Dose reduction measures with technical protective considerations during radiology
8. Different radiation measuring devices
9. Effects of radiation on biological tissue

COURSE CONTENTS

UNIT-I

07 Hours

Radiation Quantities and Units: Radiation- Radioactivity- Sources of radiation - natural radioactive sources -cosmic rays terrestrial radiation - - man made radiation sources. Units of radiation - Quality factor - Flux Fluence-Kerma- Exposure- Absorbed dose- Equivalent Dose- Weighting Factors-Effective Dose - Occupational Exposure Limits - Dose limits to public.

UNIT-II

08 Hours

Biological Effects of radiation: Ionization, excitation and free radical formation, hydrolysis of water, action of radiation on cell-Chromosomal aberration and its application for the biological dosimetry- Effects of whole body and acute irradiation, dose fractionation, effects of ionizing radiation on each of major organ system including fetus -Somatic effects and hereditary effects- stochastic and deterministic effects-Acute exposure and chronic exposure-LD50 - factors affecting radio sensitivity. Biological effects of non-ionizing radiation like ultrasound, lasers, IR, UV and magnetic fields.

UNIT-III**07 Hours**

Radiation detection and Measurements: Ionization of gases- Fluorescence and Phosphorescence -Effects on photographic emulsion. Ionization Chambers – proportional counters- G.M counters- scintillation detectors – liquid semiconductor detectors – Gamma ray spectrometer. Measuring systems – free air ionization chamber – thimble ion chamber – condenser chamber – Secondary standard dosimeters – film dosimeter – chemical dosimeter- Thermoluminescent Dosimeter. -Pocket dosimeter- Radiation survey meter-wide range survey meter -zone monitor-contamination monitor -their principle function and uses. Advantages & disadvantages of various detectors & its appropriateness of different detectors for different type of radiation measurement. Dose and Dosimetry, CT Dose Index (CTDI, etc.), Multiple Scan Average Dose (MSAD), Dose Length Product (DLP), Dose Profile, Effective Dose, Phantom Measurement Methods, Dose for Different Application Protocols, Technique Optimization. Dose area product in fluoroscopy and angiography systems, AGD in mammography

Artificial Intelligence in Radiation Safety

UNIT-IV**07 Hours**

Radiation protection: Radiation protection of self and patient- Principles of radiation protection, time - distance and shielding, shielding - calculation and radiation survey –ALARA- personnel dosimeters (TLD and film batches) - occupational exposure.

UNIT-V**07 Hours**

Radiation Hazard evaluation and control: Philosophy of Radiation protection, effects of time, Distance & Shielding. Calculation of Work load, weekly calculated dose to radiation worker & General public Good work practice in Diagnostic Radiology. Planning consideration for radiology, including Use factor, occupancy factors, and different shielding material.

SUGGESTED PRACTICALS/DEMONSTRATION (72 Hours)

- Radiation Quantities and Units
- Biological Effects of radiation
- Radiation detection and Measurements Survey meter and personal dosimeter Artificial Intelligence in Radiation Safety

- Radiation protection; Principles of radiation protection; ALARA
- Radiation Hazard evaluation and control

TRANSACTIONAL MODES

Lecture, Tutorial, Problem based learning, small group teaching and learning, Continuous interactive learning, Case-based, Project based, Seminars, Clinical conferences, E-learning, Skills laboratory, Industrial visit

SUGGESTED READING

- *Euclid Seeram and Patrick C. Brennan. Radiation Protection in Diagnostic X-Ray Imaging. Jones and Bartlett Publishers.*
- *Stewart C. Bushong. Development of Radiation Protection in Diagnostic Radiology. CRC Press.*
- *K. Thayalan. Textbook of Radiological Safety. Jaypee Brothers Medical Publishers.*
- *Statkiewicz Sherer. Radiation Protection in Medical Radiography. Elsevier.*
- *Prashant Kumar Jha. Basics of Radiation, Hazards and Prevention in Diagnostic Radiology. JBD Publications.*

Course Title: Quality Assurance in Diagnostic Radiology and Regulatory Requirements	L	T	P	Cr.
Course Code: BMRI503	1	1	2	3

Total Hours 18 hrs

Course Outcomes: At the end of the course students will be able to...

1. Aim and need of radiation protection
2. Introduction to quality assurance
3. Understanding of regulatory requirements
4. Follow radiation protection regulations and apply practically

COURSE CONTENTS

UNIT-I

04 Hours

Objectives of quality Control: Improve the quality of imaging thereby increasing the diagnostic value; to reduce the radiation exposure; Reduction of film wastage and repeat examination; to maintain the various diagnostic and imaging units at their optimal performance. Quality assurance activities: Equipment selection phase; Equipment installation and acceptance phase; Operational phase; Preventive maintenance.

Quality assurance programme at the radiological faculty level: Responsibility; Purchase; Specifications; Acceptance; Routine testing; Evaluation of results of routine testing; Quality assurance practical exercise in the X ray generator and tube; Image receptors from processing; Radiographic equipment; Fluoroscopic equipment; Mammographic equipment; 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. LASER printer calibration

UNIT-II

04 Hours

QA in Diagnostic Radiology

filtration

Contact between film and intensifying screen

Contrast Verification of Optical and Radiation field congruence

Beam alignment

Focal spot size

Linearity of tube current mA and Timer

Applied potential

HVT and total tube

Resolution

Grid alignment QA in mammography

QA in CT

QA in Digital Radiography

UNIT-III

04 Hours

Regulatory requirements in Diagnostic Radiology

National Regulatory Body

Responsibilities and organization

Safety Standards

Codes and Guides

Care and maintenance of diagnostic equipment: General principles and preventive maintenance for routine - daily, Weekly, monthly, quarterly, annually: care in use, special care of mobile equipment

UNIT-IV

03 Hours

Responsibilities of licensees, registrants and employers

Enforcement of Regulatory requirements

Role of technologist in radiology department Maintenance and care of equipment: Safe operation of equipment; Routine cleaning of equipment and instruments; Cassette, screen maintenance; Maintenance of automatic processor and manual processing units; Routine maintenance of equipments; Record keeping and log book maintenance; Reject analysis and objectives of reject analysis programme.

UNIT-V**03 Hours**

Care and maintenance of diagnostic equipment: General principles and preventive maintenance for routine - daily, Weekly, monthly, quarterly, annually: care in use, special care of mobile equipment.

SUGGESTED PRACTICALS/DEMONSTRATION (36 Hours)

- Quality assurance programme at the radiological faculty level: Responsibility; Purchase; Specifications; Acceptance; Routine testing; Evaluation of results of routine testing; Quality assurance practical exercise in the X ray generator and tube; Image receptors from processing; Radiographic equipment; Fluoroscopic equipment; Mammographic equipment; 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. LASER printer calibration
- QA in Diagnostic Radiology
 - filtration
 - Contact between film and intensifying screen
 - Contrast Verification of Optical and Radiation field congruence
 - Beam alignment
 - Focal spot size
 - Linearity of tube current mA and Timer
 - Applied potential
 - HVT and total tube
 - Resolution
 - Grid alignment QA in mammography
 - QA in CT QA in Digital Radiography
- Regulatory requirements in Diagnostic Radiology
- Responsibilities of licensees, registrants and employers Enforcement of Regulatory requirements
- Care and maintenance of diagnostic equipment: General principles and preventive maintenance for routine - daily, Weekly, monthly, quarterly, annually: care in use, special care of mobile equipment.

TRANSACTIONAL MODES

Lecture, Tutorial, Problem based learning, small group teaching and learning, Continuous interactive learning, Case-based, Project based, Seminars, Clinical conferences, E-learning, Skills laboratory, Industrial visit

SUGGESTED READING

- *Bhargava. Quality Assurance and Control in Diagnostic Radiology and Imaging. CBS Publishers and Distributors.*
- *R. Sundhararajan, M. V. Kumudhavalli and Minal T. Harde. Quality Assurance. Thakur Publications.*
- *J. McLemore. Quality Assurance in Diagnostic Radiology.*
- *Zafar Neyaz. An Introduction to Quality Assurance in Radiology. JBD Publications.*

Course Title: Clinical Education V	L	T	P	Cr.
Course Code: BMRI504	0	0	12	4

Students will gain additional skills in clinical procedures, interaction with patients and professional personnel. Students apply knowledge from previous clinical learning experience under the supervision of a senior technologist. Students are tested on intermediate clinical radio diagnosis skills.

Studentship or observership must include:

- A minimum of 14 hours per week is considered as studentship in every semester.
- Provide simulation and skill labs for practicing skills specific to the program in the initial years of observership/studentship.
- Every semester must have seminars/workshops on new developments/technologies. Check annexure for marking criteria.
- If the clinical facility is not within the same campus, transportation should be provided to the students and interns.
- All practical skills must be supervised and recorded in a Logbook and skills to be evaluated after the completion of the internship.

6TH SEMESTER

Course Title: Basics Techniques in MRI Technology	L	T	P	Cr.
Course Code: BMRI601	3	1	8	8

Total Hours 54 hrs**Course Outcomes:** At the end of the course students will be able to...

1. Define basic principle and physics of Magnetic Resonance Imaging.
2. Recognize protocols needed for Magnetic Resonance Imaging examination.
3. Prepare and positioning for Magnetic Resonance Imaging examination.
4. Interpret post processing of Magnetic Resonance Imaging images.
5. Prepare and position the patients for Magnetic Resonance Imaging examination.
6. Categorize knowledge of improving image quality in Magnetic Resonance Imaging.
7. Scanning of patient with various Magnetic Resonance Imaging protocols for better representation of images.
8. Plan of post processing for Magnetic Resonance Imaging data.
9. Management of patient for any post contrast reactions.

COURSE CONTENTS**UNIT-I****12 Hours**

Introduction to MRI; Basic principle; Image weighting and contrast in MRI; Instrumentation of MRI-Magnets- classification, types, advantages, disadvantages, Gradient & Body Coils, RF coils, Shim coils, Ramping, Cryogen, RF shielding

UNIT-II**12 Hours**

Encoding and Image formation-Encoding, K-Space; Parameters and Trade-offs; MRI Pulse sequences-Spin Echo pulse sequence, Gradient Echo pulse sequence; Fast imaging sequences

UNIT-III**10 Hours**

Flow phenomena; Flow phenomena compensation; Vascular Imaging- Digital Subtraction MRA, TOF-MRA, PC-MRA, Velocity Encoding, MR-Angiogram, MR- Venogram

UNIT-IV

10 Hours

Cardiac Imaging; Whole body MRI Protocols; MRI Artifacts and their compensation; MRI contrast agents-T1 contrast agent, T2 contrast agent

UNIT-V

10 Hours

MRI safety- Implants and pace-makers, Electrical safety, Metallic safety, Instrumental safety, Bio-effects of MRI; Documentation; Quality assurance in MRI

SUGGESTED PRACTICALS/DEMONSTRATION (144 Hours)

- Instrumentation of MRI-Magnets- classification, types, advantages, disadvantages, Gradient & Body Coils, RF coils, Shim coils, Ramping, Cryogen, RF shielding
- MRI Pulse sequences-Spin Echo pulse sequence, Gradient Echo pulse sequence; Fast imaging sequences
- Flow phenomena; Flow phenomena compensation
- Whole body MRI Protocols; MRI Artifacts and their compensation
- MRI safety and Quality assurance in MRI

TRANSACTIONAL MODES

Lecture, Tutorial, Problem based learning, small group teaching and learning, Continuous interactive learning, Case-based, Project based, Seminars, Clinical conferences, E-learning, Skills laboratory, Industrial visit

SUGGESTED READING

- *John R. Haaga and Daniel Boll. Tomography and Magnetic Resonance Imaging of the Whole Body, Volumes I and II. Elsevier.*
- *Catherine Westbrook and Carolyn Kaut. MRI in Practice. Wiley-Blackwell.*
- *Catherine Westbrook. Protocols in MRI. Wiley-Blackwell.*

- *Dominik Weishaupt, Victor D. Koechli, Borut Marincek and J. M. Froehlich. An Introduction to the Physics and Function of Magnetic Resonance Imaging. Springer.*
- *Maajid Mohi Ud Din Malik and Manjot Kaur. Concise Textbook of MRI Physics & Protocols. JBD Publications.*

Course Title: Introduction to Nuclear Medicine Techniques	L	T	P	Cr.
Course Code: BMRI602	1	1	2	3

Total Hours 18 hrs

Course Outcomes: At the end of the course students will be able to...

1. Define basic principle and physics of nuclear medicine.
2. Apply precautions while handling radiopharmaceuticals.
3. Recognizing the artefacts associated with nuclear medicine.
4. Assess the knowledge of improving image quality in nuclear medicine.
5. Management of patient for any late reactions associated with radiotracers in nuclear medicine.

COURSE CONTENTS

UNIT-I

07 Hours

History; Isotopes and Radionuclides- Production of Radionuclides, Transport of Radionuclides; Radio Activity- Radio Active transformations, Specific Activity; Radiopharmaceuticals- Preparation, Precautions while handling

UNIT-II

07 Hours

Gamma Camera instrumentation - Collimator- classification and types;

Single Photon Emission Computed Tomography (SPECT); Positron Emission Tomography (PET); Advanced techniques in NM - SPECT-CT, PET-CT, PET-MRI

UNIT-III

04 Hours

Safety Considerations & Radiation Dose in Nuclear Medicine; Room layout in nuclear medicine

SUGGESTED PRACTICALS/DEMONSTRATION (36 Hours)

- History; Isotopes and Radionuclides- Production of Radionuclides, Transport of Radionuclides; Radio Activity- Radio Active transformations, Specific Activity; Radiopharmaceuticals- Preparation, Precautions while handling

- Gamma Camera instrumentation - Collimator- classification and types; Single Photon Emission Computed Tomography (SPECT); Positron Emission Tomography (PET); Advanced techniques in NM - SPECT-CT, PET-CT, PET-MRI
- Safety Considerations & Radiation Dose in Nuclear Medicine; Room layout in nuclear medicine

TRANSACTIONAL MODES

Lecture, Tutorial, Problem based learning, small group teaching and learning, Continuous interactive learning, Case-based, Project based, Seminars, Clinical conferences, E-learning, Skills laboratory, Industrial visit

SUGGESTED READING

- *Duccio Volterrani, Paola Anna Erba, Ignasi Carrió and H. William Strauss. Nuclear Medicine Textbook: Methodology and Clinical Applications. Springer.*
- *Jennifer Prekeges. Nuclear Medicine Instrumentation. Jones and Bartlett Publishers.*
- *Ramesh Chandra and Arman Rahmim. Nuclear Medicine Physics: The Basics. Wolters Kluwer.*
- *Pete Shackett. Nuclear Medicine Technology: Procedures and Quick Reference. Lippincott Williams & Wilkins.*
- *Lalit Agarwal and Arvind Shukla. A Concise Guide on Basic Radiation Physics, Radiotherapy Physics & Nuclear Medicine. JBD Publications.*

Course Title: Ultrasound Techniques	L	T	P	Cr.
Course Code: BMRI603	2	1	0	3

Total Hours 36 hrs

Course Outcomes: At the end of the course students will be able to...

1. Describe the Ultrasound properties, interaction of ultrasound with matter
2. Describe the transducer and types
3. Explain the concepts of image display
4. Describe Doppler imaging and ultrasound contrast agents
5. Describe the image characteristics and artefacts
6. Explain the safety considerations in ultrasound and protocols

COURSE CONTENTS

UNIT-I **06 Hours**

Ultrasound: Properties of ultrasound, interaction of ultrasound with matter

UNIT-II **06 Hours**

Transducers: Types of transducers, advances in the design of modern ultrasound transducers

UNIT-III **06 Hours**

Image display: Display modes, ultrasound instrumentation, controls, image storage, scan converter memory, photographic film, multi format camera, laser imager, colour and video thermal printer, computer storage, pre and post processing techniques

UNIT-IV **06 Hours**

Doppler Imaging: Doppler principles, continuous wave Doppler and pulsed Doppler, duplex scanning, colour flow imaging, power doppler, harmonic imaging, extended field of view Ultrasound contrast agents

UNIT-V **06 Hours**

Image characteristics and artefacts: vascular, interventional, intraoperative and ophthalmic ultrasonography, 3D and 4D ultrasound imaging Artificial Intelligence in Ultrasound

UNIT-VI

06 Hours

Bio-effects and safety considerations in ultrasound, ultrasound system performance measurements, ultrasound equipments quality assurance – conventional Doppler system testing and documentation

SUGGESTED PRACTICALS/DEMONSTRATION (36 Hours)

- Ultrasound interaction of ultrasound with matter
- Types of transducers, advances in the design of modern ultrasound transducers
- Image display: Display modes, ultrasound instrumentation, controls Doppler Imaging: Doppler principles, continuous wave Doppler and pulsed Doppler, duplex scanning, colour flow imaging, power doppler, harmonic imaging, extended field of view Ultrasound contrast agents
- Image characteristics and artefacts
- Bio-effects and safety considerations in ultrasound, ultrasound system performance measurements, ultrasound equipments quality assurance

TRANSACTIONAL MODES

Lecture, Tutorial, Problem based learning, small group teaching and learning, Continuous interactive learning, Case-based, Project based, Seminars, Clinical conferences, E-learning, Skills laboratory, Industrial visit

SUGGESTED READING

- Vivien Gibbs, David Cole and Antonio Sassano. *Ultrasound Physics and Technology*. Churchill Livingstone.
- Philip E. S. Palmer. *Manual of Diagnostic Ultrasound*. World Health Organization.
- Dinesh K. Baghel. *Physics and Technical Aspects of Diagnostic Ultrasound*. AITBS Publishers.
- Carol M. Rumack and Deborah Levine. *Diagnostic Ultrasound*. Elsevier.

- *Yadav. Ultrasound Imaging (1000 Multiple Choice Questions). JBD Publications.*

Course Title: Biostatistics and Research Methodology	L	T	P	Cr.
Course Code: BMRI604	1	1	0	2

Total Hours 18 hrs

Course Outcomes: At the end of the course students will be able to...

1. Understand the Importance of statistics course in the curriculum
2. Understands Statistical Terms
3. Possess Knowledge and Skill in the use of Basic Statistics in the analysis and interpretation of data

COURSE CONTENTS

UNIT-I

03 Hours

Introduction: Meaning, Definition, Characteristics of Statistics; Importance of the Study of Statistics. Branches of Statistics; Descriptive and Inferential Statistics; Variables and Their Types. Measurement Scales.

UNIT-II

03 Hours

Tabulation of Data: Raw Data, the Array, Frequency Distribution. Basic Principles of Graphical Representation; Types of Diagrams - Histograms, Frequency Polygons, Smooth Frequency Polygon, Commutative Frequency Curve, O give; Normal Probability Curve.

UNIT-III

03 Hours

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.

UNIT-IV

03 Hours

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.

UNIT-V**03 Hours**

Probability and Standard Distributions: Meaning of Probability of Standard Distribution, The Binominal Distribution. The Normal Distribution; Divergence from Normality - Skewness, Kurtosis

UNIT-VI**03 Hours**

Sampling Techniques: Need For Sampling - Criteria for Good Samples. Application of Sampling in Community, Procedures of Sampling and Sampling Designs Errors. Sampling Variation and Tests of Significance.

TRANSACTIONAL MODES

Lecture, Tutorial, Problem based learning, small group teaching and learning, Continuous interactive learning, Case-based, Project based, Seminars, Clinical conferences, E-learning, Skills laboratory, Industrial visit

SUGGESTED READING

- *N. S. Rao. Elements of Health Statistics.*
- *Sunder Rao. An Introduction to Biostatistics.*
- *B. K. Mahajan. Methods in Bio-Statistics.*
- *Inderbir Singh. Elementary Statistics for Medical Workers.*
- *C. B. Gupta. An Introduction to Statistical Methods. Ram Prasad & Sons.*

Course Title: Clinical Education VI	L	T	P	Cr.
Course Code: BMRI605	0	0	15	5

Students will gain additional skills in clinical procedures, interaction with patients and professional personnel. Students apply knowledge from previous clinical learning experience under the supervision of a senior technologist. Students are tested on intermediate clinical radio diagnosis skills.

Studentship or observership must include:

- A minimum of 14 hours per week is considered as studentship in every semester.
- Provide simulation and skill labs for practicing skills specific to the program in the initial years of observership/studentship.
- Every semester must have seminars/workshops on new developments/technologies. Check annexure for marking criteria.
- If the clinical facility is not within the same campus, transportation should be provided to the students and interns.
- All practical skills must be supervised and recorded in a Logbook and skills to be evaluated after the completion of the internship.

7TH SEMESTER

Course Title: Internship I	L	T	P	Cr.
Course Code: BMRI701	0	0	0	20

Total Hours 1200 hrs**Course Outcomes:** At the end of the course students will be able to...

1. Correctly Identify the Anatomy to be imaged
2. To properly position the patient for radiography/Radiological and Imaging procedures
3. Correctly select appropriate projection/projections to demonstrate the area of interest
4. Use appropriate radiographic parameters to produce a radiographic image with satisfactory results
5. Should be able to differentiate a properly positioned and exposed radiographic image from a wrongly positioned and over or underexposed radiographic image
6. Should be able to correctly identify anatomical features displayed in radiographic image obtained.

LIST OF PRACTICALS/ EXERCISES/ASSIGNMENTS/CASE STUDIES

- Radiation Physics
- Radiographic Positioning
- Conventional Radiography and Equipment
- Contrast Media& Special Radiological/ imaging procedures
- Interventional Radiology/ imaging techniques
- Patient Care in Radiology

Every candidate after passing all semesters examination is required to undergo compulsory internship to the satisfaction of the college authorities and University for a period of 1 year as to be eligible for the award of the degree. The internship is partial fulfillment of the requirements for the graduation and no candidate shall be declared to have completed the program otherwise. The internship shall be completed within 18 months of the date of passing final examination.

Students must undertake the rotational postings during which students have to work under supervision of an experienced staff in the following areas:

	Postings	Duration
1	Conventional Radiography, Mammography, CR, DR and PACS	4 months
2	Radiological Imaging & Special Procedures and Advanced Equipments	2 months

FORMAT FOR TRAINING REPORT

Following is the suggestive format for the training report; actual format may differ slightly depending upon the nature of Institutes/Hospitals/Diagnostic Centers. The training report may contain the following

- Title page
- Certificate
- Abstract
- Acknowledgement
- Content Page with date and time start and end

Chapter 1. Organizational structure of Institutes/Hospitals/Diagnostic Centers and General Lay Out

Chapter 2. Introduction of Institutes/Hospitals/Diagnostic Centers (History, Facilities available. Specialization and number of employees etc.)

Chapter 3. Types of major equipment/instruments/ machines used in Radiology with their specification, approximate cost and specific use and their routine maintenance.

Chapter 4. Standard Operating procedures.

Chapter 5. Quality assurance and radiation safety procedures.

Chapter 6. Equipment handling and procedures.

Chapter 7. Safety procedures followed

Chapter 8. Particulars of Practical Experiences in Radiology and Imaging

Chapter 9. Short report/description of the project (if any done during the training)

Chapter 10. Special/challenging experiences encountered during training if any (may include students liking & disliking of work places)

References /Bibliography

8TH SEMESTER

Course Title: Internship II	L	T	P	Cr.
Course Code: BMRI801	0	0	0	20

Total Hours 1200 hrs**Course Outcomes:** At the end of the course students will be able to...

1. Correctly Identify the Anatomy to be imaged
2. To properly position the patient for radiography/Radiological and Imaging procedures
3. Correctly select appropriate projection/projections to demonstrate the area of interest
4. Use appropriate radiographic parameters to produce a radiographic image with satisfactory results
5. Should be able to differentiate a properly positioned and exposed radiographic image from a wrongly positioned and over or underexposed radiographic image
6. Should be able to correctly identify anatomical features displayed in radiographic image obtained.

LIST OF PRACTICALS/ EXERCISES/ASSIGNMENTS/CASE STUDIES

- Basics Techniques in CT Imaging Technology
- Radiation Safety in Diagnostic Radiology
- Quality Assurance in Diagnostic Radiology and Regulatory Requirements
- Basics Techniques in MRI Imaging Technology
- Introduction to Nuclear Medicine Techniques* (if facility available)
- Ultrasound Techniques

Every candidate after passing all semesters examination is required to undergo compulsory internship to the satisfaction of the college authorities and University for a period of 1 year as to be eligible for the award of the degree. The internship is partial fulfillment of the requirements for the graduation and no candidate shall be declared to have completed the program otherwise. The internship shall be completed within 18 months of the date of passing final examination.

Students must undertake the rotational postings during which students have to work under supervision of an experienced staff in the following areas:

	Postings	Duration
3	Ultrasonography & Doppler Imaging	1 months
4	Interventional Radiology	1 months
5	Computed Tomography	2 months
6	Magnetic Resonance Imaging	2 months

FORMAT FOR TRAINING REPORT

Following is the suggestive format for the training report; actual format may differ slightly depending upon the nature of Institutes/Hospitals/Diagnostic Centers. The training report may contain the following

- Title page
- Certificate
- Abstract
- Acknowledgement
- Content Page with date and time start and end

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