



MALLA REDDY VISHWAVIDYAPEETH

SCHOOL OF ALLIED HEALTH CARE SCIENCES AND TECHNOLOGY

Suraram X Roads, Jeedimetla,
Hyderabad-500055

Web: www.mallareddyvishwavidyapeeth.com

Program

Bachelor of Science (B.Sc.)

Medical Radiology and Imaging Technology

MRIT-2026

Vision

To produce highly skilled radiology and imaging technologists who contribute to accurate diagnosis and patient care through advanced imaging techniques, research, and ethical healthcare practice.

Mission

- Provide comprehensive knowledge and hands-on training in radiology and imaging technologies.
- Develop clinical, technical, and analytical skills for accurate diagnostic imaging.
- Promote ethical values, patient safety, and professional responsibility.
- Prepare students to assist in diagnosis and treatment using modern imaging modalities such as X-ray, CT, MRI, and Ultrasound.

Program Educational Objectives (PEOs)

Graduates will:

- Apply radiological and imaging knowledge effectively in clinical practice.
- Assist radiologists in diagnostic and interventional imaging procedures with competence.
- Demonstrate professionalism, ethical practice, and effective communication in healthcare environments.
- Engage in research, innovation, and continuous professional development.
- Contribute to community healthcare through early diagnosis and awareness programs.

Program Outcomes (POs)

Students will:

- Understand fundamental and advanced concepts of radiology and imaging technology.

- Perform and assist in X-ray, CT, MRI, Ultrasound, and fluoroscopy procedures.
- Analyse imaging data and support clinical diagnosis and treatment planning.
- Apply knowledge of anatomy, physiology, pathology, and radiological physics.
- Follow radiation protection principles, infection control, and patient safety protocols.
- Communicate effectively with patients, radiologists, and healthcare teams.
- Operate modern imaging equipment and digital systems (PACS, RIS).
- Demonstrate critical thinking and problem-solving in imaging procedures.
- Participate in research and evidence-based radiology practices.
- Engage in lifelong learning and professional development.

Program Specific Outcomes (PSOs)

Students can:

- Perform diagnostic imaging procedures including X-ray, CT scan, MRI, Ultrasound, and Mammography.
- Assist in interventional radiology and image-guided procedures.
- Operate, maintain, and troubleshoot radiological equipment.
- Apply radiation safety and protection measures for patients and staff.
- Recognize imaging artifacts and optimize image quality.
- Provide technical support in emergency and trauma imaging situations.
- Work efficiently in radiology departments, imaging centres, and hospitals.

Course Outcomes (COs)

Students will:

- Understand basic and advanced principles of radiology and imaging science.
- Position patients accurately and perform imaging procedures effectively.

- Interpret basic radiographic images and assist in advanced image analysis.
- Apply knowledge in CT, MRI, Ultrasound, and digital imaging systems.
- Follow radiation safety standards, biomedical ethics, and quality assurance protocols.
- Develop technical expertise in handling imaging equipment.
- Assist healthcare teams in diagnosis and patient management.
- Demonstrate research skills and analytical thinking in imaging sciences.

MALLA REDDY VISHWAVIDYAPEETH**SCHOOL OF ALLIED HEALTH CARE SCIENCES AND TECHNOLOGY****Bachelor of Medical Radiology and Imaging Technology****COURSE STRUCTURE****I YEAR I SEMESTER**

S.NO	SUBJECT CODE	SUBJECT	L	T	P	C	Examination Scheme								Grand TOTAL	
							Theory				Practical				TOTAL	
							Exam Duration Hours	CIE Max Marks	ESE Max Marks	Total Max marks	Min Marks	CIE Max Marks	ESE Max Marks	Total Max Marks		Min marks
1.	BMRIT-001	Human Anatomy	3	-	-	3	2.5	30	70	100	50	-	-	-	-	100
2.	BMRIT-002	Physiology	3	-	-	3	2.5	30	70	100	50	-	-	-	-	100
3.	BMRIT-003	Basics of Radiation Physics	2	-	6	5	2.5	30	70	100	50	30	70#	100	50	200
4.	BMRIT-004	Introduction to Healthcare	1	-	-	1	-	30	70*	100	50	-	-	-	-	-
5.	BMRIT-005	Medical Terminology and Record keeping	1	-	-	1	-	30	70*	100	50	-	-	-	--	-
6.	BMRIT-006	Basic Computers and Information science	1	-	-	1	-	30	70*	100	50	-	-	-	-	-
7.	BMRIT- 007	Medical Law and Ethics	1	-	-	1	-	30	70*	100	50	-	-	-	-	-
8.	BMRIT-008	Professionalism and Values	1	-	-	1	-	30	70*	100	50	-	-	-	-	-
9.	BMRIT-009	Principals of Management	1	-	-	1	-	30	70*	100	50	-	-	-	-	-

10.	BMRIT-010	English & Communication on skills	1	-	-	1	-	30	70*	100	50	-	-	-	-	-
11.	-----	BMRIT Radiology Clinical Education – part I (studentship)	-	-	15	5	-	-	-	-	-	-	-	-	-	-
TOTAL			13	2	21	23	-	-	-	300	-	-	-	100	-	400

Abbreviations: ESE- End Semester Exam, CIE- Continuous Internal Evaluation, L – Lectures ((hrs/week), T - Tutorial, P – Practical {Clinical / Practicals (hrs/week)} *Internal Assessment, # External Assessment

I YEAR II SEMESTER

S.NO	SUBJECT CODE	SUBJECT	L	T	P	C	Examination Scheme								Grand TOTAL	
							Theory				Practical					
							Exam Duration Hours	CIE	ESE	Total		CIE	ESE	Total		TOTAL
								Max Marks	Max Marks	Max marks	Min Marks	Max Marks	Max Marks	Max Marks	Min marks	
1.	BMRIT-011	Basics of Microbiology	2	--	--	2	2.5	30	70	100	50	--	--	--	--	100
2.	BMRIT-012	Basics of Biochemistry	2	--	--	2	2.5	30	70	100	50	--	--	--	--	100
3.	BMRIT-013	Conventional Radiography and Equipment	4	--	2	5	2.5	30	70	100	50	--	--	--	--	100
4.	BMRIT-014	Clinical Radiography Positioning (Part I) BMRIT	4	1	6	8	--	30	70	100	50	30	70#	100	50	200
5.	-----	Radiology Clinical Education – part II (studentship)	--	--	15	5	--	--	--	--	--	--	--	--	--	--
Total			12	1	23	22	--	--	--	400	--	--	--	100	--	500

II YEAR III SEMESTER

S.N O	SUBJECT CODE	SUBJECT	L	T	P	C	Examination Scheme									Grand TOTAL
							Theory					Practical				TOTAL
							Exam Duration Hours	CIE	ESE	Total		CIE	ESE	Total		
	Max Marks	Max Marks	Max marks	Min Marks	Max Marks	Max Marks	Max Marks	Min marks								
1.	BMRIT-015	Pathology	2	--	--	2	2.5	30	70	100	50	--	--	--	--	100
2.	BMRIT-016	Clinical Radiography Positioning (Part II)	2	1	6	6	2.5	30	70	100	50	30	70#	100	50	200
3.	BMRIT-017	Radiography and Image Processing Techniques	2	--	2	3	2.5	30	70	100	50	--	--	--	--	100
4.	BMRIT-018	Contrast Media &Special Radiological Procedures	2	1	6	6	2.5	30	70	100	50	30	70#	100	50	200
5.	-----	BMRIT Radiology Clinical Education -Part III (Studentship)	--	--	12	4	--	--	--	--	--	--	--	--	--	--
TOTAL			6	4	26	21	---	---	---	400	---	---	---	200	---	600

II YEAR IV SEMESTER

S.NO	SUBJECT CODE	SUBJECT	L	T	P	C	Examination Scheme									Grand TOTAL
							Theory					Practical				TOTAL
							Exam Duration Hours	CIE	ESE	Total		CIE	ESE	Total		
								Max Marks	Max Marks	Max marks	Min Marks	Max Marks	Max Marks	Max Marks	Min marks	
1.	BMRIT-019	Cross sectional anatomy	2	--	6	5	--	--	--	--	--	70#	30	100	50	100
2.	BMRIT-020	Modern Radiological Imaging Equipment and Physics	2	1	2	3	2.5	70	30	100	50	--	--	--	--	100
3.	BMRIT-021	Interventional Radiology Techniques	2	1	4	4	2.5	70	30	100	50	70#	30	100	50	200
4.	BMRIT-022	Patient Care in Radiology	1	1	4	4	2.5	70	30	100	50	70#	30	100	50	200
5.	-----	BMRIT Radiology Clinical Education – part IV (studentship)	--	--	12	4	--	--	--	--	--	--	--	--	--	--
TOTAL			7	3	26	22	--	--	--	300	--	--	--	300	--	600

III YEAR V SEMESTER

S.NO	SUBJECT CODE	SUBJECT	L	T	P	C	Examination Scheme								Grand TOTAL	
							Theory				Practical				TOTAL	
							Exam Duratio n Hours	CIE	ESE	Total		CIE	ESE	Total		
								Max Marks	Max Mark s	Max marks	Min Marks	Max Marks	Max Marks	Max Marks		Min marks
1.	BMRIT-023	Basics Techniques in CT Technology	4	1	8	9	2.5	30	70	100	50	30	70#	100	50	200
2.	BMRIT-024	Radiation Safety in Diagnostic Radiology	2	1	4	5	2.5	30	70	100	50	30	70#	100	50	200
3.	BMRIT-025	Quality Assurance in Diagnostic Radiology and Regulatory Requirements	1	1	2	3	--	--	--	--	--	30	70#	100	50	100
4.	-----	BMRIT Radiology Clinical Education – part V (studentship)	--	--	12	4	--	--	--	--	--	--	--	--	--	--
TOTAL			7	3	26	21	--	--	--	200	--	--	--	300	--	500

III YEAR VI SEMESTER

S.NO	SUBJECT CODE	SUBJECT	L	T	P	C	Examination Scheme									Grand TOTAL
							Theory					Practical				TOTAL
							Exam Duration Hours	CIE	ESE	Total		CIE	ESE	Total		
								Max Marks	Max Marks	Max marks	Min Marks	Max Marks	Max Marks	Max Marks	Min marks	
1.	BMRIT-026	Basics Techniques In MRI Technology	3	1	8	8	2.5	30	70	100	50	30	70#	100	50	200
2.	BMRIT-027	Introduction to Nuclear Medicine Techniques	1	1	2	3	2.5	30	70	100	50	--	--	--	--	100
3.	BMRIT-028	Ultrasound Techniques	2	1	--	3	2.5	30	70	100	50	--	--	--	--	100
4.	BMRIT-029	Biostatistics And Research Methodology	1	1	--	2	--	30	70*	100	50	--	--	--	--	--
5.	-----	BMRIT Radiology Clinical Education – part VI (studentship)	--	--	15	5	--	--	--	--	--	--	--	--	--	--
TOTAL			7	4	25	21	--	--	--	300	--	--	--	100	--	400

IV YEAR VII SEMESTER

S.NO	L	T	P	C	Examination Scheme									TOTAL	
					Theory					Practical					
					Exam Durati on Hours	CIE	ESE	Total		CIE		ESE*			
						Max Marks	Min Mark s	Max marks	Min Marks	Max Marks	Min Marks	Max Marks	Min marks	Max Marks	Min marks
1.	–	–	--	20	–	--	–	–	--	100	50	100	50	200	100

Note: ESE* will be conducted immediate after end of the 7th & 8th semester at the institutional level. Legends: L-Lecture, T – Tutorial/Teacher Guided Theory Practice, P –Practical, ESE -End Semester Examination, CIE- Continuous Internal Evaluation

IV YEAR VIII SEMESTER

S.NO	L	T	P	C	Examination Scheme										
					Theory					Practical					
					Exam Durati on Hours	CIE	ESE	Total		CIE		ESE*			
						Max Marks	Min Mark s	Max marks	Min Marks	Max Marks	Min Marks	Max Marks	Min marks	Max Marks	Min marks
1.	–	–	--	20	–	--	–	–	--	100	50	100	50	200	100

1.1 Under Graduate Programme

Sl. No.	Course	Duration	Eligibility for admission
1	Bachelor of Medical Radiology and imaging Technology	4 years	Intermediate BiPC, vocational Physiotherapy (with bridge course), 10+2 with Physics, Chemistry and Biology or equivalent

1.2. Medium of Instruction:

English shall be the medium of instruction for all subjects of study and for examinations.

1.3. Duration of the Course

Duration details are mentioned under clause no. 1.1 of this booklet.

1.4 Examination Regulations

1.4.1 Attendance: 75% of attendance (physical presence) is mandatory.

Medical leave or other types of sanctioned leaves will not be counted as physical presence. Attendance will be counted from the date of commencement of the session to the last day of the final examination in each subject

1.4.2 Internal Assessments:

a) Regular periodic assessment shall be conducted throughout the course. In each semester there will be **two one hour internal assessments (10 marks each)** and a continuous assessment **(10 marks)**. Thus a total of 30 marks for the internal exam. (i.e. weightage for internal assessment shall be 30% of the total marks in each subject).

b) **Exam pattern for internal assessment** in each semester will be

(a) Short questions 3 nos. out of which the student should write two questions each carrying 5 marks (i.e. $2 \times 5 = 10$ marks) . Two such internal examinations will be conducted.

(b) Continuous assessment of the student will be done. Students overall attendance, performance in class, behaviour of the student, extra-curricular activities etc will be assessed. Continuous assessment carries 10 marks.

(d) Thus a total of 30 marks for the internal examination. ($10 + 10 + 10 = 30$ marks). A candidate should secure a minimum of 40% marks in the internal assessment in each subject to be eligible to appear for the University examination

(e) For value added courses, only internal examination will be conducted. The assessment comprised of five assignments/presentations/case presentations each carrying 10 (i.e. $5 \times 10 = 50$ marks). Final examination will be for 50 marks with 5 questions each carrying 10 marks ($5 \times 10 = 50$ marks). The minimum pass is 40% marks.

1.4.3 University Examinations:

- a) University Examination shall be conducted at the end of every semester.
- b) A candidate who satisfies the requirement of attendance and internal assessment marks, as stipulated by the University shall be eligible to appear for the University Examination.
- c) Examination will be of 3 hours duration (for theory). The question pattern for those subjects without practical examination (70 marks) will be (a) Three essay questions out of which the student should answer 2 questions each carrying 10 marks (i.e. $2 \times 10 = 20$ marks) (b) Eight short note questions out of which the student should attempt six questions, each carrying 5 marks ($6 \times 5 = 30$ marks). (c) Ten very short questions each carrying 2 marks (i.e. $10 \times 2 = 20$ marks). Thus a total of 70 marks.
- d) Examination will be of 3 hours duration (for theory). The question pattern for those subjects with practical examination (70 marks) will be (a) Three essay questions out of which the students should answer two questions each carrying 10 marks (i.e. $2 \times 10 = 20$ marks) (b) Eight short note questions out of which the student should attempt six questions, each carrying 5 marks ($6 \times 5 = 30$ marks). (c) Spotters/major practical/minor practical/Viva/practical record carries 20 marks. Thus a total of 70 marks.
- e) The question pattern for practical examination (a) Spotters/major practical/minor practical/Viva/practical record.

The minimum pass for internal assessment is 40% and for the University Examination is 50% . i.e. a student should score a total of 50% (adding the internal and external examination) to pass in each subject.

Subject: Human Anatomy**Subject Code: BMRIT - 001**

Teaching Scheme (In Hours)			Total Credits (L+T+P)	Examination Scheme				
				Theory Marks		Practical Marks		Total Marks
L	T	P	C	CIE	ESE	CIE	ESE	100
3	--	--	3	30	70	--	--	

CIE, Continuous Internal Evaluation; ESE, End Semester Evaluation; L, lecture; T, Tutorial; P, Practical

THEORY COMPONENTS

The following topics/subtopics should be taught and assessed in order to attain the identified competency.

Unit	Topic and contents	Hours	Marks
I	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	08	14

II	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's 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, Soleus.	08	14
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III	Cardiovascular System Heart – size, location, chambers, exterior and interior, Bloodsupply 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, dorsalis pedis artery., Peripheral pulse, Inferior venacava, 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 RS – nose, nasal cavity, paranasal air sinuses, larynx, trachea, lungs, pleura, bronchopulmonary segments, Histology of trachea and lungs.	08	20
IV	Gastro-Intestinal System Theory Parts of GIT- oral cavity (lip, cheek, tongue, salivary glands, palate, dentition) pharynx (Waldeyer's ring) esophagus, stomach, small and large intestine and appendix, Liver, gall bladder, pancreas and spleen, Histology of esophagus, stomach, small and large intestine, liver, gall bladder and pancreas. Peritoneum Description of reflection, folds and pouches in brief.	08	14
V	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, prostate, Parts of female reproductive system- uterus, fallopian tubes, ovary, mammary gland, Histology of testis, vas deferens, epididymis, prostate, uterus, fallopian tube and ovary. Endocrine Glands	08	20
	Names of all endocrine glands, describe in detail on pituitary gland, thyroid gland and parathyroid gland, suprarenal gland, Histology of pituitary, thyroid, parathyroid, suprarenal gland.		

VI	Nervous System Neuron, Classification of nervous system, Cerebrum, cerebellum, brain stem, spinal cord & spinal nerve, Meninges, ventricles and cerebrospinal fluid, Blood supply of the brain, Cranial nerves (in brief), Nerve plexus (Brachial & lumbar)	08	14
	Sensory Organs Skin and its appendages, Eye – parts of eye ball and lacrimal apparatus, Extra-ocular muscles, Histology of cornea and retina, Ear – parts of ear- external, middle and inner ear and contents		
	Embryology Spermatogenesis and oogenesis, Ovulation, fertilization, Placenta		

Sr. No	Practical's	Hours
1.	Demonstration of Histology of types of epithelium, Histology of serous, mucous and mixed salivary gland, Surface marking of the body region wise.	1
2.	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.	1
3.	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.	1
4.	Demonstration of parts of GIT, liver, gall bladder, pancreas and spleen, Histology of tongue, salivary glands, esophagus, stomach, small and large intestine, liver, gall bladder, pancreas and spleen, Radiographs of abdomen plain and contrast. Demonstrations of reflections, folds and pouches.	1

Sr. No		Hours
5.	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.	1
6.	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.	1
	Total	6
Demonstration will be part of theory/tutorial classes. There is in separate credit for the practicals/demonstrations.		

SUGGESTED LEARNING RESOURCES

S.No.	Title of Book	Author	Publication
1	Human Anatomy, Vol.1,2 &3, 5th edition, 2010,	B.D. Chaurasia	CBS publishers & distributors Pvt. Ltd.
2	Physiology & Anatomy with Practical Considerations	Ester. M. Grishcimer	J.P. Lippincott. Philadelphia
3	Manipal Manual of Anatomy, 2nd edition, 2012	Sampath Madhyastha	CBS publishers & distributors Pvt. Ltd
4	Text Book of General Anatomy, 2nd edition, 2013	Shobha Rawlani and Shivlal Rawlani	Jaypee brothers
5	Langman's Medical Embryology, 11th edition, 2009	T.W Sadler	Wolters Kluwer

Subject: PHYSIOLOGY**Subject Code: BMRIT - 002**

Teaching Scheme (In Hours)			Total Credits (L+T+P)	Examination Scheme				
				Theory Marks		Practical Marks		Total Marks
L	T	P	C	CIE	ESE	ESE	CIE	100
3	--	--	3	30	70	--	--	

CIE, Continuous Internal Evaluation; ESE, End Semester Evaluation; L, lecture; T, Tutorial; P, Practical

THEORY COMPONENTS

The following topics/subtopics should be taught and assessed in order to attain the identified competency.

Unit	Topic and contents	Hours	Marks
I	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, Hemoglobin: Functions, concentration, physiological variations. Fate of Hemoglobin – 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 – hemophilia, vitamin K deficiency. Anticoagulants – mechanism of action and their uses, Anemia: Classification – Morphological and Etiological, Blood volume: normal values.	10	15
II	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.	10	10
III	Respiratory system Respiratory and Non-respiratory function of respiratory system. Physiological anatomy of respiratory system Functions of respiratory	8	10

	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 hemoglobin, factors affecting, oxygen carrying capacity. Carbon dioxide transport: forms, chloride shift (Hamburgers 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.		
IV	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.	4	05
V	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, Succusentericus: Composition, functions. Functions of large intestine, Movements of small intestines, Deglutition.	4	05
VI	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,	8	15

	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.		
VII	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.	10	10
Total		54	70

	SUGGESTED PRACTICALS/DEMONSTRATION	Hours
	Study of Microscope and its uses Collection of blood and study of hemocytometer Hemoglobinometry Determination of RBC count Determination of WBC count Determination of blood groups Determination of bleeding time	8

	SUGGESTED PRACTICALS/DEMONSTRATION	Hours
	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	8
	Total	16
Demonstration will be part of theory/tutorial classes. There is in separate credit for the practicals/demonstrations.		

SUGGESTED LEARNING RESOURCES

S.No.	Title of Book	Author	Publication
1	Foundation of Anatomy and Physiology	Ross Wilson	Churchill Livingstone.
2	Physiology & Anatomy with Practical Considerations	Ester. M. Grishcimer	J.P. Lippincott. Philadelphia
3	Text Book of Physiology	A. P. Krishna	Suman Publication
4	Text Book of Physiology	A.K. Jain	Avichal Publishing Company;

Subject: Basics of Radiation Physics

Subject Code: BMRIT - 003

Teaching Scheme (In Hours)			Total Credits (L+T+P)	Examination Scheme				
				Theory Marks		Practical Marks		Total Marks
L	T	P	C	CIE	ESE	CIE	ESE	200
2	--	6	5	30	70	30	70	

CIE, Continuous Internal Evaluation; ESE, End Semester Evaluation; L, lecture; T, Tutorial; P, Practical

Unit	Topic and contents	Hours
I	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.	5
II	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.	6
III	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.	5
IV	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.	5
V	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).	4
VI	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.	5

VII	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. 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).	6
Total		36

Discovery of x-rays-X-ray production and properties	25
Heat	06
Interaction of ionizing radiation with matter-	25
Exponential attenuation, Physical quantity, its unit and measurement	14
Total Marks (including optional questions)	96

SUGGESTED LEARNING RESOURCES

S.No.	Title of Book	Author	Publication
1	Basic radiological physics	K. Thayalan	Jaypee Brothers Medical Publishers (P) Limited, 2003
2	Christensen's physics of diagnostic radiology	Curry and Dowdey	Wolters Kluwer
3	X-Ray Equipment for Student	D.N. And M.O. Chesney	Blackwell Science Ltd
4	A Textbook Of Radiation Physics For Radiologic Technology	Surendra Maharjan, Suraj Sah	Samiksha Publications
5	A Concise Guide on Basic Radiographic Physics Darkroom Procedures, Radiographic Positioning & Techniques	Lalit Agarwal	JBD Publications

Subject: Introduction to Healthcare**Subject Code: BMRIT - 004**

Teaching Scheme (In Hours)			Total Credits (L+T+P)	Examination Scheme
L	T	P	C	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.
1	--	--	1	

CIE, Continuous Internal Evaluation; ESE, End Semester Evaluation; L, lecture; T, Tutorial; P, Practical

Topic and contents	Hours
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 re-cumbent, 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 bed pan, Observation of stools, urine, sputum. Understand the use and care of catheters. Enema procedures Method of giving nourishment: Feeding, tube feeding, drips, transfusion	18

Monitoring and recording of vitals	
Simple aseptic techniques, sterilization and disinfection	
Observation of surgical dressings	
Concepts of First Aid	

SUGGESTED LEARNING RESOURCES

S.No.	Title of Book	Author	Publication
1	Principles and Practice of Nursing Management and Administration	Jogindra Vati	Jaypee Brothers Ltd
2	Textbook of Preventive and Social Medicine	K Park	Banarsidas Bhanot Publishers
3	Introduction to Healthcare	Dakota Mitchell and Lee Haroun	Delmar
4	Introduction to Healthcare and Careers	Roxann Delaet	Joanes and Bartlett Learning

Subject: Medical Terminologies and Record Keeping**Subject Code: BMRIT – 005**

Teaching Scheme (In Hours)			Total Credits (L+T+P)	Examination Scheme
L	T	P	C	Institute level exam only:
1	--	--	1	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.

CIE, Continuous Internal Evaluation; ESE, End Semester Evaluation; L, lecture; T, Tutorial; P, Practical

Topic and contents	Hours
Topics include: origin, word building, abbreviations and symbols, terminology related to the human anatomy, reading medical orders and reports, and terminology specific to the student's field of study. Spelling is critical and will be counted when grading tests. Topics to be covered under the subject are as follows: 1. Derivation of medical terms. 2. Define word roots, prefixes, and suffixes. 3. Conventions for combined morphemes and the formation of plurals. 4. Basic medical terms. 5. Form medical terms utilizing roots, suffixes, prefixes, and combining roots. 6. Interpret basic medical abbreviations/symbols. 7. Utilize diagnostic, surgical, and procedural terms and abbreviations related to the integumentary system, musculoskeletal system, respiratory system, cardiovascular system, nervous system, and endocrine system. 8. Interpret medical orders/reports. 9. Data entry and management on electronic health record system.	18

SUGGESTED LEARNING RESOURCES

S.No.	Title of Book	Author	Publication
1	Medical Terminology, Documentation, and Coding	Anne P. Stich	Routledge Publisher
2	Medical Terminology for Health Professions	Ann Ehrlich, Carol L. Schroeder	Cengage Learning
3	Medical Terminology	M. Mastenbjörk M.D. S. Meloni M.D. Medical Creation David Andersson	Medical Creations
4	Medical Records: Organization and Management	GD Mogli (Author)	Jaypee Brothers Medical Publishers

Subject: Basic Computers and Information**Science Subject Code: BMRIT - 006**

Teaching Scheme (In Hours)			Total Credits (L+T+P)	Examination Scheme
L	T	P		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.
1	--	--	1	

CIE, Continuous Internal Evaluation; ESE, End Semester Evaluation; L, lecture; T, Tutorial; P, Practical

Topic and contents	Hours
Topics to be covered under the subject are as follows: 1. Introduction to computer: Introduction, characteristics of computer, block diagram of computer, generations of computer, computer languages. 2. 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). 3. Processor and memory: The Central Processing Unit (CPU), main memory. 4. Storage Devices: Sequential and direct access devices, magnetic tape, magnetic disk, optical disk, mass storage devices. 5. 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.). 6. 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. 7. Introduction to Excel: introduction, about worksheet, entering information, saving workbooks and formatting, printing the worksheet, creating graphs.	18

8. Introduction to power-point: introduction, creating and manipulating presentation, views, formatting and enhancing text, slide with graphs. 9. Introduction of Operating System: introduction, operating system concepts, types of operating system. 10. Computer networks: introduction, types of network (LAN, MAN, WAN, Internet, Intranet), network topologies (star, ring, bus, mesh, tree, hybrid), components of network. 11. 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. 12. Application of Computers in clinical settings. Practical on fundamentals of computers - 1. Learning to use MS office: MS word, MS PowerPoint, MS Excel. 2. To install different software. 3. Data entry efficiency	
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SUGGESTED LEARNING RESOURCES

S.No.	Title of Book	Author	Publication
1	Basic of Computer and Information Technology	Ashok Arora	Vikas
2	Computer and Information Science	Roger Lee (editor)	Springer
3	Computer and Information Sciences	Tadeusz Czachórski , Erol Gelenbe, Krzysztof Grochla, Ricardo Lent (Editor)	Springer
4	Information science and computer basics: An introduction	Mitchell, Ruth K	Clive Bingley

Subject: Medical law and ethics**Subject Code: BMRIT – 007**

Teaching Scheme (In Hours)			Total Credits (L+T+P)	Examination Scheme
L	T	P	C	Institute levelexam 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.
1	--	--	1	

L, lecture; T, Tutorial; P, Practical

THEORY COMPONENTS

The following topics/subtopicsshould be taught and assessed in order to attain the identified competency.

Topic and contents	Hours
The important and relevant topics that need to focus on are as follows: 1. Medicaethics - Definition - Goal - Scope 2. Introduction to Code of conduct 3. Basicprinciples of medical ethics – Confidentiality 4. Malpractice and negligence - Rational and irrational drug therapy 5. Autonomy and informed consent - Right of patients 6. Care of the terminally ill- Euthanasia 7. Organ transplantation 8. 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.	18

9. Professional Indemnity insurance policy 10. Development of standardized protocol to avoid near miss or sentinel events 11. Obtaining an informed consent. 12. Medical ethics - Definition - Goal - Scope 13. Introduction to Code of conduct 14. Basic principles of medical ethics – Confidentiality 15. Malpractice and negligence - Rational and irrational drug therapy 16. Autonomy and informed consent - Right of patients 17. Care of the terminally ill- Euthanasia 18. Organ transplantation 19. 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. 20. Professional Indemnity insurance policy 21. Development of standardized protocol to avoid near miss or sentinel events 22. Obtaining an informed consent.	
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SUGGESTED LEARNING RESOURCES

S.No.	Title of Book	Author	Publication
1	Medical Law and Ethics	Bonnie F. Fremgen	Pearson
2	Medical Law and Ethics	Jonathan Herring	OUP UK
3	Medical Law and Ethics	Purosottam Behera	Mittal Publications
4	Reflections on Medical Law and Ethics in India	Bismi Gopalakrishnan, Mercy Khaute, B. Sandeepa Bhat	Eastern Law House

Subject: Professionalism and Values**Subject Code: BMRIT – 008**

Teaching Scheme (In Hours)			Total Credits (L+T+P)	Examination Scheme
L	T	P	C	Institute levelexam 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.
1	--	--	1	

L, lecture; T, Tutorial; P, Practical

Topic and contents	Hours
1. Professional values- Integrity, Objectivity, Professional competence and due care, Confidentiality 2. Personal values- ethical or moral values 3. Attitude and behavior- professional behavior, treating people equally 4. Code of conduct, professional accountability and responsibility, misconduct 5. Differences between professions and importance of team efforts 6. Cultural issues in the healthcare environment	18

SUGGESTED LEARNING RESOURCES

S.No.	Title of Book	Author	Publication
1	Textbook of Medical Ethics	Erich H Loewy	Springer
2	Professionalism, Professional Values and Ethics in Nursing	Suresh K Sharma, Asha P Shetty	Jaypee Brothers Medical Publishers
S.No.	Title of Book	Author	Publication
3	Essentials of Professionalism, Professional Values & Ethics for BSc Nursing Students	Varinder Kaur	CBS Publishers and Distributors Pvt. Ltd
4	Textbook of Professional Ethics and Human Values	R S Naagarazan	New age International Publishers

Subject: Principals of Management**Subject Code: BMRIT – 009**

Teaching Scheme (In Hours)			Total Credits (L+T+P)	Examination Scheme
L	T	P		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.
1	--	--	1	

L, lecture; T, Tutorial; P, Practical

Topic and contents	Hours
1. Introduction to management 2. Strategic Management 3. Foundations of Planning 4. Planning Tools and Techniques 5. Decision Making, conflict and stress management 6. Managing Change and Innovation 7. Understanding Groups and Teams 8. Leadership 9. Time Management 10. Cost and efficiency	18

SUGGESTED LEARNING RESOURCES

S. No.	Title of Book	Author	Publication
1	Essentials of Professionalism, Professional Values & Ethics for BSc Nursing Students	Varinder Kaur	CBS Publishers and Distributors Pvt. Ltd
2	Professionalism Professional Values and Ethics in Nursing	Suresh K Sharma	Jaypee Brothers
3	Professionalism, Professional Values & Ethics	Shama Lohumi and Rakesh Lohumi	CBS publishers and Distributors PVT Ltd

Subject: English and Communication skills

Subject Code: BMRIT - 010

THEORY COMPONENTS

The following topics/subtopics should be taught and assessed in order to attain the identified competency.

Topic and contents	Hours
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	18

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 conversion, formal & informal conversation: Agreeing emphasizing, interrupting, politely, opinions, interviews, visual presentation. Teaching learning activities: Participating in seminar, Telephonic conversion, 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.	
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BMRIT Radiology Clinical Education – part I (studentship)

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.
- Provides 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

Subject: Basics of Microbiology**Subject Code: BMRIT - 011**

Teaching Scheme (In Hours)			Total Credits (L+T+P)	Examination Scheme				
				Theory Marks		Practical Marks		Total Marks
L	T	P	C	CIE	ESE	CIE	ESE	100
2	--	--	2	70	30	--	--	

CIE, Continuous Internal Evaluation; ESE, End Semester Evaluation; L, lecture; T, Tutorial; P, Practical

THEORY COMPONENTS

The following topics/subtopics should be taught and assessed in order to attain the identified competency.

Unit	Topic and contents	Hours
I	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	9

	Culture Methods Antimicrobial sensitivity tests Sterilization and Disinfections: Definition, Dry heat Sterilization, Moist heat Sterilization, Chemical disinfectants, Gaseous disinfection, Test for disinfection / Sterilization control	
II	Infection: Classification, Sources of infection, Modes of transmission Nosocomial infection including biomedical waste management: Definition, Classification, Significance, Prevention and control Biomedical waste management	8
III	Immunology: Immunity, Antigen, Antibody, Hypersensitivity	5
IV	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).	7
V	Applied Microbiology: Pyrexia of unknown origin, Meningitis, Zoonotic infections, Hepatitis, HIV infection and AIDS, Food poisoning, Diarrhea, Urinary tract infections, Pulmonary Tuberculosis	7
Total		36

SUGGESTED LEARNING RESOURCES

S. No.	Title of Book	Author	Publication
1	Text book of Microbiology	Ananthnarayana & Panikar	University Press
2	Text book of Microbiology	Baveja	Arya Publications
3	Text book of Microbiology	Sathish Gupte	JPB
4	Textbook of Microbiology	Dr Arora	CBS Publishers & Distributors Pvt. Ltd

Subject: Basics of Biochemistry**Subject Code: BMRIT – 012**

Teaching Scheme (In Hours)			Total Credits (L+T+P)	Examination Scheme				
				Theory Marks		Practical Marks		Total Marks
L	T	P	C	CIE	ESE	CIE	ESE	100
2	--	--	2	30	70	--	--	

CIE, Continuous Internal Evaluation; ESE, End Semester Evaluation; L, lecture; T, Tutorial; P, Practical

Unit	Topic and contents	Hours
I	Nutrition Calorific value Nitrogen Balance Respiratory quotient BMR Nutritional importance of carbohydrate, lipids, proteins, vitamins and minerals Emphasis on parenteral nutrition	9
II	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	9
III	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	9

SUGGESTED LEARNING RESOURCES

S.No.	Title of Book	Author	Publication
1	Text Book of biochemistry for dental students	Vasudevan, Sreekumari, Kannan Vaidyanathan	Jaypee Brothers
2	Biochemistry for Physiotherapy and allied health sciences students.	Nandini M, Beena V Shetty, Vinitha Ramanath Rai	Jaypee Brothers Medical Publisher (India)
3	Clinical chemistry	Varley	CBS Publishers & Distributors
4	Textbook of biochemistry for paramedical students	P Ramamoorthy	Jaypee Brothers Medical Publishers

Subject: Conventional Radiography and Equipment**Subject Code: BMRIT -013**

Teaching Scheme (In Hours)			Total Credits (L+T+P)	Examination Scheme				
				Theory Marks		Practical Marks		Total Marks
L	T	P	C	CIE	ESE	CIE	ESE	100
4	--	2	5	30	70	--	--	

CIE, Continuous Internal Evaluation; ESE, End Semester Evaluation; L, lecture; T, Tutorial; P, Practical

Unit	Topic and contents	Hours
I	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;	10
II	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.	10

III	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.	10
IV	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;	10

	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.	
V	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, photometric timers (fluorescent and photoelectric effect as applied in timers), ion chamber-based timers, integrated timer.	10
VI	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.	8

VII	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.	8
VIII	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.	6
Total		72

SUGGESTED PRACTICALS/DEMONSTRATION

Sr. No		Hours
1.	X-ray tube; Production of x-rays	5
2.	Rotating anode x - ray tube; Grid controlled and high speed tubes; Heat dissipation methods	4
3.	Filament current and voltage; X-ray generator circuits	5
4.	High tension circuits; Interlocking circuits; Relays	5
5.	Meters and exposure timers	5
6.	Control of scattered radiation: Beam limiting devices	4
7.	Fluoroscopy	4
8.	Care and Maintenance of X-ray equipment	4
	Total	36

SUGGESTED LEARNING RESOURCES

S.No.	Title of Book	Author	Publication
1	Radiographic Imaging (Cbs) I.C.R.P.	D.N. Chesney & M.O Chesney	CBS Publishers & Distributors
2	An Introduction Of Physics to Diagnostic Radiography	Christensen, Curry & Dowdey	Lea & Febiger
3	Radiological Science for technologists	Stewart C Bushong	Mosby
4	Equipment for Diagnostic Radiography	E. Forster	Springer Dordrecht
5	The Physics Of Radiology And Imaging	K Thayalan	Jaypee

Subject: Clinical Radiography Positioning (Part I)**Subject Code: BMRIT - 014**

Teaching Scheme (In Hours)			Total Credits (L+T+P)	Examination Scheme				
				Theory Marks		Practical Marks		Total Marks
L	T	P	C	CIE	ESE	CIE	ESE	200
4	1	6	8	30	70	30	70	

CIE, Continuous Internal Evaluation; ESE, End Semester Evaluation; L, lecture; T, Tutorial; P, Practical

Unit	Topic and contents	Hours
I	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	8

	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.	
II	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	10
III	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.	10
IV	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.	10

V	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.	12
VI	Skull: Routine projections for cranium and facial bones; Supplementary projections for trauma, Towne's method, Sellaturcica, Optic foramina, Jugularforamina, 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.	12
VII	Pelvic girdle and hip region: Routine projections for the whole pelvis, Sacro-Iliac joints, hip joint and Neck of Femur.	10

	Supplementary projections for the greater and lesser trochanters of Femur. Frog leg projection, Ischium, Symphysis Pubis, Ilium, Acetabulum and Congenital Dislocation of Hip, Arthrodesis. Skeletal survey: Skeletal survey for metabolic bone disease, metastases, hormonal disorder, renal disorders.	
Total		72

Sr. No		Hours
1.	Principles of Radiography	15
2.	Upper limb	17
3.	Lower limb	17
4.	Shoulder Girdle and Thorax	14
5.	Vertebral Column	15
6.	Skull	15
7.	Pelvic girdle and hip region, Skeletal survey	15
Total		108

SUGGESTED LEARNING RESOURCES

S.No.	Title of Book	Author	Publication
1	Atlas of Radiographic Positioning and Radiological Procedures	Philip W Ballinger, <u>Eugene D. Frank</u>	Mosby
2	Clarks Positioning In Radiography	Ra Swallow, E Naylor	Lippincott Williams and Wilkins
3	Merrill's Atlas of Radiographic Positioning and Procedures	Bruce W. Long & Jeannean Hall Rollins & Barbara J. Smith	Mosby
4	Bontrager's Textbook Of Radiographic Positioning And Related Anatomy	John Lampignano and Leslie E Kendrick	Elsevier Science
5	Radiology Of Positioning And Applied Anatomy For Students And Practitioners	Garkal Gs	Jaypee Brothers Medical Publishers
6	A Guide on Special Radiographic Investigations & Techniques	Lalit Agarwal	JBD Publications

BMRIT Radiology Clinical Education – part II (studentship)

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.
- Providesimulationand 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.

Subject: Pathology**Subject Code: BMRIT -015**

Teaching Scheme (In Hours)			Total Credits (L+T+P)	Examination Scheme				
				Theory Marks		Practical Marks		Total Marks
L	T	P	C	CIE	ESE	CIE	ESE	100
2	--	--	2	30	70	--	--	

CIE, Continuous Internal Evaluation; ESE, End Semester Evaluation; L, lecture; T, Tutorial; P, Practical

THEORY COMPONENTS

The following topics/subtopics should be taught and assessed in order to attain the identified competency.

Unit	Topic and contents	Hours	Marks
I	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	7	10
II	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	8	15

III	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	7	15
IV	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	7	15
V	Respiratory diseases – Chronic obstructive pulmonary airway diseases – causes, pathology and complications of	7	15

	each (asthma, chronic bronchitis, emphysema, Broncheictasis in brief). Pneumonia – classification, clinical features and morphology Pulmonary tuberculosis – classification/ types, primary, complex, miliary TB and cavitatory 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		
Total		36	70

Sr.No		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.	6

Sr.No		Hours
	- 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) 18. Lung – Pneumonias, pulmonary tuberculosis cavitary lung abscess (specimens).	
	Total	6

SUGGESTED LEARNING RESOURCES

S.No.	Title of Book	Author	Publication
1	Textbook of Pathology with Pathology	Harsh Mohan	Jaypee Brothers Medical Publishers (P) Ltd
2	Pathology Basis of Disease	Robbins and Cotran	Saunders Elsevier
3	Text book on Pathology for DMLT & Paramedical Courses	Dr. I Clement	Emmess medical publishers
4	Text book of Pathology & Microbiology for Paramedical Students	Aruna Singh	Notion Press

Subject: Clinical Radiography Positioning (Part- II)**Subject Code: BMRIT - 016**

Teaching Scheme (In Hours)			Total Credits (L+T+P)	Examination Scheme				
				Theory Marks		Practical Marks		Total Marks
L	T	P	C	CIE	ESE	CIE	ESE	200
2	1	6	6	30	70	30	70	

CIE, Continuous Internal Evaluation; ESE, End Semester Evaluation; L, lecture; T, Tutorial; P, Practical

THEORY COMPONENTS

The following topics/subtopics should be taught and assessed in order to attain the identified competency.

Unit	Topic and contents	Hours	Marks
I	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.	5	10
II	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.	6	10
III	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	5	10
IV	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	5	10
V	Neonatal and Pediatric Radiography, Forensic Radiography Microradiography: General principles, Requirement, Equipment, Technique.	5	10

VI	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.	5	10
VII	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.	5	10
Total		36	70

Sr. No		Hours
1.	Dental Radiography; Upper respiratory system	20
2.	Lungs and Mediastinum; Abdominal viscera	20
3.	Radiography in the ward; Mammography	20
4.	Operation theatre techniques; C-arm	20
5.	Neonatal and Paediatric Radiography; Forensic Radiography Microradiography	10
6.	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	10

Sr. No		Hours
7.	Localization of foreign bodies	8
	Total	108
6.	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	14
7.	Localization of foreign bodies	12
	Total Marks (including optional questions)	96

SUGGESTED LEARNING RESOURCES

S.No.	Title of Book	Author	Publication
1	Radiological positioning	Merils	Mosby
2	A guide to radiological positioning	Clarks	CBS publishers and distributors pvt. Ltd
3	Radiology Of Positioning And Applied Anatomy For Students And Practitioners	GarkalGs	Jaypee Brothers Medical Publishers
4	Bontrager's Textbook of Radiographic Positioning and Related Anatomy	John Lampignano), Leslie E. Kendrick	Mosby

S.No.	Title of Book	Author	Publication
5	A Concise Guide on Basic Radiographic Physics Darkroom Procedures, Radiographic Positioning & Techniques	Lalit Agarwal	JBD Publications

Subject: Radiography and Image Processing Techniques**Subject Code: BMRIT -017**

Teaching Scheme (In Hours)			Total Credits (L+T+P)	Examination Scheme				
				Theory Marks		Practical Marks		Total Marks
L	T	P	C	CIE	ESE	CIE	ESE	100
2	--	2	3	30	70	--	--	

CIE, Continuous Internal Evaluation; ESE, End Semester Evaluation; L, lecture; T, Tutorial; P, Practical

THEORY COMPONENTS

The following topics/subtopics should be taught and assessed in order to attain the identified competency.

Unit	Topic and contents	Hours	Marks
I	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	9	20
II	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	7	15
III	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	7	15

IV	Day Light Film handling; Xeroradiography, Stereoscopy	5	5
V	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	8	15
Total		36	70

Sr. No		Hours
1.	Radiographic film; Intensifying Screens; X-ray Cassette	20
2.	Dark Room – Planning & Construction	6
3.	Film Processing; Photochemistry;	5
4.	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	5
	Total	36

SUGGESTED LEARNING RESOURCES

S.No.	Title of Book	Author	Publication
1	Radiographic Imaging (Cbs)I.C.R.P.	D.N. Chesney & M.O Chesney	Blackwell Scientific
2	An Introduction Of Physics to Diagnostic Radiography	Christensen, Curry & Dowdey	Lea & Febiger
3	Radiological Science for technologists	Stewart C. Bushong	Mosby
4	A Concise Guide on Basic Radiographic Physics Darkroom Procedures, Radiographic Positioning & Techniques	Lalit Agarwal	JBD Publications

Subject: Contrast and Special Radiological Procedures**Subject Code: BMRIT - 018**

Teaching Scheme (In Hours)			Total Credits (L+T+P)	Examination Scheme				
				Theory Marks		Practical Marks		Total Marks
L	T	P	C	CIE	ESE	CIE	ESE	200
2	1	6	6	30	70	30	70	

CIE, Continuous Internal Evaluation; ESE, End Semester Evaluation; L, lecture; T, Tutorial; P, Practical

TUTORIAL ASSIGNMENTS

Tutorials should be planned to enhance learning. The faculty shall decide suitable assignments minimum one per unit based on the curriculum.

THEORY COMPONENTS

The following topics/subtopics should be taught and assessed in order to attain the identified competency.

Unit	Topic and contents	Hours	Marks
I	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	8	10
II	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	10	20
III	Urinary System: IVU (Intravenous Urography), Retrograde Pyeloureterography (RGU), Micturating Cysto Urethrography, Ascending Urethrography Reproductive System: HysteroSalpingogram, FTR (Fallopian Tube Recanalization)	8	20
IV	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	10	20
Total		36	70

SUGGESTED PRACTICALS/DEMONSTRATION

Sr. No		Hours
1.	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	25
2.	Procedures for gastrointestinal tract including barium studies Procedures for biliary tract	29
3.	Procedures for urinary system and reproductive system	29
4.	Procedures for central nervous system and respiratory system	25
	Total	108

SUGGESTED LEARNING RESOURCES

S. No.	Title of Book	Author	Publication
1	Radiographic Imaging (Cbs)I.C.R.P.	Bhushan and Lakkhar	Arya Publications
2	A guide to radiological procedures	Chapman	Elsevier

BMRIT Radiology Clinical Education – Part III (studentship)

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 semesters.
- Provide simulation and skill labs for practising 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.

Subject: Cross Sectional Anatomy

Subject Code: BMRIT - 019

Teaching Scheme (In Hours)			Total Credits (L+T+P)	Examination Scheme				
				Theory Marks		Practical Marks		Total Marks
L	T	P	C	CIE	ESE	CIE	ESE	100
2	--	6	5	--	--	30	70	

CIE, Continuous Internal Evaluation; ESE, End Semester Evaluation; L, lecture; T, Tutorial; P, Practical

THEORY COMPONENTS

The following topics/subtopics should be taught and assessed in order to attain the identified competency.

Unit	Topic and contents	Hours	Marks
I	Introduction to Sectional Anatomy & Terminology- Sectional planes, Anatomical relationships/terminology	12	--
	Anatomy of the upper thorax-Surface anatomy relationships, Bony structures and muscles, Blood vessels.		
	Divisions of the mid-thorax, heart and great vessels-Lungs, heart and great vessels, Esophagus		
II	CT/MRI Images of the Thorax - Normal and abnormal imaging Anatomy of the Abdomen- Major organs and their accessories, Abdominal blood vessels CT/MR Images of Abdomen – Normal and pathologic anatomy of the Pelvis- Bony structures and associated muscles, Digestive and urinary systems Reproductive Organs - Normal and abnormal imaging	12	--

III	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	12	--
Total		36	--

Sr. No		Hours
1.	Introduction to Sectional Anatomy & Terminology - Sectional planes, Anatomical relationships/terminology Anatomy of the upper thorax-Surface anatomy relationships, Bony structures and muscles, Blood vessels. Divisions of the mid-thorax, heart and great vessels-Lungs, heart and great vessels, Esophagus	36
2.	CT/MRI Images of the Thorax - Normal and abnormal imaging Anatomy of the Abdomen - Major organs and their accessories, Abdominal blood vessels CT/MR Images of Abdomen –	36
	Normal and pathologic anatomy of the Pelvis- Bony structures and associated muscles, Digestive and urinary systems Reproductive Organs - Normal and abnormal imaging	
3.	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	36

	Total	108

SUGGESTED LEARNING RESOURCES

S. No.	Title of Book	Author	Publication
1	Cross Sectional Anatomy CT & MR	G Bhavin Jhankaria	Jaypee Brothers Medical Publishers;
2	Step by step Cross-sectional Anatomy	D Karthikeyan	Jaypee brother medical publishers
3	Atlas of Cross Sectional Anatomy and Radiological Imaging	Dr David J. Jackowe	Anshan Ltd
4	Fundamentals of Sectional Anatomy: An Imaging Approach	Denise L. Lazo	Cengage Learning

Subject: Modern Radiological Imaging Equipment and Physics**Subject Code: BMRIT - 020**

Teaching Scheme (In Hours)			Total Credits (L+T+P)	Examination Scheme				
				Theory Marks		Practical Marks		Total Marks
L	T	P	C	CIE	ESE	ESE	CIE	100
2	1	2	3	30	70	--	--	

THEORY COMPONENTS

The following topics/subtopics should be taught and assessed in order to attain the identified competency.

Unit	Topic and contents	Hours	Marks
I	Modern x-ray tube. Digital Mammography and Tomosynthesis, Stitch radiography, Dual energy x-ray absorptionmetry (DEXA) scan.	9	20
II	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.	9	20
III	Modern dental equipments. Cone beam dental CT.	9	20
IV	Picture archiving and communication system (PACS), RIS and HIS.	9	10
Total		36	70

Sr. No		Hours
1.	Modern x-ray tube. Digital Mammography and Tomosynthesis, Stich radiography, Dual energy x-ray absorptionmetry (DEXA) scan.	9
2.	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.	9
3.	Modern dental equipments. Cone beam dental CT.	9
4.	Picture archiving and communication system (PACS), RIS and HIS.	9
Total		36

SUGGESTED LEARNING RESOURCES

S.No.	Title of Book	Author	Publication
1	Textbook of Radiology: Physics	Amol Sasane, Hariqbal Singh , Roshan Lodha	Jaypee Brothers Medical Publishers
2	The Physics Of Radiology And Imaging	THAYALAN K	Jaypee Brothers Medical Publishers
3	Christensen's Physics of Diagnostic Radiology	Thomas S. Curry, James E. Dowdey, Robert E. Murry	Lea & Febiger,U.S
4	Textbook Of Radiology For Residents And Technicians	BHARGAVA S. K (Author	CBS; publishers
5	Concise Text Book on Imaging Modalities & Recent Advances In Diagnostic Radiology	Lalit Agarwal, Dr. K.B. Gehlot	JBD Publications

Subject: Interventional Radiology Techniques**Subject Code: BMRIT -021**

Teaching Scheme (In Hours)			Total Credits (L+T+P)	Examination Scheme				
				Theory Marks		Practical Marks		Total Marks
L	T	P	C	CIE	ESE	CIE	ESE	200
2	1	4	4	30	70	30	70	

CIE, Continuous Internal Evaluation; ESE, End Semester Evaluation; L, lecture; T, Tutorial; P, Practical

TUTORIAL ASSIGNMENTS

Tutorials should be planned to enhance learning. The faculty shall decide suitable assignments minimum one per unit based on the curriculum.

THEORY COMPONENTS

The following topics/subtopics should be taught and assessed in order to attain the identified competency.

Unit	Topic and contents	Hours	Marks
I	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	6	15
II	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	9	20
III	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	9	20
IV	Safety considerations in angiography room; room design, protective devices, radiation monitoring	6	10
V	Care and maintenance tests: General care, functional test Quality assurance program: Acceptable limits of variation, corrective action	6	05
Total		36	70

SUGGESTED PRACTICALS/DEMONSTRATION

Sr. No		Hours
1.	Basics of angiographic equipments	18
2.	Catheter and guide wires	18
3.	Arteriography and venography procedures	18
4.	Safety considerations in angiography room	18
	Total	72

Sl. No.	Component	Marks	Weightage	IA marks
1.	Sessional test(s)			
	Two Written tests Same pattern as Summative test Average of two to be considered Absence without prior permission to be marked as 0	50		
	Total	50	0.3	15
2.	Continuous assessment			
	Seminars/Case presentations/ Logbook/ Case records/Record book/assignment			
	Total	50	0.3	15
	Total CIE marks			30

Type of question	No. of questions	Marks per question	Total
Essay Question (EQ)	3 (to answer 2)	10	20
Short Essay Question (SEQ)	9 (to answer 7)	5	35
Short Answer Question (SAQ)	7 (to answer 5)	3	15
Total marks			70
Duration (minutes)			150

End Semester Evaluation (ESE)

S. No.	Title of Book	Author	Publication
1	The practice of interventional radiology	Karim valji	
2	Interventional radiology: a survival guide	EBIR Kessel, David, Robertson, Iain	Elsevier Health Sciences
3	Handbook of Interventional Radiologic Procedures	Krishna kandarpa, lindsay machan, janettedurham	Lippincott Williams and Wilkins
4	Interventional Radiology: A Survival Guide	David Kessel , Iain Robertson	sevier Health Sciences
5	A Guide on Special Radiographic Investigations & Techniques	Lalit Agarwal	JBD Publications

Subject: Patient Care in radiology**Subject Code: BMRIT - 022**

Teaching Scheme (In Hours)			Total Credits (L+T+P)	Examination Scheme				
				Theory Marks		Practical Marks		Total Marks
L	T	P	C	CIE	ESE	CIE	ESE	200
1	1	4	4	30	70	30	70	

CIE, Continuous Internal Evaluation; ESE, End Semester Evaluation; L, lecture; T, Tutorial; P, Practical

THEORY COMPONENTS

The following topics/subtopics should be taught and assessed in order to attain the identified competency.

Unit	Topic and contents	Hours	Marks
I	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	2	10
II	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.	2	10
III	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.	3	10
IV	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.	3	10

V	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)	3	10
VI	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.	2	10

VII	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	3	10
Total		18	70

Sr. No		Hours
1.	Introduction to Patient Care and Communication	10
2.	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.	11
3.	Care of the patient	10
4.	Nursing procedures in Radiology and first aid	11
5.	Infection and Principles of asepsis	10
6.	Patient care in following investigations: GIT, Respiratory system, Cardiovascular system, CNS; Sterilization; Infection control.	10
7.	Drugs in the department and Storage and medical ethics and records	10
	Total	72

SUGGESTED LEARNING RESOURCES

S.No.	Title of Book	Author	Publication
1	Patient care in radiography	Ruth Ann Ehrlich, Dawn M Coakes	Mosby
2	Concise Textbook on Hospital Management & Patient Care in Diagnostic Radiology	N.K.Kardam,, <u>Lalit Agarwal</u>	JBD Publications
3	Patient care in radiography: with an introduction to medical imaging	<u>Ruth Ann Ehrlich</u> and Joan A. daly	St. Louis, Mo. : Mosby Elsevier
4	Introduction To Radiologic And Imaging Sciences And Patient Care	<u>Adler A M</u>	<u>Elsevier</u>
5	Concise Text Book on Hospital Management & Patient Care In Diagnostic Radiology	Lalit Agarwal , Dr. N.K. Kardam	JBD Publications

BMRIT Radiology Clinical Education – part IV (studentship)

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 semesters.
- Provide simulation and skill labs for practising 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

Subject: Basics Techniques in CT Technology**SUBJECT CODE:0023**

Teaching Scheme (In Hours)			Total Credits (L+T+P)	Examination Scheme				
				Theory Marks		Practical Marks		Total Marks
L	T	P	C	CIE	ESE	CIE	ESE	200
4	1	8	9	30	70	30	70	

CIE, Continuous Internal Evaluation; ESE, End Semester Evaluation; L, lecture; T, Tutorial; P, Practical

THEORY COMPONENTS

The following topics/subtopics should be taught and assessed in order to attain the identified competency.

Unit	Topic and contents	Hours	Marks
I	Introduction and history, CT principle, CT generations, CT Instrumentation, CT detectors, Axial & Helical CT – Slip ring technology	15	20
II	Data acquisition, Image pre-processing/reconstruction techniques, Algorithms for image reconstruction, Image display, Image post-processing techniques, CT artifacts, Image quality	14	10
III	CT Protocols for different body parts & Dental scan, CT Protocols for Angiography & Perfusion, CT contrast media and administration, CT guided interventional procedures	14	15
IV	Multi-detector CT Isotropic imaging, Cardiac CT, Flash CT, Advanced CT scanners, Dual energy & Dual Source Scanners, CT-fluoroscopy	15	15
V	Safety consideration, Documentation in CT, Role of Medical Imaging technologist in CT scan procedures, Quality assurance in CT	14	10
Total		72	70

Sr. No		Hours
1.	Introduction and history, CT principle, CT generations, CT Instrumentation, CT detectors, Axial & Helical CT – Slip ring technology	30
2.	Image post-processing techniques, CT artifacts	20

Sr. No		Hours
3.	CT Protocols for different body parts & Dental scan, CT Protocols for Angiography & Perfusion, CT contrast media and administration, CT guided interventional procedures	54
4.	Multi-detector CT	20
5.	Safety consideration, Documentation in CT, Role of Medical Imaging technologist in CT scan procedures, Quality assurance in CT	20
	Total	144

SUGGESTED LEARNING RESOURCES

S. No.	Title of Book	Author	Publication
1	Computed Tomography: Physical Principles, Clinical Applications, and Quality Control	Euclid Seeram RT(R) BSc MSc FCAMRT (Author)	Saunders
2	Computed Tomography for Technologists: A Comprehensive Text	<u>Lois Romans</u>	Lippincott Williams and Wilkins;
3	Computed Tomography: Physics and Technology. A Self Assessment Guide	Euclid Seeram	Wiley-Blackwell
4	The CT Handbook: Optimizing Protocols for Today's Feature-Rich Scanners	<u>Timothy P. Szczykutowicz</u>	Medical Physics Publishing Corporation
5	CT PROTOCOLS	Manjot Kaur, Maajid Mohi Ud Din Malik	JBD Publications

Subject: Radiation Safety in Diagnostic Radiology**Subject Code: BMRIT - 024**

Teaching Scheme (In Hours)			Total Credits (L+T+P)	Examination Scheme				
				Theory Marks		Practical Marks		Total Marks
L	T	P	C	CIE	ESE	CIE	ESE	200
2	1	4	5	30	70	30	70	

CIE, Continuous Internal Evaluation; ESE, End Semester Evaluation; L, lecture; T, Tutorial; P, Practical

THEORY COMPONENTS

The following topics/subtopics should be taught and assessed in order to attain the identified competency.

Unit	Topic and contents	Hours	Marks
I	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.	7	15
II	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.	8	15
III	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	7	15
IV	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.	7	10

V	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.	7	15
Total		36	70

Sr. No		Hours
1.	Radiation Quantities and Units	15
2.	Biological Effects of radiation	15
3.	Radiation detection and Measurements Survey meter and personal dosimeter Artificial Intelligence in Radiation Safety	15
4.	Radiation protection; Principles of radiation protection; ALARA	15
5.	Radiation Hazard evaluation and control	12
		72

SUGGESTED LEARNING RESOURCES

S. No.	Title of Book	Author	Publication
1	Radiation Protection In Diagnostic X-Ray Imaging	Euclid Seeram, Patrick C. Brennan	Jones and Bartlett Publishers
2	Development of Radiation Protection in Diagnostic Radiology	Stewart C. Bushong	CRC Press Inc.,U.S.
3	Textbook of radiological Safety	Thayalan K	Jaypee Brothers Medical Publishers
4	Radiation Protection in Medical Radiography	Statkiewicz Sherer	Elsevier Health - US;
5	Basics of Radiation, Hazards and Prevention In Diagnostic Radiology	Prashant Kumar Jha	JBD Publications

Subject: Quality Assurance in Diagnostic Radiology and Regulatory Requirements**Subject Code: BMRIT -025**

Teaching Scheme (In Hours)			Total Credits (L+T+P)	Examination Scheme				
				Theory Marks		Practical Marks		Total Marks
L	T	P	C	CIE	ESE	CIE	ESE	100
1	1	2	3	--	--	30	70	

CIE, Continuous Internal Evaluation; ESE, End Semester Evaluation; L, lecture; T, Tutorial; P, Practical

THEORY COMPONENTS

The following topics/subtopicsshould be taught and assessed in order to attain the identified competency.

Unit	Topic and contents	Hours	Marks
I	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; Qualityassurance practical	4	--
	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		

II	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	4	--
III	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	4	--
IV	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	3	
	maintenance of equipments; Record keeping and log book maintenance; Reject analysis and objectives of reject analysis programme.		
V	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.	3	--
Total		18	--

Sr. No		Hours
1.	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	7
2.	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	8

Sr. No		Hours
3.	Regulatory requirements in Diagnostic Radiology	7
4.	Responsibilities of licensees, registrants and employers Enforcement of Regulatory requirements	7
5.	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.	7
Total		36

SUGGESTED LEARNING RESOURCES

S. No.	Title of Book	Author	Publication
1	Quality Assurance and Control in Diagnostic Radiology and Imaging	Bhargava	CBS Publishers and Distributors
2	Quality Assurance	Dr. R. Sundhararajan, M.V.Kumudhavalli, Minal T. Harde	Thakur Publications Pvt Ltd
3	Quality Assurance in Diagnostic Radiology	J. McLemore (Author	Imprint unknown
4	An Introduction to Quality Assurance in Radiology	Zafar Neyaz	JBD Publications

BMRIT Radiology Clinical Education – part V (studentship)

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.

Subject: Basics Techniques in MRI Technology**Subject Code: BMRIT - 026**

Teaching Scheme (In Hours)			Total Credits (L+T+P)	Examination Scheme				
				Theory Marks		Practical Marks		Total Marks
L	T	P	C	CIE	ESE	CIE	ESE	200
3	1	8	8	30	70	30	70	

CIE, Continuous Internal Evaluation; ESE, End Semester Evaluation; L, lecture; T, Tutorial; P, Practical

THEORY COMPONENTS

The following topics/subtopics should be taught and assessed in order to attain the identified competency.

Unit	Topic and contents	Hours	Marks
I	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	12	15
II	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	12	15
III	Flow phenomena; Flow phenomena compensation; Vascular Imaging-Digital Subtraction MRA, TOF-MRA, PC-MRA, Velocity Encoding, MR-Angiogram, MR- Venogram	10	10
IV	Cardiac Imaging; Whole body MRI Protocols; MRI Artifacts and their compensation; MRI contrast agents-T1 contrast agent, T2 contrast agent	10	15
V	MRI safety- Implants and pace-makers, Electrical safety, Metallic safety, Instrumental safety, Bio-effects of MRI; Documentation; Quality assurance in MRI	10	15
Total		54	70

ESE		CIE		Grand total
Practical	Viva		Sub Total	
50	20	30	100	100

SUGGESTED LEARNING RESOURCES

S.No.	Title of Book	Author	Publication
1	Tomography and Magnetic Resonance Imaging of the Whole Body (Vol.1& II) (Saunders).	John R. Haaga, Daniel Boll	Elsevier
2	MRI inPractice	Catherine Westbrook & Caralyn Kaut	Wiley–Blackwell
3	Protocols inMRI	Catherine Westbrook	Wiley-Blackwell
4	An Introduction to the Physics and Function of Magnetic Resonance Imaging	Dominik Weishaupt , Victor D. Koechli , Borut Marincek , J.M. Froehlich	Springer;
5	Concise Textbook of MRI Physics & Protocols	MaajidMohi Ud Din Malik, Manjot Kaur	JBD Publications

Subject: Introduction to Nuclear Medicine Techniques**Subject Code: BMRIT -027**

Teaching Scheme (In Hours)			Total Credits (L+T+P)	Examination Scheme				
				Theory Marks		Practical Marks		Total Marks
L	T	P	C	CIE	ESE	CIE	ESE	100
1	1	2	3	30	70	--	--	

THEORY COMPONENTS

The following topics/subtopics should be taught and assessed in order to attain the identified competency.

Unit	Topic and contents	Hours	Marks
I	History; Isotopes and Radionuclides- Production of Radionuclides, Transport of Radionuclides; Radio Activity- Radio Active transformations, Specific Activity; Radiopharmaceuticals- Preparation, Precautions while handling	7	25
II	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	7	25
III	Safety Considerations & Radiation Dose in Nuclear Medicine; Room layout in nuclear medicine	4	20
Total		18	70

SUGGESTED LEARNING RESOURCES

Sr.No		Hours
1.	History; Isotopes and Radionuclides- Production of Radionuclides, Transport of Radionuclides; Radio Activity- Radio Active transformations, Specific Activity; Radiopharmaceuticals- Preparation, Precautions while handling	12
2.	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	12
3.	Safety Considerations & Radiation Dose in Nuclear Medicine; Room layout in nuclear medicine	12
Total		36

SUGGESTED LEARNING RESOURCES

S.No.	Title of Book	Author	Publication
1	Nuclear Medicine Textbook: Methodology and Clinical Applications	DuccioVolterrani , Paola Anna Erba , IgnasiCarrió, H. William Strauss	Springer;
2	Nuclear Medicine Instrumentation	Jennifer Prekeges (Author)	Jones and Bartlett Publishers
3	Nuclear Medicine Physics: The Basics	Ramesh Chandra & Arman Rahmim	Wolters Kluwer
4	Nuclear Medicine Technology: Procedures and Quick Reference	Pete Shackett BA CNMT ARRT(N) (Author)	LWW;
5	A Concise Guide on Basic Radiation Physics, radiotherapy Physics & Nuclear Medicine	Lalit Agarwal, Dr. Arvind Shukla	JBD Publications

Subject: Ultrasound Techniques

Subject Code: BMRIT -028

Teaching Scheme (In Hours)			Total Credits (L+T+P)	Examination Scheme				
				Theory Marks		Practical Marks		Total Marks
L	T	P	C	CIE	ESE	CIE	ESE	100
2	1	--	3	30	70	--	--	

CIE, Continuous Internal Evaluation; ESE, End Semester Evaluation; L, lecture; T, Tutorial; P, Practical

THEORY COMPONENTS

The following topics/subtopics should be taught and assessed in order to attain the identified competency.

Unit	Topic and contents	Hours	Marks
I	Ultrasound: Properties of ultrasound, interaction of ultrasound with matter	6	10
II	Transducers: Types of transducers, advances in the design of modern ultrasound transducers	6	15
III	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	6	10
IV	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	6	15
V	Image characteristics and artefacts: vascular, interventional, intraoperative and ophthalmic ultrasonography, 3D and 4D ultrasound imaging Artificial Intelligence in Ultrasound	6	10
VI	Bio-effects and safety considerations in ultrasound, ultrasound system performance measurements, ultrasound equipments quality assurance – conventional Doppler system testing and documentation	6	10
Total		36	70

Sr. No		Hours
1.	Ultrasound interaction of ultrasound with matter	6
2.	Types of transducers, advances in the design of modern ultrasound transducers	6
3.	Image display: Display modes, ultrasound instrumentation, controls	6

Sr. No		Hours
4.	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	6
5.	Image characteristics and artefacts	6
6.	Bio-effects and safety considerations in ultrasound, ultrasound system performance measurements, ultrasound equipments quality assurance	6
Total		36

SUGGESTED LEARNING RESOURCES

S.No.	Title of Book	Author	Publication
1	Ultrasound physics and technology	Vivien gibbs, davidcole, Antonio sassano	Churchill Livingstone;
2	Manual of Diagnostic Ultrasound	Philip E. S. Palmer (Author)	World Health Organization
3	Physics and Technical Aspects Diagnostic Ultrasound	DINESH K BAGHEL (Author	AITBS PUBLISHERS
4	Diagnostic Ultrasound	Carol M. Rumack (Author), Deborah Levine (Author)	Elsevier;
5	Ultrasound Imaging (1000 Multiple Choice Questions)	Yadav	JBD Publications

Subject: Biostatistics and Research Methodology**Subject Code: BMRIT -029**

Teaching Scheme (In Hours)			Total Credits (L+T+P)	Examination Scheme
L	T	P	C	
1	1	--	2	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.

Unit	Topic and contents	Hours
I	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.	3
II	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.	3
III	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	3

	and Calculation of Mode; Comparison of the Mean, and Mode; Guidelines for the Use of Various Measures of Central Tendency.	
IV	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.	3
V	Probability and Standard Distributions: Meaning of Probability of Standard Distribution, The Binominal Distribution. The Normal Distribution; Divergence from Normality - Skewness, Kurtosis	3
VI	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.	3
Total		18

SUGGESTED BOOK LEARNINGS

S. No.	Title of Book	Author	Publication
1	Elements of Health Statistics	Rao. N.S	
2	An introduction of Biostatistics	Sunder Rao	
3	Methods in Bio-Statistics	B.K. Mahajan	
4	Elementary Statistics in Medical Workers	Inderbir Singh	
5	An Introduction to. Statistical Methods, Ram Prasad & Sons	Gupta C.B	

STUDENTSHIP OR OBSERVER SHIP 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 observer ship/studentship.

"Curriculum Handbook of Medical Radiology and Imaging Technology (Intellectual Property of the National Commission for Allied and Healthcare Professions, Ministry of Health and Family Welfare)."

- 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.

