Ordinance No…..B

ORDINANCE RELATING TO BACHELOR IN MEDICAL RADIOLOGY AND IMAGING TECHNOLOGY (BMRIT) PROGRAM CURRICULUM AND SYLLABUS

1. This ordinance may be called the "**Ordinance relating to Bachelor in Medical Radiology and Imaging Technology (BMRIT) Curriculum and Syllabus**". This ordinance has been drafted in accordance with **National Commission for Allied and Healthcare Professions (NCAHP)** guidelines; all future updates issued by the NCAHP will be strictly implemented.
2. It shall come into force with academic session 2026-27.

Program Objectives

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

Expectation from the future graduate in the providing patient care.

1.Should be able to undertake all radiological and imaging procedures independently or as a key team member wherever required.
2.Able to do the image processing.
3.Should be able to handle all radiological and imaging equipment independently.
4.Should ensure radiation protection and quality assurance.
5.Undertake care and maintenance of all radiological and imaging equipment.
6.Able to evaluate images for technical quality.
7.Able to identify and manage emergency situations.
8.Able to receive and document verbal, written and electronic orders in the patient's medical record.
9.Should have computer skills.
10.Should be able to provide empathetic professional patient care.
11.Able to demonstrate professional growth, sense of professionalism and desire to learn.

12.Able to demonstrate the core values of caring, integrity and discovery.

13.To exhibit keen interest, initiative & drive in the overall development of the Department and 'Leadership Qualities' for others to follow.

14.He / She is expected to be confident and to perform all the duties diligently with utmost sincerity and honesty.

Bachelor in Medical Radiology and Imaging Technology (BMRIT)
Ist SEMESTER

Human Anatomy

Theory	Subject Code: BMRIT-001
Total Marks for Evaluation-100	No. of Contact Hours- 48, Credits:3

Course Rationale: Anatomy is a key component of all education programmes for MRITs and should have a strong focus on organ position, orientation and relationships. The topics provide the student with an understanding of the structure and relationships of the systems and organs of the body which is essential in patient preparation and positioning. The radiographic anatomy component will enable MRITs to evaluate images prior to reporting by the radiologist.

COURSE OUTCOMES

At the end of the course students will be able to...

CO1: Describe the general anatomy of human body.

CO2: Explain normal disposition of various structures and organs in the body and its clinical correlation.

CO3: Describe the microscopic structure of various tissues.

CO4: Determine the topography of various structures on the surface of the body.

CO5: Identify and locate structures of the body.

CO6: Identify organs and tissues under microscope.

CO7: Point out various features of appearance of normal body in skiagrams.

THEORY COMPONENTS

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

Unit	Topic	Hours
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	8
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.	8
III	**Cardiovascular System** Heart – size, location, chambers, exterior and interior, Blood supply of heart, Pericardium, Systemic and pulmonary circulation, Branches of aorta -common carotid artery, subclavian artery, Axillary artery, brachial artery, radial artery, superficial palmar arch, femoral artery, popliteal artery**,** dorsalis pedis artery., Peripheral pulse, Inferior vena cava, portal vein, portosystemic anastomosis, Great saphenous vein, median cubital vein, Dural venous sinuses, Lymphatic system – cisterna chyli and thoracic duct, Lymphatic tissues and its histology, Regional lymph nodes – cervical, axillary and inguinal lymph nodes. **Respiratory System** Parts of RS – nose, nasal cavity, paranasal air sinuses, larynx,	8

	trachea, lungs, pleura, bronchopulmonary segments, Histology of trachea and lungs.	
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.	**8**
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** 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.	**8**
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) **Sensory Organ** Skin and its appendages, Eye – parts of eye ball and lacrimal apparatus, Extraocular muscles, Histology of cornea and retina, Ear –	**8**

	parts of ear- external, middle and inner ear and contents **Embryology** Spermatogenesis and oogenesis, Ovulation, fertilization, Placenta	
	Total	**48**

Suggested Practicals/Demonstration

1.Demonstration of Histology of types of epithelium, Histology of serous, mucous and mixed salivary gland, Surface marking of the body region wise.

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.

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.

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.

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.

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.

***Suggested Learning Resources**

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
3Manipal 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

Physiology

Theory	Subject Code: BMRIT-002
Total Marks for Evaluation-100	No. of Contact Hours-54, Credits:3

Course Rationale: Physiology provides the students with knowledge of the function of systems and organs and their relationships and underpins the understanding of how various imaging modalities are to be selected depending upon the clinical history.

COURSE OUTCOMES

At the end of the course students will be able to...

CO1: Explain the normal functioning of organs and systems.

CO2: Understand the interrelationships and interactions among various organs and systems for maintaining homeostasis.

CO3: Assess the relative contribution of each organ systems toward the maintenance of constant internal environment

CO4: Differentiate between normal and abnormal functioning of organs and systems,

CO5: Understand physiological basis of pathogenesis and treatment of diseases and disorders.

CO6: Apply the physiological basis in the field of allied health care.

Unit	Topic	Hours
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 &	**10**

	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.	
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**
III	**Respiratory system** Respiratory and Non-respiratory function of respiratory system.	**8**

	Physiological anatomy of respiratory system Functions of respiratory tract. Respiratory membrane. Respiratory muscles. Surfactant: functions, respiratory distress syndrome. Definitions of terms used in respiratory physiology: Eupnea, Hyperpnoea, Tachypnea, Apnea, Dyspnea. Mechanics of breathing – intrapulmonary and Intrapleural pressure changes during a respiratory cycle. Spirometry – Lung volumes and capacities. Vital capacity. Oxygen transport: Role of 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**
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**

VI	**Endocrine system** Major endocrine glands- Hormone: Definition, Anterior pituitary: hormones and their functions, disorders – Giganitism, acromegaly, dwarfism, Posterior pituitary: Hormones – diabetes insipidus, Thyroid: Hormones, normal values, functions, role of TSH. Disorders: simple goitre, myxoedema, cretinism, Grave's disease, Adrenal cortex: hormones, functions of cortisol and aldosterone. Addison's disease, Cushing's syndrome, Adrenal medulla: actions of adrenaline and noradrenaline, Endocrine pancreas: Insulin & glucagon, functions, Regulation of blood glucose level, diabetes mellitus, Parathyroid: Functions of PTH. **Nervous system** Synapse: Types, Transmission, Sensory receptors: Definition, Classification Organization of spinal cord, Functions of Dorsal column and Spinothalamic tract, Functions of Corticospinal tract, Reflex Action: Definition, reflex arc, Functions of Cerebellum, Basal ganglia, Thalamus, Hypothalamus, Cerebral cortex: Lobes & functions. EEG – Definition and uses, Autonomic nervous system: Organization & functions, Cerebrospinal fluid: Composition and function.	**8**
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**
	Total	**54**

Suggested Learning Resources

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;

Basics of Radiation Physics

Theory	Subject Code: BMRIT-003
Total Marks for Evaluation-100	No. of Contact Hours-36, Credits:2

Course Rationale: Radiation physics is one of the primary pillars underlying the practice of radiology technology and

understanding the principles of radiation physics helps BMRIT become better technologist.

COURSE OUTCOMES

At the end of the course students will be able to...

CO1: Describe general physics related to imaging.

CO2: Differentiate between within general radiation.

CO3: Identify construction of radiology equipment’s.

CO4: Interpret quality of control of radiology equipment’s.

CO5: Differentiate between x-ray equipment’s and other radiology related equipment’s.

CO6: Describe production of x-rays.

CO7: Describe circuit system of radiology equipment’s.

Unit	Topic	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-	**5**

	Electromagnetic radiation-Quantum nature of radiation-mass energy equivalence-Fluorescence-electromagnetic spectrum.	
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**	**4**

	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).	
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 andatomic 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 derivedquantity, SI unit, various physical/radiation quantity used in Diagnostic Radiologyand its unit (for example, KVp, mA, mAS, Heat unit.	**6**
	Total	**36**

Basics of Radiation Physics Practical

Practical	Subject Code: BMRIT-003
Total Marks for Evaluation-100	No. of Contact Hours-108, Credits:3

Suggested Practicals/Demonstration

1. Basic concepts
2. Electricity and magnetism, Electromagnetic waves
3. Electronics
4. Discovery of x-rays-X-ray production and properties
5. Heat

6. Interaction of ionizing radiation with matter-
7. Exponential attenuation, Physical quantity, its unit and measurement

Suggested Learning Resources

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

Introduction to Healthcare

Theory	Subject Code: BMRIT-004
Total Marks for Evaluation-100	No. of Contact Hours-18, Credits:1

Course Rationale: The course provides the students a basic insight into the main features of Indian health care delivery system and how it compares with the other systems of the world.

Unit	Topic	Hours
I	Introduction to Health: Definition of Health, Determinants of Health, Health indicators of India, Health team concept National Health Policy National Health Programs (Brief objectives and scope) Family welfare programs in India Introduction to Nursing: Nursing and Nursing principles, Interpersonal relationships, Bandaging basic turns, Bandaging extremities, Triangular bandages and their applications Nursing position, bed making, prone, lateral, dorsal, dorsal recumbent, Fowler's position, comfort measures, Aids, rest and sleep Lifting and transporting patients, transferring patients to wheel chair, transferring from bed to stretcher Bedside Management: Proper usage of 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, Monitoring and recording of vitals Simple aseptic techniques, sterilization and	**18**

	disinfection Observation of surgical dressings Concepts of First Aid	
	Total	**18**

Suggested Readings:

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

Medical Terminologies and Record Keeping

Theory	Subject Code: BMRIT-005
Total Marks for Evaluation-100	No. of Contact Hours-18, Credits:1

Course Rationale: This course introduces the elements of medical terminology. Emphasis is placed on building familiarity with medical words through knowledge of roots, prefixes, and suffixes.

Unit	**Topic**	**Hours**
I	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	**18**

	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 syste	
	Total	**18**

Suggested Learning Resources

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

Basic Computers and Information Science

Theory	Subject Code: BMRIT-006
Total Marks for Evaluation-100	No. of Contact Hours-18, Credits:1

Course Rationale: The students will be able to appreciate the role of computer technology. The course has focus on computer organization, computer operating system and software, and MS windows, Word processing, Excel data worksheet and PowerPoint presentation.

Unit	Topic	Hours
I	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	**18**

	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. 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	
	Total	**18**

Suggested Learning Resources

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

Medical Law and Ethics

Theory	Subject Code: BMRIT-007
Total Marks for Evaluation-100	No. of Contact Hours-18, Credits:1

Course Rationale: Legal and ethical considerations are firmly believed to be an integral part of medical practice in planning patient care. Advances in medical sciences, growing sophistication of the modern society's legal framework, increasing awareness of human rights and changing moral principles of the community at large, now result in frequent occurrences of healthcare professionals being caught in dilemmas over aspects arising from daily practice.

Medical ethics has developed into a well based discipline which acts as a "bridge" between theoretical bioethics and the bedside. The goal is "to improve the quality of patient care by identifying, analyzing, and attempting to resolve the ethical problems that arise in practice". Doctors are bound by, not just moral obligations, but also by laws and official regulations that form the legal framework to regulate medical practice. Hence, it is now a universal consensus that legal and ethical considerations are inherent and inseparable parts of good medical practice across the whole spectrum.

Unit	Topic	Hours
I	The important and relevant topics that need to focus on are as follows: 1. Medical ethics - Definition - Goal - Scope 2. Introduction to Code of conduct 3. Basic principles of medical ethics – Confidentiality	**18**

	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. 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.	
	Total	**18**

Suggested Learning Resources

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

Professionalism and Values

Theory	Subject Code: BMRIT-008
Total Marks for Evaluation-100	No. of Contact Hours-18, Credits:1

Course Rationale: The module on professionalism will deliver the concept of what it means to be a professional and how a specialized profession is different from a usual vocation. It also explains how relevant is professionalism in terms of healthcare system and how it affects the overall patient environment.

Unit	**Topic**	**Hours**
I	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**
	Total	**18**

Suggested Learning Resources

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
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

Principals of Management

Theory	Subject Code: BMRIT-009
Total Marks for Evaluation-100	No. of Contact Hours-18, Credits:1

Course Rationale: The course is intended to provide a knowledge about the basic principles of Management.

Unit	Topic	Hours
I	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**
	Total	**18**

Suggested Learning Resources

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 Distributers PVT Ltd

English and Communication Skills

Theory	Subject Code: BMRIT-010
Total Marks for Evaluation-100	No. of Contact Hours-18, Credits:1

Course Rationale: Patients need to feel safe enough to communicate honestly and openly with their care providers to receive effective treatments. Providers need to convey treatment plans and health education clearly, accessibly, and empathetically so that patients can receive optimal care.

Unit	Topic	Hours
I	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	**18**

	Precise writings Diary writing Reports on health problem etc. Official correspondence: Outgoing correspondence, replying incoming correspondence, writing circulars, notices, charge memos, note taking, writing summaries, observation reports. Teaching learning activities: Exercise on writing: Letter writing, resume/CV Essay writing. Assessment methods: Applications, short reports to be written. Content: English- Spoken mode, Debates, Telephonic 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.	
	Total	**18**

Suggested Learning Resources

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

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 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.

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.

IInd SEMESTER

Basics of Microbiology

Theory	Subject Code: BMRIT-011
Total Marks for Evaluation-100	No. of Contact Hours-36, Credits:2

Course Rationale: Students will acquire knowledge on the Historical Development of Microbiology, various types of microscopes, bacterial anatomy and staining methods, sterilisation methods, culture media, culture methods, biochemical tests and antibiotic susceptibility tests, and understand the underlying concepts of bacterial genetics and its applications in recombinant DNA technology.

Learning Objective: At the end of the course, students should be able to

1. Comprehend knowledge of Microscopes, their types and applications.
2. Explain microbial structure, physiology, growth, and reproduction.
3. Identify common methods used in the control and prevention of microbial growth and infection.
4. Demonstrate knowledge of aseptic techniques and basic microbiological laboratory procedures.

Unit	Topic	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 macronutrient growth requirements) Culture Media. Culture Methods Antimicrobial sensitivity tests Sterilization and Disinfections: Definition, Dry heat Sterilization, Moist heat Sterilization, Chemical disinfectants, Gaseous disinfection, Test for disinfection, Sterilization control	**9**
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,	**7**

	Hepatitis, HIV infection and AIDS, Food poisoning, Diarrhea, Urinary tract infections, Pulmonary Tuberculosis.	
	Total	**36**

Suggested Learning Resources

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

Basics of Biochemistry

Theory	Subject Code: BMRIT-012
Total Marks for Evaluation-100	No. of Contact Hours-36, Credits:2

Course Rationale: Biochemistry is a key component of all education programmes for MRITs and should have a strong focus on laboratory investigation with radiological procedures. The topics provide the student with an understanding of the blood investigation and relationships of the systems which are essential in patient preparation and procedures.

COURSE OUTCOMES

At the end of the course students will be able to...

CO1: Understand the responsibility of health care personals and hazards faced in the clinical laboratory
CO2: Explain the different types, use, care and maintenance of laboratory apparatus and instruments.
CO3: Understand the fundamental chemistry and knowledge of different solutions
CO4: Understand what acids, bases, salts and indicators are and also know about acid base balance
CO5: Describe the sample collection procedure to analyse various biochemical parameters
CO6: Describe assimilation of nutrients and consequences of malnutrition
CO7: Understand the different functional tests like LFT (Liver function test), RFT (Renal function test)
CO8: Understand the overview of tumor markers, cardiac markers, blood sugar and GTT, lipid profile and diagnostic enzymology
CO9: Describe the applications of radioisotopes

Unit	Topic	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	**9**

	Cardiac markers Diagnostic Enzymology Lipid profile. Blood sugar and GTT Normal &Abnormal urine analysis	
IV	Radioisotopes: Definition, Application &Hazards Normal and abnormal urine analysis Clinical charts on LFT, RFT, and diagnostic enzymology	**9**
	Total	**36**

Suggested Learning Resources

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

Conventional Radiography and Equipment

Theory	Subject Code: BMRIT-013
Total Marks for Evaluation-100	No. of Contact Hours-72, Credits:4

Course Rationale: Conventional Radiography and Equipment provide the students' knowledge about the x-ray equipment working and also about how x-rays are produced.

COURSE OUTCOMES

At the end of the course students will be able to...

CO001: Describe the structure and working of x-ray tube, production of x-rays
CO002: Describe the types of x-ray tube and heat dissipation methods
CO003: Explain the x-ray generator circuits
CO004: Describe the different circuit types

CO005: Describe the meters and exposure timers
CO006: List the control of scattered radiation
CO007: Describes about the fluoroscopy
CO008: Explains about the care and maintenance of x-ray equipment's

Unit	Topic	Hours
I	X-ray tube: historical aspects, construction of X-ray tubes, requirements for Xray 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 Xray 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-	**10**

	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.	
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; 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.	**10**
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, photo metric 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**

Conventional Radiography and Equipment Practical

Practical	Subject Code: BMRIT-013
Total Marks for Evaluation:	No. of Contact Hours-36, Credits:1

Suggested Practicals/Demonstration

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

Suggested Learning Resources

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

Clinical Radiography Positioning (Part I)

Practical	Subject Code: BMRIT-014
Total Marks for Evaluation-100	No. of Contact Hours-72, Credits:5

Course Rationale: Clinical Radiography Positioning Part- 1 provides the students with knowledge of x-ray imaging, positioning and all the care that should be taken.

COURSE OUTCOMES

At the end of the course students will be able to...

CO1: Understand the basic patient positioning during radiographic investigation.

CO2: Apply special positioning skills for different pathological and physical conditions.

CO3: Application of equipments while working in radiology departments.

CO4: Choose proper position during radiography.

CO5: Explain relative positions of x-ray tube and patient relevant exposure factors during radiography.

CO6: Explain the use of accessories.

CO7: Explain the anatomic and physiological basis of the procedure to be undertaken.

CO8: Explain the radiographic appearances of both normal and common abnormal conditions.

Unit	Topic	Hours
I	Principles of Radiography: Preparation of the Room, Apparatus and Instruments Positions of the Patient: Erect, Sitting, Supine, Prone, Lateral, Oblique, Decubitus	**8**

	Etc. Relative position of X-Ray tube and patient, relevant exposure factors. Use of accessories such as radiographic cones, grid and positioning aids. Anatomic and Physiological basis. of the procedure, Association with theory with practical work. Radiographic appearances, both normal and common abnormal conditions where elementary knowledge of the pathology involved will ensure the application of the appropriate radiographic technique. Modifications in technique for various disabilities and types of subject. Radiation protection, use of gonad shield, practical methods of reducing radiation dose to the patient.	
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, kneejoint, 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, Scoleosis and	**12**

	Kyphosis, Sacro Ileac Joint.	
VI	Skull: Routine projections for cranium and facial bones; Supplementary projections for trauma, Towne's method, Sellaturcica, Optic foramina, Jugular foramina, Temporal bones, Mastoids, Petrous bone, Zygomatic arches, Orbits, Maxillae, Nasal bones, Mandible, Temporomandibular joints. Nasal Sinuses: Techniques for Frontal, Maxillary, Ethmoidal and Sphenoid Sinuses, erect and horizontal projections for fluid levels.	**12**
VII	Pelvic girdle and hip region: Routine projections for the whole pelvis, Sacro-Ileac joints, hip joint and Neck of Femur. Supplementary projections for the greater and lesser trochanters of Femur. Frog leg projection, Ischeum, Symphysis Pubis, Ileum, Acetabulum and Congenital Dislocation of Hip, Arthrodesis. Skeletal survey: Skeletal survey for metabolic bone disease, metastases, hormonal disorder, renal disorders.	**10**
	Total	**72**

Clinical Radiography Positioning (Part I) Practical

Practical	Subject Code: BMRIT-014
Total Marks for Evaluation-100	No. of Contact Hours-108, Credits:3

Suggested Practicals/Demonstration

1. Principles of Radiography
2. Upper limb
3. Lower limb
4. Shoulder Girdle and Thorax
5. Vertebral Column
6. Skull
7. Pelvic girdle and hip region, Skeletal survey

Suggested Learning Resources

1.Atlas of Radiographic Positioning and Radiological Procedures Philip W Ballinger, Eugene D. Frank 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 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.

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.

IIIrd SEMESTER

Pathology

Theory	Subject Code: BMRIT-015
Total Marks for Evaluation-100	No. of Contact Hours-36, Credits:2

Course Rationale: Pathology helps students to learn about the advances in basic science and clinical pathology. And help students learn and classify the type of diseases, to help learn about the mechanism of action of various diseases and to gain knowledge on lab tests.

COURSE OUTCOMES

At the end of the course students will be able to...

CO1: Define the term "Disease" or concepts of Diseases.

CO2: Define, classify diseases and the medical terms used.

CO3: Describe the cause and mechanism of a few common diseases they come across during their routine work.

CO4: Common changes seen in these diseased persons in different organs/tissues/body fluids.

CO5: Names of the common laboratory tests done to diagnose the diseases like examination of urine, blood, other body fluids and tissues.

CO6: Enumerate the proper methods of collection, preservation and delivery of the samples to the respective laboratories.

CO7: Describe the procedures of procuring the whole blood or blood components from blood bank and the complications of blood transfusion.

Unit	Topic	Hours
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**
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:	**8**

	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, resectedspecimen preservation, fixation and filling of request forms	
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**
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	**7**

	Cardiovascular diseases – Introduction, Atherosclerosis –definition, risk factors, sites/ organs, pathologymanifestations, 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	
V	Respiratory diseases – Chronic obstructive pulmonary airway diseases – causes, pathology and complications of 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	**7**
	Total	**36**

Suggested Practicals/Demonstration

1.Fatty liver – Gross & Microscopy
2.T.B. Lymphadenitis – Gross & Microscopy
3.Acute Appendicitis – Gross & Microscopy
4.Granulation tissue – Microscopy
5.Mechanism of thrombosis, Sites & complications and clinical features (effects)
6.Atrophy & Hypertrophy (Heart).
7.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
8.Metastasis – Lung, liver, lymph nodes (specimens)
9.Blood collections – Containers, Anticoagulants Hb%,PCV, ESR, Peripheral smear and Bone marrow aspiration
10.Cytology – Body fluids, FNAC.
11.Histopathology – Specimens, biopsies, fixatives.Request form writing. Blood grouping, Transfusion complications, components.

12.Anemias – Microcytic hypochromic, Megaloblastic (slides)
13.Leukemia – AML & CML (Slides)
14.Atherosclerosis, MI, Rheumatic valvular lesions
15.Renal stones, hydronephrosis, chronic pyelonephritis (specimens)
16.Lung – Pneumonias, pulmonary tuberculosis cavitatory lung abscess (specimens).

Suggested Learning Resources

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

Clinical Radiography Positioning (Part-II)

Theory	Subject Code: BMRIT-016
Total Marks for Evaluation-100	No. of Contact Hours-36, Credits:3

Course Rationale: Clinical Radiography Positioning Part-2provides the students with knowledge of x-ray imaging, positioning and all the care that should be taken. To improve skills and knowledge on patient positioning for students. MRIT and to identify radiological pathologies and to gain knowledge on radiographic anatomy. They also gain knowledge of image quality in radiological images and management of patients in emergency situations.

COURSE OUTCOMES

At the end of the course students will be able to...

CO1: Prepare management and positioning of patients
CO2: Correlate of indications, contraindications of the patient
CO3: Understand the patient preparations needed before any radiological examination.
CO4: Generalize knowledge of post procedural care.
CO5: Students will be able position the patients for radiological procedures.
CO6: Knowledge of image quality in radiological images.
CO7: Management of patients in radiology department for various procedures.
CO8: Ability to handle emergency situations in radiology department.

Unit	Topic	Hours
I	Dental Radiography Technique for intra oral full mouth. - Occlusal projections. - Extra oral projections including orthopantomography. -	**5**

	Supplementary techniques. Upper respiratory system Technique for postnasal airways, larynx, trachea, thoracic inlet, Valsalva maneuver. - Phonation	
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**
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**
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**
V	Neonatal and Pediatric Radiography, Forensic Radiography Microradiography: General principles, Requirement, Equipment, Technique..	**5**
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	**5**

	Change in radiographic contrast. Scatter elimination; beam collimation; grid ratio. Speed and type of grid movement. Radiographic factor; application and uses.	
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**
	Total	**36**

Clinical Radiography Positioning (Part-II) Practical

Practical	Subject Code: BMRIT-016
Total Marks for Evaluation-100	No. of Contact Hours-108, Credits:3

Suggested Practicals/Demonstration

1. Dental Radiography; Upper Respiratory System
2. Lungs And Mediastinum; Abdominal Viscera
3. Radiography In The Ward; Mammography
4. Operation Theatre Techniques; C-Arm
5. Neonatal And Paediatric Radiography; Forensic Radiography Microradiography
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.
7. Localization Of Foreign Bodies

Suggested Learning Resources

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 Garkal Gs Jaypee Brothers Medical Publishers
4.Bontrager's Textbook Of Radiographic Positioning And Related Anatomy John Lampignano), Leslie E. Kendrick Mosby
5.A Concise Guide On Basic Radiographic Physics Darkroom Procedures, Radiographic Positioning & Techniques Lalit Agarwal Jbd Publications

Radiography and Image Processing Techniques

Theory	Subject Code: BMRIT-017

Total Marks for Evaluation-100	No. of Contact Hours-36, Credits:2

Course Rationale: Radiography and Image processing techniques provides construction and working of film, intensifying screen, cassette, dark room and automatic processor.

COURSE OUTCOMES

At the end of the course students will be able to...

CO1: Know basic physics of radiography processing system
CO2: Describe construction and working of film, intensifying screen, cassette, dark room and automatic
processor
CO3: Explain radiographic film Processing chemistry
CO4: Discuss the factors affecting image quality in radiographic image and their application
CO5: Operate the workflow in x-ray imaging
CO6: Apply knowledge for the use of radiation factors
CO7: Demonstrate process the radiographic film in different systems
CO8: Prepare care and maintenance of radiographic films, cassettes, intensifying screens, darkroom accessories and X-ray equipment.

Unit	Topic	Hours
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**
II	Dark Room – Planning & Construction:	**7**

	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.	
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**
IV	Day Light Film handling; Xeroradiography, Stereoscopy	**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**
	Total	**36**

Radiography and Image Processing Techniques Practical

Practical	Subject Code: BMRIT-017
Total Marks for Evaluation-	No. of Contact Hours-36, Credits:1

Suggested Practicals/Demonstration

1.Radiographic film; Intensifying Screens; X-ray Cassette
2. Dark Room – Planning & Construction
3. Film Processing; Photochemistry;
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

Suggested Learning Resources

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

Contrast Media and Special Radiological Procedures

Theory	Subject Code: BMRIT-018
Total Marks for Evaluation-100	No. of Contact Hours-36, Credits:3

Course Rationale: Contrast & Special Radiological Procedures are diagnostic procedures usually performed by giving contrast through oral or intravenous to diagnose the disease. These imaging procedures are done under the guided of fluoroscopy or c-ram equipment.

COURSE OUTCOMES

At the end of the course students will be able to...

CO1: Prepare management and positioning of patients while performing radiological procedures.
CO2: Correlate of indications, contraindications, contrast media, radiation dose, exposure timing and radiation safety measures for different radiological procedures.
CO3: Understand the patient preparations needed before any radiological examination.
CO4: Generalize knowledge of post procedural care.
CO5: Students will be able position the patients for radiological procedures.
CO6: Knowledge of image quality in radiological images.
CO7: Management of patients in radiology department for various procedures.
CO8: Ability to handle emergency situations in radiology department.
CO9: Precautions and care required in interventional suits.

Unit	Topic	Hours
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**
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 Cholengiography; Percutaneous Transhepatic Biliary Drainage; Endoscopic Retrograde Cholengiopancreatography	**10**
III	Urinary System: IVU (Intravenous Urography), Retrograde Pyeloureterography (RGU), Micturating Cysto Urethrography, Ascending Urethrography Reproductive System: Hystero Salpingogram, FTR (Fallopian Tube Recanalization)	**8**
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**
	Total	**36**

Contrast Media and Special Radiological Procedures Practical

Practical	Subject Code: BMRIT-018
Total Marks for Evaluation-100	No. of Contact Hours-108, Credits:3

Suggested Practicals/Demonstration

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.
2.Procedures for gastrointestinal tract including barium studies Procedures for biliary tract.
3. Procedures for urinary system and reproductive system.
4. Procedures for central nervous system and respiratory system.

Suggested Learning Resources
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 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.

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.

IVth SEMESTER

Cross Sectional Anatomy

Theory	Subject Code: BMRIT-019
Total Marks for Evaluation-100	No. of Contact Hours-36, Credits:2

Course Rationale: Cross sectional anatomy provides the students with Skills that are important to help the technologist in MRI and CT to identify the anatomy being imaged and to communicate effectively with the radiologist and physicians.

COURSE OUTCOMES

At the end of the course students will be able to...

CO1: Identify cross-sectional anatomy in the sagittal, coronal and axial planes on CT and MR images.
CO2: Describe anatomical structural relationships.
CO3: Recognize normal anatomy and build a personal resource system for future study.
CO4: Locate and identify pertinent cerebral, upper thorax, mid-thorax, and abdominal anatomy.
CO5: On CT and MR images, identify anatomical structures of the body and of the head.
CO6: Distinguish between arterial and venous anatomy of the entire body's vascular system.
CO7: Classify the various sections of anatomical regions and their associated parts.

Unit	Topic	Hours
I	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	**12**
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**

Cross Sectional Anatomy Practical

Practical	Subject Code: BMRIT-019
Total Marks for Evaluation-100	No. of Contact Hours-108, Credits:3

Suggested Practicals/Demonstration

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.

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 – 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.

Suggested Learning Resources

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

Modern Radiological Imaging Equipment and Physics

Theory	Subject Code: BMRIT-020
Total Marks for Evaluation-100	No. of Contact Hours-36, Credits:3

Course Rationale: Modern radiological Imaging Equipment and Physics provides the students knowledge about the modern x-ray equipment and working principle. Modern imaging techniques ‑ including X-rays, ultrasound, CT scans and MRI ‑ can show structures inside your body in great detail. Radiologic Physics is the study of medical imaging components,

technology, and parameters in an effort to produce optimal imaging results. The goal with studying radiologic physics is to ensure you get clear images while ensuring the patient is safe from radiation.

COURSE OUTCOMES

At the end of the course students will be able to...

CO001: Describe the special radiological equipments
CO002: Describe the digital and computed radiography
CO003: Describe PACS, RIS and HIS

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

Modern Radiological Imaging Equipment and Physics Practical

Practical	Subject Code: BMRIT-020
Total Marks for Evaluation-	No. of Contact Hours-36, Credits:1

Suggested Practicals/Demonstration

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

3. Modern dental equipments. Cone beam dental CT.

4. Picture archiving and communication system (PACS), RIS and HIS. Intermediary Metabolism and Endocrinology Practical

Suggested Learning Resources

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

6. Nader Rifai et al, *Tietz Textbook of Clinical Chemistry and Molecular Diagnostics,* Saunders / Elsevier

Interventional Radiology Techniques

Theory	Subject Code: BMRIT-021
Total Marks for Evaluation-100	No. of Contact Hours-36, Credits:3

Course Rationale: Interventional radiology (IR) helps student MRIT to gain about the basics diagnostics and interventional procedures and to learn procedures in modalities like digital radiography CT and MRI and nuclear medicine and to increase the level of understandings and knowledge required to meet current radiologic procedures and to understand the physical principles of radiography and basic radiography positioning to perform the procedures. it a medical specialty that performs various minimally-invasive procedures using medical imaging guidance, such as x-ray fluoroscopy, computed tomography, magnetic resonance imaging, or

ultrasound. IR performs both diagnostic and therapeutic procedures through very small incisions or body orifices

COURSE OUTCOMES

At the end of the course students will be able to...

CO1: Know the basic principle and physics of interventional equipment.
CO2: Know the management and positioning of patients while performing interventional radiological procedure.
CO3: Have knowledge about the indications, contraindications, contrast media, radiation dose, exposure
timing and radiation safety measures for the different interventional radiological procedure.
CO4: Understand the patient preparation needed before any interventional radiological procedures.
CO5: Have knowledge about the post procedural care and safety.

Unit	Topic	Hours
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**
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**
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**
IV	Safety considerations in angiography room; room design, protective	**6**

	devices, radiation monitoring	
V	Care and maintenance tests: General care, functional test Quality assurance program: Acceptable limits of variation,corrective action	**6**
	Total	**36**

Interventional Radiology Techniques Practical

Practical	Subject Code: BMRIT-021
Total Marks for Evaluation-100	No. of Contact Hours-72, Credits:2

Suggested Practicals/Demonstration
1.Basics of angiographic equipments
2.Catheter and guide wires
3.Arteriography and venography procedures
4.Safety considerations in angiography room

Suggested Learning Resources
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

Patient Care in Radiology

Theory	Subject Code: BMRIT-022
Total Marks for Evaluation-100	No. of Contact Hours-18, Credits:2

Course Rationale: Patient management is based on team work, it is essential that the student should appreciate the technologist’ s role and that the importance of co-operation with wards and other departments. The students should be attached to wards or the accident and emergency department for a definite training period.

COURSE OUTCOMES

At the end of the course, students will be able to…

CO1: Understand the responsibility of the imaging technologist and other health care facility.
CO2: Understand the management and care of patient during different procedures and emergency
situations.
CO3: Know about different patient transfer techniques and to restrain the uncooperative patients during radiological examination
CO4: Differentiate the types of consent forms
CO5: Know about infection control, infection source and isolation techniques
CO6: Describe sterilization techniques
CO7: Understand the radiation safety and protection

Unit	Topic	Hours
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**
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**
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**
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	**3**

	apparatus, drug reactions; prophylactic measures; administration of oxygen; electric shock; burns; scalds; hemorrhage; pressure points; compression band. Fractures; splints, bandaging; dressing, foreign bodies; poisons.	
V	Infection: Bacteria, their nature and appearance; spread ofinfections; auto-infection or cross-infection; the inflammatory yprocess; 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**
VI	Patient care in following investigations: GIT, Respiratorysystem, Cardiovascular system, CNS; Sterilization; Infectioncontrol 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**
VII	Drugs in the department and Storage: classification; labelling and checking, regulations regarding dangerous and other drugs; units of measurement, special drugs, anti-depressive, antihypertensive 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**
	Total	**18**

Patient Care in Radiology Practical

Practical	Subject Code: BMRIT-022

Total Marks for Evaluation-100	No. of Contact Hours-72, Credits:2

Suggested Practicals/Demonstration

1. Introduction to Patient Car and Communication
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; outpatient and follow-up clinics; stock-taking and stock keeping.
3. Care of the patient
4. Nursing procedures in Radiology and first aid
5. Infection and Principles of asepsis
6. Patient care in following investigations: GIT, Respiratory system, Cardiovascular system, CNS; Sterilization; Infection control.
7. Drugs in the department and Storage and medical ethics and records.

Suggested Learning Resources

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,, Lalit Agarwal JBD Publications

3.Patient care in radiography: with an introduction to medical imaging Ruth Ann Ehrlich and Joan A. daly St. Louis, Mo.: Mosby Elsevier

4.Introduction To Radiologic And Imaging Sciences And Patient Care Adler A M Elsevier

5.Concise Text Book on Hospital Management & Patient Care In Diagnostic Radiology Lalit Agarwal, Dr. N.K. Kardam JBD Publications

BMRIT Radiology Clinical Education-Ppart 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 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.

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.

Vth SEMESTER

Basics Techniques in CT Technology

Theory	Subject Code: BMRIT-023
Total Marks for Evaluation-100	No. of Contact Hours-72, Credits:5

Course Rationale: Basics techniques in CT Technology provide the students with knowledge of the basic physics of CT. It creates relationship between scan and patient with various CT protocols for better representation of images.

COURSE OUTCOMES

At the end of the course students will be able to...

CO1: Define basic principle and physics of Computed Tomography scan
CO2: Recognize protocols needed for Computed Tomography examination
CO3: Prepare and positioning for Computed Tomography examination
CO4: Interpret post processing of raw Computed Tomography images
CO5: Prepare and position the patients for Computed Tomography examination
CO6: Categorize knowledge of improving image quality in Computed Tomography images
CO7: Plan of scanning with various Computed Tomography protocols for better representation of images
CO8: Systematize post processing for Computed Tomography scan
CO9: Management of patient for any post contrast reactions

Unit	Topic	Hours
I	Introduction and history, CT principle, CT generations, CT Instrumentation, CT detectors, Axial & Helical CT – Slip ring	**15**

	technology	
II	Data acquisition, Image preprocessing/ reconstruction techniques, Algorithms for image reconstruction, Image display, Image post-processing techniques, CT artifacts, Image quality	**14**
III	CT Protocols for different body parts & Dental scan, CT Protocols for Angiography & Perfusion, CT contrast media and administration, CT guided interventional procedures	**14**
IV	Multi-detector CT Isotropic imaging, Cardiac CT, Flash CT, Advanced CT scanners, Dual energy & Dual Source Scanners, CTfluoroscopy	**15**
V	Safety consideration, Documentation in CT, Role of Medical Imaging technologist in CT scan procedures, Quality assurance in CT	**14**
	Total	**72**

Basics Techniques in CT Technology Practical

Practical	Subject Code: BMRIT-023
Total Marks for Evaluation-100	No. of Contact Hours-144, Credits:4

Suggested Practicals/Demonstration

1.Introduction and history, CT principle, CT generations, CT Instrumentation, CT detectors, Axial & Helical CT – Slip ring technology

2.Image post-processing techniques, CT artifacts

3. CT Protocols for different body parts & Dental scan, CT Protocols for Angiography & Perfusion, CT contrast media and administration, CT guided interventional procedures

4. Multi-detector CT

5. Safety consideration, Documentation in CT, Role of Medical Imaging technologist in CT scan procedures, Quality assurance in CT

Suggested Learning Resources

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 Lois Romans 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 Timothy P. Szczykutowicz Medical Physics Publishing Corporation
5.CT PROTOCOLS Manjot Kaur, Maajid Mohi Ud Din Malik JBD Publications

Radiation Safety in Diagnostic Radiology

Theory	Subject Code: BMRIT-024
Total Marks for Evaluation-100	No. of Contact Hours-36, Credits:3

Course Rationale: Radiation protection aims to reduce unnecessary radiation exposure with a goal to minimize the harmful effects of ionizing radiation. In the medical field, ionizing radiation has become an inescapable tool used for the diagnosis and treatment of a variety of medical conditions .to study radiation physics relevant to radiation protection to gain information on radiation types and does receive to study the molecular and cellular effects of radiations and to know the radiation quantities units dose limits and regulatory bodies to know about equipment design for radiation protection and to implement patient and personnel radiation protection practices for radiological procedures.

COURSE OUTCOMES

At the end of the course, students will be able to learn:

CO1: Aim and need of radiation protection
CO2: Introduction to Radiation units and quantities
CO3: Understanding of various Radiation protection regulations and the dose limits
CO4: Radiation protection to patients, occupational workers and general public in Diagnostic Radiology
CO5: Layout of Radiology department
CO6: Use of protective devices and awareness of radiation with radiation signages
CO7: Dose reduction measures with technical protective considerations during radiology
CO8: Different radiation measuring devices
CO9: Effects of radiation on biological tissue

Unit	Topic	Hours
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	**7**

	Limits - Dose limits to public.	
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**
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**
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**
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	**7**

	public Good work practice in Diagnostic Radiology. Planning consideration for radiology, including Use factor, occupancy factors, and different shielding material.	
	Total	**36**

Radiation Safety in Diagnostic Radiology Practical

Practical	Subject Code: BMRIT-024
Total Marks for Evaluation-100	No. of Contact Hours-72, Credits:2

Suggested Practicals/Demonstration

1.Radiation Quantities and Units
2.Biological Effects of radiation
3.Radiation detection and Measurements Survey meter and personal dosimeter,Artificial Intelligence in Radiation Safety
4.Radiation protection; Principles of radiation protection; ALARA
5.Radiation Hazard evaluation and control Genetics and Molecular Biology Practical

Suggested Learning Resources

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

Quality Assurance in Diagnostic Radiology and Regulatory Requirements

Theory	Subject Code: BMRIT-025
Total Marks for Evaluation-	No. of Contact Hours-18, Credits:2

Course Rationale: Quality assurance testing includes the monitoring, evaluation and maintenance of equipment for optimal performance and stability. It is essential that radiological technologists recognize, record and report, according to policy, when a significant increase or underexposure in radiation exposure occurs.

COURSE OUTCOMES

At the end of the course students will be able to...

CO1: Aim and need of radiation protection
CO2: Introduction to quality assurance
CO3: Understanding of regulatory requirements
CO4: Follow radiation protection regulations and apply practically

Unit	Topic	Hours
I	Objectives of quality Control: Improve the quality of imaging there by increasing the diagnostic value; to reduce the radiation exposure; Reduction of film wastage and repeat examination; to maintain the various diagnostic and imaging units at their optimal performance. Quality assurance activities: Equipment selection phase; Equipment installation and acceptance phase; Operational phase; Preventive maintenance. Quality assurance programme at the radiological faculty level: Responsibility; Purchase; Specifications; Acceptance; Routine testing; Evaluation of results of routine testing; Quality assurance practical exercise in the X ray generator and tube; Image receptors from processing; Radiographic equipment; Fluoroscopic equipment; Mammographic equipment; Conventional tomography; Computed tomography; Film processing, manual and automatic; Consideration for storage of film and chemicals; Faults tracing; Accuracy of imaging imagedistortion for digital imaging devices. LASER printer calibration	**4**
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	**4**

	HVT and total tube Resolution Grid alignment QA in mammography QA in CT QA in Digital Radiography.	
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; Routinemaintenance of equipments; Record keeping and log book maintenance; Reject analysis and objectives of reject analysis programme.	**3**
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**

Quality Assurance in Diagnostic Radiology and Regulatory Requirements Practical

Practical	Subject Code: BMRIT-025
Total Marks for Evaluation-100	No. of Contact Hours-36, Credits:1

Suggested Practicals/Demonstration

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
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.
3. Regulatory requirements in Diagnostic Radiology
4. Responsibilities of licensees, registrants and employers Enforcement of Regulatory requirements
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.

Suggested Learning Resources

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 Medical Laboratory Management and Quality Control

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.

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.

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.

VIth SEMESTER

Basics Techniques in MRI Technology

Theory	Subject Code: BMRIT-026
Total Marks for Evaluation-100	No. of Contact Hours-54, Credits:4

Course Rationale: Magnetic Resonance Imaging (MRI) is a non-invasive imaging technology that produces three-dimensional detailed anatomical images. It is often used for disease detection, diagnosis, and treatment monitoring. It is based on sophisticated technology that excites and detects the change in the direction of the rotational axis of protons found in the water that makes up living tissue. The student learn to Recognize and planning different protocols and prepare and position patients for MRI examination. To gain knowledge on Management of patients, contrast reactions MRI Safety.

COURSE OUTCOMES

At the end of the course students will be able to...

CO1: Define basic principle and physics of Magnetic Resonance Imaging.
CO2: Recognize protocols needed for Magnetic Resonance Imaging examination.
CO3: Prepare and positioning for Magnetic Resonance Imaging examination.
CO4: Interpret post processing of Magnetic Resonance Imaging images.
CO5: Prepare and position the patients for Magnetic Resonance Imaging examination.
CO6: Categorize knowledge of improving image quality in Magnetic Resonance Imaging.
CO7: Scanning of patient with various Magnetic Resonance Imaging protocols for better representation of images.
CO8: Plan of post processing for Magnetic Resonance Imaging data.
CO9: Management of patient for any post contrast reactions.

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

Basics Techniques in MRI Technology Practical

Practical	Subject Code: BMRIT-026
Total Marks for Evaluation-100	No. of Contact Hours-144, Credits:4

Suggested Practicals/Demonstration

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

Suggested Learning Resources

1.Tomography and Magnetic Resonance Imaging of the Whole Body (Vol.1& II) (Saunders). John R. Haaga, Daniel Boll Elsevier
2.MRI in Practice Catherine Westbrook & Caralyn Kaut Wiley–Blackwell
3.Protocols in MRI 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 Maajid Mohi Ud Din Malik, Manjot Kaur JBD Publications

Introduction to Nuclear Medicine Techniques

Theory	Subject Code: BMRIT-027
Total Marks for Evaluation-100	No. of Contact Hours-18, Credits:2

Course Rationale It is the branch of medicine that deals with the use of radioactive substances in research, diagnosis, and treatment disease. In this student will learn about the fundamentals of radioactivity and various interactions of radiation with matter, radiopharmaceuticals, instrumentations measuring radioactivity, PET imaging and patients care and safety.

COURSE OUTCOMES

At the end of the course students will be able to...

CO1: Define basic principle and physics of nuclear medicine.
CO2: Apply precautions while handling radiopharmaceuticals.
CO3: Recognizing the artefacts associated with nuclear medicine.
CO4: Assess the knowledge of improving image quality in nuclear medicine.
CO5: Management of patient for any late reactions associated with radiotracers in nuclear medicine.

Unit	Topic	Hours
I	History; Isotopes and Radionuclides- Production of Radionuclides, Transport of Radionuclides; Radio Activity- Radio Active transformations, Specific Activity; Radiopharmaceuticals- Preparation, Precautions while handling	**7**
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**

III	Safety Considerations & Radiation Dose in Nuclear Medicine; Room layout in nuclear medicine.	**4**
	Total	**18**

Introduction to Nuclear Medicine Techniques Practical

Practical	Subject Code: BMRIT-027
Total Marks for Evaluation-	No. of Contact Hours-36, Credits:1

Suggested Practicals/Demonstration

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

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

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

Suggested Learning Resources

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

Ultrasound Techniques

Theory	Subject Code: BMRIT-028
Total Marks for Evaluation-100	No. of Contact Hours-36, Credits:3

Course Rationale: Ultrasound techniques provide students knowledge on the basic principles of ultrasonography and how to prepare the patients for the scan and also to identify any artefacts. To learn about the physics behind ultrasound and to gain knowledge regarding various

ultrasound procedures equipment used in ultrasound and patient care during ultrasound procedures

COURSE OUTCOMES

At the end of the course students will be able to...

CO001: Describe the Ultrasound properties, interaction of ultrasound with matter
CO002: Describe the transducer and types
CO003: Explain the concepts of image display
CO004: Describe Doppler imaging and ultrasound contrast agents
CO005: Describe the image characteristics and artefacts
CO006: explain the safety considerations in ultrasound and protocols

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

Suggested Practicals/Demonstration

1. Ultrasound interaction of ultrasound with matter
2. Types of transducers, advances in the design of modern ultrasound transducers
3. Image display: Display modes, ultrasound instrumentation, controls Immunohematology and Transfusion Medicine
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
5. Image characteristics and artefacts
6. Bio-effects and safety considerations in ultrasound, ultrasound system performance measurements, ultrasound equipments quality assurance.

Suggested Learning Resources

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

Biostatistics and Research Methodology

Theory	Subject Code: BMRIT-029
Total Marks for Evaluation-	No. of Contact Hours-18, Credits:2

Course Rationale: The application of statistical techniques to scientific research in health-related fields, including medicine, biology, and public health, and the development of new tools to study these areas

COURSE OUTCOMES

At the end of the course students will be able to...

CO1: Understand the Importance of statistics course in the curriculum
CO2: Understands Statistical Terms
CO3: Possess Knowledge and Skill in the use of Basic Statistics in the analysis and interpretation of data.

Unit	Topic	Hours
I	Introduction: Meaning, Definition, Characteristics of Statistics;	**3**

	Importance of the Study of Statistics. Branches of Statistics; Descriptive and Inferential Statistics; Variables and Their Types. Measurement Scales.	
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. and Calculation of Mode; Comparison of the Mean, and Mode; Guidelines for the Use of Various Measures of Central Tendency.	**3**
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 Learning Resources

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 Analytical Biochemistry Practical

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 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.

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.

VIIth and VIIIth SEMESTER

Teaching and Examination Scheme
Course Name: Bachelor in Medical Radiology and Imaging Technology
Duration of Program: Four Years (8 Semesters) Pattern: Full Time Rotatory Internship Semester: Seventh & Eighth (4th year)
Internship: minimum 2400 hours (calculated based on 8 hours per day for one year of internship)

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

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

Area	Duration (Months)
Conventional Radiography, Mammography, CR, DR and PACS	4
Radiological Imaging & Special Procedures and Advanced Equipments	2
Ultrasonography & Doppler Imaging	1
Interventional Radiology	1
Computed Tomography	2
Magnetic Resonance Imaging	2

Assessment of Internship

The intern shall maintain a record of work which is to be verified and certified by the faculty under whom he/she works. Apart from scrutiny of the record of work, assessment and evaluation of training shall be undertaken by an objective approach using situation tests in knowledge, skills and attitude during and at the end of the training. Based on the record of work and date of evaluation, the Head of the Institution/hospital will issue a certificate of satisfactory completion of training, following which the University will award the BMRIT degree or declare him eligible for it.

Guideline for Internship

Course Rationale:

The Clinical Education, is designed for the students to familiarize them with the applications of radiography, mammography, radiological special procedures, CT, MRI and advanced imaging techniques etc. Student should be able to reliably perform all non-contrast plain radiography as well as contrast radiological and imaging procedures along with Radiologist.

COMPETENCY

Identify the Anatomy to be imaged, properly position the patient for Imaging, Correctly select appropriate projection/projections to demonstrate the area of interest Use appropriate radiographic/radiological and imaging parameters.

Course Outcomes

On completion of this subject, the student should be able to:

1.Correctly Identify the Anatomy to be imaged

2.To properly position the patient for radiography/Radiological and Imaging procedures

3.Correctly select appropriate projection/projections to demonstrate the area of interest

4.Use appropriate radiographic parameters to produce a radiographic image with satisfactory results

5.Should be able to differentiate a properly positioned and exposed radiographic image from a wrongly positioned and over or underexposed radiographic image

6.Should be able to correctly identify anatomical features displayed in radiographic image obtained.

TEACHING AND EXAMINATION SCHEME

Teaching Scheme			**Duration (Months)**	**Examination Scheme**													
			(L+T+P)	Theory								Practical					
				Paper Hrs.	CIA		ESE		Total			CIE		ESE*		Total	
					Max	Min	Max	Min	Max	Min		Max	Min	Max	Min	Max	Min
			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

LIST OF PRACTICALS/ EXERCISES/ASSIGNMENTS/CASE STUDIES

Students have to do hands on practice on following Techniques:	
Exp. No.	**Name of Practical/ Exercise/ Assignment/ Case Study**
VIIth Semester	
1	Radiation Physics
2	Radiographic Positioning
3	Conventional Radiography and Equipment
4	Contrast Media& Special Radiological/ imaging procedures
5	Interventional Radiology/ imaging techniques
6	Patient Care in Radiology
VIIIth Semester	
7	Basics Techniques in CT Imaging Technology
8	Radiation Safety in Diagnostic Radiology
9	Quality Assurance in Diagnostic Radiology and Regulatory Requirements
10	Basics Techniques in MRI Imaging Technology
11	Introduction to Nuclear Medicine Techniques* (if facility available)
12	Ultrasound Techniques

GENERAL GUIDELINES FOR CLINICAL EDUCATION (INTERNSHIP)

Training Area: Students should be trained in Large and Medium scale Hospitals/Diagnostic Centers. However, despite the best efforts by the Institute, if large and medium scale Hospitals/Diagnostic Centers are not available to all students then, students can also be placed in Small scale Institutes/Hospitals/Diagnostic Centers approved by the NCAHP competent body.
Skill Knowledge Partner (SKP): To be identified by the Institute as per their programme areas like

1. Government Hospitals.
2. Corporate Hospitals
3. Private Hospitals
4. Diagnostic Centers
5. Any other relevant industry

Note: All these needs to be approved by the NCAHP competent body.

EXPECTATIONS FROM Skill Knowledge Partner (SKP)

Helping institute in developing the following competencies among students.
Soft Skills i.e. Communication, Presentation and others.
Life Skills i.e. Time management, Safety, Innovation, Entrepreneurship, Team building and others.
Hands-on Practices i.e. Patient Safety, Radiography/Radiological and Imaging and Quality Assurance aspects.

ROLE OF PARENT DEPARTMENT OF THE INSTITUTE

1.Identify Hospitals/Diagnostic Centers available for training along with capacity.

2. Institutions have to enter in to MOU with number of SKPs (Institutes/Hospitals/Diagnostic Centers) for accommodating all the enrolled students for the mandatory internship

3. Student and mentor allocation as per the slots available for Hands on training (Desirable mentor student ratio is 1:10).

4. Communication with Institutes/Hospitals/Diagnostic Centers available for training along with capacity and its confirmation.

5. Student enrollment for training.

6. Issuing letter to the Institutes/Hospitals/Diagnostic Centers for the training along with details of students and mentors.

7. Principal/ HOD/ Faculty should address students about safety norms, rules and discipline to be maintained in the Institutes/Hospitals/Diagnostic Centers during the training before relieving students for training.

8. The designated faculty member would visit the Institutes/Hospitals/Diagnostic Centers periodically to check the progress of the student in the training, his/ her attendance, discipline, log book preparation &project report preparation

9. Mentors to carry out progressive assessment of the students during the training through Continuous Internal Evaluation (CIE), End Semester Examination (ESE) assessment by mentor along with Institutes/Hospitals/Diagnostic Centers expert as external examiner

ROLES AND RESPONSIBILITIES OF THE STUDENTS

Following should be informed to students in the letter deputing them for the training; an undertaking for this should also be taken from them

Students would interact with the mentor to suggest choices for suitable Institutes/ Hospitals/ Diagnostic Centers. If students have any contact in Institutes/Hospitals/Diagnostic Centers (through their parents, relatives or friends) then same may be utilized for securing placement for themselves and their peers.

He/she will have to get all the necessary information from the training officer regarding schedule of the training, rules and regulations of the Institutes/Hospitals/Diagnostic Centers and safety procedures to be followed. Student is expected to observe these rules, regulations, procedures.

Students have to fill the forms duly signed by authorities along with training letter and submit it to training officer in the Institutes/Hospitals/Diagnostic Centers on the first day of training. Student should also carry with him/her the Identity card issued by institute during training period.

Students should know that if they break any rule of Institutes/Hospitals/Diagnostic Centers or do not follow the discipline then Institutes/Hospitals/Diagnostic Centers can terminate the training and send back the student.

It is the responsibility of the student to collect information from Institutes/Hospitals/Diagnostic Centers about Radiography/Radiological & Imaging procedures/ Patient Safety /work ethics/professional practices/organizational structure etc.

During the training period students have to keep daily record of all the useful information in Log book along with the time and date and type of Radiography/Radiological & Imaging procedures, how it was performed with patients history any difficulty encountered.

Maintain the Diary/Logbook and get it signed from mentor as well as Institutes /Hospitals /Diagnostic Centers Training in-charge.

In case they face any major problem in industry such as an accident or any disciplinary issue then they should immediately report the same to the institute.

Prepare final report about the training for submitting to the department at the time of presentation and viva-voce and get it signed from mentor as well as Institutes/Hospitals/Diagnostic Centers training incharge.

FORMAT FOR TRAINING REPORT

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

Title page

Certificate

Abstract

Acknowledgement

Content Page with date and time start and end Learning Outcomes

1. Preanalytical phase - Safely collect, identify, and manage clinical specimens, follow proper safety precautions.
2. Conduct clinical investigations and interpret findings.
3. Perform equipment quality control and resolve technical issues.
4. Manage documentation, communication, ethics, and teamwork.
5. Demonstrate leadership and entrepreneurship in lab environments.
6. Write and critique scientific literature reviews.

Chapter 1. Organizational structure of Institutes/Hospitals/Diagnostic Centers and General Lay Out
Chapter 2. Introduction of Institutes/Hospitals/Diagnostic Centers (History, Facilities available. Specialization and number of employees etc.)
Chapter 3. Types of major equipment/instruments/ machines used in Radiology with their specification, approximate cost and specific use and their routine maintenance.
Chapter 4. Standard Operating procedures.
Chapter 5. Quality assurance and radiation safety procedures.
Chapter 6. Equipment handling and procedures.

Chapter 7. Safety procedures followed
Chapter 8. Particulars of Practical Experiences in Radiology and Imaging
Chapter 9. Short report/description of the project (if any done during the training)
Chapter 10. Special/challenging experiences encountered during training if any (may include students liking & disliking of work places)
References /Bibliography

ASSESSMENT SCHEME FOR CLINICAL EDUCATION (INTERNSHIP)

INTERNSHIP

Training duration	**CONTINUOUS INTERNAL EVALUATION (Weekly report of all 6 months and attendance)**		**END SEMESTER ASSESSMENT (Practical and Oral)**		**Total marks**	
6 months	**Maximum. Marks**	**Minimum Marks**	**Maximum. Marks**	**Minimum Marks**	**Maximum. Marks**	**Minimum Marks**
	100	**50**	**100**	**50**	**100**	**50**

EVALUATION SHEET FOR CONTINUOUS INTERNAL EVALUATION

Sr. No.	**Enrollment Number**	**Name of Student**	**Seminar/presentation in workshop or conference**	**Marks by Supervisor**	**Marks by Mentor Faculty**	**Total Marks**
			Out of 40 (A)	**Out of 30 (B)**	**Out of 30 (C)**	**Out of 100 (A+B+C)**

Marking criteria for seminar/presentation at workshop/conference and marking criteria for supervisor/mentor faculty mentioned in the log book template.

DISTRIBUTION OF END-SEMESTER-EXAMINATION (ESE*) MARKS

Marks for Training Report	Marks for Practical's	Marks for Oral/Viva-voce	Total ESE marls
25	25	50	100

Practical (25 marks) must include minimum two practical related demonstration in front of the internal examiners.

Board of examiners for 7th & 8th semester:

HOD of Radiology: Chairperson

Programme Co-ordinator/Course Co-ordinator/Chief of MRIT/Incharge of MRIT: Co chairperson

Subject Experts: Internal examiners (two) members.

SEMESTER VII & SEMESTER VIII

LOG BOOK

BACHELOR IN MEDICAL RADIOLOGY AND IMAGING TECHNOLOGY (BMRIT)

SUBHARTI COLLEGE OF ALLIED AND HEALTHCARE

SWAMI VIVEKANAND SUBHARTI UNIVERSITY, MEERUT

BACHELOR IN MEDICAL RADIOLOGY AND IMAGING TECHNOLOGY
SUBHARTI COLLEGE OF ALLIED AND HEALTHCARE
SWAMI VIVEKANAND SUBHARTI UNIVERSITY, MEERUT

Logo Book Template:

Cover Page

Institute/University Logo

Bachelor in Medical Radiology and Imaging Technology

(BMRIT)

Log Book

Name of the Student:

Name of the Under Graduate degree:

USN:

Batch:

PARTICULARS OF STUDENT

Photograph

Name of the student:

Reg no:

Sessions:

Year of admission:

Year of completion:

Address:

Contact details:

Email id:

Signature of the student:

CERTIFICATE

This is to certify that Mr/Ms…… …….. has satisfactorily completed the training requirements for the programme of Bachelor in Medical Radiology and Imaging Technology (BMRIT) from (name of the Institute/University & address). She/He has completed all the clinical responsibilities during her/his Undergraduation training from…….to…….....

Signature
Head/Programme Co-ordinator

Signature
Principal/Dean

Index		
Sl.No.	**Content**	**Page No.**

SECTION I : CLINICAL POSTING

Date	Department/Modalities	Posting brief descriptions	Name & Signature of the staff/mentor /supervisor

SECTION II. SEMINARS PRESENTED/ATTENDED

Sl. No.	Date	Topic of the Seminar	Signature of the Moderator

SEMINAR EVALUATION FORM

Evaluation of Seminar

Sl. No.	Criteria	5 Excellent	4 Good	3 Average	2 Below Average	1 Poor
1	Content of the Presentation					
2	Aesthetic of slides preparation					
3	Oratory & Presentation Skills					
4	Audio- visual aids used					
5	Clarity of presentation					
6	Critical Analysis					
7	Ability to respond to questions on the subject					
8	Ability to defend the topic					
9	Referencing					
10	Implementation recent advancement on the topic					
	Total marks					

SEMINAR SCORE SHEET

Sl. No.	Date	Topic	Total Marks (Max.50)	Evaluations Signature	Coordinator Signature
1					
2					
3					
4					
5					

Supervisor/mentor shall be determined the marks basis of the following:

Sl. No.	Parameter	Score
1	Proficiency of knowledge required for each radiological imaging procedures	0-5
2	The competency in skills expected to manage each radiological imaging procedures	0-5
3	Responsibility, punctuality, work up of case, involvement in follow-up reports	0-5
4	Capacity to work in a team (Behaviour with colleagues, technologist and relationship with other healthcare workers)	0-5
5	Initiative, participation in discussions, research aptitude	0-5

SCORING SCALE:

1 Poor
2 Below Average
3 Average
4 Good
5 Excellent

Note: A score of less than 2 in any of above items will represent unsatisfactory completion of internship.

SECTION III. EXTENSION/EXTRA CURRICULAR ACTIVITIES

(CONFERENCES/CME/WORKSHOP/TRAININGS)

Sl. No.	Date	Event (Institution/Place)	Achievements	Signature of the Faculty
1				
2				
3				
4				
5				

DETAILS OF ABSENCE

Sl. No.	Date		Reason	Signature of the Faculty
	From	To		
1				
2				
3				
4				
5				

EVALUATION OF THE LOGBOOK

Sl. No.	Items of observation during presentation	I	II	III	IV	V	VI	Internship
1	Organization of the log book							
2	Adequacy of Content/ Information in the log book							
3	Punctuality							
4	Relevance of Content/ Information in the log book							
5	Shows professional conduct during the Teachingn Learning session							
6	Timely submissions of Projects/Synopsis/Seminar effectively							
7	Work Relationship & Frequency of consulting faculty							
8	Overall quality of department work							
	Total score							
	Signature of the Co-ordinator							

Scoring:
1 Poor
2 Below Average
3 Average
4 Good
5 Excellent

Annexures

MONITORING LEARNING PROGRESS

It is essential to monitor the learning progress of each candidate through continuous appraisal and regular assessment. It not only helps teachers to evaluate students, but also students to evaluate themselves. The monitoring be done by staff of the department based on participation of students in various teaching/ learning activities. It may be structured and assessment shall be done using checklists that assess various aspects. Model checklists are given which may be copied and used.

The learning out comes to be assessed should include:

a. Acquisition of knowledge: the methods used comprise of 'Log Book' which records participation in various teaching/ learning activities and mentoring of students. The number of activities attended and the number in which presentations are made are to be recorded. The log book should periodically be validated by the supervisors. Some of the activities are listed.

b. Seminars/ symposia: the topics should be assigned to the student well in advance to facilitate in depth study. The ability to do literature search, in depth study, presentation skills and use of audio- visual aids are to be assessed using a checklist (see Model ChecklistI).

c. Work diary/ Log Book- every candidate shall maintain a work diary and record his participation in the training programmes conducted by the department such as journal reviews, seminars, etc. Special mention may be made of the presentations by the candidate as well as details of experiments or procedures, if any conducted by the candidate.

d. Records: records, log books and marks obtained in tests will be maintained by the Head of the Department and will be made available to the University.

Log Book

The log book is a record of important activities of the candidates during his training, Internal assessment should be based on the evaluation of log book. Collectively, log books are a tool for the evaluation of training programme of the institution by external agencies. The record includes academic activities as well as the presentations and procedures carried out by the candidate.

Procedure for defaulters: every department should have a committee to review such situations. The defaulting candidate is counseled by the guide and head of the department. In extreme cases of default the departmental committee may recommend that defaulting candidate be withheld from appearing the examination, if he fails to fulfill the requirements inspite of being given adequate chances to set himself right.