School of Health Sciences

CSJM University, Kanpur

Ordinance & Syllabus

for

Bachelor in Medical Radiologic & Imaging Technology

Academic Programme

Ordinance according to NEP-2020

Duration :

3 Years (06 Semesters) & 01 Year Internship

Bachelor in Medical Radiologic & Imaging Technology

ORDINANCE
Chapter
"A"

About BMRIT

Bachelor in Medical Radiologic & Imaging Technology is the health profession concerned with the direct administration of radiation, primarily x-rays, in disease diagnosis and injury assessment and treatment. From the humble beginnings of plain film techniques, we are now with a wide array of imaging methods using Conventional and Digital X-rays, ultrasound, magnetic resonance and Radionuclide. Modern diagnostic radiography and Medical Imaging forms an integral part of medical practice, both in making diagnosis and also in treatment. The term "diagnostic radiography" is used to describe a variety of radiographic or x-ray examinations. These simple procedures as well as those which require the use of contrast agents, make it possible to study organs that otherwise cannot be seen. These professionals are at the heart of modern medicine.

Diagnostic radiographers employ a range of different imaging techniques and sophisticated equipment to produce high quality images of an injury or disease. They take the images using range of techniques including: X-rays, Mammography, Fluoroscopy, CT (computed tomography), MRI (magnetic resonance imaging), Nuclear medicine, Angiography etc. Medical imaging studies have been a cornerstone in medical diagnosis for decades; however, technological advances and the addition of new imaging modalities now place medical imaging among the most dynamic, expanding and high demand fields in clinical medicine.

Radiology is a branch of medicine that uses radiation and imaging technology to diagnose and treat disease. It allows the radiologic technologist to produce images of various internal parts of the body, to aid in the detection of injury or disease by using radiations. Radiology is central to the clinical practice of medicine across a wide range of disciplines. It is the best practical way to diagnose, monitor treatment and detect progression or relapse of many important and common diseases in a minimally invasive and anatomically precise manner. As a consequence of the increasing sophistication and accuracy of clinical imaging, the utilization and importance of radiology has increased dramatically and consistently over the last 20 years. In recent years, the increasing complexity of radiologic procedures has made Radiology and Imaging technology a highly specialized and sophisticated science requiring competently trained personnel to maintain a high degree of accuracy in radiographic positioning and exposure technique. A qualified Medical Imaging Technologist is skilled in both interventional and Diagnostic Radiology.

Course Objectives:

At the completion of this course, the student should –

1. Carry out all diagnostic procedures.
2. Use the necessary laboratory services in a modest manner.
3. Manage a wide range of clinical diagnostic techniques.
4. Demonstrate proficiency with latest medical imaging equipment.
5. Develop leadership qualities in order to lead effectively in a laboratory setting.
6. Provide laboratory services as well as excellent communication with doctors and hospital management.
7. To improve knowledge and skills in data processing, reporting, and record keeping, as well as laboratory investigations.
8. Mammography, CT scans, and MRI procedures should be performed independently.
9. Assist in the performance of specific radiological procedures.
10. Capable of image processing
11. Must be capable of operating all radiological and imaging equipment on their own.
12. It is necessary to assure radiation safety and quality assurance.

13. Maintain and care for all radiological and imaging equipment.
14. Able to recognise and manage emergency circumstances. g. Able to analyse photos for technical quality.
15. Able to take verbal, written, and electronic orders and enter them in the patient's medical record.
16. Computer skills are required.
17. Should be able to deliver professional patient care with empathy.
18. Demonstrate professional progress, professionalism, and an eagerness to learn.
19. Capable of demonstrating the key principles of compassion, integrity, and exploration.
20. Demonstrate a genuine interest, initiative, and drive in the Department's overall development as well as 'Leadership Qualities' for others to emulate.
21. He or she is expected to be self-assured and to carry out all responsibilities with utmost sincerity and honesty.

Course Outcomes:

1. The graduate will be a competent and reflective radio-imaging technician who can function safely and effectively while adhering to legal, ethical and professional standards of practice in a multitude of radio-imaging settings for patients and clients across the lifespan and along the continuum of care.
2. The graduate will utilize critical inquiry and evidence based practice to make clinical decisions essential for autonomous practice.
3. The graduate will function as an active member of professional and community organizations. The graduate will be a service-oriented advocate dedicated to the promotion and improvement of community health.
4. The graduate will demonstrate lifelong commitment to learning and professional development.

1. Bachelor in Medical Radiologic & Imaging Technology degree will be under the **faculty of Medicine** of C.S.J.M. University, Kanpur.

2. Duration of Course :

- Bachelor in Medical Radiologic & Imaging Technology will be a full time course.
- Duration will be three years (06 Semesters) followed by compulsory 01 Year internship.

3. No. of Seats :

Total no. of Students to this course **shall be 40.**

4. Admission.

Eligibility Criteria:

For admission in this course candidate has to pass 10 + 2 or its equivalent examination in Science (Biology) conducted by any Board or University incorporated by law and recognized by this University with minimum 50% marks in aggregate in Physics, Chemistry & Biology (relaxation of 5% marks for SC/ST student).

Mode of Admission :

The candidates for admission to this course shall be selected through an entrance test conducted by the University/ procedure decided by the governing body of the institute or on the basis of merit of marks obtained (Physics, Chemistry & Biology) in 10 + 2 or its equivalent examination.

5. Medium of instruction :

English shall be the medium of instruction in the class and in the University examination.

6. Method of Teaching :

The method of teaching adopted shall be a combination of lectures, demonstrations and practicals by the full time faculty, visiting or part time or guest faculty.

7. Examination:

- As per the University norms.

Duration of Examination:

Each theory paper shall be of three-hours duration OR as per the University norms.

8. Attendance to appear in the end semester examination :

The permission to appear in end semester examination shall be granted to such candidate only who have fulfill the condition of 75% attendance in each subject separately in theory and practical as per the university rule.

Regarding attendance requirements students will have to fulfill the condition of 75% attendance. 15% relaxation in attendance, in exceptional circumstances can be made by the Vice Chancellor on the recommendation of the Director/Coordinator/Head of the Institute/Department.

Chapter

"B"

Regulations: Scheme of Examination

Bachelor in Medical Radiologic & Imaging Technology Part-I (First Semester) University Examination

S. No.	Subjects	Subject code	THEORY MARKS			PRACTICAL MARKS			Total marks
			Theory Paper	Internal Assessment	Total	Practical	Internal Assessment	Total	
1	**Human Anatomy-I**	BMRIT-101	75	25	100	75	25	100	200
2	**Human Physiology-I**	BMRIT -102	75	25	100	75	25	100	200
3	**Clinical Biochemistry**	BMRIT -103	75	25	100	-	-	-	100
4	**Fundamental of Medical Imaging & Radiotherapy**	BMRIT -104	75	25	100	75	25	100	200
								Grand Total	**700**

Bachelor in Medical Radiologic & Imaging Technology Part-II (Second Semester) University Examination

S. No.	Subjects	Subject code	THEORY MARKS			PRACTICAL MARKS			Total marks
			Theory Paper	Internal Assessment	Total	Practical	Internal Assessment	Total	
1	**Human Anatomy-II**	BMRIT-201	75	25	100	75	25	100	200
2	**Human Physiology-II**	BMRIT -202	75	25	100	75	25	100	200
3	**Basic Radiation Physics**	BMRIT -203	75	25	100	_	_	_	100
4	**Preventive Medicine & Radiation Protection**	BMRIT-204	75	25	100	_	_	_	100
								Grand Total	**600**

Bachelor in Medical Radiologic & Imaging Technology Part-III (Third Semester)
University Examination

S. No.	Subjects	Subject code	THEORY MARKS			PRACTICAL MARKS			Total marks
			Theory Paper	Internal Assessment	Total	Practical	Internal Assessment	Total	
1	Advanced Radiographic Techniques	BMRIT-301	75	25	100	75	25	100	200
2	Special Radiographic Techniques & Procedures	BMRIT-302	75	25	100	75	25	100	200
3	General Pathology	BMRIT-303	75	25	100	75	25	100	200
4	General Microbiology	BMRIT-304	75	25	100	-	-	-	100
								Grand Total	700

Bachelor in Medical Radiologic & Imaging Technology Part-IV (Fourth Semester)
University Examination

S. No.	Subjects	Subject code	THEORY MARKS			PRACTICAL MARKS			Total marks
			Theory Paper	Internal Assessment	Total	Practical	Internal Assessment	Total	
1	Radiation Physics & Radiation Protection	BMRIT-401	75	25	100	-	-	-	100
2	Research Methodology & Biostatistics	BMRIT-402	75	25	100	-	-	-	100
3	Pharmacology	BMRIT-403	75	25	100	-	-	-	100
4	Clinical work	BMRIT-404	-	-	-	-	-	100	100
								Grand Total	400

Bachelor in Medical Radiologic & Imaging Technology Part-V (Fifth Semester)
University Examination

S. No.	Subjects	Subject code	THEORY MARKS			PRACTICAL MARKS			Total marks
			Theory Paper	Internal Assessment	Total	Practical	Internal Assessment	Total	
1	Radiotherapy Planning and Quality Control	BMRIT-501	75	25	100	75	25	100	200
2	Equipments of Radio Diagnosis	BMRIT-502	75	25	100	75	25	100	200
3	Interventional Radiology & drugs used in diagnostic Radiology	BMRIT-503	75	25	100	75	25	100	200
4	Clinical work	BMRIT-504				-	-	100	100
								Grand Total	700

Bachelor in Medical Radiologic & Imaging Technology Part-VI (Sixth Semester)
University Examination

S. No.	Subjects	Subject code	THEORY MARKS			PRACTICAL MARKS			Total marks
			Theory Paper	Internal Assessment	Total	Practical	Internal Assessment	Total	
1	**Radiotherapy & Brachytherapy techniques in Malignant and Non-Malignant diseases**	BMRIT-601	75	25	100	-	-	-	100
2	**Equipments of Radiotherapy**	BMRIT-602	75	25	100	-	-	-	100
3	**Orientation in Clinical Sciences**	BMRIT-603	75	25	100	-	-	-	100
4	**Clinical work**	BMRIT-604	-	-	-	-	-	100	100
								Grand Total	**400**

INTERNAL ASSESSMENT

- It will be for theory and practical both.
- It will be done through the whole semester.
- Candidate must obtain at least 40% marks in theory and practicals separately in internal assessment to be eligible for the semester university examination.

- **Internal assessment (Theory)** will be done as follows:

a) Mid-term/ class test etc. = 10 marks
b) Assignments/Project/Quiz/ Presentations etc. = 10 marks
c) Attendance = 05 marks
Total = 25 marks

- **Internal assessment (Practical)** will be done as follows:

a) Laboratory Manual/Assignments/Class test etc. = 10 marks
b) Day to day performance/continuous evaluation/record etc. = 10 marks
c) Attendance = 05 marks
Total = 25 marks

CRITERIA FOR PASSING

- As per the University Norms.

DIVISION:

- As per the University Norms.

INTERNSHIP

- A candidate will have to undergo internship for a period of one year in a medical college/hospital equipped with modern laboratory facility or in a fully equipped laboratory, which fulfills the norms decided by the University .

DEGREE:

The degree of Bachelor in Medical Radiologic & Imaging Technology (BMRIT) course of the University shall be conferred on the candidates, who have pursued the prescribed course of study for not less than six semesters and have passed examinations as prescribed under the relevant scheme and completed 01 year of compulsory internship.

Bachelor in Medical Radiologic & Imaging Technology

Syllabus

Course of Study

Bachelor in Medical Radiologic & Imaging Technology Part-I (First Semester)

			Teaching hours			Credit Hours
Sl.	**Subjects**	**Subject Code**	**Theory**	**Practical**	**Total**	
1.	**Human Anatomy-I**	BMRIT-101	60	60	120	06
2.	**Human Physiology-I**	BMRIT -102	60	60	120	06
3.	**Clinical Biochemistry**	BMRIT -103	80	-	80	04
4.	**Fundamental of Medical Imaging & Radiotherapy**	BMRIT -104	60	60	120	06
					Total	**22**

Bachelor in Medical Radiologic & Imaging Technology Part-II (Second Semester)

			Teaching hours			Credit Hours
Sl.	**Subjects**	**Subject Code**	**Theory**	**Practical**	**Total**	
1.	**Human Anatomy-II**	BMRIT-201	60	60	120	06
2.	**Human Physiology-II**	BMRIT-202	60	60	120	06
3.	**Basic Radiation Physics**	BMRIT-203	80	-	80	04
4.	**Preventive Medicine & Radiation Protection**	BMRIT-204	80	-	80	04
					Total	**20**

Bachelor in Medical Radiologic & Imaging Technology Part-III (Third Semester)

			Teaching hours			Credit Hours
Sl.	**Subjects**	**Subject Code**	**Theory**	**Practical**	**Total**	
1.	**Advanced Radiographic Techniques**	BMRIT-301	60	60	120	06
2.	**Special Radiographic Techniques & Procedures**	BMRIT-302	60	60	120	06
3.	**General Pathology**	BMRIT-303	60	60	120	06
4.	**General Microbiology**	BMRIT-304	80	-	80	04
					Total	**22**

Bachelor in Medical Radiologic & Imaging Technology Part-IV (Fourth Semester)

			Teaching hours			Credit Hours
Sl.	**Subjects**	**Subject Code**	**Theory**	**Practical**	**Total**	
1.	**Radiation Physics & Radiation Protection**	BMRIT-401	80	-	80	04
2.	**Research Methodology & Biostatistics**	BMRIT-402	80	-	80	04
3.	**Pharmacology**	BMRIT-403	80	-	80	04
4.	**Clinical work**	BMRIT-404	-	80	80	04
					Total	**16**

Bachelor in Medical Radiologic & Imaging Technology Part-V (Fifth Semester)

			Teaching hours			Credit Hours
Sl.	**Subjects**	**Subject Code**	**Theory**	**Practical**	**Total**	
1.	**Radiotherapy Planning and Quality Control**	BMRIT-501	60	60	120	06
2.	**Equipments of Radio Diagnosis**	BMRIT-502	60	60	120	06
3.	**Interventional Radiology & drugs used in diagnostic Radiology**	BMRIT-503	60	06	120	06
4.	**Clinical work**	BMRIT-504	-	80	80	04
					Total	**22**

Bachelor in Medical Radiologic & Imaging Technology Part-VI (Sixth Semester)

			Teaching hours			Credit Hours
Sl.	**Subjects**	**Subject Code**	**Theory**	**Practical**	**Total**	
1.	**Radiotherapy & Brachytherapy techniques in Malignant and Non-Malignant diseases**	BMRIT-601	80	-	80	04
2.	**Equipments of Radiotherapy**	BMRIT-602	80	-	80	04
3.	**Orientation in Clinical Sciences**	BMRIT-603	80	-	80	04
4.	**Clinical work**	BMRIT-604	-	80	80	04
					Total	**16**

INTERNSHIP

- There shall be one year of Internship after the final year examination for candidates declared to have passed the examination in all the subjects.
- During the internship candidate shall have to work full time average 7 hours per day (each working day) for one year.
- Each candidate is allowed maximum of 6 holidays during entire Internship Program and in case of any exigencies during which the candidate remains absent for a period more than 6 days, he/she will have to work for the extra days during which the candidate has remained absent.
- The Internship should cover all the services provided by Radio-diagnosis department of medical college/hospital. Based on the attendance and work done during posting the Director/Principal/ head of institution/department shall issue '**Certificate of Satisfactory Completion**' of training following which the University shall award the Bachelor in Medical Radiologic & Imaging Technology degree or declare the candidate eligible for the same.
- **No candidate shall be awarded degree without successfully completing one year internship**.
- Institution shall have to satisfy themselves that satisfactory infrastructure facilities of Radio-diagnosis department exist in the Institute / Hospital where the internship training has to be undertaken. Following parameters / guidelines have been suggested:
  a. It is mandatory for the Institution to have its own well equipped and modern Radio-diagnosis department.
  b. Senior Radiologist should manage Radio-diagnosis department in the Institutes/Hospitals.
- Institute's Director / Principal can at his discretion grant NOC to the students to do the Internship at the place of his choice provided the concerned Hospital fully satisfies the above criteria. For the purpose of granting NOC the candidate shall have to submit to the Institution the status of radiological imaging services available at the place where he intends to do his Internship.

Bachelor in Medical Radiologic & Imaging Technology First Semester

Human Anatomy-I
Subject code: BMRIT-101
Minimum hours: Theory-60 Hrs., Practical-60 Hrs.

Learning objective - It is designed to provide students with the working knowledge of the structure of the human body which is essential foundation for their clinical studies. The study of anatomy will include identification of all gross anatomical structures. Particular emphasis will be placed on description of bones, joints, muscles, the brain, cardio pulmonary and nervous system, as these are related to the application of physiotherapy in patients.

Learning outcomes- The student will be able to –

1. Describe anatomical aspects of muscles, bones, joints, their attachments of thorax and upper quadrant and to understand and discuss analysis of movements with respect to bones, joints and soft tissues related to musculoskeletal system of thorax & upper extremity.
2. Describe structures of the cardio-vascular & respiratory system, mechanism of respiration and the course of blood vessels, structure of rib cage & its contents with special emphasis to lungs, tracheo-bronchial tree, respiratory muscles & heart.
3. Describe source & amp; course of major arterial, venous & lymphatic system, related to upper quadrant, thorax and heart.
4. Describe various structures of the genito-urinary system, abdomen, pelvic organs and sense organs and apply knowledge to living anatomy

THEORY

Topics to be covered:

1. General Anatomy:
   - Introduction to Anatomy, terms and terminology.
   - Regions of Body, Cavities and systems.
   - Surface anatomy – musculo-skeletal, vascular, cardiopulmonary system
   - General Embryology.
   - Applied anatomy.
2. Musculoskeletal system.
   - Connective tissue & its modification, tendons, membranes, special connective tissue.
   - Bone structure, blood supply, growth, ossification, and classification.
   - Muscle classification, structure and functional aspect.
   - Joints – classification, structures of joints, movements, range, limiting factors, stability, blood supply, nerve supply, dislocations and applied anatomy.

2(a). Upper extremity:
   - Bony architecture
   - Joints – structure, range of movement
   - Muscles – origin, insertion, actions, nerve supply
   - Major nerves – course, branches and implications of nerve injuries
   - Development of limb bones, muscles and anomalies
   - Radiographic identification of bone and joints
   - Applied anatomy

2(b). Lower Extremity:
   - Bony architecture
   - Joints – structure, range of movement
   - Muscles – origin, insertion, actions, nerve supply

- Major nerves – course, branches and implications of nerve injuries
- Development of limb bones, muscles and anomalies
- Radiographic identification of bone and joints
- Applied anatomy

2(c). Spine and thorax

- Back muscles - Superficial layer, Deep muscles of back, their origin, insertion, action and nerve supply.
- Vertebral column – Structure & Development, Structure & Joints of vertebra
- Thoracic cage
- Radiographic identification of bone and joints
- Applied anatomy

2(d). Head and neck:

- Cranium
- Facial Muscles – origin, insertion, actions, nerve supply
- Temporomandibular Joints – structure, types of movement

PRACTICAL

Topics to be covered:

1. Identification and description of all anatomical structures.
2. The learning of Anatomy is by demonstration only through dissected parts, slides, models, charts, etc.
3. Demonstration of dissected parts (upper extremity, lower extremity & thoracic).
4. Demonstration of skeleton- articulated and disarticulated.
5. During the training more emphasis will be given on the study of bones, muscles, joints, nerve supply of the limbs and arteries of limbs.
6. Surface anatomy:
   -surface land mark-bony, muscular and ligamentous.
   -surface anatomy of major nerves, arteries of the limbs.
7. Points of palpation of nerves and arteries.

Human Physiology-I
Subject Code: BMRIT-102
Minimum Hours: Theory-60 Hrs., Practical-60 Hrs.

Learning objective- The course in Physiology is designed to give the student an in-depth knowledge of fundamental reactions of living organisms, particularly in the human body. The major topics covered include the following: the cell; primary tissue; connective tissue; skin; muscle; nervous tissue; blood; lymphoid tissues; respiration; blood vessels; circulation; cardiac cycle; systemic circulation; gastrointestinal tract; kidneys; uterus; urinary tract; pregnancy; endocrine system.

Learning outcomes- The student will be able to
1. Describe physiology of blood.
2. Discuss nerve-muscle physiology.
3. Define and describe physiological functions of cardio vascular and respiratory system.
4. Define and describe physiological functions of Digestive system.
5. Define and describe physiological functions of Endocrine system.

THEORY

Topics to be covered:

1. General Physiology
   - Cell: morphology, Structure and function of cell organelles
   - Structure of cell membrane
   - Transport across cell membrane
   - Intercellular communication
   - Homeostasis
2. Blood
   - Introduction-composition & function of blood
   - W.B.C., R.B.C., Platelets formation & functions, Immunity
   - Plasma: composition, formation & functions, Plasma Proteins:-types & functions
   - Blood Groups- types , significance, determination
   - Hemoglobin
   - Haemostasis
   - Lymph-composition, formation, circulation &functions
3. Cardiovascular system
   - Conducting system-components, impulse conduction
   - Heart valves
   - Cardiac cycle- definition, phases of cardiac cycle
   - Cardiac output- definition, normal value, determinants. Stroke volume and its regulation
   - Heart rate and its regulation
   - Arterial pulse, Blood pressure-definition, normal values, factors affecting blood pressure
   - Shock-definition, classification, causes and features
   - Basic idea of ECG
   - Cardiovascular changes during exercise
4. Respiratory System
   - Mechanics of respiration
   - Lung volumes and capacities
   - Pulmonary circulation, transport of respiratory gases
   - Factors affecting respiration

- Regulation of respiration-neural regulation, voluntary control and chemical regulation
- Hypoxia, Hypercapnoea, Hypocapnoea
- Artificial respiration
- Disorders of respiration- dyspnoea, orthopnoea, hyperpnoea, hyperventilation, apnoea, tachypnoea
- Respiratory changes during exercise.

5. Nerve Muscle Physiology
   - Muscles- classification, structure, properties, Excitation contraction coupling
   - Motor unit, EMG, factors affecting muscle tension,
   - Muscle tone, fatigue, exercise
   - Nerve –structure and function of neurons, classification, properties
   - Resting membrane potential & Action potential their ionic basis
   - All or None phenomenon
   - Neuromuscular transmission

PRACTICAL

Topics to be covered:

Practical classes include hematology experiments, clinical examinations, amphibian chart, and recommended demonstrations.

1. Haematology: To be done by the students

a. Study of Microscope and its uses
b. Determination of RBC count
c. Determination of WBC count
d. Differential leukocyte count
e. Estimation of hemoglobin
f. Calculation of blood indices
g. Determination of blood groups
h. Determination of bleeding time
i. Determination of clotting time

Demonstrations only

j. Determination of ESR
k. Determination of PCV

2. Clinical Examination

a. Examination of Radial pulse.
b. Recording of blood pressure
c. Examination of CVS
d. Examination of Respiratory system

3. Amphibian Experiments – Demonstration and Dry charts Explanation.

a. Normal cardiogram of amphibian heart.
i. Properties of Cardiac muscle
ii. Effect of temperature on cardiogram.

4. Recommended Demonstrations

a. Spirometry
b. Artificial Respiration
c. ECG
d. Perimetry

Clinical Biochemistry
Subject Code: BMRIT-103
Min. Hrs. - Theory: 80 Hrs.

Learning objective- This course provides the knowledge and skills in fundamental organic chemistry and introductory biochemistry that are essential for further studies It covers basic biochemical, cellular, biological and microbiological processes, basic chemical reactions in the prokaryotic and eukaryotic cells, the structure of biological molecules, introduction to the nutrients i.e. carbohydrates, fats, enzymes, nucleic acids and amino acids.

Learning outcomes- At the end of the course, the candidate will able to –

1. Describe structures & functions of cell in brief.
2. Describe biochemistry of connective tissues.
3. Discuss acid base balance.
4. Define nutrition, balance diet & nutritional disorders.
5. Describe Nucleotide and Nucleic acid Chemistry
6. Discuss role of enzymes.
7. Describe Carbohydrate Chemistry, Amino-acid Chemistry & Vitamins.
8. Discuss Carbohydrate Metabolism, Lipid Metabolism, Amino acid and Protein Metabolism.

THEORY

Topics to be covered:

1. Nutrition: RDA, BMR, SDA, caloric requirement and balanced diet.
2. Carbohydrates: Definition, classification and general functions. Carbohydrate Metabolism - Glycolysis, T.C.A cycle.
3. Lipids: Definition, classifications and general functions. Essential fatty acids and their importance, Cholesterol, Lipoproteins. Metabolism-β–Oxidation of fatty acids, fatty liver and ketosis.
4. Amino Acids : Definition, classification, essential and non essential aminoacids.
5. Proteins: Definition, classification, and Bio-medical Importance. Metabolism: Formation and fate of ammonia, Urea cycle and its significance.
6. Study of hemoglobin and myoglobin with their functions.
7. Enzymes: Definition, classification with examples, Factors affecting enzyme action, isoenzyme and co-enzyme, Clinical importance of enzymes.
8. Biochemistry of connective tissue - Introduction, various connective tissue proteins: collagen, elastin- structure and associated disorders.
9. Vitamins: Definition, classification and functions, dietary source, daily requirement and deficiency disorders.
10. Diabetes mellitus - definition, types & causes.

Fundamentals of Medical Imaging & Radiotherapy
Subject code - BMRIT- 104
Min. Hrs. - Theory: 60 Hrs. & Practical: 60 Hrs.

Learning Objective- To enable the students to gain knowledge on the field of radiation along with the basic atomic and electric physics to the designing of x-ray circuits and its system.

Learning Outcome- At the end of the course, the students will be able to differentiate different types of radiation and its uses for medical diagnosis and therapy.

THEORY

Topics to be covered:

The X-Ray machine :

1. X-ray production, emission & interactions with matter
2. Radiographic film, latent Image, intensifying screens, Grids
3. Radiographic exposure, Film developing & processing, Radiographic Quality
4. Physical principles of diagnostic Ultrasound Piezoelectric Effect.
5. Acoustic intensity, reflection, impedance & absorption.
6. Ultra Sound transducer, Beam, Operational Modes & Biological effects.
7. Compound Tomography, Principles of operation system components & image reconstruction.
8. Physical principles of Magnetic Resonance Imaging: Basic concept, system components, biological hazards, advantage over CT

PRACTICAL

1. X-ray tubes general features and mobile equipments.
2. Care and maintenance of X-ray equipments and image intensifier
3. To study effects of Kilo Voltage Peak (KVP) and Milli Ampere Second (MAS)
4. T o check the safety of dark room.
5. To check the speed of intensifying screen.
6. To check the developing time test and function.
7. Silver recovery method

Bachelor in Medical Radiologic & Imaging Technology Second Semester

Human Anatomy-II
Subject code: BMRIT-201
Minimum hours: Theory-60 Hrs., Practical-60 Hrs.

Learning objective- Studies are concerned with the topographical and functional anatomy of the limbs. Particular attention is paid to the muscles, bones and joints of the regions. The head and neck and central nervous system (CNS) are studied with particular reference to topics of importance to physiotherapists. The study of the CNS includes detailed consideration of the control of motorfunction.

Learning outcomes- The student will be able to –

1. Describe anatomy of lower quadrant including spine, pelvis and lower extremities: list bones, joints, soft tissues, muscles related to musculoskeletal system of spine & lower extremities and to localize various surface land-marks, apply related radiological and living anatomy
2. Describe anatomy of structures of head, face and neck
3. Describe and outline various parts of nervous system: Source, course & components of various trans-sections of spinal tracts and C.N.S; Source, course & components of various trans-sections of brain, cranial nerves (Special emphasis to III, IV, V, VI and VII) and peripheral nerves.
4. Describe blood circulation of C.N.S. & spinal cord.
5. Describe the course of peripheral nerves.
6. Discuss anatomical basis of clinical conditions of nervous system.
7. Demonstrate movements of lower extremity joints – Identify & describe the origin/insertion, nerve /blood supply, root value & function of various skeletal muscles (including lower extremity and spine).

THEORY

Topics to be covered:

1. Nervous system
   - Classification of nervous system
   - Nerve – structure, classification, microscopy with examples.
   - Neurons, classification with examples. Simple reflex arc.
   - Parts of a typical spinal nurve/Dermatome
   - Central nervous system – disposition, parts and functions
   - Cerebrum
   - Cerebellum
   - Midbrain & brain stem
   - Blood supply & anatomy of brain
   - Spinal cord- anatomy, blood supply, nerve pathways
   - Pyramidal, extra pyramidal system
   - Thalamus, hypothalamus
   - Structure and features of meningies
   - Ventricles of brain, CSF circulation
   - Development of nervous system & defects
   - Cranial nerves – (course, distribution, functions and palsy)
   - Sympathetic nervous system, its parts and components
   - Parasympathetic nervous system
   - Applied anatomy

2. Sensory system
   - Structure and function of
     - Visual system
     - Auditory system
     - Gustatory system
     - Olfactory system
     - Somato sensory system
3. Cardiovascular system
   - Circulatory system – major arteries and veins of the body, structure of blood vessels
   - Heart structure, positions, chambers, valves, internal & external features
   - Blood supply to heart
   - Conductive system of heart
4. Lymphatic system
   - Circulation, structure & functions
   - Lymph nodes
5. Respiratory system
   - Structure of upper and lower respiratory tract

   Thorax:
   - Pleural cavities & pleura
   - Lungs and respiratory tree
   - Heart and great vessels
   - Diaphragm
6. Digestive system
   - Parts of digestive system
   - Abdominal cavity – divisions
   - Muscles of abdominal wall
   - Liver
   - Pancreas
   - Spleen
   - Alimentary canal
   - Gall bladder
   - Intestine (small & large)
7. Urinary and Reproductive system
   - Urinary system
   - Pelvic floor, innervations
     - Kidney, Ureter, bladder, urethra
   - Genital system – male and female
     - Reproductive system of male
     - Reproductive system of female
8. Endocrine system
   - Pituitary gland
   - Thyroid
   - Parathyroid

PRACTICAL

Topics to be covered:

1. Demonstration of dissected parts (abdominal viscera, face and brain).
2. Demonstration of skeleton- articulated and disarticulated.
3. During the training more emphasis will be given on the study of CNS, PNS, Cardiovascular System, Respiratory System, Digestive System, Urinary System bones& reproductive system muscles, joints, nerve supply of the limbs and arteries of limbs.
4. Audio visual material for practical study of related anatomical parts.
5. Demonstration on Anatomical models
6. Students visit to Anatomy Museum

Human Physiology-II
Subject Code: BMRIT-202
Minimum Hours: Theory-60 Hrs., Practical-60 Hrs.

Learning objective- The course in Physiology is designed to give the student an in-depth knowledge of fundamental reactions of living organisms, particularly in the human body.

Learning outcomes- At the end of the course student will be able to:

1. Describe physiology of special senses.
2. Discuss Exercise physiology.
3. Define and describe physiological functions of Nervous system.
4. Define and describe physiological functions of renal system.
5. Define and describe physiological functions of Reproductive system.

THEORY

Topics to be covered:

1. Nervous system
   - Introduction, central and peripheral nervous system, functions of nervous system
   - Reflexes- monosynaptic, polysynaptic, superficial, deep &withdrawal reflex
   - Sense organ, receptors, electrical & chemical events in receptors
   - Sensory pathways for touch, temperature, pain, proprioception & others
   - Control of tone & posture: Integration at spinal, brain stem, cerebellar, basal ganglion levels, along with their functions
   - Motor mechanism: motor cortex, motor pathway: the descending tracts-pyramidal& extra pyramidal tracts-origin, course, termination & functions. Upper motor neuron and lower motor neuron paralysis.
   - Spinal cord lesions- complete transection & hemisection of the spinal cord
   - Autonomic nervous system: features and actions of parasympathetic & sympathetic nervous system
   - Hypothalamus
   - Higher functions of nervous system
   - Special senses- eye, ear, nose, mouth
2. Renal System
   - Physiology of kidney and urine formation
   - Glomerular filtration rate, clearance, Tubular function
   - Water excretion, concentration of urine-regulation of Na^+, Cl^-, K^+ excretion
   - Physiology of urinary bladder
3. Digestive System
   - Digestion & absorption of nutrients
   - Gastrointestinal secretions & their regulation
   - Functions of Liver &Stomach.
4. Endocrinology
   - Physiology of the endocrine glands – Pituitary, Pineal Body, Thyroid, Parathyroid, Adrenal, Gonads, Thymus, Pancreas. Hormones secreted by these glands, their classifications and functions.
5. Male & female reproductive system
   - Male - Functions of testes, pubertal changes in males, testosterone - action & regulations of secretion.
   - Female - Functions of ovaries and uterus, pubertal changes, menstrual cycle, estrogens and progestron - action and regulation.

PRACTICAL

Topics to be covered:

Recognize the abnormalities in the ECG and spirometry findings in clinical examination

a. Examination of Sensory system
b. Examination of Motor System
c. Examination of reflexes
d. Examination of cranial nerves

Basic Radiation Physics
Subject code - BMRIT- 203
Min. Hrs. - Theory: 80 Hrs.

Learning objective- To enable the students to gain knowledge on the field of radiation along with the basic atomic and electric physics.

Learning outcome- At the end of the course, the students will be able to differentiate different types of radiation and its uses for medical diagnosis and therapy.

THEORY

Topics to be covered:

Fundamental of Physics

- Matter & energy
- Radiation & spectra
- Electricity and Magnetism
- Atoms & nuclei
- Radioactivity

X-rays

- Production
- Properties
- Measurement
- Interaction of X-rays- Gamma rays and electron radiation with matter and principles of differential absorption in biological materials.

Preventive Medicine and Radiation Protection
Subject code - BMRIT- 204
Min. Hrs. - Theory: 80 Hrs.

Learning Objective- The objective of this particular section of the foundation course is to sensitize potential learners with essential knowledge on basic concept of health and universal disease conditions and basic idea on radiation protection.

Learning outcome- At the end of the course, student will be able to understand and work under various health organization and also will be able to give and apply protection from different types of radiation causing health hazards.

THEORY

Topics to be covered:

1. Definition of Health, Determinants of Health, Health Indicators of India, Health Team Concept.
    a. National Health Policy
    b. National Health Programmers (Briefly objectives and scope)
    c. Population of India and Family welfare programme in India.
2. Family :
    b. The family, meaning and definitions
    c. Functions of types of family
    d. Changing family patterns
    e. Influence of family on individuals Health, family and nutrition, the effects of sickness in the family and psychosomatic disease.
3. Community:
    a. Rural community: Meaning and features – Health hazards to rural communities, health hazards to tribal community.
    b. Urban community – Meaning and features – Health hazards of urbanities
4. Culture and Health Disorders :
    a. Social Change
    b. Meaning of social changes
    c. Factors of social changes
    d. Human adaptation and social changes
    e. Social changes and stress
    f. Social changes and deviance
    g. Social changes and health programme
    h. The role of social planning in the improvement of health and rehabilitation
5. Social Problems of disabled:
    a. Consequences of the following social problems in relation to sickness and disability
    b. Population explosion.

Bachelor in Medical Radiologic & Imaging Technology Third Semester

Advanced Radiographic Techniques
Subject code - BMRIT- 301
Min. Hrs. - Theory: 60 Hrs. & Practical: 60 Hrs.

Learning Objective- The objective is to learn basic knowledge on ultrasound, CT scan and MRI equipments for various imaging and equipments used for imaging and techniques.

Learning Outcomes- At the end of the course, student will be able to assist the radiologist and sinologist on:

• Transducer selection
• Patient selection and preparation
• Managing image quality and artefacts in ultrasound, CT scan and MRI
• Sufficient knowledge about contrast media selection and its adverse effect.

THEORY

Topics to be covered:

1. **Ultra Sound :**
   - Principle of Ultra Sound
   - Types of Ultra sound
   - Description of Equipment
   - Indication and clinical Application
2. **CT Scan :**
   - Basic principle of CT scan
   - Description of Equipment
   - Conventional CT Scan
   - Indications and Contra indications
3. **MRI**
   - Preparation of Patients
   - Contrast Media
   - Indication and Contraindication
   - Clinical application, Procedure
   - MR Angiography

PRACTICAL

1. Based on Theory topics.

Special Radiographic Techniques & Procedures
Subject code - BMRIT- 302
Min. Hrs. - Theory: 60 Hrs. & Practical: 60 Hrs.

Learning objective- The main objective is to aware the student about the conventional and special technique of radio imaging technique like (manual image processing & fluoroscopy / dynamic imaging/contrast media) along with the image formation, developing and reading. To learn basic and special projections for the better and delineation diagnosis of the disease conditions of different anatomical structure (upper and lower extremities, shoulder joint, pelvis griddle, whole spine).

Learning outcomes- At the end of the course, student will be expert in practicing various radiographic positioning and procedure independently and understanding the radiographic diagnosis. The students will have knowledge on:

- Image recording techniques of various parts of the body
- Guidelines for radiodiagnosis
- Contrast media and its component.

THEORY

Topics to be covered:

1. Special procedure and related Contrast Media
   - Contrast Media
   - Emergency in Radiology Department
   - Excretory System
     a) IVP
     b) RGU
     c) MCU
   - Oral Cholecystography
   - Percutaneous Trans Hepatic Cholecystography
   - G.I. Tract
     a) Barium Swallow
     b) Barium Meal Series
     c) Barium Meal Follow Through
     d) Barium Enema
   - Hystero Salpingoraphy
   - Angiography
   - Tomography
2. Radiography of body parts and their poisoning
   - Upper limb
   - Lower limb
   - Abdomen, Head and Neck
3. Guideline for design and location of X-ray equipments
4. Dark Room designing
   - Outline structure of Dark Room
   - Material used
   - Miscellaneous

PRACTICAL

1. Radiography in various positions for all the special radiological procedures, using contrast media as per syllabus.

2. Positioning and treatment of various cases patients by using:
   a. Prescribed filters and wedges
   b. Protection of various organs

General Pathology
Subject code - BMRIT - 303
Min. Hrs. - Theory: 60 Hrs. & Practical: 60 Hrs.

Learning Objectives-

- To provide general insight into the history and basics of General Pathology**.**
- To Impart knowledge about general outline of pathology**.**
- To provide brief knowledge about basic procedure done in pathology laboratory.

Learning outcome-

At the end of the course, the students will have knowledge in inflammation and repair aspects as well as the various pathological change of the human body.

THEORY

Topics to be covered:

1. Cell Injury and Cellular Adaptations.

a) Normal Cell
b) Cell Injury- types of cell injury, etiology of cell injury, morphology of cell injury, cellular swelling.
c) Cell death: types- autolysis, necrosis, apoptosis & gangrene.
d) Cellular adaptations-atrophy, hypertrophy, hyperplasia & dysplasia.

2. Inflammation

a) Acute inflammation - vascular event, cellular event, inflammatory cells.
b) Chronic Inflammation - general features,granulomatous inflammation, tuberculoma.

3. HemodynamicDisorders:

Edema, hyperemia, congestion, hemorrhage,circulatory disturbances, thrombosis, ischemia&infarction.

4. Neoplasia:

Definition, how does it differ from hyperplasia,Feature of Benign Tumor and Malignant Tumor
difference between benign tumor and malignant tumor.

5. Healing

Definition, different phases of healing, factors influencing wound healing.

PRACTICAL

1. Components & setting of the Compound microscope.
2. Focusing of object.
3. Use of low & high power objectives of microscope.
4. Use of oil immersion lens.
5. Care and Maintenance of the microscope.
6. Different types microscopy
   - Dark field microscopy
   - Fluorescence Microscopy
7. Electron Microscopy in brief.1. Introduction to Pathology

General Microbiology
Subject code - BMRIT - 304
Min. Hrs. - Theory: 60 Hrs. & Practical: 60 Hrs.

Learning objective-

- To provide knowledge of bacteria, Sterilization etc.

Learning outcome-

At the end of the course, the students will be able to understand the pathogenesis of the diseases caused by the organisms in the human body.

THEORY

Topics to be covered:

1. **General characters and classification of Bacteria.**
2. **Characteristics of Bacteria**
   Morphology- Shape, Capsule, Flagella, Inclusion, Granule, Spore.
3. **Growth and Maintenance of Microbes**
   Bacterial division, Batch Culture, Continuous culture, bacterial growth- total count, viable count, bacterial nutrition, oxygen requirement, CO_2 requirement, temperature, pH, light.
4. **Sterilization and Disinfection.**
   Physical agents- Sunlight, Temperature less than 100^0C, Temperature at 100^0C, steam at atmospheric pressure and steam under pressure, irradiation, filtration.
   Chemical Agents- Alcohol, aldehyde, Dyes, Halogens, Phenols, Ethylene oxide.
5. **Culture Media**
   Definition, uses, basic requirements, classification, Agar, Peptone, Transport Media, Sugar Media, Anaerobic Media, Containers of Media, Forms of Media
6. **Staining Methods**
   Simple, Grams staining, Ziehl-Neelsen staining or AFB staining, Negative Impregnation
7. **Collection and Transportation of Specimen**
   General Principles, Containers, Rejection, Samples- Urine, Faeces, Sputum, Pus, Body fluids, Swab, Blood.
8. **Care and Handling of Laboratory Animals**
   Fluid, Diet, Cleanliness, Cages, ventilation, Temperature, Humidity, handling of Animals, Prevention of disease.
9. **Disposal of Laboratory/Hospital Waste**
   Non-infectious waste, Infected sharp waste disposal, infected non-sharp waste disposal.

PRACTICAL

1. Preparation of swabs/sterile tubes & bottles.
2. Preparation of smear.
3. Staining.: Gram & Ziehl -Neelsen staining.
4. Identification of Culture media.
5. Identification of instruments.
6. Identification of common microbes

Bachelor in Medical Radiologic & Imaging Technology Fourth Semester

Radiation Physics & Radiation Protection
Subject code - BMRIT - 401
Min. Hrs. - Theory: 80 Hrs.

Learning objective- The objective is to learn aim, objective, philosophy and principle of radiation physics and protection to protect oneself from biological effect of radiation and monitoring of radiation exposure.

Learning outcomes- At the end of the course, student will have knowledge on:
- Radiation physics and its determinants
- Quality control and assessment of equipments installed in radio department.
- Layout planning of radiology department.

THEORY

Topics to be covered:

Radiation Physics :

1. Atomic structure as applied to generation of X-rays and radioactivity spectrum of diagnostic imaging and therapy X ray.
2. Effects of variation of tube voltage current, filtration, III waveform and target material on X-ray production lows of radioactivity and decay schemes of different alpha, Beta, gamma ray. Megatron and position emitters as used in medicine especially in radiotherapy.
3. Artificial radionuclide generators employed in medicine in general and radiotherapy sources in particulars.
4. Interaction of radiation with matter attenuation absorption and scattering phenomenon.
5. Photoelectric absorption Compton scattering pair-production and annihilation process ionization, effects of geometry of thickness of the absorber. Dependence on the nature and atomic number of the absorber and on radiation quality.
6. Transmission of X-ray through body tissues linear energy transfer.
7. Range of secondary electrons and electron build up relative amount of scatter from homogeneous and homogonous beam defining the passage through a patient.
8. Physical requirements of beam defining devices e.g. cones, diaphragm, collimators etc.
9. Units of radiation measurements specification of quality and half- valve thickness (HIV) and its measurements, filters and filtration.
10. Measurement of radiation and dosimeteric procedures.
11. Radiation detectors and their principles of working.
12. Definition of Bragg-peak , percentage depth dose, peak scatter factor, tissue air-ratio, tissue maximum ratio, scatter air ratio, isodose curves and radiation penumbra of different beams.
13. Wedge filters, wedge angle, hinge angle.
14. Compensator beams flattering filters, scattering foils.
15. Physical properties of phantom materials, bolus and substitutes.
16. Factor used for treatment dose calculations, Daily treatment time and monitor units calculation method, physical aspects of electron and neutron therapy.

Radiation Protection :

1. Definition of radiation hazards maximum permissible dose and annual limit of intake (ALI) permissible dose levels on and around sealed source housing and installation principles of radiation protection and MPD of different ICRP rules, stochastic and non-stochastic effects.
2. Importance of 'ALARA' physical principles of design and planning of installation safe work practice in teletherapy and brachytherapy.
3. Shielding materials Radiation survey and personnel monitoring devices film badge, TLD badges pocket dosimeters.

Research Methodology and Biostatistics
Subject Code: BMRIT-402
Min. Hrs. : 80 Hrs.

Learning Objective: The objective of this module is to help the students understand the basic principles of research and methods applied to draw inferences from the research findings

Learning Outcomes: The student will be able to

1. Describe the basic principles of research and methods applied to draw inferences from the research findings
2. Discuss the basic concepts of Biostatistics
3. Explain Design, Methodology of Experiment/Survey, Demography & vital statistics, Sampling & interpretation of Data

THEORY

Topics to be covered:

Research Methodology

1. Introduction to Research methodology:
   Meaning of research, objectives of research, Motivation in research, Types of research & research approaches, Research methods vs methodology, Criteria for good research.
2. Research problem:
   Statement of research problem, Statement of purpose and objectives of research problem, Necessity of defining the problem
3. Research design:
   Meaning of research design, Need for research design, Features for good design, Different research designs, Basic principles of research design.
4. Measurement & scaling techniques: Measurement in research-
   Measurement scales, sources of error in measurement, Technique of developing measurement tools, Meaning of scaling, its classification, important scaling techniques.
5. Methods of data collection: collection of primary data, collection data through questionnaires & schedules, Difference between questionnaires & schedules.
6. Computer technology:
   Introduction to Computers, computer application in research computers & researcher.

Biostatistics

1. **Introduction**: Meaning, definition, characteristics of statistics. Importance of the study of statistics, Branches of statistics, Statistics and health science , Parameters and Estimates, Variables and their types, Measurement scales.
2. **Tabulation of Data**: Basic principles of graphical representation, Types of diagrams – histograms, frequency polygons, smooth frequency polygon, cumulative frequency curve, Normal probability curve.
3. **Measures of Central Tendency**: Need for measures of central Tendency, Definition and calculation of **Mean** – ungrouped and grouped, interpretation and calculation of Median- ungrouped and grouped, Meaning and calculation of Mode, Geometric mean & Hormonic mean, Guidelines for the use of various measures of central tendency.
4. **Measures of Dispersion** : Range, mean deviation, standard deviation & variance.
5. **Probability and Standard Distributions:** Meaning of probability of standard distribution, the binominal distribution, the normal distribution, Divergence from normality – skewness, kurtosis.
6. **Correlation & regression :** Significance, correlation coefficient, linear regression & regression equation.
7. **Testing of Hypotheses , Level of significance, Degrees of freedom.**
8. **Chi-square test, test of Goodness of fit & student t-test.**
9. **Analysis of variance & covariance:** Analysis of variance (ANOVA), what is ANOVA? Basic principle of ANOVA, ANOVA technique, Analysis of Co variance (ANCOVA)
10. **Sampling:** Definition, Types- simple, random, stratified, cluster and double sampling. Need for sampling - Criteria for good samples, Application of sampling in community, Procedures of sampling and sampling designs errors.

Pharmacology
Subject code - BMRIT - 403
Min. Hrs. - Theory: 80 Hrs.

Learning objective- The objective of this course is to help the students understand the basic concepts of drugs, their mechanism of action on the human body.

Learning outcome- At the end of the course, the students have thorough knowledge of the basic principle of pharmacokinetics and pharmacodynamics as well as the commonly used drugs, mechanism, indications, contraindications, drug dosage and adverse effects.

THEORY

Topics to be covered:

1. **General Pharmacology:**
   - Introduction, Definitions, Classification of drugs, Sources of drugs, Routes of drug administration,
   - Distribution of drugs, Metabolism and Excretion of drugs, Pharmacokinetics, Pharmacodynamics,
   - Factors modifying drug response.
   - Elementry knowledge of drug toxicity, drug allergy, drug resistance, drug potency, efficacy & drug antagonism.
   - Adverse drugs reactions & management
2. **Autonomic Nervous system:**
   - General considerations – The Sympathetic and Parasympathetic Systems, Receptors, Somatic Nervous System
   - Cholinergic and Anti-Cholinergic drugs, Adrenergic and Adrenergic blocking drugs, Peripheral muscle relaxants.
3. **Cardiovascular Pharmacology :**
   - Antihypertensive and drugs useful in Angina.
4. **Neuropharmacology (in brief) :**
   - Sedative-Hypnotic Drugs: Barbiturates, Benzodiazepines
   - Antianxiety Drugs: Benzodiazepines, Other Anxiolytics
5. **Inflammatory/Immune Diseases-**
   - Non-narcotic Analgesics and Nonsteroidal Anti-Inflammatory Drugs: Acetaminophen, NSAIDs, Aspirin, Nonaspirin NSAIDs, drug Interactions with NSAIDs
   - Glucocorticoids: Pharmacological Uses of Glucocorticoids, adverse effects, Physiologic Use of Glucocorticoids
6. **Digestion and Metabolism (in brief):**
   - Gastrointestinal Pharmacology: Peptic Ulcer Disease, Constipation, Diarrhea
   - Drugs Used in Treatment of Diabetes Mellitus: Insulin, Oral Hypoglycemics
7. **Pharmacology of different dyes used in Radiological procedures.**

Clinical Work
Subject code - BMRIT - 404
Min. Hrs. - Practical : 80 Hrs.

Students shall be deputed to various labs of Radiology department wherein they shall undergo practical training of handling patients, collection and processing of investigation (X Ray, Special procedures, CT Scan, MRI, Ultrasound etc) and equipments.

Identification of patient's particulars based on CR number, Lab Number and transfer of samples from collection to different labs.

Process of performing various tests in different labs.

Each student is required to maintain a logbook of the various posting. Student's performance shall be evaluated on continuous basis by the faculty concerned.

Bachelor in Medical Radiologic & Imaging Technology Fifth Semester

Radiotherapy Planning and Quality Control
Subject code - BMRIT- 501
Min. Hrs. - Theory: 60 Hrs. & Practical: 60 Hrs.

Learning objective- The objective is to learn about the clinical aspects of radiotherapy treatment and quality control in various radio imaging modalities.

Learning outcome- At the end of the course, student will have knowledge on scanning protocol, indications, patient preparation, quality control & image quality.

THEORY

Topics to be covered:

1. Definition of treatment planning.
2. Planning procedure in general with special emphasis on turnout localization and target volume measurement by conventional radiographic method and simulator imaging.
3. Role of special contrast medium base radiotherapy.
4. CT/MRI/Ultrasound/ radionuclide imaging methods physical and clinical requirements of field selection of treatment in Teletherapy, role of portal films in treatment planning. Choice of central axis percentage depth dose data and isodose curve form a spectrum of radiotherapy beams used treatment.
5. Requirement and practice of organ shielding single multiple fields, and rotational field therapy, planning procedures.
6. Computerized treatment planning system, choice of dose, time and fraction.
7. Safety of critical organs in planning methods, Role of treatment shell immobilization devices and laser in patients set up and positioning.
8. Acceptance tests on therapy, simulator telescope megavoltage X-ray and electron bean machines.
9. Contribution of technologist in radiation calibration of quality control assurance in execution of radiation treatment.

PRACTICAL

1. Treatment planning of patient
2. Dealing with equipments
3. Maintenance of all radiological equipments
4. Safety of critical organs in planning methods, Role of treatment shell immobilization devices and laser in patients set up and positioning.
5. Computerized treatment planning system uses in radiation dose, time and fraction.
6. Uses of special contrast medium in radiotherapy.

Equipments of Radio Diagnosis
Subject code - BMRIT- 502
Min. Hrs. - Theory: 60 Hrs. & Practical: 60 Hrs.

Learning objective- The objective is to learn about the various equipments used for diagnosis of the medical conditions with various radio imaging modalities.

Learning outcome- At the end of the course, student will have knowledge on radio diagnosis equipments.

THEORY

Topics to be covered:
Equipments and description :

1. Color Doppler
   - Flow Imaging
   - indication
   - clinical Application
2. **CT Scan**
   - Advancement in CT
   - Spiral CT
   - Preparation of Patient
   - Contrast Media
   - Indication and Contraindication
   - Technical aspects of various procedures in CT
3. **Nuclear medicines, PET scan and Mammography**
   - Definition
   - Characteristic of Radio Nuclide
   - Commonly used Radio Nuclides
   - Description of Equipment

PRACTICAL

1. Application of various procedures in well-equipped Hospitals and Diagnostic Centers.
2. Uses and functioning method of ultrasound probe.
3. Patient evaluation on different disease and their diagnosis.
4. Working method of CT scan and MRI.
5. Calculation of radio nuclide isotopes.

Interventional Radiology & Drugs used in diagnostic Radiology
Subject code – BMRIT- 503
Min. Hrs. - Theory: 60 Hrs. & Practical: 60 Hrs.

Learning objective- The objective is to learn about the special procedures done with the interventional approaches in radiology department with the help of radiological equipments.

Learning outcomes- At the end of the course, student will have knowledge on:

1. Equipments, procedure, technique and outcome of interventional radiology
2. Drugs, contrast media &equipments of interventional radiography
3. Sterilized techniques and radiation protections.

THEORY

Topics to be covered:

Interventional Radiology

- Definition
- Indication
- Clinical Application
- Name of different type of procedures

Anaesthesia in Diagnostic Radiology

- Facilities regarding general Anesthesia in the X-ray Department.
- Anesthetic Problems associated specific technique)
  a) Vascular Studies
  b) Carotid Angiography
  c) Venography
  d) T and NMR

PRACTICAL

1. Radiography in various positions for all the special radiological procedures, using contrast media as per syllabus.
2. Positioning and treatment of various patients by using
   a) Prescribed filters and wedges
   b) Protecting various organs
   c) Handle all patients in special and general radiography.

Clinical Work
Subject code - BMRIT - 504
Min. Hrs. - Practical : 80 Hrs.

Students shall be deputed to various labs of Radiology department wherein they shall undergo practical training of handling patients, collection and processing of investigation (X Ray, Special procedures, CT Scan, MRI, Ultrasound etc) and equipments.

Identification of patient's particulars based on CR number, Lab Number and transfer of samples from collection to different labs.

Process of performing various tests in different labs.

Each student is required to maintain a logbook of the various posting. Student's performance shall be evaluated on continuous basis by the faculty concerned.

Bachelor in Medical Radiologic & Imaging Technology Sixth Semester

Radiotherapy & Brachytherapy techniques in Malignant and Non-Malignant diseases
Subject code - BMRIT- 601
Min. Hrs. - Theory: 80 Hrs.

Learning Objective- The objective is to learn radiotherapy and brachytherapy techniques to be used in malignant and non-malignant diseases.

Learning Outcome- At the end of the course, student will be expert handling patients with malignant and non-malignant disease referred to radiology department. Knowledge to allocate the patients to various modalities according to their pathological condition.

THEORY

Topics to be covered:

1. Orthovoltage Techniques in skin tumours, and cancers of the breast, Advantages and disadvantages of orthovoltage in radiotherapy.
2. Tele isotope cobalt therapy Techniques in skin and deep sealed tumours parallel opposed fields and small beam directed therapy and wedge field Techniques in head and neck tumours especially cancers of larynx treatment, Techniques for cancer of maxillary antrum and pituitary tumours.
3. Treatment techniques in cancer of breast by telecobalt and low energy megavoltage X-rays and electron beam.
4. Tele and brachy-therapy techniques of treatment of different stages of carcinoma cervix uteri with special emphasis on HDR and LDR brachytherapy.
5. Three field Techniques in cancer of esophagus and bladder.
6. Radiotherapy technique in medulo blastoma. Whole body and hemi body radiation Techniques.
7. Treatment Techniques of malignant and non-malignant conditions in ovarian and kidney tumors.
8. Radiation Treatment techniques of lymphomas with special emphasis on mantle field irradiation radiotherapy, techniques in head and neck cancer.

Salient features of computers in radiotherapy and its application.

1. Introduction to computer, Hardware and software component.
2. Input and output data systems computerized treatment planning systems in tele brachytherapy and documentations.

Radiological protection

1. Dose limits of occupational workers & Publics.
2. Principle & Method of Protection.
3. Monitoring devices.

Equipments of Radiotherapy
Subject code - BMRIT - 602
Min. Hrs. - Theory: 80 Hrs.

Learning objectives- The objective is to learn about the various equipments used for treatment of the medical conditions with various radiotherapy modalities.

Learning outcomes- At the end of the course, student will have knowledge on radiotherapy equipments.

THEORY

Topics to be covered:

1. Orthovoltage equipment with special reference to physical design equipment of tube and its accessories and interlocks, gamma ray sources used in radiotherapy especially cobalt 60 source its construction and source housing and handling mechanism.
2. Principles of isocentric Tele-isotope machines, megavoltage x-ray and electron beam accelerators and betatron.
3. Salient features of components of Linear Accelerator like tube design, wake guide, target design, beam bending system.
4. Radio-frequency generators like magnetron and klestron.
5. Basic principle of remote after-loading system/machines and sources used.
6. Principles of simulators and vacuum forming machines for making casts.
7. Sterofoam template cutting system introduction to radio-surgery.
8. Equipment and dosimetry equipment.

Orientation in Clinical Sciences
Subject code - BMRIT- 603
Min. Hrs. - Theory: 80 Hrs.

Learning Objective- The objective is to learn basic pathological conditions related to cardiology, surgery, nephrology, orthopedic, gastrology, neurology and general medicine for the diagnosis.

Learning outcome- At the end of the course, student will be expert handling patients with different disease condition referred to radiology department. Knowledge to allocate the patients to various modalities according to their pathological condition.

THEORY

Topics to be covered:

Medicine

- **Respiratory & cardiac diseases:** Pericarditis, Valvular diseases, Rheumatic Heart Disease, Heart failure , Chronic Bronchitis, Emphysema, Brochitis, Pneumonia, Tuberculosis, Pleural effusion, Empyema, Spontaneous Phenumo thorax.
- **Gastro intestinal diseases**: Aclasia cardia, Peptic ulcer, Intestinal obstruction, Crohn's disease, Ulcerative colitis, Pancreatitis, Portal Hypertension, Ascitis, Cirrhosis, Cholecystitis, Diseases of Renal System, Glomerulo nephritis, Nephrotic Syndrome,
- **Renal diseases:** Urinary calculi, Polycystic Kidney disease
- **Disease of brain:** Cerebral Vascular Disorders, Meningitis, Encephalitis.

Orthopaedics

- Fracture
- Type, mechanism, Healing, Delayed Union, Non- complication
- Injuries of the shoulder girdle, Dislocation of shoulder
- Fracture of Humerus, Elbow Forearm
- Fracture of Distal Radius & ulna
- Injuries of the carpal
- Dislocation of Hip
- Femur, Tibia, Ankle, calcaneum
- Acute & chronic osteo arthritis
- Rhematoid arthritis
- Paget's Disease
- Ankylosing spondylitis
- Club foot
- Bone Tumour-Benign Malignant

Surgery

- Cholelithiasis
- Peritonitis
- Supraphrenic Abscess
- Appendicitis
- Benign Hypertrophy of prostate
- Sinusitis

Obstetrics

- Diagnosis of Pregnancy
- Normal Labour

Clinical Work
Subject code - BMRIT- 604
Min. Hrs. - Practical: 80 Hrs.

Students shall be deputed to various labs of Radiology department wherein they shall undergo practical training of handling patients, collection and processing of investigation (X Ray, Special procedures, CT Scan, MRI, Ultrasound etc) and equipment.

Identification of patient's particulars based on CR number, Lab Number and transfer of samples from collection to different labs.

Process of performing various tests in different labs.

Each student is required to maintain a logbook of the various posting. Student's performance shall be evaluated on continuous basis by the faculty concerned.