SHRI GURU RAM RAI UNIVERSITY

[Estd. by Govt. of Uttarakhand, vide Shri Guru Ram Rai University Act no. 03 of 2017 & recognized by UGC u/s (2f) of UGC Act 1956]

SYLLABUS FOR

Bachelor Of Medical Radio Imaging and Technology

With CO and PO Mapping

School of Paramedical Sciences

(W.E.F 2023-2024)

BACHELOR OF MEDICAL RADIO IMAGING AND TECHNOLOGY

OUTCOME BASED EDUCATION

Programme outcome (POs)

Students will be able to

PO 1	Develop basic knowledge of anatomical and physiological composition of body.
PO2	Identify, understand, formulate and solve problems related to radiological equipment
PO3	Design and develop solutions in case of emergency condition during radiological examination and identify various pathological conditions.
PO4	Develop an understanding to conduct investigation of complex problems.
PO5	Apply the basic and advanced knowledge of hardware, software and applications of computers in health care systems.
PO6	Develop an understanding to evaluate the factors affecting technical quality of images and various pathological conditions.
PO7	Develop an understanding of the impact of radiation on society.
PO8	Understand their ethical and legal responsibilities as a radiographer.
PO9	Understand the importance of team work while handling patients with drugs & equipment in general as well as in emergency situations.
PO10	Develop understanding of laws/provisions for radiation safety by various regulatory bodies.
PO11	Implement and follow standard protocols while doing various radiological procedures and scans to avoid any reaction.
PO12	Maintain quality assurance, quality control measures, safety procedures and maintenance of radiological equipment.

SHRI GURU RAM RAI UNIVERSITY DEHRADUN (UTTARAKHAND)

REGULATIONS OF THE UNIVERSITY FOR THE AWARD OF THE DEGREE OF BACHELOR OF SCIENCE ON MEDICAL RADIO & IMAGING TECHNOLOGY

In exercise of the powers conferred by section of the SGRR University Act no.3 of 2017.Academic Council of the Shri Guru Ram Rai University Dehradun hereby makes the following regulations: -

SHORT TITLE AND COMMENCEMENT

(1) These regulations shall be called "THE REGULATIONS FOR THE BACHELOR OF SCIENCE IN MEDICAL RADIO & IMAGING TECHNOLOGY OF THE SHRI GURU RAM RAI UNIVERSITY, DEHRADUN".

(2) They shall come into force from the 2021-2022 academic sessions.

(3) The regulations framed are subject to modification from time to time by the sending them to the Academic Board of the University.

ADMISSION, SELECTION, MIGRATION AND TRAINING
ADMISSION TO THE B. Sc, MEDICAL RADIO & IMAGING TECHNOLOGY COURSE.

'ELIGIBILITY CRITERIA'

No Candidate shall be allowed to be admitted to the B.Sc. Medical Radio Imaging Technology (BMRIT) until: -

1) He/she has completed the age of 17 years on or before first day of July of the year commencing the prescribed academic session of the said course;

2) He/she has passed qualifying examination as under:

a) The Indian school Certificate Examination which is equivalent to 10+2 Higher Secondary Examination after a period of 12 years study, the last two years study comprising of Physics, Chemistry, Biology or Mathematics or any other elective subject with English at a level not less than the core course for English as prescribed by the National Council for Educational Research and training after the introduction of the introduction of the 10+2+3 years educational structure as recommended by the National Committee on education;

OR

b) The Intermediate examination in science of an Indian University/Board or other recognized examine body with Physics, Chemistry, Biology /Maths which shall include a practical test in these subjects and also English as a compulsory subject.

OR

c) B.Sc. examination of an Indian University, provided that he/she has passed the B.Sc. examination with not less than two of the following subjects-Physics, Chemistry (Botany, Zoology) and further that he/she has passed the earlier qualifying examination with the following subjects Physics, Chemistry/Biology and English (10+2 level)

OR

d) 10+2 with vocational training in Radiology/ Medical Microbiology/MLT/Diploma in Radiology/ Diploma in MLT are also eligible.

MIGRATION/TRANSFER OF CANDIDATE

1) Migration/ Transfer of candidate from one recognized institution to another institution of this University or from another University will not generally be considered.

2) However, under extra ordinary circumstances, the Vice –Chancellor shall have the power to place any migration/ transfer he deems fit I the Governing Council and get its approval for grant of permission for migration/ transfer to candidates to candidates undergoing course of study in affiliated institutes of this university.

TRAINING PERIOD AND TIME DISTRIBUTION

1) The course of BMRIT shall be Three and a Half academic years including 6 months compulsory internship. The practical training should be in SMI hospital. A part from practical training in non-clinical subjects, the students shall also undergo practical training in

the said hospital equipped with X-rays, Ultra Sound & CT scan, MRI in Dept. of Radiology of the said hospital.

2) The period of Three & a Half years is divided into phase as follows: -

(a) Phase I- First Year B.Sc. Medical Radio & Imaging Technology (BMRIT) (One Year duration)

i)	Human Anatomy	**BMRT-101**
ii)	Human Physiology	**BMRT -102**
iii)	Preventive Medicine and Health care	**BMRT -103**
iv)	Basic & Radiation Physics	**BMRT -104**
v)	Orientation of Diagnostic Radiology & Radiological Imaging	**BMRT -105**
vi)	Medical Laws & Radiation Protection in Diagnostic Radiology	**BMRT-106**
vii)	Human Anatomy	**BMRT-101P**
viii)	Human Physiology	**BMRT-102P**
ix)	Orientation of Diagnostic Radiology & Radiological Imaging	**BMRT-105P**

(b) Phase II- Second Year B. Sc Medical Radio & Imaging Technology (BMRIT) (One Year duration)

I.	Orientation in Para clinical Science.	**BMRT - 201**
II.	Special radiological equipment	**BMRT - 202**
III.	Radiographic Techniques.	**BMRT - 203**
IV	special radiological procedures	**BMRT - 204**
V.	Computed tomography	**BMRT - 205**
VI.	Magnetic Resonance Imaging	**BMRT – 206**
VII.	Special radiological equipment	**BMRT 202P**
VIII.	Radiographic Techniques	**BMRT 203P**
IX.	Special Radiological Procedures	**BMRT 204P**

(c) Phase III- Third Year B. Sc Medical Radio Imaging Technology (BMRIT) (One Year Duration)

I.	Pathology in Diagnostic Radiology.	**BMRT -301**
II.	Radiotherapy Planning, Procedure and Equipment	**BMRT -302**
III.	Advanced Modalities	**BMRT -303**
IV.	Interventional Radiological Procedures and Techniques.	**BMRT -304**
V.	Patient Care and Radiation Protection in Diagnostic Radiology.	**BMRT -305**
VI.	Advanced Radiological Procedures	**BMRT -306**
VII.	Radiotherapy Planning, Procedure and Equipment	**BMRT-302P**
VIII.	Interventional Radiological Procedures and Techniques.	**BMRT-304P**
IX.	Advanced Radiological Procedures	**BMRT-306P**

(d) Phase IV - Six –months compulsory internship in SMI Hospital.

Compartments / Supplementary/ Back Paper:

I. A student who obtains 40% of the marks individually Including Internal but has failed in two papers shall be permitted to appear in those papers only at the two consecutive examination and if he/she passes at either of those examination he/she will be deemed to have passed the examination and will be promoted to higher class. (Aggregate marks should be 50%).

II. A student (s) appearing in back paper/ supplementary shall be Eligible to join the next higher Class provisionally however any student who fails to pass Ist year would not be admitted in 3rd year course.

There shall be one main examination in a year and a supplementary to be held not less than 3 months after publication of its results.

THEORY EXAMINATION: All the papers in each year carrying 100 marks out of which 30 marks will be internal assessment and 70 marks for external assessment based on the question paper sent by the University the paper will be 3 hrs. Each paper will have 8 questions out of which the candidate will have to attempt 5 questions.

The practical examination will be held with the Final Examination. The practical and Viva voice in each subject will carry 30% marks as internal & 70% marks as external assessment (according to examination scheme) prescribed for the year.

PHASE DISTRIBUTION AND TIMING OF EXAMINATION:

1. Ist Annual Examination at the end of Ist year.
2. 2nd Annual Examination at the end of 2nd year.
3. 3rd Annual Examination at the end of 3rd year.
4. Six months Internship after third Annual Examination.

EXAMINATION REGULATIONS

Essentialities for qualifying to appear in professional examinations. The performance in essential components of training to be assessed based on.

ATTENDANCE: 75% of attendance in a subject for appearing in the examination is compulsory provided he/she has 80% attendance in non-lecture teaching i.e., seminars group discussions. Practical in Hospital postings and bedside clinics of SMI hospital.

INTERNAL ASSESSMENT:

(a) It shall be based on day today assessment (see note), evaluation of student assignment, preparation for seminar. Clinical case presentation etc.

(b) Sessional examinations shall be conducted throughout the course. The question of number of examinations is left to the institutions;

(c) Day to day records should be given importance during internal assessment.

(d) Weightage for the internal assessment shall be 20% marks of the total marks fixed for internal.

(e) Student must secure at least 50% marks of the total marks fixed for internal Assessment in Particular subject in order to eligible to appear in final university examination of the subject.

Note: Internal Assessment shall be different ways in which students' participation in learning process is evaluated. Some examples are as follows-

(i) Preparation of subject for student's seminar.
(ii) Preparation of a clinical case for discussion.
(iii) Clinical case study problem solving exercise.
(iv) Proficiency in carrying out a practical or a skill in small research project.
(v) Multiple choice questions (MCQ) test after completion of a system/ teaching. Each item tested shall be objectively assessed and recorded. Some of the items can be assigned as homework'/Vacation work.

UNIVERSITY EXAMINATIONS:

Theory Papers will be prepared by examiners as prescribed. Nature of question will be short answer type / objective type and marks for each part indicated separately.

Practical/ clinical will be conducted in the laboratories or hospital wards. Objective will be to assess proficiency in skills Conduct of experiment, interpretation of date and logical conclusion. Clinical cases should preferably include common diseases not esoteric syndromes or rare disorders. Emphasis should be on candidate's capability in eliciting physical signs and their interpretation.

Viva/ oral evaluation is based on theory and practical.

The examinations are to be designed with a view to ascertain whether the candidate has acquired the necessary for knowledge, skills along with clear concepts of the fundamentals, which are necessary for him to carry out his professional day to day work competently. Evaluation will be carried out on an objective basis and practical Question papers should preferably be of short structure/objective type.

Clinical cases/ practical shall take into account common diseases, which the student is likely to come in contact in practice.

During evaluation (both external and internal) it shall be ascertained if the candidate has acquired the skills. -

There shall be one main examination in a year and a supplementary to be held not less than 6 months after publication of its results.

Note: Result of all University Examinations shall be decided before the start of teaching for next session.

DURATION OF EXAMINATION & QUESTIONS

(i) Each written paper will be attempted by the student in the given three-hour duration.

(ii) A clinical / practical examination in any subject for student shall not be for more than a day.

INTERNSHIP

GENERAL

Internship is a phase of training wherein a graduate is expected to conduct actual practice of Medical Radio Imaging & Technology and acquired skills under supervision so that he/she may become capable of functioning independently.

SPECIFIC OBJECTIVES

At the end of internship training the graduate shall be able to:

(i) Perform all the diagnostic techniques.

(ii) Use discretely the essential diagnostic services.

(iii) Manage all type of clinical diagnostic methods (X-ray, Fluoroscopy, Mammography, CT and MRI)

(iv) Demonstrate skills in handling the modern equipment in Medical Radio Imaging & Technology.

(v) Develop leadership qualities to function effectively as a reader of the Laboratory environment.

(vi) Render service of the Laboratory setup and to communicate effectively with the Doctors and the hospital management.

INTERNSHIP TIME DISTRIBUTION

Total Period of Internship: 6 Months

OTHER DETAILS

(1) All parts of internship shall be done at SMI hospital.

(2) Every candidate will be required after passing the final B.Sc. Medical Radio Imaging Technology, Examination to undergo compulsory rotatory internship to the satisfaction of the college Authorities and University concerned for a period of 6 months so as to be eligible for the award of the degree of Bachelor of Science in Medical Radio & Imaging Technology.

(3) The University shall issue a provisional B.Sc. Pass Certificate on passing the final examination after the internship completion on demand by the candidate.

(4) The intern shall be entrusted with responsibilities under direct Supervision of Senior Radiotechnologist. They shall not be working independently.

(5) Interns will not issue certified reports or other related documents under their signature.

ASSESSMENT OF INTERNSHIP

(1) The interns maintain the record of work, which is to be verified and certified by the senior Radiotechnologist 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 test in knowledge, skills and attitude during and at the end of training. Based on the record of work and date of evaluation the Director / Principal shall issue 'Certificate of Satisfactory Completion" of training following which the University shall award the B.Sc. (MRIT) Degree and declare the candidate eligible for the same.

(2) Satisfactory completion shall be determined on the basis of the following:

(a) Proficiency of knowledge required for each Diagnostic Techniques

(b) The competency in skills expected to manage each Diagnostic Technique.

- Competency for performance of self –performance
- Of having assisted in procedures
- Of having observed.

(c) Responsibility, Punctuality, workup Diagnostic Techniques, involvement in procedures, follows of report.

(d) Capacity to work in a team (behaviour with colleagues, nursing staff and relationship with Medical and Para medicals.

(e) Initiating, participation in discussions, research aptitude.

MEDIUM OF INSTRUCTION

English shall be the Medium of Instructions for all the subject of study and for examinations of Bachelor of Medical Radio Imaging Technology course.

WORKING DAYS IN AN ACADEMIC YEAR

Each Academic year shall spread over a period of not less than 180 working days.

CONDITION OF LACK OF ATTENDANCE

As per the existing rules and regulations of SGRR University, Dehradun

SUBMISSION OF RECORD NOTE BOOKS

At the time of practical examination, each candidate shall submit to the examination the record notebooks duly certified by the Head of the College as a bonafide record of work done by the candidate.

CLASSIFICATION OF SUCCESSFUL CANDIDATE

REVALUATION OF ANSWER PAPAERS

The regulations as prescribed by the University for other Undergraduate Course shall be applicable.

WARD OF MEDALS AND PRIZES

The University shall award at its convocation medals and prizes to outstanding candidates, as and when instituted by the donors as per the schedule as per the prescribed for the award.

UNIVERSITY RANKING

First, Second and third University ranks may be awarded to candidates, who have passed all the examination in the first appearance and taking into consideration the aggregate marks obtained in all the subjects in which the candidate had been examined during the entire course of study.

DISTRIBUTION OF PAPERS & MARKS IN VARIOUS YEARS

IST YEAR

Course Code	Course title	Periods			Credit	Evaluation Scheme		
		L	T	P		IA*	EE*	Total
BMRT 101	Human Anatomy	3	-	-	3	30	70	100
BMRT 102	Human Physiology	3	-	-	3	30	70	100
BMRT 103	Preventive Medicine and Health Care	3	-	-	3	30	70	100
BMRT 104	Basic & Radiation Physics	3	-	-	3	30	70	100
BMRT 105	Orientation of Diagnostic Radiology & Radiological Imaging	3	-	-	3	30	70	100
BMRT 106	Medical Laws and Radiation Protection in Diagnostic Radiology	3	-	-	3	30	70	100
BMRT 101P	Human Anatomy	-	-	2	2	30	70	100
BMRT 102P	Human Physiology	-	-	2	2	30	70	100
BMRT 105P	Orientation of Diagnostic Radiology & Radiological Imaging	-	-	2	2	30	70	100
	TOTAL	18	-	6	24	270	630	900

IIND YEAR

Course Code	Course title	Periods			Credit	Evaluation Scheme		
		L	T	P		IA*	EE*	Total
BMRT 201	Orientation in Paraclinical Sciences	3	-	-	3	30	70	100
BMRT 202	Special Radiological Equipment	3	-	-	3	30	70	100
BMRT 203	Radiographic Techniques	3	-	-	3	30	70	100
BMRT 204	Special Radiological Procedures	3	-	-	3	30	70	100
BMRT 205	Computed Tomography	3	-	-	3	30	70	100
BMRT 206	Magnetic Resonance Imaging	3	-	-	3	30	70	100
BMRT 202P	Special radiological equipment	-	-	2	2	30	70	100
BMRT 203P	Radiographic Techniques	-	-	2	2	30	70	100
BMRT 204P	special radiological procedures	-	-	2	2	30	70	100
	TOTAL	18	-	6	24	270	630	900

IIIRD YEAR

Course Code	Course title	Periods			Credit	Evaluation Scheme		
		L	T	P		IA*	EE*	Total
BMRT-301	General Pathology in Diagnostic Radiology.	3	-	-	3	30	70	100
BMRT-302	Radiotherapy Planning, Procedure and Equipment	3	-	-	3	30	70	100
BMRT-303	Advanced Modalities	3	-	-	3	30	70	100
BMRT-304	Interventional Radiological Procedures and Techniques	3	-	-	3	30	70	100
BMRT-305	Patient Care and Radiation Protection in Diagnostic Radiology	3	-	-	3	30	70	100
BMRT 306	Advanced Radiological Procedures	3	-	-	3	30	70	100
BMRT-302P	Radiotherapy Planning, Procedure and Equipment	-	-	2	2	30	70	100
BMRT 303P	Interventional Radiological Procedures and Techniques	-	-	2	2	30	70	100
BMRT 304P	Advanced Radiological Procedures	-	-	2	2	30	70	100
	TOTAL	18	-	6	24	270	630	900

Note:

1. The minimum pass marks will be 40% in individual subjects in theory and Practical and 50% in aggregate.

2. The Theory and Practical papers will be of equal weightage with 30% in Sessional and 70% in final University Examination.

3. The division will be determined on the basis of the aggregate of the marks of all the courses/Subjects prescribed for the degree as under:
   a) Passed with honours will be rewarded on 75% and above only in first attempt.
   b) First Division will be marked on 60% and above.
   c) Second Division will be marked on 50% and above but less than 60%.

Examination Scheme:

Components	Internal Examination (Average of Ist Internal exam & IInd Internal Exam)	External Examination Yearly
Weightage (%)	Out of 30 Marks	70 Marks

Bachelors in Medical Radio Imaging and Technology Ist year

Course code	**:**	BMRT-101
Course Name	**:**	Human Anatomy
Semester /Year	**:**	Ist Year

	L	**T**	**P**	**C**
	03	**-**	**-**	**03**

UNIT-I

Introduction- Scope of Anatomy-Terminology-Body parts and areas- Anatomical position of the body, Axis and planes of body-Different Positions of body-Body Cavities: Ventral cavity, Dorsal Cavity, Planes & Sections. Organization of cells-Organization of Tissues- Organs and systems- The integumentary System: Structure and function of skin.

UNIT-II

Bones-Classification development, parts of long bones and blood supply of bones.
Muscles- Classification of various muscles, types of muscles, their role.
Joints- Definition, classification, movements of different joint.

UNIT –III

Upper Extremity
Osteology- Clavicle, scapula, Humerus, Radius, ulna, carpals, metacarpals and Phalanges.
Soft tissue- Breast, pectoral region, axilla, front & back of arm, front of forearm, back of forearm, Palm, dorsum aspect of Hand. (Only Outline)
Joints- Shoulder girdle, Shoulder joint, elbow joint, radio-ulnar joint, wrist joint and joints of hand.
Surface measuring and Radiological Anatomy of upper limb.

UNIT-IV

Lower Extremity
Osteology-Hipbone, Femur, Tibia, Fibula, Patella, Tarsals, Metatarsals and Phalanges.
Soft tissue parts: Gluteal region, front and back of the thigh (femoral triangle, femoral canal and inguinal canal) medial side of the thigh (adductor canal). Lateral side of the thigh, popliteal fossa, Anterior and posterior compartment of leg, sole of the foot. (Only outline)
Joints- Hip joint, knee joint, ankle joints of the foot.
Surface Anatomy and Radiological Anatomy of Lower Limb.

UNIT –V

Trunk

Osteology-Vertebra and ribs, sternum.

Soft tissue- Vertebral muscles & intercostals muscles

Joints-Costochondral, Costovertebral, Intervertebral Joints.

Head And Neck

Osteology-Mandible and bones of skull.

Joints-Temporomandibular Joints.

Surface and Radiological Anatomy of the Head & Neck.

UNIT- VI

Thorax

Pleura, Lungs, Mediastinum, Pericardium, Heart, Trachea, Oesophagus

Surface measuring and Radiological Anatomy of Thorax.

Abdomen

Soft Tissue-Abdominal cavity & Peritoneum, Stomach, Intestine, Spleen, Pancreas, Liver & Gall Bladder, Kidney & Ureter, Urinary Bladder & Urethra, Diaphragm, Male & Female reproductive organs, Rectum & Anal Canal. (Only Outline)

II- Surface measuring and Radiological Procedure Used in the study of Abdominal Organs.

UNIT- VII

Neuro Anatomy

Meninges & C.S.F., Sulcus & Gyrus and various areas of Cerebral Hemispheres, Thalamus, Hypothalamus and basal Ganglia, Cerebellum, Pons Medulla, Spinal Cord, IIIrd, IVth & Lateral Ventricles, Blood Supply of Spinal Cord & Brain.

Surface and Radiological Anatomy of Brain.

Text Books:

1. B.D. Chourasia's Human Anatomy Fifth Edition
2. Vishram Singh's Textbook of Anatomy

Reference Books:

1. Atlas of Anatomy
2. Osteology

Course outcomes (COs):

Upon successful completion of the course a student will be able to

CO1	To identify different body parts, body surfaces, skeletal composition of human body.
CO2	To categorize bones, muscles, body parts as per their shape and size.
CO3	To determine various joints of body, body cavities, muscular attachments of different body parts.
CO4	Able to explain major and minor arterial and venous supply of different body parts.
CO5	Able to assess important regions present in different compartments of the body.
CO6	To write anatomical composition of body.

CO-PO Mapping

Course	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	-	3	1	-	1	-	-	-	-	-	-
CO2	3	-	3	-	-	2	-	-	-	-	-	-
CO3	3	-	2	-	-	2	-	-	-	-	-	-
CO4	3	-	3	-	-	1	-	-	-	-	1	-
CO5	3	-	2	-	-	2	-	-	-	-	-	-
CO6	3	-	2	-	-	1	-	-	-	-	-	-

3: Highest Correlated, 2: Medium Correlated, 1: Lowest Correlated

Course code	:	BMRT-102	L	T	P	C
Course Name	:	Human Physiology	03	-	-	03
Semester /Year	:	Ist Year				

UNIT-I

Cell Physiology: Structure of cell, Transportation system of cell, Active and passive Organization of body, Body Composition, Body fluid volumes

Terminology: Diffusion, viscosity, Osmosis, Tonicity, homeostasis

UNIT-II

Physiology Of Blood: Composition of Blood, Function of RBC WBC, Blood groups, Blood Circulation-General Principles, Blood Groups, anaemia, Haemoglobin, Coagulation

Lymphatic System: Composition of lymphatic system, Role of lymphatic system, Lymphatic tissues, Thymus

UNIT-III

Cardiovascular System: Structure and function of Heart, arteries, veins and capillaries Cardiac cycle and output, pulse rate, Blood Pressure: Systolic and diastolic, heart sounds, E.C.G, Hypertension and Hypotension and their types, shock.

UNIT-IV

Respiratory System: Organs included in the respiratory system, Mechanism of respiration- internal and external, Pulmonary function and pulmonary circulation, Capacity and lung volumes, Gas exchange at lungs, Gas transport between lungs and tissues.

Definition of Hypoxia, Dyspnoea, cyanosis, asphyxia, COPD, obstructive airway diseases.

UNIT-V

Digestive System: Introduction to digestive system, Function of organs of GIT, The Salivary glands, The stomach and its secretion, Intestine & its secretion, Function of liver, spleen, gall bladder and pancreas, digestion, absoption and assimilation, GI hormones, Physiology of digestion of carbohydrates, lipids and proteins

Definition of Jaundice, cirrhosis, pancreatitis, hepatomegaly

UNIT-VI

Endocrinal System: General Principle of endocrinology, Thyroid, Parathyroid, adrenal, pituitary.

Urogenital System

Physiology of Kidney and Urine formation, Constituent of normal urine etc., Kidney function tests, Physiology of Male and Female reproductive system.

UNIT-VII

Nervous System: Reflex arc, Physiology of the central nervous system, Physiology of Spinal cord, Neuron, nerve impulse, Physiology of the sympathetic and Parasympathetic nervous system, Function of Cerebrum, Cerebellum, basal ganglia, thalamus, Hypothalamus, CSF and Blood brain barrier.

UNIT-VIII

Skin: Structure & function of Skin.
Special Senses: General organization and physiology.
Electrolytes: Their balance and Imbalances.
Definition of acidosis and alkalosis.
Nerve physiology of muscles: Structural and functional properties of different muscles.

Text Books:

1. Human Physiology for BDS by Dr. A.K Jain (Fifth Edition)

2. Textbook of Radiology for Residents and Technicians by S.K Bhargava. Sumeet Bhargava Fourth Edition

Reference Books:

1. Anatomy and Physiology in Health and Illness by Ross and Wilson

Course outcomes (COs):

Upon successful completion of the course a student will be able to

CO1	To define about basic physiological phenomenon of body.
CO2	To identify role of physiology, mechanism of physiology.
CO3	To determine general principle of endocrinology, structure and function of skin
CO4	To illustrate physiology of kidney and reproductive system, KFT and constituents of urine.
CO5	To review reflex arc, physiology of CNS, physiology of sympathetic and parasympathetic nervous system and to assess function of different parts of brain.
CO6	To facilitate experimental handling by doing TLC, DLC, RBC, Hb, ESR, BP etc. during lab sessions

CO-PO Mapping

Course	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	-	3	-	-	3	-	-	1	-	-	-
CO2	3	-	3	-	-	3	-	-	-	-	-	-
CO3	3	-	2	-	-	2	-	-	-	-	-	-
CO4	3	-	3	1	-	3	-	-	1	-	-	-
CO5	3	-	2	1	-	3	-	-	-	-	-	-
CO6	3	-	3	2	3	2	-	-	-	-	-	-

Bachelors in Medical Radio Imaging and Technology Ist year

Course code	**:**	BMRT-103
Course Name	**:**	Preventive Medicine and Health Care
Semester /Year	**:**	Ist Year

	L	**T**	**P**	**C**
	03	**-**	**-**	**03**

UNIT-I

Introduction: Definition of Health care, Common health problems of developed and developing countries, Role of nutritional diet, Various nutritional disorders, Role of physical exercises and yoga in prevention of various diseases.

Water, air, and noise Pollution: Removal of water hardness, purification of water and standards of water quality. Air and Pollution and their prevention. Housing and air conditioning.

UNIT-II

Hygiene and sanitation: Sanitation barriers, excreta disposal and disposal of hospital waste. Incineration and disinfection.

Infections and control: Microbial Pathogenicity, source and spread of infection in community, pathogenesis, toxigenicity, invasiveness, variations and virulence, host factors controlling infections to men, mode of spread and their control by physical & chemical agents.

UNIT-III

Epidemiology: Definition of Epidemiology, aetiology, surveillance and control of community infections of various communicable diseases like malaria, TB, dengue, rabies, poliomyelitis, measles, cholera, leprosy, diarrhoea. Emergence of drugs resistance. Methods of prevention and control-Isolation of patients, quarantine and incubation periods of various infectious diseases.

UNIT- IV

Prophylactic immunization: Rationale of immunization, immune response and duration of immunity, controlled studies of prophylactic Vaccines and hazards immunization. Various national immunization programs and vaccine schedule. Reproductive, Family Planning & Child Health Care Programs.

Various Health related organizations: WHO, UNICEF, UNFPA, FAO, Indian Red Cross Society, ILO, Family Welfare and Planning.

UNIT- V

Health care by balance diet and yoga: Normal constituents of diet, various diet programs, balanced diet and factors responsible for aetiology of various nutritional disorders. Carcinogens in food, Role of regular exercise and yoga in prevention and management of various diseases.

Health Planning and Management: Health planning, Planning cycle, malaria eradication and various other national health policy and programs. Various national immunization programs, National cancer control or prevention programs, AIDS control program, Population control program.

Text Books:

1. Park's Textbook of Preventive and social medicine 25th Edition

Reference Books:

1. Community Medicine (PSM) Vivek Jain Third Edition

Course outcomes (COs):

Upon successful completion of the course a student will be able to

CO1	To outline about water, air and noise pollution
CO2	To associate with hygiene and sanitation.
CO3	To examine infection and control like microbial pathogenicity and source and spread of infection
CO4	To illustrate about epidemiology, surveillance, methods of prevention and control of infection.
CO5	To debate on prophylactic immunization.
CO6	To write about role of balanced diet and yoga for health care and health planning and management.

CO-PO Mapping

Course	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	-	-	-	-	-	-	-	-	-	-	-	-
CO2	-	-	1	-	-	2	-	1	-	-	-	-
CO3	1	-	-	-	-	3	1	-	-	-	-	1
CO4	1	-	1	-	-	3	1	1	1	-	-	-
CO5	-	-	-	-	-	2	1	-	-	-	-	-
CO6	-	-	2	-	-	1	2	-	-	-	-	-

Bachelors in Medical Radio Imaging and Technology Ist year

Course code	**:**	BMRT-104
Course Name	**:**	Basic Physics
Semester /Year	**:**	Ist Year

	L	**T**	**P**	**C**
	03	**-**	**-**	**03**

UNIT-I

Basic concepts: Physical Quantity, Basic Units and measurements – Fundamental and derived units, Power, Work, Force, Energy, Temperature, Heat, electric field, magnetic field, luminous intensity, sound, Radioactivity and various quantities used in diagnostic and therapeutic radiology-SI units of above parameters.

Atomic structure- Atomic Structure-Atom-Nucleus - Atomic Number, Mass Number- electron orbit and energy levels-Periodic table -Isotopes-Isobars-Isomers- Ionization-excitation-Binding

UNIT-II

Electrical energy and power – electric charge-electric potential-unit of charge, current and potential-resistance, coulombs law, Ohm 's law, circuit laws, Joules Law, Kirchhoff's law, -capacitance and capacitors-oscillators-Alternating current-direct current- Heating effect of current-transformers theory and losses, practical aspects-reactance, resonance, impedance and power factors.

Magnetism-Para magnetism, diamagnetism, ferromagnetism- Magnetic field lines-Magnetic flux-Magnetic effect of an electric current - applications of magnetic field. Electro-magnetic induction,

UNIT-III

Heat: Definition- temperature-heat capacity- Specific Heat capacity- Conduction- Convection-Radiation-Thermal Conductivity- equation of thermal conductivity (k)-thermal expansion-Newton's law of cooling-Stefan Law-Process of Heat dissipation in X-ray tubes.

Sound: Nature and propagation of sound-speed of sound-intensity of sound-interference of sound-Diffraction- Ultrasonic Wave- Production of Ultrasonic Wave-Piezo-electric effect.

UNIT-IV

Electromagnetic Waves- Introduction-electromagnetic spectrum-energy density-frequency and wavelength-radiation in atmosphere-Inverse square law

Radiation: Quantum nature of radiation-mass energy equivalence- Luminescence- Fluorescence-Phosphorescence-X-Rays introduction, frequency, wavelength- Properties of alpha particles, beta particles and gamma rays.

UNIT-V

Radioactivity: Natural and artificial radioactivity-alpha decay-beta decay and Gamma decay. Half-life- Physical Half Life- Biological Half Life- Nuclear Fission-Nuclear reactor.

Radiation sources-Natural and artificial-production of radio isotopes-reactor produced isotopes Fission products-Gamma ray source for medical uses.

UNIT-VI
X-ray: Discovery of X-rays- Production of X-rays (bremsstrahlung and Characteristic radiations)- X-Ray emission spectrum-Properties of X-Rays- X-Ray Quality and Quantity- Half Value Layer- Application of X-rays
UNIT-VII
Interaction of Ionizing radiation with matter: Attenuation of X-ray or Gamma Rays-Absorption and scattering- linear attenuation coefficient- coherent scattering-Photoelectric effect-Compton scattering-pair production and photoelectric Disintegration-**Differential Absorption.** Exponential attenuation- Half- value thickness- Tenth value Thickness- Linear energy Transfer-

Text Books:

1. Textbook of Radiology for Residents and Technicians by S.K Bhargava. Sumeet Bhargava Fourth Edition
2. Basic Radiological Physics by K. Thayalan Second Edition

Reference Books:

1. Christensen's Physics of Diagnostic Radiology by Thomas S. Curry

Course outcomes (COs):

Upon successful completion of the course a student will be able to

CO1	To define basic concepts of atomic structure, ionization, excitation, basic units and measurements.

CO2	To interpret practical aspects behind electromagnetic induction, capacitance, circuit laws, impedance and power factors.
CO3	To examine the phenomenon of Radioactive decay, production of radioisotopes and fission products.
CO4	To explain the process of radiation production and interpret properties of X- rays.
CO5	To debate on the interaction of radiation with matter and outline measurement units like absorbed dose & RAD.
CO6	To write about measurement of radiation dose through different radiation detectors

CO-PO Mapping

Course	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	1	-	-	1	3	-	3	2	1	2	-	1
CO2	-	2	-	2	2	2	-	-	-	-	-	1
CO3	-	-	-	-	2	-	2	-	-	1	1	-
CO4	-	-	-	1	3	3	2	-	-	-	2	1
CO5	-	1	-	-	-	-	3	-	-	-	-	1
CO6	-	1	-	-	3	-	1	1	-	1	-	1

Bachelors in Medical Radio Imaging and Technology Ist year

Course code	**:**	BMRT-105
Course Name	**:**	Orientation of Diagnostic Radiology and Para clinical Imaging
Semester /Year	**:**	Ist Year

	L	T	P	C
	03	**-**	**-**	**03**

UNIT-I

The X-Ray machine: Historical aspects of X-ray Tube-Gas filled X-ray tube- Construction of X-Ray Tube, Tube housing, Anode & Cathode, Types of anodes, --speed of anode rotation- target angle- Construction, working principle and limitations of stationary anode X-Ray tube- Construction, working principle and limitations of rotating anode X-Ray tube Focal spot size, Line focus Principle-

UNIT-II

Quality, Quantity and Intensity of X-rays, HVL Measurements, Heel effect, soft and Hard X-rays, added and inherent Filtration, tube failure causes- Factors affecting X-ray Emission spectra-off focus radiation

Exposure timing. - the Heat produced by X-ray tubes- tube rating-Heat units- Requirement of X-ray production

UNIT-III

Circuit of X-ray generator, types of generators- 3 Phase, 6 Phase and 12 Phase circuits, Filament circuit, high voltage circuit- Rectifiers, half wave and full wave rectification -Exposure switches and timers- tube current- tube voltage- space charge-Filament current- Filament Voltage-Automatic Exposure control assembly-Switch fuses

UNIT-IV

Control of Scattered Radiation- Beam limiting devices (cones, diaphragms, beam centering devices, light beam collimators)

Cassette: Structure, Types of cassettes, Film Handling-Storage of Film-Loading & Unloading, safe light.

Radiographic Film: Structure- Types of radiographic-Single and double coated radiographic films-Screen and non-screen films-Latent Image-Film Handling-Film artifacts

UNIT-V

Intensifying Screens: Types of intensifying screen, Construction and working principle of IR-Luminescence-screen characteristics.

Grid: Principle, Structure, Types of Grids, Stationary grid, moving grid Parallel grid, Focused grid, crossed grid, moving grid potter bucky diaphragms-types of grid movements- Grid control system-Interlocking and X-ray tube overload protection- Grid Ratio- Grid cut off-

UNIT-VI
Layout: Lay out of X-ray room and dark room Radiographic Exposure, Film Developing & Processing, Dark room, **Radiographic Image:** Magnification penumbra un sharpness inverse square law patient exposure-Image contrast, density, sharpness, magnification, distortion of image, noise and blur, radiographic illuminators, mottle

Text Books:

1. Textbook of Radiology for Residents and Technicians by S.K Bhargava. Sumeet Bhargava Fourth Edition
2. Basic Radiological Physics by K. Thayalan Second Edition

Reference Books:

1. Christensen's Physics of Diagnostic Radiology by Thomas S. Curry

Course outcomes (COs):

Upon successful completion of the course a student will be able to

CO1	To Describe the use x-ray exposure switches
CO2	To classify the equipment maintenance of equipment procedure of X-ray machine and cooling method.
CO3	To Demonstrate work flow digital/equipment handling.
CO4	To assess the importance of radiographic exposure.
CO5	To evaluate the radiographic image quality
CO6	To design the parameter for identification of radiographic image quality

CO-PO Mapping

Course	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	-	2	1	-	2	-	-	-	-	-	-	1
CO2	-	2	2	-	2	1	1	1	-	1	-	3
CO3	-	2	-	-	2	1	-	-	-	-	-	1
CO4	-	1	2	-	-	-	-	-	-	-	1	-
CO5	-	-	-	-	1	3	-	-	-	-	-	-
CO6	-	-	-	-	1	3	-	-	-	-	-	-

Bachelors in Medical Radio Imaging and Technology I[st] year

Course code	**:**	BMRT-106
Course Name	**:**	Medical Laws and Radiation Protection in Diagnostic Radiology
Semester /Year	**:**	I[st] Year

	L	**T**	**P**	**C**
	03	**-**	**-**	**03**

UNIT-I

Introduction of Radiation Protection, Difference between Primary radiation and Secondary Radiation, Advantages of Radiation Protection

Regulatory authorities of Radiation Facility: IAEA, AERB, e LORA, PCPNDT.

UNIT-II

Radiation protection principle: Principles of radiation protection, concept of 'ALARA', guidelines given by ALARA, time - distance and shielding, shielding. Importance of 'ALARA'. Radiation protection of self and patient-Guidelines for radiation protection by ICRP,

NRPB, WHO-NABH guidelines, AERB guidelines, PNDT Act and guidelines, AERB Specifications for site planning.

UNIT-III

Radiation Monitoring-Shielding materials, Radiation survey meters, **Radiation detector** –area monitoring and personnel monitoring devices-Application of area monitoring devices-Application of personal monitoring devices.

UNIT-IV

Area Monitoring devices- Geiger Muller counter (GM counter)- Construction and Working principle, Scintillation detector Construction and Working principle, Ionization chamber-Construction and Working principal.

Personal Monitoring Devices- TLD badge-Construction and Working principle, Pocket Dosimeter- Construction and Working principle, Film Badge- Construction and Working principle.

Criteria for proper handling of Radiation Protection Devices.

UNIT-V

Radiobiology- Harmful effects of Radiation- Direct and Indirect effects of Radiation, Stochastic Effects, deterministic effects, Somatic Effects, Genetic effects, Threshold Dose, Antenatal Exposure of radiation, 10-day rule, 14-day rule, 28-day rule

Text Books:

1. Textbook of Radiology for Residents and Technicians by S.K Bhargava. Sumeet Bhargava Fourth Edition
2. Basic Radiological Physics by K. Thayalan Second Edition

Reference Books:

1. Christensen's Physics of Diagnostic Radiology by Thomas S. Curry

Course outcomes (COs):

Upon successful completion of the course a student will be able to

CO1	To define the need of radiation protection.
CO2	To interpret various radiation safety measures.
CO3	To apply various radiation measurement techniques through area and personal monitoring devices.
CO4	To explain the various guidelines of radiation protection.
CO5	To debate on various harmful effects of radiation.
CO6	To write about various radiation protection and radiation measurement devices.

CO-PO Mapping

Course	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	-	-	1	-	-	1	3	3	1	3	1	1
CO2	-	1	1	-	-	-	2	2	-	2	1	1
CO3	-	1	1	-	-	-	2	3	-	2	2	1
CO4	-	-	-	-	-	-	2	3	1	3	1	1
CO5	-	-	-	-	-	-	3	1	-	3	1	1
CO6	-	-	1	-	-	-	1	2	-	2	1	1

Bachelors in Medical Radio Imaging and Technology Ist year

Course code	**:**	BMRT-101P
Course Name	**:**	Human Anatomy
Semester /Year	**:**	Ist Year

	L	**T**	**P**	**C**
	-	**-**	**02**	**01**

PRACTICALS

1. Demonstration of anatomical position, various imaginary planes, body surfaces.
2. Demonstration of different body parts, body cavities.
3. Demonstration of different body positions.
4. Demonstration of different types of bones present in the human body.
5. Demonstration of different types of muscles.
6. Demonstration of various types of joints present in body.
7. Demonstration of bones present in upper limb of body.
8. Demonstration of bones present in lower limb of the body.
9. Demonstration of pectoral region, axilla portion of upper limb.
10. Demonstration of Gluteal region, femoral triangle portion of the lower body.
11. Identification of Anatomical structures with help of models, charts, CD Rom etc**.**
12. Demonstration of various organs, bones and joints of trunk area.
13. Demonstration of various organs, bones and joints of head and neck area.
14. Demonstration of various organs, bones and joints of thorax
15. Demonstration of various organs, bones and joints of abdomen.
16. Demonstration of various parts of nervous system.

***Course outcomes of above practical are covered in their respective theory courses.**

Bachelors in Medical Radio Imaging and Technology Ist year

Course code	**:**	BMRT-102P
Course Name	**:**	Human Physiology
Semester /Year	**:**	Ist Year

	L	**T**	**P**	**C**
	-	**-**	**02**	**01**

Practical:

1. Demonstration to measure temperature.
2. Demonstration to measure blood pressure (Systolic and diastolic)
3. Demonstration to measure pulse rate.
4. Demonstration to measure oxygen level.
5. Demonstration of ECG.
6. Demonstration to measure vital capacity.
7. Determination of different blood groups.
8. Demonstration of various organs of urogenital system.
9. General organization and functions of sense organs.
10. Demonstration of function of Nervous system.
11. Reflexes- Superficial & Deep
12. Test for functions of cerebrum

Test for function of cerebellum

***Course outcomes of above practical are covered in their respective theory courses.**

Bachelors in Medical Radio Imaging and Technology I[st] year

Course code	**:**	BMRT-105P
Course Name	**:**	Orientation of Diagnostic Radiology and Para clinical Imaging
Semester /Year	**:**	I[st] Year

	L	**T**	**P**	**C**
	-	**-**	**02**	**01**

Practicals:

1. Demonstration of tube housing, cathode (filament, focusing cup), anode (target, anode angle, rotor, stator,), tube window.
2. Observation of outer shielding of the X- Ray tube.
3. Demonstration of Heel effect.
4. Demonstration of Beam limiting devices (cones, diaphragms, beam centering devices, light beam collimators)
5. Demonstration of Types of cassettes, Structure and different sizes of cassettes
6. Demonstration of Film Handling-Loading & Unloading.
7. Demonstration of Structure and Types of radiographic film and Film Handling technique.
8. Demonstration of Structure and Types of intensifying screen.
9. Demonstration of Structure and types of grids, types of grid movements- Grid control system-Interlocking and X-ray tube overload protection.
10. Demonstration of Lay out of X-ray room and dark room
11. Demonstration of Film Development & Processing in the Dark room.
12. Demonstration of Radiographic Image Magnification, Image contrast, density, sharpness, magnification, distortion of image, noise and blur, radiographic illuminators, mottle

***Course outcomes of above practical are covered in their respective theory courses.**

Bachelors in Medical Radio Imaging and Technology II[nd] year

Course code	**:**	BMRT-201

Course Name	**:** Orientation in Para clinical Imaging
Semester /Year	**:** IInd year

	L	T	P	C
	03	**-**	**-**	**03**

UNIT-I

MICROBIOLOGY

Morphology & physiology of Bacteria, Staphylococcus, Streptococcus, Mycobacterium Tuberculosis, Spirochetes, Corynebacterium Diphtheria

UNIT-II

VIRUS

General Properties, Herpes Virus, Poliovirus, Hepatitis Virus, Oncogenic Virus, HIV

UNIT-III

PATHOLOGY

Inflammation, Osteomyelitis, Fractures, Osteoporosis, Rickets, Osteomalacia, Rheumatoid Arthritis, Gout, Osteoarthritis, Hangman's Fracture, Spondylitis, Scoliosis, Kyphosis, Pott's TB Spine, Paget's Disease**,** Ankylosing spondylitis**,** Club foot**,** Bone Tumour- Benign, Malignant, Cholelithiasis**,** Peritonitis**,** Subphrenic Abscess**,** Appendicitis**,** Hydronephrosis**,** Benign Hypertrophy prostate**,** Sinusitis, Aneurysms, Shock, Arachnoids cysts, Cerebral Vascular Disorders.

UNIT-IV

PHARMACOLOGY

General Pharmacology: Definition of Pharmacology**,** Pharmacokinetic and pharmacodynamics**,** Routes of drug administration**,** Side effect of drugs, adverse effect of drug potency and efficacy of drug, bioavailability of drug**,** Importance of Pharmacology in Radiological Procedures

Autonomic Nervous System Drugs: Cholinergic Drugs and Anticholinergic Drugs, Adrenergic Drugs and Antiadrenergic Drugs

Central Nervous System Drugs: Sedatives, Hypnotics, and Anxiolytics, Analgesics and Narcotics, Antiepileptic Drugs

UNIT-V

PHARMACOLOGY

Radiographic Contrast Media: Introduction to Radiographic Contrast Media, Types of Contrast Media (Iodinated Contrast Agents, Barium sulphate, etc.), Pharmacological Management of Contrast Media Reactions, Adverse Reactions and Complications of Contrast Media, Treatment and Management of Non-allergic Reactions (e.g., Vasovagal reaction.

Pharmacological Agents used in Interventional: Radiology (e.g., Sedatives, Analgesics, Anaesthetics), Periprocedural Medications and Management, Contrast Agents in Interventional Procedure, Adverse Effects and Complications Management in Interventional Radiology

Text Books:

1. Harsh Mohan. Textbook of Pathology. Eight Edition.
2. Baweja, 2018. Textbook of Microbiology. Sixth Edition.
3. Textbook of Pharmacology for Paramedical Students by Jogendra Pathania, Rupendra k. Bharti

and Vikas Soodh.

Reference Books:

1. Essentials of Medical Pharmacology (K.D Tripathi)

Course outcomes (COs):

Upon successful completion of the course a student will be able to

CO1	To outline the morphology and physiology of various microbial agents and viruses.
CO2	To done contrasting between various microbial and viral agents.
CO3	To examine treatment option required to treat various clinical conditions.
CO4	To explain clinical features, treatment options, required diagnostic investigations of various clinical conditions.
CO5	To comment on pharmacological management of various contrast media reactions.
CO6	To write about various pharmacological agents required in diagnostic radiology.

CO-PO Mapping

Course	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	-	-	-	-	-	-	-	-	-	-	-	-
CO2	-	-	-	-	-	-	-	-	-	-	-	-
CO3	-	-	2	1	-	1	-	-	-	-	1	-
CO4	-	-	2	2	-	2	-	-	-	-	1	-
CO5	-	-	-	1	-	-	1	-	2	-	-	1
CO6	-	-	-	1	-	-	-	-	2	-	-	1

Bachelors in Medical Radio Imaging and Technology IInd year

Course code	**:**	BMRT-202
Course Name	**:**	Special Radiological Equipment
Semester /Year	**:**	IInd year

	L	T	P	C
	03	-	-	03

UNIT-I

Conventional Radiography: Process of film developing-Composition of developer and Fixer-Fixer replenishment-silver recovery-Film Storage-Film Handling-Loading and unloading of cassette-Film screen contact-Film contrast- Manual processing assembly and technique-Automatic processing assembly and technique-Formation of Latent image-silver recovery

UNIT-II

C.R (principle, equipment & imaging System).
Digital Radiography-principle, equipment & imaging System-advancements and applications.

UNIT-III

Fluoroscopy: Fluorescence and Phosphorescence-Types of fluorescent and Phosphorescent materials used in fluoroscopy-Fluoroscopic screen-Tilting Table-Construction and working principle of Image intensifier &TV Monitor-construction and working principle of picture tube, vidicon camera and CCD- image formation and quality-Automatic brightness control-Serial radiography-Manual Cassette changer assembly and automatic cassette changer assembly- Principal of Cine Fluoroscopy -Digital Fluoroscopy- patient radiation dose and its safety measures. Advantages of image intensifier over fluoroscopic screen.

UNIT-IV

Mammography: Basic principle, equipment & image acquisition, Screen film system, image formation and quality, Patient radiation dose and its safety measures, Digital Mammography. Scanning protocol, Indication, Patient preparation, Patient Position, Technique

UNIT-V

Ultrasound: Definition-Modes of ultrasound: A, B, M, TM -Basic Acoustics-Principal of ultrasound- Piezoelectric effect, Piezoelectric Crystal-Controls of Ultrasound Equipment-Terminologies: power, gain, acoustic pressure, impedance, speed, frequency. Physical characteristics of sound- interaction of US with matter: reflection, refraction, attenuation, absorption, scattering, transmission-transducer-Types of Transducers, Principal, construction and working of transducers-Coupling agent- Doppler technique & its types real the ultrasound instrumentation bio effect and safety consideration.

UNIT-VI

Computed Tomography: Basic Principle, Historical developments, various generations, clinical applications-Imaging principles in computed tomography.

Magnetic Resonance imaging: Introduction- Magnetism-Magnetic Susceptibility-Fringe Field- **Principle:** Principles of magnetic resonance imaging-Motion within the atom- MR active nuclei-Hydrogen nucleus-NMV-Spin-Alignment-Classical Theory- Quantum Theory- Precession-Spin Wobble-Larmor Equation-Gyromagnetic Ratio-Resonance-MR Signal- Free Induction Decay-Relaxation-T1 Recovery- T2 Decay- T2* decay -Time Pulse cycle T1 weighted image T2 weighted image Proton density image.

Text Books:

1. Textbook of Radiology for Residents and Technicians by S.K Bhargava. Sumeet Bhargava Fourth Edition
2. Basic Radiological Physics by K. Thayalan Second Edition

Reference Books:

1. Christensen's Physics of Diagnostic Radiology by Thomas S. Curry

Course outcomes (COs):

Upon successful completion of the course a student will be able to

CO1	To define basic principle of different imaging modalities.
CO2	To done contrasting between conventional, computed and digital radiography.
CO3	To determine the role of dynamic imaging to identify various pathologies.
CO4	To outline developments, Principle and various generations of computed tomography.
CO5	To outline the working principle of Magnetic Resonance Imaging
CO6	To manage and operate different imaging modalities.

CO-PO Mapping

Course	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	-	3	1	-	2	1	-	-	1	-	-	2
CO2	-	3	1	-	2	1	-	-	1	-	-	2
CO3	-	3	1	-	2	1	-	-	1	-	-	2
CO4	-	2	-	-	3	-	-	-	-	-	-	-
CO5	-	-	-	-	2	-	3	1	-	3	-	-
CO6	-	-	-	-	-	-	-	-	-	1	-	2

Course code	**:** BMRT-203
Course Name	**:** Radiographic Techniques
Semester /Year	**:** IInd year

	L	**T**	**P**	**C**
	03	**-**	**-**	**03**

UNIT-I

Common terminology, Patient handling & Preparation-Clinical, Ethical & Legal Responsibility, (including medico legal /Accident cases)

Patient Preparation: Introduction, Need of Patient Preparation, General Abdominal Preparation, Purgatives- Type of Purgatives, Their Use, Their Side effects, Prevention of Intestinal gas, Clothing of Patient, High KV technique, soft tissue radiography, Xeroradiography

UNIT-II

Chest Radiography –Basic views (PA & AP) - inspiratory & expiratory films- special chest views & their significance – larynx- trachea- thoracic inlet -Sternum - Ribs – Heart and great vessels – mediastinum -Diaphragm – double exposure technique.

Spine Radiography -Vertebral column – Atlanta occipital articulation- cervical spine- dorsal spine - lumbar spine – sacrum -vertebral canal- vertebral foramen.

UNIT-III

Abdomen and Pelvis: Preparation of patient, positioning for fluid and air Levels in abdomen. Basic and special projection for Abdomen and Pelvis, the acute abdomen investigation.

Extremities Radiography – Hand, Finger, Wrist joint- Forearm -Elbow joint – humerus -Shoulder joint. Foot – Toes- Tarsal bones -Ankle joint - Knee joint – patella –tibia- femur – Hip joint – pelvis - sacroiliac joint.

UNIT-IV

Skull Radiography – general, Sella – temporal bone – mastoid – optic foramen –Internal auditory canal – Superior and inferior orbital fissure – base of skull

Facial bones – petrous apex – Zygomatic bone, nasal bone, sinuses of skull – mandible – Tempo-mandibular joint – Paranasal sinuses Radiography

UNIT-V

Ward mobile radiography: General precautions, Asepsis in techniques-Checking of mains supply and functions of equipment, selection of exposure factors, explosion risks. Radiation protection and rapid processing techniques.

Dental Radiography: Techniques of intra oral full mouth- occlusal projections- Extra oral projections including orthopantomography- Techniques for post nasal airways, larynx, trachea, thoracic inlet, Valsalva manoeuvre-phonation.

Text Books:

1. Bontrager's Textbook of Radiographic Positioning and Related Anatomy by John P. Lameignano and Leslie E. Kendrick. Tenth Edition

2. Clark's Positioning in Radiography by A. Stewart Whipley, Gail Jefferson, Ken Holmes, Charles Sloand, Craig Anderson and Graham Hoadley. Thirteenth Edition

Reference Books:

1. Radiology of Positioning and applied anatomy by G. S. Garkal. Fourth Edition

Course outcomes (COs):

Upon successful completion of the course a student will be able to

CO1	To Describe the professional laws and ethics.
CO2	To discuss the legal aspect and medical ethics in health setup
CO3	To Demonstrate patient handling and preparation.
CO4	To assess the importance Chest, abdomen, pelvis and extremities Radiography.
CO5	To evaluate the radiographic image quality.
CO6	To design the parameter for identification of radiographic image quality.

CO-PO Mapping

Course	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	-	-	-	-	-	-	2	3	-	3	1	-
CO2	-	-	-	-	-	-	2	3	-	3	1	-
CO3	-	-	-	-	-	1	-	-	-	-	3	-
CO4	-	-	-	1	-	-	-	-	-	-	3	-
CO5	-	-	-	-	-	3	-	-	-	-	-	-
CO6	-	-	-	-	-	3	-	-	-	-	-	-

Bachelors in Medical Radio Imaging and Technology IInd year

Course code	**:**	BMRT-204
Course Name	**:**	Special Radiological Procedures
Semester /Year	**:**	IInd year

	L	T	P	C
	03	**-**	**-**	**03**

UNIT-I

Contrast Media; properties, Types, Reaction and treatment of contrast media-Emergency drug used in Radiology Department- Emergency equipment in the radiology department-Aseptic Technique-Patient handling & Preparation.

Patient Preparation: Introduction, Need of Patient Preparation, General Abdominal Preparation, Purgatives- Type of Purgatives, Their Use, Their Side effects, Prevention of Intestinal gas, Clothing of Patient.

UNIT-II

Procedures of G.I. Tract: Barium Swallow, pharynx and esophagus, Barium Meal Series, Barium Meal Follow Through, Barium Enema (Small bowel enema, Double Contrast Enema, Loopogram, Sinogram, colostomy

Procedures Of Excretory System: IVP, IRGU**,** Micturating Cystourethrography, Ascending Urethrography, Voiding Cystography (VCUG)

UNIT-III

Extremities Radiography – Hand, Finger, Wrist joint- Forearm -Elbow joint – humerus - Shoulder joint. Foot – Toes- Tarsal bones -Ankle joint - Knee joint – patella –tibia- femur – Hip joint – pelvis -sacroiliac joint.

Reproductive system HSG (Hysterosalpingography)

UNIT-IV

Hepatobiliary system: T-tube cholangiography, ERCP Percutaneous Trans hepatic Cholecystography

Spinal cord: Myelography

UNIT-V

Other procedures: Sialography, Dacrocystography, Sinograpy, Fistulography Related anatomy, Associated pathology and radiographic appearance Indications, contraindications and technique

Text Books:

1. Chapman & Leinakienly's guide to Radiological Procedures. Third Edition
2. Clark's Positioning in Radiography by A. Stewart Whipley, Gail Jefferson, Ken Holmes, Charles Sloand, Craig Anderson and Graham Hoadley. Thirteenth Edition

Reference Books:

1. Textbook of Radiology for Residents and Technicians by S.K Bhargava. Sumeet Bhargava Fourth Edition

Course outcomes (COs):

Upon successful completion of the course a student will be able to

CO1	To Describe the properties of contrast media.
CO2	To discuss the legal aspect and medical ethics in health setup. …
CO3	To Demonstrate patient handling and preparation
CO4	To assess the importance of Radiological Procedure done in Radiology Department
CO5	To evaluate the radiographic image quality
CO6	To design the parameter for identification of radiographic image quality

CO-PO Mapping

Course	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	-	-	-	-	-	-	-	-	-	-	-	-
CO2	-	-	-	-	-	-	2	3	-	3	1	-
CO3	-	-	-	-	-	1	-	-	-	3	-	-
CO4	-	-	-	1	-	-	-	-	-	-	3	-
CO5	-	-	-	-	-	3	-	-	-	-	-	-
CO6	-	-	-	-	-	3	-	-	-	-	-	-

Bachelors in Medical Radio Imaging and Technology IInd year

Course code	**:**	BMRT-205
Course Name	**:**	Computed Tomography
Semester /Year	**:**	IInd year

	L	**T**	**P**	**C**
	03	**-**	**-**	**03**

UNIT-I
Basic Principle, Historical developments, various generations, clinical applications-Imaging principles in computed tomography
UNIT-II
Equipment/Hardware: Instrumentation of CT scan-CT Gantry-Advances in Detector technology- Slip ring technology- Helical CT-Single slice and Multi slice CT Scan system (recent advancement in CT scanner)-Pressure Injector-Data Acquisition System-Image Display System-Storage-CT Control Console.
UNIT-III
Image Reconstruction: Basic Principle, Image reconstruction in CT. Hounsfield Unit, CT Number, Pitch, Post processing Technique; MPR, MIP, Min IP, 3D rendering, Contrast in CT, Phase Enhancement in CT, Windowing, Resolution.
UNIT-IV
Protocols: Patient Preparation, Clinical Indications, Contraindications, Equipment Required during Scan, Patient Position of NCCT Head, CECT Head, Temporal Bones, Routine chest, HRCT of Lungs Technical aspects Volumetric HRCT Expiratory, Routine Abdomen, NCCT Abdomen, CT Urography, Routine cardiac, CT Coronary calcium scoring, Routine cervical, Lumbosacral, Routine Thoracic, CT Knee.
UNIT-V
Artefacts: Classification and Types of artefacts, Various artefacts of CT and their preventive measures. Advantages of CT over X-Ray Limitations and Advancements of computed tomography

Text Books:

1. Christensen's Physics of Diagnostic Radiology by Thomas S. Curry
2. MRI at a Glance. Catherine Wrest brook.

Reference Books:

1. Textbook of Radiology for Residents and Technicians by S.K Bhargava. Sumeet Bhargava Fourth Edition

Course outcomes (COs):

Upon successful completion of the course a student will be able to

CO1	To outline developments, Principle and various generations of computed tomography.
CO2	To interpret technical aspects behind instrumentation of CT scan, advancements in detector technology, helical CT, and HRCT.
CO3	To implement standard protocols of various CT examinations.
CO4	To illustrate the difference between artefact and normal regions on radiograph.
CO5	To assess basic reconstruction mechanism of Computed Tomography.
CO6	To write about the advantages of CT in diagnosing various pathological conditions.

CO-PO Mapping

Course	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	-	3	-	-	3	-	-	-	-	-	1	-
CO2	-	3	-	-	3	-	-	-	-	-	1	2
CO3	-	2	2	-	2	-	-	-	-	-	3	-
CO4	-	3	-	-	3	1	-	-	-	-	2	-
CO5	-	2	-	-	3	1	-	-	-	-	2	-
CO6	-	2	3	3	3	3	1	1	-	3	3	-

Bachelors in Medical Radio Imaging and Technology IInd year

Course code	**:** BMRT-206

Course Name	**:** Magnetic Resonance Imaging
Semester /Year	**:** IInd year

	L	**T**	**P**	**C**
	03	**-**	**-**	**03**

UNIT-I

Introduction- Magnetism-Magnetic Susceptibility-Fringe Field-**Principle:** Principles of magnetic resonance imaging-Motion within the atom- MR active nuclei-Hydrogen nucleus-NMV-Spin-Alignment-Classical Theory- Quantum Theory- Precession-Spin Wobble-Larmor Equation-Gyromagnetic Ratio-Resonance-MR Signal- Free Induction Decay- Relaxation-T1 Recovery- T2 Decay- T2* decay -Time Pulse cycle T1 weighted image T2 weighted image

UNIT-II

Hardware: MR Instrumentation, Types of magnets- Permanent Magnet, Resistive Magnet, Superconducting Magnet, RF transmitter & receiver coils-Gradient coils-Shim coils-RF shielding-Computers- Patient Transportation System- Console Panel.

MR Parameters: Extrinsic Parameters- Intrinsic Parameters-Signal to Noise Ratio- Contrast to Noise Ratio-Spatial resolution- Volume Imaging

UNIT-III

Pulse Sequences: Introduction-Types of Pulse Sequences-Spin echo pulse sequence – Conventional Spin Echo- Fast Spin Echo-turbo spin echo pulse sequence-Inversion Recovery-STIR-SPIR-FLAIR-Proton density Imaging- Gradient echo Pulse sequences – Conventional Gradient Echo Sequence-Coherent Residual Transverse Magnetization-Incoherent Residual Transverse Magnetization.

UNIT-IV

Encoding and Data Collection: Introduction, Slice Selection, Phase Encoding, Frequency Encoding, k- space filling.

Safety Aspects: Main magnetic field, Fringe Field, Implants and Prosthesis, Claustrophobia, Quenching.

Protocols: Patient preparation, Clinical Indications, Contraindications, Patient Positioning, Common sequences, After care of routine MRI examinations.

UNIT-V

Contrast Media: Type of contrast media, Gadolinium Safety.

Artifacts: MRI artifacts- Their appearance, Causes and Safety aspects to prevent artifacts.

Advantage of MRI over computed tomography or ultrasonography. Its limitations and use and cross-sectional anatomy.

Text Books:

1. Christensen's Physics of Diagnostic Radiology by Thomas S. Curry
2. MRI at a Glance. Catherine Wrest brook.

Reference Books:

1. Textbook of Radiology for Residents and Technicians by S.K Bhargava. Sumeet Bhargava Fourth Edition

Course outcomes (COs):

Upon successful completion of the course a student will be able to

CO1	To outline the working principle of Magnetic Resonance Imaging
CO2	To understand the role of various components of MR machine.
CO3	To implement technical methods required to operate MRI modality.
CO4	To min map the conditions, which needs to be fulfilled before starting a MR scan.
CO5	To predict difference between artefact and normal regions on a radiograph.
CO6	To write about benefits of MRI over other modalities.

CO-PO Mapping

Course	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	-	-	-	-	3	-	-	-	-	-	1	-
CO2	-	2	-	-	3	-	-	-	-	-	1	-
CO3	-	2	-	-	2	-	-	-	-	-	3	-
CO4	-	-	-	-	3	1	-	-	-	-	2	-
CO5	-	2	1	-	3	1	-	-	-	-	2	-
CO6	-	2	-	-	3	3	1	1	-	3	3	-

Bachelors in Medical Radio Imaging and Technology IInd year

Course code	**:**	BMRT-202P
Course Name	**:**	Special Radiological Equipment

Semester /Year	**:** II[nd] year

	L	T	P	C
	-	-	02	01

Practicals:

1. Demonstration of Process of film developing-Composition of developer and Fixer- Fixer replenishment-silver recovery.
2. Demonstration of Film Storage and Film Handling in conventional radiography.
3. Demonstration of Loading and unloading of cassette
4. Demonstration of Film Handling-Loading & Unloading.
5. Demonstration of Conventional Radiography equipment.
6. Demonstration of Digital Radiography assembly, detectors.
7. Demonstration of Construction and working principle of Image intensifier &TV Monitor
8. Demonstration of equipment & image acquisition, Screen film system, image formation and quality, Digital Mammography
9. Demonstration of Types of Transducers, Principal, construction and working of transducers-Coupling agent
10. Demonstration of basic components of CT and MRI machine.

***Course outcomes of above practical are covered in their respective theory courses.**

Bachelors in Medical Radio Imaging and Technology II[nd] year

Course code	**:** BMRT-203P
Course Name	**:** Radiographic Techniques
Semester /Year	**:** II[nd] year

	L	T	P	C

	-	-	02	01

Practicals:

1. Demonstration of basic views of chest radiography.
2. Observation of basic views of spine radiography.
3. Demonstration of basic techniques to examine abdominal region and pelvic region.
4. Demonstration of basic radiographic views of upper and lower extremities.
5. Demonstration of basic views of skull radiography.
6. Demonstration of various techniques to diagnose facial bones.
7. Demonstration of various techniques and methods of ward mobile radiography.
8. Demonstration of various techniques of dental radiography.

***Course outcomes of above practical are covered in their respective theory courses.**

Bachelors in Medical Radio Imaging and Technology IInd year

Course code	**:**	BMRT-204P
Course Name	**:**	Special Radiological Procedures
Semester /Year	**:**	IInd year

	L	T	P	C
	-	-	02	01

Practicals:

1. Demonstration of basic contrast procedures of GI Tract.
2. Observation of basic procedures of excretory system.
3. Demonstration of Extremities
4. Demonstration of biliary system.
5. Demonstration of abdominal organs.

***Course outcomes of above practical are covered in their respective theory courses.**

Bachelors in Medical Radio Imaging and Technology IIIrd year

Course code	**:**	BMRT-301
Course Name	**:**	General Pathology in Diagnostic Radiology
Semester /Year	**:**	IIIrd year

	L	T	P	C

	03	**-**	**-**	**03**

UNIT-I
Pericarditis, Valvular diseases, Rhematic Heart Disease, Heart failure, Hypertension, Coronary Artery disease, Arrhythmia, Congenital Heart Disease
UNIT-II
Chronic Bronchitis, Emphysema, Bronchiectasis, Pneumonia, Tuberculosis, Pleura effusion, Empyema, Spontaneous Pneumothorax, Asthma, Pulmonary Oedema, Pulmonary Fibrosis, Sarcoidosis.
UNIT-III
Achalasia Cardia, Peptic ulcer, Intestinal obstruction, Crohn's disease, Ulcerative Colitis, Pancreatitis, Portal Hypertension, Ascites, Cirrhosis, Cholecystitis, Appendicitis, diverticulitis.
UNIT-IV
UTI, Glomerulonephritis, Nephrotic syndrome, Urinary Calculi, Polycystic Kidney disease, Hydronephrosis, Hydrocele, Haematuria, UTI, cystitis, Enlarged Prostate, Incontinence, Bladder Prolapse, Ectopic Kidney, Dysuria
UNIT-V
Cerebral Vascular Disorders, Meningitis, Encephalitis, Stroke, Haemorrhage, Epilepsy, infarct, Brain infection, Multiple Sclerosis, vertigo, Cerebral Palsy, Congenital Brain Disorders, Dementia, Parkinson's Disease, Alzheimer's disease, Neurocysticercosis, Myelopathy, Motor neuron Disease

Text Books:

1. Fundamental of Orthopaedics. Mahindra. Jain. Second Edition
2. Textbook of Operative Surgery by Vipul Yagnik.
3. Five Teachers Textbook of Gynaecology by Rashid Lalit Khan and Yousuf Lalit Khan. Seventh Edition

Course outcomes (COs):

Upon successful completion of the course a student will be able to

CO1	To identify various clinical pathologies.
CO2	To interpret clinical symptoms of patient related to various pathologies
CO3	To determine the examinations required to identify various pathologies.
CO4	To correlate various clinical pathologies on radiograph.
CO5	To assess treatment option required to treat various clinical conditions.
CO6	To write about clinical features, treatment options, required diagnostic

	investigations of various clinical conditions.

CO-PO Mapping

Course	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	-	3	1	-	1	-	-	-	-	-	-
CO2	-	-	3	-	-	1	-	-	-	-	-	-
CO3	-	-	1	-	-	1	-	-	-	-	-	-
CO4	1	-	1	-	-	1	-	-	-	-	-	-
CO5	1	-	1	-	-	1	-	-	-	-	-	-
CO6	2	-	2	1	-	1	-	-	-	-	-	-

Bachelors in Medical Radio Imaging and Technology IIIrd year

Course code	**:**	BMRT-302
Course Name	**:**	Radiotherapy Planning, Procedure and Equipment
Semester /Year	**:**	IIIrd year

	L	**T**	**P**	**C**
	03	**-**	**-**	**03**

UNIT-I
Radiotherapy: Introduction, Types of Radiotherapy-Teletherapy, Brachytherapy, Types of Teletherapy, Clinical Applications, Types of brachytherapy-Roles of radiation therapy treatment, Clinical Applications.
UNIT-II
Introduction Radiography equipment used in Radiotherapy-Orthovoltage and Kilovoltage equipment, Cobalt 60 Units, its construction and source housing and handling mechanism, Linear Accelerator, Principle, working, tube design, wave guide system, target design beam bending
UNIT-III
Definition of treatment planning. Planning procedure in general and special Technique. Terminology, tumours localization and target volume, Isodose Chart, Parameters of Isodose chart, Treatment Planning Setup- Treatment Simulation, CT Simulator, Simulation Procedure, tissue air-ratio, tissue maximum ratio, wedge angle, hinge angle.
UNIT-IV
Percentage depth dose, Immobilization devices- Beam modification devices-Beams flattering filters, scattering foils. Physical properties of phantoms, phantom materials, bolus and bolus substitutes.
UNIT-V
Basic principle of Manual and remote after-loading system, Introduction to Radio-surgery equipment-Gamma knife- Gamma ray sources used in radiotherapy.

Text Books:

1. Faiz M. Khan. (Khan's The Physics of Radiation Therapy). Faiz M. Khan and John P. Gyvbons. Fifth Edition
2. Basic Radiological Physics by K. Thayalan Second Edition

Reference Books:

1. Step by Step Radiation Therapy (Treatment and Planning) by Arun Kumar Rathi

Course outcomes (COs):

Upon successful completion of the course a student will be able to

CO1	To define role of radiotherapy, its planning and procedures.
CO2	To understand the role of simulation technique in radiotherapy.
CO3	To efficiently present terminology of radiotherapy
CO4	To organize treatment setup efficiently with use of proper immobilization devices.
CO5	To measure percentage of radiation dose at particular depth
CO6	To write about various types of radiotherapy machines.

CO-PO Mapping

Course	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	-	-	1	1	-	1	1	-	2	-	1	-
CO2	-	1	-	2	2	1	1	-	1	-	1	-
CO3	-	1	-	-	1	-	1	-	-	-	-	-
CO4	-	3	2	1	3	2	1	-	-	-	1	-
CO5	-	-	-	-	-	-	3	1	-	2	-	1
CO6	-	3	-	-	2	-	-	-	-	-	-	-

Bachelors in Medical Radio Imaging and Technology IIIrd year

Course code	**:**	BMRT-303
Course Name	**:**	Advanced Imaging Modalities
Semester /Year	**:**	IIIrd year

	L	**T**	**P**	**C**
	03	**-**	**-**	**03**

UNIT-I
Radiovisigraphy (RVG)- Principal, Basic Components-X-ray Machine, Intra Oral Sensor, Display Processing Unit, Advantages of RVG. **Cath Lab & DSA Machine-** Principal, Components of Machine, Technique, Common Procedures.
UNIT-II
DEXA- Principal of working, Components of machine, Types of DEXA Scanners, Benefits and application of DEXA.
UNIT-III
PET Scan- Principal of working, Components of PET Scanners- Gantry, Table, detector System, Scintillator, PMT, Types of PET Scanners, Radiopharmaceuticals in PET Scan, Advantages and applications of PET.
UNIT-IV
SPECT- Basic principle of SPECT, Components of SPECT Scanner- Gantry, Table, Scintillation Camera, PMT, Radiopharmaceuticals in SPECT Scan, Advantages and applications of PET.
UNIT-V
Hybrid Imaging: PET-CT, SPECT-CT, MRI-PET, MRI-SPECT- Advantages of Hybrid Imaging, Application of Hybrid Imaging.

Text Books:

1. Faiz M. Khan. (Khan's The Physics of Radiation Therapy). Faiz M. Khan and John P. Gyvbons. Fifth Edition
2. Basic Radiological Physics by K. Thayalan Second Edition

Reference Books:

1. Step by Step Radiation Therapy (Treatment and Planning) by Arun Kumar Rathi

Course outcomes (COs):

Upon successful completion of the course a student will be able to

CO1	To identify different imaging modalities used for diagnostic purpose.
CO2	To understand the working principle of different advanced modalities.
CO3	To Demonstrate the role of hybrid scanning.
CO4	To assess the importance and mechanism of Radiopharmaceuticals
CO5	To evaluate the application and importance of advanced imaging modalities.
CO6	To write about the components, working principle and application of various advanced modalities.

CO-PO Mapping

Course	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	-	2	2	-	2	-	-	-	-	-	-	-
CO2	-	2	1	-	3	-	-	-	-	-	-	-
CO3	-	2	-	1	1	-	-	-	-	-	-	1
CO4	-	-	1	-	-	-	-	-	-	-	1	-
CO5	-	3	2	2	3	-	-	-	-	-	1	-
CO6	-	3	-	-	3	-	-	-	-	-	-	-

Bachelors in Medical Radio Imaging and Technology IIIrd year

Course code	**:**	BMRT-304
Course Name	**:**	Interventional Radiological Procedures and Techniques
Semester /Year	**:**	IIIrd year

	L	**T**	**P**	**C**
	03	**-**	**-**	**03**

UNIT-I

1. Definition of interventional radiology.
2. Basic of Interventional radiology.
3. Interventional radiology suite: machine handling, imaging detector, patient positioning, pulsed fluoroscopy, fluoroscopy mode.
4. DSA
5. Name of different interventional radiology procedure and the modality (CT, C-arm, USG, and DSA/ Cath Lab Guidance).
6. Differentiation between lines, tubes and drain in imaging correct or not.

UNIT-II

Equipment used in various interventional radiology procedures.

a) Cath Lab / DSA equipment and machine part
b) C-arm equipment: instrumentation and working procedure
c) Tools of the trade: -Type of needles, Type of vascular sheath, Type of guide wires, Type of catheters, Type of balloon, Type of stent, Sterilization of interventional radiology equipment, Type of biopsy guns, Type of drains.

UNIT-III

General principles of interventional radiology procedures

a) History
b) Pre procedure tasks: -Consent, Patient evaluation and management, Safety consideration, Medications, Tools, Contrast agents
c) Intra procedure tasks; -Sedation, Antibiotic prophylaxis, Blood pressure control, Anticoagulation, Fluid management, Vascular access, Imaging, Treatment of adverse events and reaction
d) Post procedure patient care; -Sheath removal, Patient shifting, Patient monitoring, Images storage and transfers, Orders, Discharge criteria

UNIT-IV

Vascular and non-vascular anatomy and pathology with gross anatomy appearance on DSA and other image modality.

Clinical application: disease diagnosis, severity interpretation, case follow up

Sterile techniques in angiography procedures

a) Common interventional radiology procedures

b) Types of interventional radiology procedure: vascular and non-vascular
c) Definition, indication contraindication
d) Patient preparation and technique
e) Needle puncture: direct and guided
f) Catheter angiography (cerebral, peripheral, visceral)

UNIT-V

Anaesthesia and emergency drugs used in interventional radiology

a) Anaesthesia equipment handling
b) Facilities regarding general anaesthesia in the interventional radiology department
c) Anaesthetic problems associated with specific technique: Vascular studies, non-vascular studies, Carotid angiography, Venography

Embolization agents

Radiation safety in interventional radiology department

Basic knowledge of OT instruments and sterility

Text Books:

1. RadCases. Interventional Radiology. Hector Ferral, Jonathan Lorenz. International Edition
2. Textbook of Radiology for Residents and Technicians by S.K Bhargava. Sumeet Bhargava Fourth Edition

Reference Books:

1. Handbook of Interventional Radiological Procedures. Krishna Kandarpa, Lindsay Machan, Janette D. Durham. Fifth Edition

Course outcomes (COs):

Upon successful completion of the course a student will be able to

CO1	To define role of interventional radiology, IR machine handling, DSA, different IR procedures and modalities.
CO2	To exemplify equipment used in IR procedures like Cath Lab/ DSA, C-arm equipment etc
CO3	To efficiently present principles of Pre, intra and Post IR procedures
CO4	To organize treatment setup efficiently by understanding vascular and non-vascular anatomy and pathology, clinical applications and sterile techniques in angiography procedures.
CO5	To distinguish anaesthesia and emergency drugs in IR
CO6	To write about emboli zing agents, radiation safety aspects in IR department, OT instruments and sterility.

CO-PO Mapping

Course	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	-	1	1	2	2	-	-	-	-	-	2	-
CO2	-	2	1	1	2	-	-	-	-	-	2	1
CO3	-	3	3	3	-	-	-	-	-	-	3	-
CO4	-	2	3	1	2	1	-	-	2	-	2	-
CO5	-	-	2	-	-	-	-	-	3	-	-	-
CO6	-	-	-	2	2	-	-	-	-	3	2	-

Bachelors in Medical Radio Imaging and Technology IIIrd year

Course code	**:**	BMRT-305
Course Name	**:**	Patient care and & Management in diagnostic radiology
Semester /Year	**:**	IIIrd year

	L	**T**	**P**	**C**
	03	**-**	**-**	**03**

UNIT-I
Introduction to Patient Care Responsibilities of the Healthcare facility Responsibilities of the Imaging Technologist. General Patient Care Patient transfer technique Restraint techniques Aspects of patient comfort Specific patient conditions Security of patient property Obtaining vital signs Laying up a sterile trolley IV injection administration
UNIT-II
Patient care during Investigation G.I. Tract, Biliary tract, Respiratory tract, Gynaecology, Cardiovascular, Lymphatic system, C.N.S. etc Infection Control Isolation Technique Infection sources – Transmission modes Procedures Psychological considerations Sterilization & sterile techniques.
UNIT-III
Patient Education Communication Patient communication problems Explanation of examinations Radiation Safety / Protection Interacting with terminally ill patient Informed Consent
UNIT-IV
Aim & Principle of Radiation Protection Concept of ALARA, ICRP regulation, Radiation Protection in: Radiography, CT, Fluoroscopy, Mammography, Ward radiography, radiation shielding.
UNIT-V
Direct & Indirect effects of radiation, Stochastic, Deterministic effects, Somatic, Genetic effects, dose relationship, Antenatal exposure.

Text Books:

1. Concise Textbook on Hospital Management and Patient care in Diagnostic Radiology by N. K. Kardam and Lalit Aggarwal.

Reference Books:

1. Textbook of Radiology for Residents and Technicians by S.K Bhargava. Sumeet Bhargava Fourth Edition

Course outcomes (COs):

Upon successful completion of the course a student will be able to

CO1	To describe the Importance of the Professional Laws &Ethics.
CO2	To discuss the legal aspect and medical ethics in health setup
CO3	To demonstrate body mechanics & transferring of patient.
CO4	To assess the Knowledge of departmental safety and infection control.
CO5	To evaluate the roll of Radiological exposure & protection principle.
CO6	To design the parameter for identification of patient care responsibility & health care facility of a radiographer.

CO-PO Mapping

Course	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	-	-	-	-	-	-	2	3	2	3	1	2
CO2	-	1	-	-	-	-	3	3	2	2	1	1
CO3	-	-	1	-	-	1	-	-	2	-	1	-
CO4	-	2	-	-	1	-	3	2	-	2	-	1
CO5	-	1	-	-	-	-	2	2	-	3	2	3
C06	-	-	-	-	-	-	2	1	1	1	1	-

Bachelors in Medical Radio Imaging and Technology IInd year

Course code	**:** BMRT-306
Course Name	**:** Advanced Radiological Procedures
Semester /Year	**:** IIIrd year

	L	**T**	**P**	**C**
	03	**-**	**-**	**03**

UNIT-I
Cerebral Studies- Ventriculography-Arthrography (shoulder, hip, knee, elbow)-Carotid Angiography-Thoracic and arch aortography-Selective studies: Renal, SMA, Coeliac Axis-Vertebral Angiography-Femoral Arteriography-Angiocardiography-Peripheral venography-cerebral venography- inferior and superior venocavography-visceral phlebography-PTCA-BMV-CAG-Electrophysiology
UNIT-II
USG Doppler studies: Technique of sonography-Patient Preparation, Patient positioning, part positioning and technique for TVS, TAS and TRUS-USG Guided FNAC and biopsy
UNIT-III
CT guided FNAC and Biopsy, CT coronary angiography-Peripheral angiography- Brain angiography- Triple Phase
UNIT-IV
Advanced Procedures: MR contrast media MR angiography – TOF & PCA MR Spectroscopy-Functional MRI MRCP-Diffusion/Perfusion scans-MRS blood flow imaging-MR Spectroscopy-Functional MRI-
UNIT-V
Common interventional radiology procedures Types of interventional radiology procedure: vascular and non-vascular

Text Books:

1. Chapman & Leinakienly's guide to Radiological Procedures. Third Edition
2. Clark's Positioning in Radiography by A. Stewart Whipley, Gail Jefferson, Ken Holmes, Charles Sloand, Craig Anderson and Graham Hoadley. Thirteenth Edition

Reference Books:

1. Textbook of Radiology for Residents and Technicians by S.K Bhargava. Sumeet Bhargava Fourth Edition

Course outcomes (COs):

Upon successful completion of the course a student will be able to

CO1	To define research and the steps of research.
CO2	To understand the role of research study.
CO3	To Demonstrate about the different types of research
CO4	To assess the societal importance of research
CO5	To predict research problem and its solutions.
CO6	To write synopsis by following standard protocols.

CO-PO Mapping

Course	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	-	-	-	-	-	-	-	-	-	-	-	-
CO2	-	-	-	-	-	-	1	1	-	1	1	-
CO3	-	-	-	-	-	1	-	-	-	1	-	-
CO4	-	-	-	1	-	-	-	-	-	-	1	-
CO5	-	-	-	-	-	1	-	-	-	-	-	-
CO6	-	-	-	-	-	1	-	-	-	-	-	-

Bachelors in Medical Radio Imaging and Technology IIIrd year

Course code	**:**	BMRT-302P

Course Name	**:**	Radiotherapy Planning, Procedure and Equipment
Semester /Year	**:**	IIIrd year

	L	**T**	**P**	**C**
	-	**-**	**02**	**01**

Practicals:

1. Demonstration of orthovoltage and kilovoltage equipment.
2. Demonstration of treatment planning procedure.
3. Demonstration of various beam modification devices.
4. Demonstration of various immobilization devices.
5. Demonstration of Conventional Radiography equipment.

***Course outcomes of above practical are covered in their respective theory courses.**

Bachelors in Medical Radio Imaging and Technology IIIrd year

Course code	**:**	BMRT-304P
Course Name	**:**	Interventional Radiological Procedures and Techniques

Semester /Year	**:** III[rd] year

	L	**T**	**P**	**C**
	-	**-**	**02**	**01**

Practicals:

1. Demonstration of machines used in intervention radiology.
2. Demonstration of machine handling.
3. Demonstration of various equipment required in intervention radiology.
4. Demonstration of various intervention procedures.

***Course outcomes of above practical are covered in their respective theory courses.**

Bachelors in Medical Radio Imaging and Technology II[nd] year

Course code	**:** BMRT-306P
Course Name	**:** Advanced Radiological Procedures
Semester /Year	**:** III[rd] year

	L	T	P	C
	-	-	02	01

Practicals

1. Demonstration of basic contrast procedures of GI Tract.
2. Observation of basic procedures of excretory system.
3. Demonstration of Extremities
4. Demonstration of biliary system.
5. Demonstration of abdominal organs.

***Course outcomes of above practical are covered in their respective theory courses.**