PONDICHERRY UNIVERSITY

Curriculum

BACHELOR OF SCIENCE

MEDICAL RADIOLOGY AND IMAGING TECHNOLOGY

B.Sc. (MRIT)

Regulation & Syllabus

(B.Sc MRIT General and Lateral entry)

2020-21

Bachelor of Science in Medical Radiology and Imaging Technology Course
B.Sc MRIT

Model Curriculum

This curriculum is as per the MHRD document outlines, the structure of the Medical Radiology and Imaging Technology training program, the knowledge and skills expected from the graduates at various levels. It also enumerates the nature of the various examinations and assessments that planned throughout the training program.

The aims of the recommended curriculum are to produce MRIT'S who are

- Technically and clinically competent;
- Aware of radiation safety issues and the importance of quality assurance;
- Understand the theoretical basis for evidence based practice;
- Effective members of the multidisciplinary team;
- Prepared to participate in or initiate research into practice;
- Can work according to registration requirements on the respective continents.

All aspects of medical radiological and imaging technology have been considered in the development of this curriculum together with the identification of the roles expected for different levels of MRIT'S based on their qualification and experience. The need for connecting the dots between the education and employment practices has been the road map for devising this curriculum.

CONTENT

* Subjected to change

B.Sc. MRIT
Medical Radiology and Imaging Technology (Regulations)

Learning Objectives

The Aim of B.Sc. in Medical Radiology and Imaging Technology (MRIT) program is to provide highest and Atomic Energy Regulatory Board (AERB) accredited educational process through formal didactic and state-of-the-art clinical experiences that will render qualified, patient focused, compassionate, critical thinkers Medical Radiology and Imaging Technologist for the community who are engaged in lifelong learning. The graduates of the program are prepared to apply for the Level-I Radiation Safety Officer (RSO) as per AERB norms.

The aim & objectives of the program are to

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

Expected Programme outcome from the future graduate:

1. Should be able to undertake Radiography & Medical Imaging procedures independently.
2. Assist in specialized radiological procedures.
3. Able to do the image processing.
4. Should be able to handle all radiological and imaging equipment independently.
5. Should ensure radiation protection and quality assurance
6. Undertake care and maintenance of all radiological and imaging equipment
7. Able to evaluate images for technical quality
8. Able to identify and manage emergency situations.
9. Able to receive and document verbal, written and electronic orders in the patient's medical record.
10. Should have computer skills.
11. Should be able to provide empathetic professional patient care.
12. Able to demonstrate professional growth, sense of professionalism and desire to learn
13. Able to demonstrate the core values of caring, integrity and discovery.
14. To exhibit keen interest, initiative & drive in the overall development of the Department and 'Leadership Qualities' for others to follow.
15. He/she is expected to be confident and to perform all the duties diligently with utmost sincerity and honesty.
16. Any other duty/task/work assigned by any higher authority like Director, Dean, Medical Superintendent, Head of the Department from time to time; either in "Public Interest" or in the interest of upkeep / development of the Department / Institutions.

Eligibility for admission:
Registration of Courses

The admission is based on the CENTAC process. The reservation and other process in as per the government norms from time to time

Selection procedure

1. Candidates who have passed the HIGHER SECONDARY (CBSC or State Board higher Secondary School Examination) with the specified minimum 50% marks (40% marks for SC, ST, MBC and OBC candidates) marks or the approved marks by the government laid committee in the following group subjects and should have English as one subject
    a. English, Physics, Chemistry, Botany, Zoology
    b. English, Physics, Chemistry, Biology and any other language OR

    For Lateral Entry: Diploma in Radiography and Imaging Technology courses approved by the government after completing 12th class/ 10 +2 of CBSE or equivalent with minimum aggregate of 50% marks in physics chemistry and biology provided the candidate has passed in each subject separately. The age limit is 35 years. The government service candidates will be exempted if approved by the Committee or the government.

2. Candidates who have studied abroad and have passed the equivalent qualification as determined by the University guideline to determine the eligibility and must have passed in the subjects: Physics, Chemistry, Biology and English upto 12th Standard level.
3. He/she has attained the age of 17 years as on 31st December & maximum age limit is 30 years. (Relaxable as per government norms)
4. He/she has to furnish at the time of submission of application form, a certificate of Physical fitness from a Government Hospital and testifying to satisfactory general character.
5. Admission to B.Sc. Medical Radiology and Imaging Technology course shall be made on the basis of eligibility and as per the Government Rules from time to time.
6. If the Selection is based on entrance, it will be as per the Government rules and regulations.
    a. Entrance test will be conducted by the institute/university as per the syllabus under 10 +2 scheme of CBSE, subject-wise distribution of questions will be as 30% in Physics, 30% in biology, 30% in Chemistry, 5% in English (Language & Comprehension) and 5% in General Awareness about health related methods.
    b. Successful candidates on the basis of written Test will be called for the interview & shall face an interview board. The interview board will include the Principal/Head of the Department of medical imaging (Chairman of the Board) along with the faculty as well as other nominees, whose recommendations shall be final for the selection of the students.
    c. During subsequent counseling (s) the seat will be allotted as per the merit of the candidate depending on the availability of seats on that particular day.
    d. Candidate who fails to attend the Medical Examination on the notified date(s) will forfeit the claim for admission and placement in the waiting list except permitted by the competent authority under special circumstances.
    e. The name of the student(s) who remain(s) absent from classes for more than 15 days at a stretch after joining the said course will be struck off from the college rolls without giving any notice.

Provision of Lateral Entry:

Lateral entry to second year for B.Sc MRIT course for candidates who have passed diploma program in Radiography from the Government Boards and recognized by State/Central University, fulfilling the conditions specified and these students are eligible to take admission on lateral entry system only if the same subject have been studied at 10+2 Scheme and diploma level. The admission process is as per the government rule and regulations from time to time. Students to be admitted under Lateral Entry shall be 10% over and above the sanctioned intake

The lateral entry candidates have the direct entry into the second year (ie from III semester) are exempted from the first year (Semester – I and Semester – II) curriculum. For the grant of the university degree the lateral entry candidates have to complete the semester – III to Semester – VI, and the internship compulsory and mandatory.

Duration of the course

Duration of the course: 4 years with 6 semesters and 1(one) year compulsory Internship. The maximum period to course successfully should not exceed a period of 8 (eight) years from the date of admission including the course and the compulsory internship.

Medium of instruction

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

Attendance

A candidate has to secure minimum attendance in each subject of the semester / academic year as per the University norms. *Condonation of shortage of attendance* in aggregate up to 10% in each semester may be granted by the College Academic Committee and as per the regulations of University.

For Student INTERNSHIP offered during VII and VIII semesters, 100 per cent attendance is compulsory. However, the attendance may be condoned up to 15 per cent, under extra-ordinary situations, by the Dean based on the genuineness of the case and upon the recommendation of the concerned course teacher and Head of the Department.

The students failing to attend the classes / examinations on non-official ground will be treated as absent.

Students deputed for sports, cultural meets, *etc.* with prior permission of the Principal/Dean of the college shall be given attendance for the period of absence. However, students under this category must have attended a minimum of 50 per cent classes in the total theory and practical classes conducted.

Calculation of Attendance

Number of Theory/Practical classes conducted for a course from the first working day as per the time table to the last practical class of that semester is to be construed as the total number of practical classes conducted by the course teacher.

The student belonging to a batch will attend classes and earn attendance in the particular batch only as per the time table. No student shall be permitted to attend along with another batch to gain attendance either in theory or in practical.

For calculating 75 percent attendance, the number of working days may be calculated only from the date of joining of the student for first year first semester only.

Academic year of the course implementation

The course curriculum will be implemented and come into force from the academic year 2020-2021.

Assessment and Evaluation of Student's Performance

Assessments should be completed by the academic staff, based on the compilation of the student's theoretical & clinical performance throughout the training program of the semester. To achieve this, all performance in assessment, class test, clinical work, preparation and seminar presentation assessed by the concerned faculty and feedback should be included and evaluated. The marks secured by the candidate in each subject shall be forwarded to the university at the end of the semester before the examination as per the university.

Examination

The University examination will be conducted in the semester pattern for all the Three years, each consisting of two semesters. The college itself shall conduct the examination for the subjects not covered under the scheme of the examination and during the Internship in the fourth year.

The maximum number of candidates for practical examination should not exceed 20 per day, One internal and one external examiner should jointly conduct practical examination for teach student. An examiner shall not be below the rank of a Assistant Professor or Tutor/Demonstrator.

Passing Minimum and distribution of marks

1. The candidate should secure minimum 50% in THEORY and 50% in PRACTICAL examinations separately.
2. The weightage of marks shall be in the ratio of 50:50 respectively for external and internal examination.
3. Each subject Theory and Practical course shall carry a maximum of 100 marks.

Internship

The candidate having passed all the examination prescribed in the curriculum examination of the course shall be eligible to undergo the compulsory internship.

The compulsory FULL-TIME rotator internship should be done for a period of ONE year from the date of the start in a Hospital/ Institution approved by the University. The internship should be completed at a stretch without gap. The internship should be started once the results are declared by the University.

Eligibility for award of DEGREE

The candidate shall be eligible for the award of degree of Bachelor of Science Medical Radiology and Imaging Technology (B. Sc (MRIT) when have successfully passed all the prescribed examination of the curriculum of 3 years in an institute recognized by the university and have completed the compulsory internship of one year in the approved institute after passing all the examination of the curriculum.

Declaration of CLASS

A successful candidate obtaining 75% and more marks in the grand total aggregate in *FIRST* attempt shall be declared passed with *DISTINCTION.* The candidate passed with 60% and more but less than 74.9% marks in the grand total aggregate in the *FIRST* attempt shall be declared passed with *FIRST CLASS*. The candidate passed with 50% and more but less than 59.9% marks in the grand total aggregate in the *FIRST* attempt and a candidate who passed with more than one attempt irrespective of the percentage of mark secured shall be declared passed with *SECOND CLASS*.

The rank shall be declared on the basis of aggregate marks obtained in all subjects of the curriculum by a candidate in the University examination in the *FIRST* attempt shall be eligible for the award of rank.

Removal of Difficulties

If any difficulty arises in giving effect to the Provisions of these regulations, the Vice-Chancellor may issue necessary orders which appear to him/her to be necessary or expedient for removing the difficulty. Every order issued by the Vice-Chancellor under this provision shall be laid before the Academic Council of the University immediately after the issuance. Not-withstanding anything contained in the rules and regulations, the Board of Studies or Academic Council shall make changes whenever necessary.

Details of fees to be paid by the student (Apart from Admission Fee)

The fees to be paid by the student other than admission and semester fee are given below.

Sl. No	Particular	Amount
1	Late registration fee	1000
2	Missing mid semester examination fee per course	1000
3	Duplicate hall ticket fee	250
4	Transfer and conduct certificate fee	250
5	Examination fee per course (regular / arrear)*	250
6	Revaluation fee per course*	500
7	Retotaling fee per course*	250
8	Mark sheet*	100
9	Provisional certificate*	250
10	Degree certificate*	500
11	Transcript card*	500
12	Migration certificate*	100

* As per University rules and regulations from time to time

Norms for the conduct of course

Infrastructure

- Class Rooms – 1 (one) for each semester, Office Room – 1 No, Audio Visual Room cum Demonstration room – 1 No, OHP/LCD Projector – 3 Nos
- The college should have MOU or affiliated to a hospital or Radiology and imaging technology Centers where all the equipments related to the conduct of training for the course available for practical and clinical purpose. The college/Institution should provide the transportation for the students for carrying during the college hours.

Staffing Pattern

Teaching staff

- Principal (Professor/Associate Professor) : 1 No
- Associate Professor : 2 Nos
- Assistant Professor : 2 Nos
- Anatomy (Assistant Professor) : 1 No
- Physiology (Assistant Professor) : 1 No
- Faculty/student ratio : 01:10
- Guest faculties may be appointed for other non-radiology subjects
- Office staff : LDC – 1 No, UDC – 1 No, Peon/Attender - 1 No

Curriculum Outline

First Semester

Code	Course Titles	Hours		
		Theory	Practical	Total
--	Healthcare Delivery System in India **	40	--	40
--	Basic Computers, English and Communication Soft skills**	50	20	70
BMRIT – 001	Medical Terminology, Law, Ethics, Record keeping & Quality Patient Care	60	--	60
BMRIT – 002	Human Anatomy	60	20	80
BMRIT – 003	(PRACTICALS) Human Anatomy	--	40	40
---	Clinical Education – I (Conventional Radiography Part – I)	--	180	180
Total		210	260	470

**** Non Exam**

Second Semester

Code	Course Titles	Hours		
		Theory	Practical	Total
BMRIT – 004	Human Physiology	60	20	80
BMRIT – 005	Basics Physics including Radiological Physics	60	--	60
BMRIT – 006	Radiographic Positioning & Image Processing Technique	100	--	100
ENVS – 123	Environmental Studies	60	--	60
BMRIT – 007	PRACTICALS – Positioning Radiography	--	100	100
---	Clinical Education – I (Conventional Radiography Part – I)	--	80	80
Total		280	200	480

Third Semester

Code	Course Titles	Hours		
		Theory	Practical	Total
BMRIT – 008	Special Radiography Procedures	60	--	60
BMRIT – 009	Radiation Detection, Measurement and Protection	60	--	60
BMRIT – 010	Basic Microbiology & Pathology	60	20	80
BMRIT – 011	Basic Biochemistry & Pharmacology	60	20	80
BMRIT – 012	PRACTICALS – Special Radiographic Procedures	--	100	100
---	Clinical Education – III (Special Radiology procedures)	--	120	120
Total		240	260	500

Fourth Semester

Code	Course Titles	Hours		
		Theory	Practical	Total
BMRIT – 013	Computed Tomography	60	50	110
BMRIT – 014	Physic of Imaging Equipment's	60	--	60
BMRIT – 015	Quality Control in Radiology and Radiation Safety	60	--	50
BMRIT – 016	PRACTICALS – Computed Tomography Procedures	--	100	100
---	Clinical Education – IV (CT) Studentship	--	180	180
Total		180	270	500

Fifth Semester

Code	Course Titles	Hours		
		Theory	Practical	Total
BMRIT – 017	Magnetic Resonance Imaging	60	50	110
BMRIT – 018	Modern Imaging Technology	60	40	100
PADM – 113	Public Administration	40	--	40
BMRIT – 019	PRACTICALS – Magnetic Resonance Imaging	--	100	100
---	Clinical Education – V (MRI) Studentship	--	120	120
Total		160	310	470

Sixth Semester

Code	Course Titles	Hours		
		Theory	Practical	Total
BMRIT – 020	Interventional Imaging Technology & Ultrasonography	90	--	90
BMRIT – 021	Research Methodology, Biostatistics & Principles of Management and Act, rules & regulations of Radiology	80	--	80
---	Seminars, Journal club & Group Discussions	30	60	90
---	Project (Medical Imaging Techniques)	--	50	50
---	Clinical Education – VI (Medical Radiography) Studentship	--	150	150
Total		200	260	460

Seventh & Eighth Semester (INTERNSHIP)

Course Titles	Hours		
	Theory	Practical	Total
Medical Radiology and Imaging Technology – Internship	0	1080	1080

INTERNSHIP **– Minimum 1080 hours (6-hours a day with 180 working days in a year)**
Students have to undertake the rotational postings during which students have to work under supervision of an experienced staff in the following areas:

Sl. No.	Postings	Duration
1	Conventional radiography	2 months
2	Radiographic special procedures	2 months
3	CR, DR and PACS	2 months
4	Computed Tomography	2 months
5	Magnetic Resonance Imaging	2 months
6	Ultrasonography & Doppler Imaging	1 month
7	Advanced and Modern Imaging	1 month

Guidelines for setting the Question Paper for Theory Examination
(For Courses Involving Theory and Practical/ Only Theory)

1. Please prepare the **question papers for 75 marks** in such a way that the question paper shall contain **Section – A (questions)** for **40 marks** and **Section – B (questions)** for **35 marks** as per the template enclosed.
2. Please see that questions are set within the course syllabus covering entire syllabus WITH EQUAL DISTRIBUTION FROM ALL TOPICS IN EACH PART.

Sl. No.	Code & Paper	Section – A (40 Marks)	Section – B (35 Marks)
1	BMRIT – 001 Medical Terminology, Law, Ethics, Recordkeeping and Quality Patient Care	Medical Terminology, Law, Ethics, Recordkeeping	Quality Patient Care
2	BMRIT – 006 Radiographic Positioning & Image Processing Technique	Radiographic Positioning	Image Processing Technique
3	BMRIT – 010 Basic Microbiology & Pathology	Microbiology	Pathology
4	BMRIT – 011 Basic Biochemistry & Pharmacology	Biochemistry	Pharmacology
5	BMRIT – 020 Modern Imaging Technology – III(Ultrasonography & Advanced Imaging Technology)	Ultrasonography	Advanced Imaging Technology
6	BMRIT – 021 Research Methodology, Biostatistics & Principles of Management and Act, rules & regulations of Radiology	Research Methodology, Biostatistics	Principles of Management and Act, rules & regulations of Radiology

3. Question papers should be computer generated only (No hand writing)

4. Please give continuous question numbers for all the sub-questions under each part as given in question paper template.

5. Please provide key answers**.** While providing key answers, please mention the answer number and the answer.

6. Remuneration for setting question paper with key answers and actual postal expenses will be paid to the examiner as per the university norms.

7. Please fill the remuneration form completely and send it along with question paper.

Pattern of Question Paper

Time – 3 Hours *Maximum Marks – 75 Marks*

Answer Section – A and Section – B Separately

SECTION – A (40 Marks)

I. *Essay Questions:(Any ONE)* *(1 x 10 = 10)*

(1)

Or

(2)

II. *Write short Notes on any SIX* *(6 x 5 = 30)*

(3)
(4)
(5)
(6)
(7)
(8)
(9)
(10)

SECTION – B (35 Marks)

I. *Essay Questions:(Any ONE)* *(1 x 10 = 10)*

(11)

Or

(12)

II. *Write short Notes on any FIVE* *(5 x 5 = 25)*

(13)
(14)
(15)
(16)
(17)
(18)

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NOTE: ***Refer the Guidelines for setting the Question Paper for Theory Examination for the subjects***

First Semester

Introduction to National Healthcare Delivery System in India *Theory – 40*
(Non-Examination Paper)

The course provides the students a basic insight into the main features of Indian health care delivery system and how it compares with other system of the world. The topics to be covered under the subject are as follows.

Unit	Titles
1	***Introduction to healthcare delivery system*** ➢ Healthcare delivery system in India at primary, secondary and tertiary care ➢ Community participation in healthcare delivery system ➢ Health system in developed countries. ➢ Private Sector ➢ National Health Mission ➢ National Health Policy ➢ Issues in Health Care Delivery System in India
2	***National Health Programme*** ➢ Background objectives, action plan, targets, operations, achievements and constraints in various National Heath Programme
3	***Introduction to AYUSH system of medicine*** ➢ Introduction to Ayurveda. ➢ Yoga and Naturopathy ➢ Unani ➢ Siddha ➢ Homeopathy ➢ Need for integration of various system of medicine
4	***Health scenario of India*** ➢ Past, present and future
5	***Demography & Vital Statistics*** ➢ Demography – its concept ➢ Vital events of life & its impact on demography ➢ Significance and recording of vital statistics ➢ Census & its impact on health policy
6	***Epidemiology*** ➢ Principles of Epidemiology ➢ Natural History of disease ➢ Methods of Epidemiological studies ➢ Epidemiology of communicable & non-communicable diseases, disease transmission, host defense immunizing agents, cold chain, immunization, disease monitoring and surveillance

Basic Computers, English, Communication and Soft skills
(Non-Examination Paper)

Basic Computers *(Theory – 20 & Practical 20)*
(Non-Examination Paper)

The students will be able to appreciate the role of computer technology. The course has focus on computer organization, computer operating system and software, and MS windows, Word processing, Excel data worksheet and PowerPoint presentation. Topics to be covered under the subject are as follows:

Unit	Titles
1	**Introduction to Computer:** Introduction, characteristics of computer, block diagram of computer, generations of computer, computer languages.
2	**Input output Devices:** Input devices(keyboard, point and draw devices, data scanning devices, digitizer, electronic card reader, voice recognition devices, vision-input devices), output devices(monitors, pointers, plotters, screen image projector, voice response systems).
3	**Processor and Memory:** The Central Processing Unit (CPU), main memory
4	**Storage Devices:** Sequential and direct access devices, magnetic tape, magnetic disk, optical disk, mass storage devices
5	**Introduction of windows:** History, features, desktop, taskbar, icons on the desktop, operation with folder, creating shortcuts, operation with windows (opening, closing, moving, resizing, minimizing and maximizing, etc.).
6	**Introduction to MS-Word:** Introduction, components of a word window, creating, opening and inserting files, editing a document file, page setting and formatting the text, saving the document, spell checking, printing the document file, creating and editing of table, mail merge
7	**Introduction to Excel:** Introduction, about worksheet, entering information, saving workbooks and formatting, printing the worksheet, creating graphs
8	**Introduction to power-point:** Introduction, creating and manipulating presentation, views, formatting and enhancing text, slide with graphs.
9	**Introduction of Operating System:** Introduction, operating system concepts, types of operating system.
10	**Computer networks:** Introduction, types of network (LAN, MAN, WAN, Internet, Intranet), network topologies (star, ring, bus, mesh, tree, hybrid), components of network.
11	**Internet and its Applications:** Definition, brief history, basic services (E-Mail, File Transfer Protocol, telnet, the World Wide Web (WWW)), www browsers, use of the internet.
12	Application of Computers in clinical settings.
13	**Practical Demonstration**: Fundamentals of computers - Learning to use MS office: MS word, MS PowerPoint, MS Excel. To install different software. Data entry efficiency

Teaching & practical learning activities

The course content in Computer Applications will be covered by:

1. Computer operating systems like MS-DOS and WINDOWS
2. Study of software packages and Microsoft package and online tools for research and study
3. Interactive Lectures
4. One on one computer training

English – Communication and Soft Skills
(Non-Examination Paper) *(Theory – 30)*

Unit	Titles
1	**Foundation English:** Review of Grammar, Remedial study of Grammar, Phonetics Public Speaking
2	**(Writing Skills)** Letter writing, Note taking, Precise Writing, Anecdotal records, Diary writing, The different methods of writing like letters, E-mails, report, case study, collecting the patient data etc. Basic compositions, journals, with a focus on paragraph form and organization, Preparing reports, Resume / CV
3	**Vocabulary** Medical terminology – roots, prefixes and suffixes, Medical abbreviation
4	**Communication Skills** Concepts and principles of good communication, Types and process of communication , Barriers of communication and how to overcome, Conversations, discussions, dialogues and sort presentations
5	**Soft Skills** Team work, Leadership skills, Decision making &problems solving, Managing time and pressures, Self-Management & Attitude
6	Interpret medical orders/report and medical words

TEXT BOOKS RECOMMENDED

1. Functions of English by Tickoo subramaniam
2. English for Professional Nursing by David (MT)
3. English Grammar and composition by Wren and Martin

TEACHING LEARNING ACTIVITIES

The course content in English will be covered by:

1. Lectures
2. Group Discussion

Medical Terminology, Law, Ethics, Record Keeping & Quality Patient Care

BMRIT – 001 *(Theory – 60)*

Medical Terminology, **Medical Law, Ethics & Record Keeping**

SECTION – A *(Theory – 30)*

This course introduces the elements of medical terminology. Emphasis is placed on building familiarity with medical words through knowledge of roots, prefixes, and suffixes. Topics include: origin, word building, abbreviations and symbols, terminology related to the human anatomy, reading medical orders and reports, and terminology specific to the student's field of study. Topics to be covered under the subject are as follows:

Unit	Titles
1	Derivation of medical terms
2	Define word roots, prefixes, and suffixes
3	Conventions for combined morphemes and the formation of plurals
4	Basic medical terms
5	Form medical terms utilizing roots, suffixes, prefixes, and combining roots
6	Interpret basic medical abbreviations/symbols.
7	Utilize diagnostic, surgical, and procedural terms and abbreviations related to the integumentary system, musculoskeletal system, respiratory system, cardiovascular system, nervous system, and endocrine system.
8	Interpret medical orders/reports.
9	Data entry and management on electronic health record system.
10	**Medical Law, Ethics & Record Keeping** *(Theory – 15)* Legal and ethical considerations are firmly believed to be an integral part of medical practice in planning patient care. Advances in medical sciences, growing sophistication of the modern society's legal framework, increasing awareness of human rights and changing moral principles of the community at large, now result in frequent occurrences of healthcare professionals being caught in dilemmas over aspects arising from daily practice. Medical ethics has developed into a well based discipline which acts as a "bridge" between theoretical bioethics and the bedside. The goal is "to improve the quality of patient care by identifying, analyzing, and attempting to resolve the ethical problems that arise in practice". Doctors are bound by, not just moral obligations, but also by laws and official regulations that form the legal framework to regulate medical practice. Hence, it is now a universal consensus that legal and ethical considerations are inherent and inseparable parts of good medical practice across the whole spectrum. Few of the important and relevant topics that need to focus on are as follows: ➢ Introduction to Code of conduct, Medical ethics – Definition - Goal – Scope ➢ Basic principles of medical ethics – Confidentiality ➢ Malpractice and negligence - Rational and irrational drug therapy ➢ Autonomy and informed consent - Right of patients ➢ Care of the terminally ill- Euthanasia ➢ Organ transplantation, Medico legal aspects of medical records & other aspects involved ➢ Professional Indemnity insurance policy ➢ Development of standardized protocol to avoid near miss or sentinel events ➢ Obtaining an informed consent Quality assurance and management ➢ Concepts of Quality of Care & Quality Improvement Approaches & Tools ➢ Standards and Norms ➢ Introduction to NABH guidelines

Introduction to Quality Patient Care

SECTION – B *(Theory – 30)*

The objective is to help students understand the basic concepts of quality in health Care and develop skills to implement sustainable quality assurance program in the health system.

Including Basic emergency care and life support skills, Infection prevention and control, biomedical waste management, Disaster management and Antibiotic resistance Quality and Patient Care

Quality assurance and management – The objective of the course is to help students understand the basic concepts of quality in health Care and develop skills to implement sustainable quality assurance program in the health system.

Unit	Titles
1	**Quality assurance & management** Concepts of Quality of Care, Quality Improvement Approaches, Standards and Norms, Quality Improvement Tools, NABH guidelines, Basics of emergency care and life support skills
2	**Basic emergency life support skills (BLS)** Basic life support (BLS) is the foundation for saving lives following cardiac arrest. Fundamental aspects of BLS include immediate recognition of sudden cardiac arrest (SCA) and activation of the emergency response system, early cardiopulmonary resuscitation (CPR), and rapid defibrillation with an automated external defibrillator (AED). Initial recognition and response to heart attack and stroke are also considered part of BLS. The student is also expected to learn about basic emergency care including first aid and triage. Topics to be covered under the subject are as follows: a. Vital signs and primary assessment b. Basic emergency care – first aid and triage c. Ventilations including use of bag-valve-masks (BVMs) d. Choking, rescue breathing methods e. One- and Two-rescuer CPR f. Using an AED (Automated external defibrillator). g. Managing an emergency including moving a patient At the end of this topic, focus should be to teach the students to perform the maneuvers in simulation lab and to test their skills with focus on airways management and chest compressions. At the end of the foundation course, each student should be able to perform and execute/operate on the above mentioned modalities
3	**Bio medical waste management and environment safety** The aim of this section will be to help prevent harm to workers, property, the environment and the general public. Topics to be covered under the subject are as follows: a. Definition of Biomedical Waste, Waste minimization (including color coding) b. BMW – Segregation, collection, transportation, treatment and disposal c. Liquid BMW, Radioactive waste, Metals / Chemicals / Drug waste d. BMW Management & methods of disinfection e. Modern technology for handling BMW f. Use of Personal protective equipment (PPE) g. Monitoring & controlling of cross infection (Protective devices)
4	**Infection prevention and control** The objective of this section will be to provide a broad understanding of the core subject areas of infection prevention and control and to equip AHPs with the fundamental skills required to reduce the incidence of hospital acquired infections and improve health outcomes. Concepts should include a. Evidence-based infection control principles and practices [such as sterilization, disinfection, effective hand hygiene and use of Personal protective equipment (PPE), b. Prevention & control of common healthcare associated infections, c. Components of an effective infection control program, and d. Guidelines (NABH and JCI) for Hospital Infection Control

5	**Antibiotic Resistance** History of Antibiotics, How Resistance Happens and Spreads, Types of resistance (Intrinsic, Acquired, Passive), Trends in Drug Resistance, Actions to Fight Resistance, Bacterial persistence, Antibiotic sensitivity, Consequences of antibiotic resistance, Antimicrobial Stewardship – Barriers and opportunities, Tools and models in hospitals
6	**Disaster preparedness and management** The objective of this section will be to provide knowledge on the principles of on-site disaster management. Concepts to be taught should include – (Fundamentals of emergency management, Psychological impact management, Resource management, Preparedness and risk reduction) Key response functions (including public health, logistics and governance, recovery, rehabilitation and reconstruction), information management, incident command and institutional mechanisms
7	**Hospital Practice and Care of Patient** Hospital staffing and administration, records, professional, ethics, co-operation with other staff and departments, Departmental organizations. Handling of the patients, seriously ill and traumatized patients, visually impaired, speech and hearing impaired, mentally impaired, drug addicts and non-English speaking patients. Understanding patient needs - patient dignity of inpatient and out patients. Interaction with the patient's relatives and visitors. Methods of effective communication - verbal skills, body language, professional appearance, visual contact etc. Elementary personal and departmental hygiene, dealing with receptacles, bed pans and urinal etc. General preliminaries to the exam. Moving chair and stretcher, patient. Unconscious patient, general comfort and reassurance for the patient. Vital signs and oxygen - patient's Haemetasis status. Body temp, respiratory rate, pulse, blood pressure, oxygen therapy, oxygen devices, Chest tubes and lines. First aid - shock, electrical shock, hemorrhage, burns, Asphyxia, fractures, loss of consciousness. Emergency treatment to the collapsed patient. Artificial respiration and resuscitation. Preparation of patient for general and special radiological examinations. Supervision of patients undergoing special examination. Administration of drugs and contrast media. Aseptic and sterile procedures. Handling of infections patients in the department or in the ward. Regulation of dangerous drugs. Trolley set up for special x-ray examinations, Radiation hazardous and protective measure.
8	**Hospital procedure** Hospital staffing and organization; records relating to patients and departmental statistics; professional attitude of the technologist to patients and other members of the staff; medico- legal aspects; accidents in the departments, appointments, organization; minimizing waiting time; out-patient and follow-up clinics; stock-taking and stock keeping
9	**Care of the patient** FIRST contact with patients in the department; management of chair and stretcher patients and aids for this, management of the unconscious patient; elementary hygiene; personal cleanliness; hygiene in relation to patients (for example clean linen and receptacles , nursing care; temperature pulse and respiration; essential care of the patient who has a tracheostomy; essential care of the patient who has a colostomy; bedpans and urinals; simple application of a sterile dressing
10	**First aid** Aims and objectives of first aid; wounds and bleeding, dressing and bandages; pressure and splints, supports etc. Shock; insensibility; asphyxia; convulsions; resuscitation, use of suction apparatus, drug reactions; prophylactic measures; administration of oxygen; electric shock; burns; scalds; hemorrhage; pressure points; compression band. Fractures; splints, bandaging; dressing, foreign bodies; poisons

Instruction to question paper setter (Distribution of questions)

Section – A	**40 Marks**	Medical Terminology, Law, Ethics, Record Keeping
Section – B	**35 Marks**	Quality Patient Care

Human Anatomy

(BMRIT – 002) *Theory – 60 & Practical - 40*

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

Unit	Titles
1	**General anatomy** **Introduction to Anatomical terms and organization of the human body** ➢ Human cell structure. Tissues – Definition, Types, Characteristics, Classification, Location, Functions and formation, ➢ Membranes and glands – Classification and structure. **The Skeletal System** ➢ Bones – Types, structure, Axial & Appendicular Skeleton, Bone formation and growth ➢ Joints – Classification and structure, Joints of Limbs and movements **The Muscular System** ➢ Types and structure of muscles, Muscle groups
2	**The Respiratory SystemParts of Respiratory System** Structure of the organs of Respiratory System, Muscles of respiration, Pleura.
	Heart and blood vessels (Circulatory System) ➢ Heart: General features, Blood supply, Nerve supply, Conducting system of heart. ➢ Pulmonary, systemic & portal circulation , Main blood vessels and its branches. ➢ Pericardium
4	**The Lymphatic system** ➢ Lymph nodes, Tonsil, Spleen, Thymus, MALT
5	**The Digestive system** ➢ Parts & Structure of Alimentary tract ➢ Organs associated with digestive system
6	**The Urinary system (Excretory System)** ➢ Organs of Urinary system ➢ Structure of Kidney, Ureter, Urinary bladder & Urethra
7	**The Reproductive System including Breast**. ➢ Female reproductive organ – Parts and Structure ➢ Male reproductive organ - Parts and Structure ➢ Mammary gland
8	**The Endocrine system** ➢ Definition, Name the endocrine glands ➢ General features and Structure of Pituitary gland, Thyroid & Parathyroid gland, Pancreas, Adrenal gland
9	**The organ of sense** ➢ Sensory Organs, Structure of Skin ➢ Eye – Structure and Optic pathway, Ear – Structure and Auditory pathway ➢ Nose – Structure and Olfactory pathway, Tongue
10	**The Nervous System** ➢ Structure of Neuron & types. ➢ Somatic Nervous System – Structure of brain, spinal cord, cranial nerves, spinal nerves and peripheral nerves ➢ Autonomic Nervous System- Sympathetic, Parasympathetic – structure, location and functions

11	**Cross sectional Anatomy** Radiology has been developing dramatically during the past few years. With enhancements in magnetic resonance imaging (MRI) and computed tomography (CT), the role of the radiologic technologist has also been changing. Skills in cross-sectional anatomy are important to help the technologist in MRI and CT to identify the anatomy being imaged and to communicate effectively with the radiologist and physicians. ➢ Identify cross-sectional anatomy in the sagittal, coronal and axial planes on CT and MR ➢ Describe anatomical structural relationships. ➢ Recognize normal anatomy and build a personal resource system for future study. ➢ Locate and identify pertinent cerebral, upper thorax, mid-thorax, and abdominal anatomy. ➢ On CT and MR images, identify anatomical structures of the body and of the head. ➢ Distinguish between arterial and venous anatomy of the entire body's vascular system. ➢ Classify the various sections of anatomical regions and their associated parts. **Understanding** of: ➢ Introduction to Sectional Anatomy & Terminology- Sectional planes, Anatomical relationships/terminology ➢ Anatomy of the upper thorax- Surface anatomy relationships, Bony structures and muscles, Blood vessels, Divisions of the mid-thorax, heart and great vessels- Lungs, heart and great vessels, Esophagus, CT/MRI Images of the Thorax - Normal and pathologic ➢ Anatomy of the Abdomen- Major organs and their accessories, Abdominal blood vessels, CT/MR Images of Abdomen - Normal and pathologic ➢ Anatomy of the Pelvis- Bony structures and associated muscles, Digestive and urinary systems, Reproductive Organs, CT/MR Images of the Male/Female Pelvis- Normal and pathologic ➢ Neuro Anatomy- Scan planes ➢ Brain - Cerebral hemispheres, Sinuses, Ventricles, Brainstem and associated parts, Arterial/venous systems, Basal ganglia, Cranial nerves, Spine- Vertebra and disc, Spinal cord and meninges Neck- Arterial/venous systems, Muscles, Glands and pharynx
14	**Practicals** Osteology - Name of the bones - Joints & movements.

Text books Recommended:

- General Anatomy – B D Chaurasia
- Systemic Anatomy – Anatomy and Physiology for Nursing and Health care Students – Vijaya D Joshi Asalata
- Human Anatomy by Inderbir Singh

Reference Books:

- Surface and Radiological Anatomy - Halim
- Snell's Regional Anatomy Book

Teaching Learning Activities

The course content in Anatomy will be covered by:
Interactive Lectures, Practical Demonstrations, Seminars & Assignments

Instruction to question paper setter (Distribution of questions)

Section - A	**40 Marks**	**Systemic Anatomy**
Section - B	**35 Marks**	**General Anatomy**

Human Anatomy (PRACTICALS)

(BMRIT – 003) ***Practical – 60***

Gross Anatomy Practical:

- The students should be able to identify the given gross specimen and answer
- Side of the organ if necessary
- Gross features, parts
- Location
- Related questions of the given organ

Gross specimen spotter

Osteology: Should be able to identify the all bones of skeleton, Parts of the bone, Movements and muscles responsible

Viva voce

Student should be able to identify the

- All bones, and the major parts and joints formed by the bones.
- Gross specimen, location, parts and answer the related questions

Distribution of marks in Practical

Practical Marks 75 (Minimum – 37)			Internal Assessment Marks – 25 (Minimum – 12)	Total
Osteology spotter 20	Gross Spotter 20	Viva Voce 35	25	100

Second Semester

Human Physiology
(BMRIT – 004) *(*Theory – *60 & Practical's - 20)*

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

Unit	Tiles
1	**Cell Physiology** Cell: Structure & functions of components, Functions of membranes & glands
2	**Circulatory System** Blood: Component and their functions, blood groups, coagulation, blood volume and its regulation. RBC, WBC & platelet counts, names of developmental stages of RBC, functions and fate of RBC. Functions of WBC and platelets, Functions and regulations of the heart, cardiac cycle, cardiac output, E.C.G., heart sounds, Blood pressure: Maintenance and regulation, Effects of exercises.
3	**Respiratory System** Functions of the respiratory organs, Physiology of respiration, Pulmonary ventilation, volume Mechanics of respiration, Gaseous exchange in lungs, Regulation of respiration, Effects of exercises on respiration
4	**Digestive System** Functions of organs of digestive tract,Movements of the alimentary tract, Digestion in mouth, stomach, intestines, Absorption of food, Metabolism of carbohydrates, proteins and fat
5	**Excretory System** Functions of organs of excretory tract, Composition of urine, Mechanism of urine formation & Micturition Functions of skin
6	**Endocrine System** Functions of the various endocrine glands, Endocrine Hormones: Functions and their abnormalities
7	**Reproductive System** Functions of male reproductive system, Functions of female reproductive system, Outline of pregnancy, parturition, lactation, Contraceptive measures, Physiology of foetal growth
8	**Nervous System** Properties and functions of Neuron, Mechanism of Stimulus and nerve impulse, Functions of brain, spinal cord, cranial and spinal nerves. Synaptic transmission, reflexes, control of postures and voluntary motor activity. Autonomic Nervous System
9	**Sensory Organs** Functions of the skin, eye, ear, nose and tongue
10	**Muscular System** Microscopic structure of muscle tissue, myoneural junction, Physiology of Muscle contraction Exercise metabolism, Muscular activity based on metabolism and fatigue, Physiological changes on aging, Exercise physiology
11	**Applied Physiology** Heart and circulation: Normal ECG, blood pressure, cardiovascular compensation for postural and gravitational changes, determinants of cardiac performance. Neuromuscular system: Degeneration and regeneration of nerves control of posture and voluntary movement, neuromuscular transmission, electrical phenomenon. Respiratory system: Normal breath sound, volume and compliance, effects of exercise on respiration, artificial respiration.
12	***Practical's*** Microscopic slides examination of elementary human tissues, cells, General physical examination, Pulse examination, Recording of blood pressure and postural changes in blood pressure, Examination of cardio vascular system, Examination of respiratory system, Examination of nervous system

Instruction to question paper setter (Distribution of questions)

Section – A	**40 Marks**	Nerve, muscle, blood, kidney, GI tract, endocrines and reproduction
Section – B	**35 Marks**	Cardio vascular system, respiratory system, central nervous system and special senses

Text books recommended

Latest editions of the following books:

- Textbook of Medical Physiology by Arthur Guyton and John E Hall.
- Essential of Medical Physiology by K. Sembulingam P Sembulingam
- Manual of Medical Physiology by C.N. Chandrashekar.
- Review of Medical Physiology by Ganong
- Text book of Medical Physiology by Guyton

Teaching learning activities

The course content in Physiology will be covered by:

- Interactive Lectures, Group Discussions, Practical Demonstrations, Seminars & Assignments

Basic Physics and Radiological Physics

(BMRIT – 005) (Theory – *60)*

Unit	Tiles
1	**Basic Physics** Matter and energy, Units and Measurement, System of units, Force, work, Power and energy
2	**Applied Mathematics** Elementary use of Algebraic Symbols and Signs, Measurement of angles, Graphical representation of data
3	**Heat** Heat and Temperature, Heat transfer, Black Body radiation, Thermal conductivity
4	**Electricity & Magnetism** Electrical Charges, Law of Electrical charges, Capacitance, Capacitor, Electrical induction, Ohms Law, Conductor, Insulator and Semiconductor, Alternative current, Direct current, Circuit laws, Serial and parallel connection, Magnetism Laws, Magnets and its types, Magnetic Lines of force
5	**Rectification And Transformers** Rectification and its types, Rectifier Circuit, Transformer principle, construction, Types, Transformer Ratios, Transformer Losses, Efficiency
6	**Electromagnetic Radiation** Electromagnetic spectrum, Properties of Electro Magnetic Radiation
7	**Atomic Structure** Atomic Models, Structure of Atom, Atomic Number, Mass number, Isotopes, Ionization and Excitation
8	**Radioactivity** Type of Radiation, Alpha, Beta and Gamma radiation, Radioactive Isotopes, Half Life periods
9	**Production of X Ray** Thermionic emission, Characteristic X ray, Bremmstrahlung Radiation, Construction and working of X ray tube, Heal effect, Anode angle, Cloud charge, Properties of X rays, Dual Focus, Rating chart/Cooling chart.
10	**Interaction of X-ray With Matter** Classical Scattering, Compton Scattering, Photo Electric Effect, Pair Production, Photo Nuclear Disintegration

Text books recommended

Latest editions of the following books:

- A Primer in Applied Radiation Physics by F A Smith
- Atomic Physics – J. B. Rajam
- Radiologic Science for Technologists, 9th Edition - Bushong
- Christensen's Physics of Diagnostic Radiology – Thomas S curry, James E. Dowdey, Robert C. Murry
- The Physics of Radiology Harold Elford Johns &Jonh Robert Cunningham.

Radiographic Positioning Techniques & Image Processing Techniques
(BMRIT – 006) *Theory – 100 & Practical's – 100*

Radiographic Positioning Techniques *(BMRIT – 006)*
SECTION – A *Theory – 60*

Unit	Tiles
1	**Skeletal system:** **Upper limb:** Technique for hand, fingers, thumb, wrist joint carpal bones, forearm, elbow joint, radio ulnar joints and humerus supplementary techniques for the above. **Lower limb:** Technique for foot, toes, great toe, tarsal bones, calcaneum, ankle joint, lower leg, knee, patella & femur. Stress view for torn ligaments, Subtalar joint and talo calcaneal joint. Inter condylar projection of the knee, Tibial tubercle. Length measurement technique. **Shoulder girdle and thorax:** Technique for shoulder joint, scapular, clavicle, acromio clavicular joints, sternum, ribs, sterno-clavicular joint. Supplementary projections and techniques **Vertebral column:** Technique for atlanto-occipital joint, cervical spine, cervico thoracic spine, thoracic spine, thoraco-lumbar spine, lumbo-sacral spine, sacrum and coccyx. Supplementary techniques to demonstrate: (Scoliosis, Kyphosis, Spondylolisthesis, disc lesion, spinal graft) **Pelvic girdle and hip region:** Technique for whole pelvis. Ilium, ischium, pubic bones, sacro iliac joint, symphysis pubis, hip joint, acetabulum neck of femur, greater and lesser trochanter. Supplementary techniques- Congenital dislocation of hips, Epiphysis of femur, Lateral projections for hip joints to show femoral head and neck relationship. **Skeletal survey:** Skeletal survey for metabolic bone disease, metastases, hormonal disorder, renal disorders. **Skull:** Basic projections for cranium, facial bones, & mandible. Technique for Petrous, temporal for mastoids. Internal auditory canal - Accessory nasal sinuses. Tempero-mandibular joint, Orbits & optic foramen, Zygomatic arches, Styloid process, Pituitary fossa, Jugular foramen.
2	**Dental Radiography**: Technique for intra-oral full mouth. Occlusal projections - Extra oral projections including orthopantomography – Supplementary techniques
3	**Upper respiratory system** : Technique for post nasal airways, larynx, trachea, thoracic inlet, Valsalva manoeuvre – Phonation Technique for routine projections, Supplementary projections: Antero-posterior, obliques, lordotic, apical projection, use of penetrated postero-anterior projection. - Expiration technique. - Technique for pleural fluid levels and adhesions.
4	**Abdominal viscera** : Technique for plain film examination. - Projection for acute abdomen patients. - Technique to demonstrate: Foreign bodies, Imperforate anus
5	**Mobile X-ray Radiography** : Radiography in the ward: Radiography in the specialized unit, such as: Intensive care unit, Coronary care, Neonatal unit.- Radiography in the operating theatre electrical supply, radiation protection, equipment and instructions to be followed for portable/ward radiography
6	**Operation theatre techniques:** General precautions, Asepsis in techniques - Checking of mains supply and functions of equipment, selection of exposure factors, explosion risk, radiation protection and rapid processing techniques.
7	Trauma radiography/Emergency radiography
8	Neonatal and Paediatric Radiography
9	Tomography and Tomosynthesis
10	Forensic Radiography
11	***Practicals :*** Radiographic positioning of all parts of the body

Text books recommended
Latest editions of the following books:

- Philip W. Ballinger: Atlas of radiographic positioning and Radiological Procedures.
- RA Swallow, E Naylor: Clark's positioning in Radiography. EJ Roebuck, AS Whitley
- Sante LR: Roentgenologic technique (Edwards Inc.)
- Goldman : A Radiographic index
- Rossand Gailway: A Handbook of Radiography(Lewis)
- Glenda J. Bryan: Diagnostic Radiography (Mosby)

Image Processing Technique *(BMRIT – 006)*

SECTION – B *Theory – 40 & Practical's – 20*

Unit	Tiles
1	Appreciation and application of all the factors
2	**Radiographic Film:** Structure of film emulsion-film, characteristics (speed, base, latitude)-effect of grain size on film response to exposure, interpretation of characteristics curve-Grain technology Gelatin-Basic film types-Film formats and packing, Direct exposure duplitised films-Single coated emulsions-Films for specialized process. Structure, properties, handling, film wrappings. Handling of exposed and unexposed films. Types, applications, advantages/limitations of different types, safe light requirements.
3	**Sensitometer:** Photographic density-characteristic curve-information from the characteristic curve-speed Vs definition. Storage of X-ray film.
4	**Control of scattered radiation:** Methods of minimizing formation of scatter radiation, effectiveness of grids-grid ratio-preventing scattered radiation, use of cones, diaphragm light beam devices and effectiveness of collimation in reducing effects of scatter. Effects of scatter radiation on radiograph image quality, patient dose and occupational exposure.
5	**Intensifying screens:** Structure and functions, common phosphors used-types, screen mounting, care and maintenance of film screen contact. Intensifying factor-speed and detailcrossover effect-resolution-mottle-reciprocity-screen asymmetry-cleaning. New phosphor technology-influence of kilo voltage. Photo-stimulable phosphor Imaging.
6	**Cassettes:** Structure and function-Types-single, gridded, film holder-Design features and consideration with loading/unloading-Care and maintenance (cleaning).
7	**Photochemistry:** Principles: Acidity, alkalinity, pH, the processing cycle, development, developer solution. Fixing, fixer solution, washing, drying replenishment, checking and adjusting-latent image formation--nature of development-constitution of developerdevelopment time-factors in the use of developer. Fixers-constitution of fixing solutionfactors affecting the fixer-replenishment of fixer-silver conservation-Drying-developer and fixer for automatic film processor-rinsing-washing and drying. Replenishment rates in manual and automatic processing-Silver recovery-Auto and manual chemicals.
8	**Processing:** Manual processing-care of processing equipment-automatic processor-manual VS automatic processing-principles and typical equipment Microprocessor controlled-Cine processing-Daylight systems-Processing faults-maintenance.
9	**Automatic Film Processor**. Functions of various components, Film roller transport-transport time, film feed system. Importance and relation to temp, fixed and variable time cycles. Care and maintenance (cleaning routine and methods of cleaning).
10	**Factors affecting Image Quality:** Meaning of radiographic image contrast, density, resolution, sharpness, magnification and distortion of image, noise and blur. Radiographic illuminators and viewing conditions, visual acuity and resolution. Components of image quality-unsharpness in radiographic image contrast of the radiographic image-distinctness of the radiographic image-size, shape and spatial relationships.
12	**Presentation of radiographs** Opaque letters and markers-Identification of dental films preparation of stereo radiographs-viewing conditions.
13	**Monitor images** Characteristics of the video image-television camera-imaging camera. Laser light and laser-laser imaging-laser imagers-imaging plates-Dry cameras.
14	**Processing room:** Location of the dark room-dark room illumination-equipment and layout-X-ray viewing room-Day light processing-Daylight handling-daylight systems with cassettes-without cassettes.
15	**Dark Room Planning** For A Small Hospital, for A Large Hospital Location of Dark Room and construction of Dark Room. Ventilation, Wall Protection Entrance to Dark Room - Single Door, Double Door, Labyrinth

Instruction to question paper setter (Distribution of questions)

Section – A	40 Marks	Radiographic Positioning Techniques
Section – B	35 Marks	Image Processing Technique

Text books recommended

Latest editions of the following books:

- The Physics of Radiology Harold Elford Johns & Jonh Robert Cunningham..
- Christensen's Physics of Diagnostic Radiology – Thomas S curry, James E.
- Dowdey, Robert C. Murry
- Review of Radiologic Physics – Walter Huda and Richard M. Slone
- A practical approach to modern imaging equipment - Trefler. M
- Radiographic latent image processing – W.E.J Mckinney
- Photographic processing chemistry – L.F.A. Mason
- Physical and photography principles of medical radiography – Seeman & Herman
  Nuclear Physics by I. Kaplan

Environmental Studies

(ENVS – 123) *Theory – 60*

The subject is designed as per the UGC Regulation for all undergraduate courses as a branch of higher education. The subject is designed to refresh the students regarding the multidisciplinary nature of the environment and conservation of the ecosystem.

Objective: At the end of the course, the candidate should know about the environment, understand the surrounding and to know about the biotic interaction.

Unit	Tiles
1	**Renewable and non-renewable resources** ➢ The multidisciplinary nature of environment studies: Definition, scope, and importance- need for public awareness ➢ Forest resources: Uses and over exploitation, deforestation, case studies. Timber extraction mining, dams and their effect on forest and tribal people ➢ Water resources : uses and over utilization of surface and ground water, floods, drought, conflicts over water, dame benefits and problems ➢ Mineral resources: Use and exploitation, environmental effects of extracting the using mineral resources, case studies ➢ Food resources: World food problems, changes caused by agriculture and overgrazing, effects of modern agriculture fertilizer – pesticide problems, water logging salinity, case studies ➢ Energy resources : Growing energy needs, renewable and non – renewable energy resources use of alternate energy sources, case studies ➢ Land resources : land as a resource, land degradation, man induces landslides, soil erosion and desertification ➢ Role of an individual in conservation of natural resources ➢ Equitable use of resources for sustainable lifestyles
2	**Eco systems** ➢ Concept of ecosystem, Structure and function of an ecosystem – producers, consumers, and decomposers ➢ Energy flow in the ecosystem, Ecological succession ➢ Food chain, good webs and ecological pyramids ➢ Introduction, types, characteristic features, structure and function of the following ecosystem – Forest ecosystem, grassland ecosystem, desert ecosystem. Aquatic ecosystem (Ponds, streams, lakes, estuaries)
3	**Biodiversity and its conservation** ➢ Introduction – Definition of genetics, species and ecosystem diversity, Bio-geographical classification of India ➢ Value of Biodiversity : Consumptive use, productive use, social, ethical aesthetic, and option values, Biodiversity at global, national, & local levels ➢ India as a mega diversity nation, Hot spots of biodiversity ➢ Threats to Biodiversity: habitat loss, poaching of wild life, man wildlife conflicts ➢ Endangered and endemic species of India ➢ Conversation and biodiversity : In-situ and ex-situ conversation of biodiversity
4	**Environmental Pollution:** ➢ Definition , causes, effects and control measures of air pollution, water pollution , soil pollution, Marine pollution, noise pollution, thermal pollution, nuclear pollution ➢ Solid waste management: Causes, effects and control measures of urban and industrial wastes ➢ Role of Individual in prevention of pollution ➢ Pollution case studies ➢ Disaster management : Floods, earthquake, cyclone and landslides
5	**Social issue and the environment** ➢ From Unsustainable to sustainable development, Urban Problems related to energy, Water conservation, rain water harvesting, watershed management, Resettlement and rehabilitation of people, its problems and concerns – Case studies ➢ Environmental ethics Issues and possible solutions, climate change, global warming, acid rain, ozone depletion, nuclear accidents and holocaust – Case studies.

	➢ Waste land Reclamation – Consumerism and water products ➢ Environmental protection acts – Air (prevention and control of pollution) Act, water (prevention and control of pollution) Act, wildlife protection Act, Forest conservation Act ➢ Issues Involved in enforcement of environmental legislation – Public awareness ➢ Human Population and the environment : Population growth, variation among nations, population explosion, Family welfare programmes, Environment and human health, human rights, value education, HIV/AIDS, woman and child welfare, Role of Information Technology in environment and human health – Case studies

Field work

- Visit to local area to document environment assets – Rivers/forest/grassland/hill/mountain.
- Visit to local polluted site – Urban/Rural/Industrial/agricultural
- Study of common plants, insects, birds, etc.
- Study of simple ecosystem – pond, river, hill, slopes, etc.

Radiographic Positioning Techniques & Image Processing Technique – PRACTICALS

(BMRIT – 007) *Practical – 80*

Practical:

The students should be able to identify the given gross specimen and answer

- Side of the organ if necessary
- Gross features, parts
- Location
- Related questions of the given organ

Gross specimen spotter:

Machines, films, marker, cassette, hanger, chemicals and the things necessary for positioning

Osteology: should be able to identify the all bones of skeleton and tell joint/s formed by any bone

Viva voce

Student should be able to identify the patient positioning and orientation

1. All bones, and the major parts and joints formed by the bones.
2. Gross specimen, location, parts and answer the related questions

Distribution of marks in Practical

Practical Marks 75 (Minimum – 37)				Internal Assessment Marks – 25 (Minimum – 12)	Total
Demonstration 20	Skill 20	Viva Voce 20	Presentation 15	25	100

Third Semester

Special Radiography Procedures

(BMRIT – 008) *Theory –60 & Practical's 100*

Unit	Tiles
1	**Points for each of the Special Radiography examination** ➢ Review the anatomy of the area. ➢ State the clinical indication for the examination. ➢ State contra indication if any for the examination. ➢ Describe the preparation of the patient including the pre medication if appropriate. ➢ Specify the type and quantity of contrast agent used. ➢ Describe the method of introduction of the contrast agent. ➢ Describe the series of projections taken during the examination. ➢ Indicate the timings of the radiographs in relation to the administration of contrast agent. ➢ Outline the practical problems and the way in which they may be overcome. ➢ Explain the choice of exposure factor. ➢ Detail the measures that should be taken for radiation protection. ➢ Explain the after care of the patient.
2	**Special Radiographic Procedures** ➢ Responsibility of Radiographer during Radiological Procedures. ➢ Preparation of Patient for Different Procedures. ➢ Contrast Media - Positive and Negative, Ionic & Non – Ionic ➢ Adverse Reactions To Contrast Media and Patient Management ➢ Emergency Drugs in the Radiology Department ➢ Emergency Equipments In the Radiology Department ➢ Aseptic technique ➢ Indications, contraindications, basic techniques and relationship to other techniques of the following special procedures
3	**Gastrointestinal Tract** ➢ Fluoroscopy, general considerations, responsibility of radiographers ➢ Barium swallow, pharynx and oesophagus ➢ Barium meal and follow through ➢ Hypotonic duodenography ➢ Small bowel enema ➢ Barium Enema routine projections for colon and rectum, colonic activators; double contrast studies; colostomy. Special techniques for specific disease to be examined ➢ Water soluble contrast media - eg. gastrograffin studies
4	**Salivary Glands** ➢ Routine technique, procedure – sialography
5	**Biliary System** ➢ Plain film radiography ➢ Intravenous cholangiography ➢ Percutaneous cholangiography ➢ Endoscopic retrograde cholangio-pancreatography (ERCP) ➢ Operative cholangiography ➢ Post-Operative cholangiography (T - tube Cholangiography)
6	**Urinary System** ➢ Intravenous urography ➢ Retrograde pyelography ➢ Cystography and micturating cystouresthrography, Urethrography (ascending)
7	**Male & Female Reproductive System** ➢ AUG, Vesiculography ➢ Hysterosalpingography. ➢ Mammography: Mammography: Basic views, special views, wire localization
8	**Respiratory System** ➢ Bronchography.
9	**Sinusography** Routine Technique and Procedure**.**

10	**Tomography** : ➢ General principles, Estimation, selection of depth of layer, spacing of layers. ➢ Layer thickness required for different examination. ➢ Types and advantages of various movements. ➢ Choice of tomographic movement- exposure factor. ➢ Sequential, horizontal and multi section tomography. ➢ Application of tomography to specific regions
11	**Macroradiography** ➢ General principles, Requirement, Equipment, Technique.
12	**Soft Tissue Radiography** ➢ High and low kilo voltage technique; differential filtration, Screen & Non - screen technique ➢ Multiple radiography. ➢ Uses of soft tissue radiography.
13	**High KV Radiography** : ➢ General principles ➢ Relation to patient dose ➢ Change in radiographic contrast. ➢ Scatter elimination; beam collimation; grid ratio. ➢ Speed and type of grid movement. ➢ Radiographic factor; application and uses.
14	**Localization of foreign body:** ➢ General location principles ➢ Ingested; inhaled; inserted; embedded foreign bodies. ➢ Foreign bodies in eye. ➢ Preparation of the area to be investigated. ➢ Appropriate projection for all ➢ Techniques to locate non-opaque foreign body

Text books recommended

Latest editions of the following books:

- Philip W. Ballinger: Atlas of radiographic positioning and Radiological Procedures.
- RA Swallow, E Naylor: Clark's positioning in Radiography. EJ Roebuck, AS Whitley
- Sante LR: Roentgenologic technique (Edwards Inc.)
- Goldman : A Radiographic index
- Rossand Gailway: A Handbook of Radiography(Lewis)
- Glenda J. Bryan: Diagnostic Radiography (Mosby)
- Piles : Medical Radiographic Technique (Thomas)
- Scorrow: Contrast Radiography (Schering Chemicals)
- Stephen Chapman &Richard Nakielny: A Guide to Radiological Procedures (Jaypee Brothers)

Radiation Detection, Measurement & Protection

(BMRIT – 009) *Theory – 60*

Unit	Tiles
1	**Radiation Detection** ➢ Principles of radiation detection ➢ Gas filled Detectors - Ionization Chamber, GM counters ➢ Chemical Detectors ➢ Scintillation detectors ➢ Solid state Detectors-Semiconductor Detectors, Thermoluminescent Detectors ➢ Photographic Emulsions (film)
2	**Radiation Measuring Instrument** ➢ Personnel Monitoring- Film badge, TLD, Pocket Dosimeter ➢ Area Monitoring (Work place Monitoring) ➢ Calibration and Maintenance of Radiation Measuring Instrument
3	**Radiation Quantities and Units:** ➢ Radiation- Radioactivity- Sources of radiation - natural radioactive sources -cosmic rays terrestrial radiation – man-made radiation sources. ➢ Units of radiation – Quality factor – Flux – Fluence-Kerma – Exposure- Absorbed dose – Equivalent Dose – Weighting Factors – Effective Dose – ➢ Occupational Exposure Limits, Dose limits to public.
4	**Principles Of Radiation Protection** ➢ Justification, Optimization, Dose limitation, ALARA
5	**Operational Limits** ➢ Operational limits, Background Radiation limits ➢ Dose Limit for Radiation Workers, Dose Limit for Members of Public ➢ Occupational Exposure of Women
6	**Practical Aspects Of Radiation Protection** ➢ Protection of Staff, Protection of Patient, Protection of Public ➢ Patient Doses and dose assessment
7	**Radiation Protection Instruments** ➢ Protective materials (Diagnostic Radiology) ➢ Lead and Equivalent materials ➢ Concept of barriers, Structural Shielding design
8	**Typical Lay Out For Diagnostic Radiology** ➢ Location of X-ray installation ➢ Layout, Room size, Shielding ➢ Opening and Ventilation ➢ Illumination control ➢ Equipment Layout, Control panel plan, Waiting Area, Warning Light and Poster ➢ Radiation Protection in Diagnostic Radiology

Text books recommended

Latest editions of the following books:

- Sante LR: Roentgenologic technique (Edwards Inc.)
- Goldman : A Radiographic index
- Rossand Gailway: A Handbook of Radiography(Lewis)
- Piles : Medical Radiographic Technique (Thomas)
- An introduction to Radiation Protection – Allen Martin & Samuel
- Physics for Radiation Protection: A Handbook. James E. Martin . Wiley-Vch
- Principles of Radiation Protection – K. Z. Morgan and J. E. Turner.

Basic Microbiology & Pathology
(BMRIT – 010) *(Theory – 60 & Practical – 20)*

Basic Microbiology *(BMRIT – 010)*
SECTION – A *(Theory – 30 & Practical – 10)*

Unit	Tiles
1	**Introduction:** ➢ History of microbiology-(contribution of Louis Pasteur, Robert Koch, Joseph Lister, Edward Jenner, Alexander Fleming) ➢ Importance of Microbiology in the practice of Radiology ➢ Microscope –Types & Uses
2	**General Microbiology:** ➢ Infection, parasite, host, vector, fomite, contagious disease, infectious disease, epidemic, endemic, pandemic, Zoonosis, Epizootic, Attack rate ➢ Normal flora of the human body ➢ Routes of infection and spread, endogenous and exogenous infections at reservoir of infections ➢ Antimicrobials : mode of action, interpretation of susceptibility tests, resistance spectrum of activity ➢ Staining techniques : Gram staining, Acid fast staining, Culture methods ➢ Laboratory diagnosis of infection
3	**Sterilization & Disinfection:** ➢ Definition of Asepsis, Sterilization and Disinfection ➢ Hospital Acquired infection, Universal safety precautions and Biomedical waste Disposal & Management
4	Immunilogy: ➢ Antigen- Antibody-reaction & application for Diagnosis, ➢ Immune response- Normal / Abnormal, Innate Immunity & acquired immunity (Vaccination) ➢ Hyper sensitivity & auto-immunity, Serological tests, Immunoprophylaxis
5	**Bacteriology:** ➢ Morphology, Classification according to the Pathogenicity, Mode of Transmission, methods of prevention, Collection and transport of samples for laboratory diagnosis, Interpretation of laboratory reports ➢ Staphylococci, Streptococci, & Pneumococci Neisseria, Mycobacterium : Tuberculossi, M.Leprae, Enterobacteriaceae, Escherichia Coli, Salmomnella, Corynebactrium, Vibrosis, V. Cholerae and otjher medically important Vibrios, Campoylobacters and Helocobacters ➢ Pseudomonas, Mycoplasma, Rickettsiae, Chlamydia, Bacillus anthracis, Sporing & nonsporing anaerobes, Clostridium
6	**Virology:** ➢ General Properties, Basic structure and broad Classification of Viruses. ➢ Pathogenesis and Pathology of viral infection (HIV, Hepatitis, Polio, Measles, Congenital viral infections, Rubella, CMV, Herpes) ➢ Immunity and Prophylasis of viral Diseases, Principles of viral diseases ➢ List of commonly used antiviral agents
7	**Parasitology:** ➢ Amoebiases, Malaria, Filaria, Toxoplasma, cystisarcosis, Roundworm, Hookworm, & Echinococcus.
8	**Mycology:** ➢ General Properties of Fungi, Classification based on fungal infection ➢ Candidiasis, Cryptococcosis, Dermatophytoses, Mycetoma, Aspergillosis.

Text books recommended
Latest editions of the following books:

- CK Jayaram Paniker, Ananthanarayan R. Textbook of Microbiology
- Satish Gupte. Short Textbook of Medical Microbiology. Jaypee Brothers Medical Pub (p) Ltd;
- CP.Baveja. Textbook of Microbiology for nurses.4th Ed. Arya Publishing Company
- Rl Ichhpujani, Rajesh Bhatia. Essentials of Medical Microbiology. Jaypee Brothers Medical Pub (P) Ltd

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Basic Pathology (*BMRIT – 010*)

SECTION – B *(Theory – 30 & Practical – 10)*

Unit	Tiles
1	**Basic Concepts In Cellular Adaption's** ➢ Cell injury and Cell death ➢ Cellular response to stress and other stimuli ➢ Over view of Cell injury and Cell death
2	**Basic Principles in Inflammatory Process** ➢ General features including inflammatory mediators and Basic Mechanisms of disorders of Immunity, General features of the immune system, Disorders of the Immune System, ➢ Acute and Chronic inflammation
3	**Infectious Diseases** ➢ Infectious diseases, Bacterial Infections (Typhoid, Tuberculosis and Leprosy) ➢ Viral infections (HIV, HbSAg and Polio) ➢ Specific Examples of Fungal, Parasitic and Syphilis infections
4	**Neoplasia** ➢ Nomenclature, Rudimentary aspects on Tumor growth and Metastasis ➢ Definition of Neoplasia, Differences between Benign and Malignant tumors ➢ Staging and Grading of Tumors (Basic Aspects), Oncogenes and Tumor Suppressor genes
5	**Haematology** ➢ Structure and functions of Formed elements ➢ Objective use of anticoagulants, Mechnasims of Haemostasis ➢ Tests to monitor Coagulation, Blood Grouping and Blood Bank (Basic aspects on Blood Components) ➢ Fixatives and Basic details in Cytology, Aspiration Cytology of Bone marrow ➢ Basic concepts in Anaemia, Cellular aspects of Leukemia (Basic Concepts)
6	**Histopathology** ➢ Use of Microscopes, Grossing and Mounting Techniques ➢ Processing of Biopsy specimen, Paraffin sections
7	**Biomedical Waste Management And Environmental Pathology** ➢ Biomedical waste management from perspectives of Pathology ➢ Environment and Disease – Smoking hazards, Asbestosis and Silicosis & Occupational Exposure
8	**Clinical Pathology** ➢ Collection, transport, preservation and processing of Clinical Specimen ➢ Clinical Pathology of specialized Body Fluids (CSF), Synovial fluid, Pleural Fluid ➢ Urine Examination (Urinalysis)
9	**Overview Of Systemic Pathology** ➢ Rheumatic Heart Disease ➢ Lungs : Pneumonia, COPD, Asthma, ARDS ➢ Liver : Hepatitis, Cirrhosis ➢ Muscle: Myasthenia GravisBrain : Meningitis, Aspergillosis, CNS Tumor – (Classification)
10	**Practical Demonstration** ➢ Demo of Coagulation Profile, Phlebotomy techniques ➢ Blood Grouping and Rh typing, Urine Routine, Hemogram, Fecal Examination ➢ Safety Precautions in Clinical Pathology

Text books recommended

Latest editions of the following books:

- Illustrated Pathology – McFarlen
- Essentials of Rubin's Pathology
- Basic Pathology by Robbins
- General and Systematic Pathology – Underwood and Cross

Basic Biochemistry & Pharmacology
(BMRIT – 011) *(Theory – 60 & Practical – 20)*

Basic Biochemistry *(BMRIT – 011)*
SECTION – A *(Theory – 30 & Practical – 10)*

Unit	Tiles
1	**Introduction to Biochemistry**
2	**Biophysical aspect of Biochemistry**
3	**Carbohydrates** ➢ Chemistry of carbohydrates, Classification and biological importance ➢ Digestion and absorption, Glycolysis, glycogen metabolism, glucono-genesis, TCA cycle ➢ Regulation of blood glucose, Diabetes mellitus
4	**Proteins** ➢ Biological importance, Classification of amino acids & proteins ➢ Digestion and absorption ➢ Urea synthesis, Transamination
5	**Lipids** ➢ Biological importance ➢ Classification of lipids, lipoproteins, Overview of lipid metabolism
6	**Enzymes** ➢ Classification, Factors affecting enzyme action ➢ Enzyme inhibition & Chemical enzymology
7	**Endocrinology** ➢ Hormones, Role of biological important hormones ➢ Pituitary, thyroid, adrenal cortex and medulla ➢ Sex hormones
8	**Mineral metabolism** ➢ Regulation of blood level ➢ Consequences of excess and deficiency of calcium, phosphate, iron , copper & zinc
9	**Vitamins** ➢ Fat soluble vitamins, Water soluble vitamins ➢ Biochemical function, Deficiency, Manifestation, Source & RDA
10	**Clinical biochemistry** ➢ LFT, RFT ➢ Urine analysis

Text books recommended
Latest editions of the following books:

- Illustrated Pathology – McFarlen:
- Medical Laboratory Procedure Manual (T-M) by K.L. Mukerjee 1987, Tata McGraw Hill Publication.
- Text book of Medical biochemistry by Ramakrishna.
- Text Book Biochemistry by Vasudevan and Sree Kumari.

Basic Pharmacology *(BMRIT – 011)*

SECTION – B *(Theory – 30 & Practical – 10)*

Unit	Tiles
1	**General Pharmacology** ➢ Routes of drug administration, Absorption, Distribution ➢ Metabolism and excretion of drugs, Pharmacodynamics ➢ Adverse drug reaction
2	**CNS Pharmacology** ➢ General anesthetic, Sedative of hypnotics ➢ Antiepileptic drugs, Opiod analgesics ➢ NSAID
3	**CVS Pharmacology** ➢ Antihypertensive, Antianginal, Antiarrhythmic ➢ Cardiac glycosides
4	**Hormones and related drugs** ➢ Insulin, Oral hypoglycemic, Corticosteriods, Oxytocin ➢ Oral contraceptives
5	**Respiratory system** ➢ Drugs for asthma, cough
6	**Renal System** ➢ Drugs for diuretics
7	**Drugs on Haemopoietic system** ➢ Hematinic, Coagulant, anticoagulant
8	**Drug on GIT** ➢ Antiulcer, Antiemetic, etc
9	**Anti-microbial** ➢ Pencillins, Cephalosporins ➢ Quinolones, Anti TB drugs ➢ Antileprosy drugs, etc.
10	**Anti Cancer Drugs**
	Radio contrast Media

Text books recommended

Latest editions of the following books:

- Fundamentals of experimental Pharmacology by Dr.M.N . Ghosh
- Pharmacology & Pharmacotherapeutics by Satoskar(RS)
- Essentials of Medical Pharmacology by Tripathi(KD)
- Pharmacology by Rang (HP)

Teaching learning activities

The Pharmacology will be covered by Interactive Lectures, Group Discussions, Practical demonstrations, Seminars, Assignments

Special Radiography Procedures – PRACTICALS

(BMRIT – 012) *Practical – 120*

Practical:

The students should be able to perform the special radiology procedure and to identify the structure and answer

- The abnormality of the structure if necessary
- Gross features, parts
- Location
- Related questions of the given organ

Gross specimen spotter:

Machines, films, marker, cassette, hanger, chemicals and the things necessary for positioning and Special Radiography Procedures

Viva voce

Student should be able to identify the patient positioning, orientation and steps involved for the safe imaging of the structures and the importance of the study

1. All bones, organs and the major parts of the human body in medical imaging.
2. Gross specimen, location, parts and answer the related questions

Distribution of marks in Practical

Practical Marks 75 (Minimum – 37)				Internal Assessment Marks – 25 (Minimum – 12)	Total
Demonstration 20	Skill 20	Viva Voce 20	Presentation 15	25	100

Fourth Semester

Computed Tomography

(BMRIT – 013) *Theory –60 & Practical's 150*

Unit	Tiles
1	**Computed Tomography** ➢ History, principle of CT
2	**Instrumentation** ➢ Tube design ➢ Detectors ➢ Collimator
3	**Generations of CT** ➢ Various generation in CT and its advantages
4	**Detector and its Type** ➢ Scintillation crystal, Gas Detector, Solid State Detector ➢ Single Detector Array and Multiple Detector Array ➢ Pitch ➢ Advantage of Multi row Detector
5	**Image Reconstruction** ➢ Data Acquisition and Data Presentation, Back Projection Method, Iterative Method ➢ Analytical Method, Reconstruction Algorithm,
6	**Image Display** ➢ Pixel and Voxel, 2D and 3D Images ➢ Hounsfield Unit (HU) ➢ Linear Attenuation Coefficient, Mass Attenuation Coefficient ➢ Window Width and Window Level ➢ Multi planar Reconstruction
8	**Advanced CT Imaging Techniques** ➢ Helical CT scan: Slip ring technology, advantages, ➢ Reconstruction of helical CT images, ➢ CT angiography, CT fluoroscopy, HRCT. CT post processing techniques: MPR, MIP, Min IP, 3D rendering: SSD and VR. Dual Energy CT ➢ CT Dose, patient preparation, imaging techniques. ➢ CT Protocols for various parts of body Imaging. ➢ CT contrast enhanced protocols ➢ Recent Advancements in CT
	Interventional CT Guided Procedures ➢ CT Guided biopsy ➢ CT Guided Aspiration
9	**CT Radiation Safety, Quality Assurance & Maintenance** ➢ CT calibration, Types of calibration ➢ CT image documentation and Filing. ➢ CT maintenance of equipment and accessories ➢ Radiation safety in CT, Dose management in CT, Quality Assurance
10	**CT Contrast Media,** ➢ Oral Contrast, IV Contrast and its advantages, Adverse Reaction ➢ Different phases of Contrast media, Injectors
11	**CT Artefacts** Various Artifacts involving the CT and to avoid the artifact

Text books recommended

Latest editions of the following books:

1. Adrian K. Dixon: Body CT – A handbook (Churchill Livingstone)
2. John M. Stevens , Alan R. Valentine & Brain E. Kendall : Computed cranial & spinal imaging (Williams & Wilkins)
3. John R. Haaga, Charles F. Lanzion, David J. Sartoris & Elias A. Aerhouni: Computerized Tomography and Magnetic Resonance Imaging of the whole Body(Vol I & II) (Saunders)

Physics of Imaging Equipment's

(BMRIT – 014) *Theory –60*

Unit	Tiles
1	**X Ray Tube Design** ➢ Stationary Anode X ray tube, Rotating Anode X ray tube ➢ Modern X ray tube ➢ Filament design ➢ Anode design ➢ Special X ray tubes - Mammography, CT Scan, Fluoroscopy
2	**High Tension Circuits** ➢ Diode and Triodes, Semiconductors, Rectifiers ➢ X ray circuit, kV control circuit, mA Control circuit, Interlocking Circuits, Circuit locker, ➢ Switches and Fuses ➢ Exposure Switches
3	**Meters And Exposure Timers** ➢ Moving iron meter, Moving coil meter, Mechanical Timer ➢ Electronic Timer, Photo timer (AEC), Exposure timer ➢ Pulse counting timer
4	**Management Of Scatter Radiation** ➢ Filters, Aperture diaphragm, Collimators ➢ Cones and cylinders, Grids ➢ Air gap technique ➢ Moving slit Radiography
6	**Fluoroscopy And Image Intensifier** ➢ Conventional Fluoroscopy ➢ Digital Fluoroscopy ➢ Image Intensifier
7	**Equipment For Special Procedure** ➢ OPG, C-Arm machine, Mammography, Tomography ➢ DSA

Text books recommended

Latest editions of the following books:

1. The Physics of Radiology Harold Elford Johns & John Robert Cunningham.
2. Radiological physics – M.E.J. Young.
3. Text book of physics applied to Radiotherapy and Radio-diagnosis – Massey and Meredith.
4. X-Rays their origin dosage and practical application - Schall W E
5. Radiation Detection and measurement – Glenn F. Knoll.
6. Radiation Dosimetry – H.E.Johns
7. Radiation Oncology physics A Handbook for Teachers and Students – E.B. Podgorsak.
8. ICRU Report 8

Quality Control in Radiology & Radiation Safety

(BMRIT – 015) *Theory –60*

Unit	Tiles
1	**Objectives of quality Control:** Improve the quality of imaging thereby increasing the diagnostic value; to reduce the radiation exposure; Reduction of film wastage and repeat examination; to maintain the various diagnostic and imaging units at their optimal performance
2	**Quality assurance activities:** Equipment selection phase; Equipment installation and acceptance phase; Operational phase; Preventive maintenance
3	**Quality assurance programme at the radiological faculty level:** Responsibility; Purchase; Specifications; Acceptance; Routine testing; Evaluation of results of routine testing; Quality assurance practical exercise in the X ray generator and tube; Image receptors from processing; Radiographic equipment; Fluoroscopic equipment; Mammographic equipment; Conventional tomography; Computed tomography; Film processing, manual and automatic; Consideration for storage of film and chemicals; Faults tracing; Accuracy of imaging- image distortion for digital imaging devices. LASER printer calibration
4	**Quality assurance programme tests:** General principles and preventive maintenance for routine, daily, weekly, monthly, quarterly, annually – machine calibration. Basic concepts of quality assurance – LASER printer - Light beam alignment; X-ray out-put and beam quality check; KVp check; Focal spot size and angle measurement; Timer check; mAs test; Grid alignment test; High and low contrast resolutions; Mechanical and electrical checks; Cassette leak check; Proper screen-film contact test; Safe light test; Radiation proof test; Field alignment test for fluoroscopic device; Resolution test; Phantom measurements - CT, US and MRI
6	**Quality assurance of film and image recording devices:** Sensitometry; Characteristic curve; Film latitude; Film contrast; Film speed Resolution; Distortion; Artifacts of films and image recording. Monitor calibration. SMPTE pattern
7	**Maintenance and care of equipment:** Safe operation of equipment; Routine cleaning of equipment and instruments; Cassette, screen maintenance; Maintenance of automatic processor and manual processing units; Routine maintenance of equipments; Record keeping and log book maintenance; Reject analysis and objectives of reject analysis programme Quality Assurance in Diagnostic Radiology, Congruence of optical and radiation fields, Central beam alignment, Focal spot size, Applied tube potential, Total filtration, Linearity of timer and mA Loading Station, Consistence of radiation output, Radiation leakage through tube housing
8	**Care and maintenance of diagnostic equipment:** General principles and preventive maintenance for routine - daily, Weekly, monthly, quarterly, annually: care in use, special care of mobile equipment
9	**Biological Effects of radiation:** Ionization, excitation and free radical formation, hydrolysis of water, action of radiation on cell-Chromosomal aberration and its application for the biological dosimetry- Effects of whole body and acute irradiation, dose fractionation, effects of ionizing radiation on each of major organ system including fetus - Somatic effects and hereditary effects- stochastic and deterministic effects-Acute exposure and chronic exposure-LD50 - factors affecting radio sensitivity. Biological effects of non-ionizing radiation like ultrasound, lasers, IR, UV and magnetic fields.

Text books recommended

Latest editions of the following books:

- The Physics of Radiology, Harold Elford Johns & John Robert Cunningham.
- Text book of physics applied to Radiotherapy and Radio-diagnosis – Massey and Meredith.
- X-Rays their origin dosage and practical application - Schall W E
- Principles of Radiation Protection – K. Z. Morgan and J. E. Turner.
- ICRP Report 60 and 103
- Radiobiology for the radiologist – Eric J Hall.
- Basic Clinical Radiology – G. G. Steel, & Michael Joiner & Albert Van der Kogel.
- Introduction to radiobiology - Uma Devi
- The Safety Code for Medical Diagnostic X-ray Equipment and Installations {No. AERB/SC/MED-2 (Rev.1), 2001}

Computed Tomography – PRACTICALS

(BMRIT – 016) *Practical – 100*

Practical:

The students should be able to perform the CT imaging radiology procedure and to identify the structure and answer

- The abnormality of the structure if necessary
- Gross features, parts
- Location
- Related questions of the given organ

Gross specimen spotter:

Machines, phantoms, injectors, chemicals and the things necessary for positioning, Special Radiography Procedures and CT equipments

Viva voce

Student should be able to identify the patient positioning, orientation and steps involved for the safe CT imaging of the structures and the importance of the study

1. All bones, organs and the major parts of the human body in CT medical imaging.
2. Gross specimen, location, parts and answer the related to CT questions

Distribution of marks in Practical

Practical Marks 75 (Minimum – 37)				Internal Assessment Marks – 25 (Minimum – 12)	Total
Demonstration 20	Skill 20	Viva Voce 20	Presentation 15	25	100

Fifth Semester

Magnetic Resonance Imaging

(BMRIT – 017) *Theory –60 & Practical's 150*

Unit	Tiles
1	**Advanced technique & instrumentation of MRI** ➢ Basic Principles: Spin – precession – relaxation time – pulse cycle – T1 weighted image – T2 weighted image – proton density image. ➢ Pulse sequence : Spin echo pulse sequence – turbo spin echo pulse sequence - Gradient echo sequence – Turbo gradient echo pulse sequence - Inversion recovery sequence – STIR sequence – SPIR sequence – FLAIR sequence – Echo planar imaging – Advanced pulse sequences. ➢ MR Instrumentation: Types of magnets – RF transmitter – RF receiver – Gradient coils – shim coils – RF shielding – computers. ➢ Image formation: 2D Fourier transformation method – K-space representation – 3D Fourier imaging – MIP. ➢ MR contrast media – MR angiography – TOF & PCA – MR Spectroscopy – functional MRI
2	**Advanced technique & instrumentation of MRI** ➢ Basic Principles: Spin – precession – relaxation time – pulse cycle – T1 weighted image – T2 weighted image – proton density image. ➢ Pulse sequence : Spin echo pulse sequence – turbo spin echo pulse sequence - Gradient echo sequence – Turbo gradient echo pulse sequence - Inversion recovery sequence – STIR sequence – SPIR sequence – FLAIR sequence – Echo planar imaging – Advanced pulse sequences. ➢ MR Instrumentation: Types of magnets – RF transmitter – RF receiver – Gradient coils – shim coils – RF shielding – computers. ➢ Image formation: 2D Fourier transformation method – K-space representation – 3D Fourier imaging – MIP. ➢ MR angiography – TOF & PCA – MR Spectroscopy – Functional MRI
3	**MRI Scanners** ➢ Methods of MRI imaging methods – Head and Neck ,Thorax, Abdomen, Musculoskeletal System imaging ➢ Clinical indications and contraindications ➢ Types of common sequences effects of sequence on imaging - Protocols for various studies- slice section ➢ Patient preparation-positioning of the patient -patient care ➢ Calibration ➢ Paramagnetic agents and dose ➢ Additional techniques and recent advances in MRI ➢ Image acquisition – modification of procedures in an unconscious or un co-operative patient - plain studies- contrast studies -special procedures- reconstructions- 3D images- MRS blood flow imaging, Diffusion/perfusion scans ➢ Strength and limitations of MRI ➢ Role of radiographer as MRI Technician
4	**MRI Artifact**
6	**MR safety and quality control** ➢ MR safety, Bio effects, RF antenna effect, Safety guidelines, Calibration, Quality control
7	**MR flow techniques** ➢ MR angiography, MR spectroscopy
8	**MR Contrast Agents**

Text books recommended

Latest editions of the following books

- John R. Haaga, Charles F. Lanzion, David J. Sartoris & Elias A. Aerhouni: Computerised Tomography and Magnetic Resonance Imaging of the whole Body(Vol I & II) (Saunders)
- Roger C. Sanders: Clinical Sonography: a Practical Guide (Little Brown & Company)
- Sandra L. Hagen Ansert: Textbook of Diagnostic Ultrasonography (BI publications)
- Philip T. English & Christine Moore: MRI for Radiographers (Springer)
- Pablo T. & W. Dean Bidgood : Abdominal Magnetic Resonance Imaging (Mosby)

Modern Imaging Technology
(BMRIT – 018) *Theory –60 & Practical's 40*

Nuclear Medicine Technology
SECTION – A

Unit	Tiles
1	**Nuclear Medicine** History, Isotopes and radionuclide, Production of Radionuclide, Radioactivity, Radioactive transformation, Specific Activity, Radiopharmaceuticals and their preparations, precaution while handling radiopharmaceuticals, , radioimmunoassay (RIA), documentation, safety consideration- Radiation dose and Quality Assurance. Disposal of Radio-active waste , safety considerations
2	**Gamma Camera** Principles of tracer techniques, instrumentation – Parallel Multihole Collimator, converging collimator, diverging collimator, pinhole collimator ,crystal, photomultiplier, scanning techniques, resolution- Spatial, temporal and its importance
3	**Nuclear Imaging** SPECT- Principle, Patient preparation, Procedure, Applications PET- Principle, Patient preparation, Procedure, Applications
4	**Fusion Imaging Technology** PET-CT- Principle, Patient preparation, Procedure, Applications, PET-MRI - Principle, Patient preparation, Procedure, Applications
5	DEXA

Modern Image Processing Techniques
SECTION – B

Unit	Tiles
1	**Computed Radiography** CR plate, CR reader, Image Processing & Characteristics
2	**Digital Radiography** Indirect-CCD, Indirect-Flat panel, Direct Digital, Image characteristics
3	**DICOM** Introduction, Components, Compatibility of equipment and Licensing, Functions
4	**PACS** Introduction, Components, HIS, RIS, Types of Architecture, Maintenance and Security, Future Directions, Electronic medical records standards, etc
5	**Teleradiology**

Text books recommended
Latest editions of the following books

- Farr's Physics for Medical Imaging. PA Roberts,J. Williams. Saunders
- Essentials of Nuclear Medicine Imaging 5th edition .Fred A. Mettler Jr. Milton J. Guiberteau . Saunders
- Stephen Chapman & Richard Nakielny: A Guide to Radiological Procedures (Jaypee Brothers)

Public Administration

(PADM – 113) *Theory –40*

(Compulsory Course designed as per the directions issued by Government of India, MHRD, Department of Higher Education (Central University Bureau) F.No.19-6.2014-Desk U Dated 19-05-2014)

Unit	Tiles
1	**Course Rationale** This Course introduces the students to the elements of public administration. This would help them obtain a suitable conceptual perspective on Public Administration. In addition, the course introduces to students, the growth of such institution devices as to meet the need of changing times. The course also aims to instill and emphasize the need of ethical seriousness in contemporary Indian public administration within the Constitutional framework.
2	**Introduction:** Meaning, nature and Scope of Public Administration and its relationship with other disciplines- Evolution of Public Administration as a discipline – Woodrow Wilson, Henry Fayol , Max Weber and others – Evolution of Public Administration in India – Arthashastra – Colonial Administration upto 1947
3	**Public Administration in India:** Enactment of Indian Constitution - Union Government – The Cabinet – Central Secretariat – All India Services – Training of Civil Servants – UPSC – Niti Ayog – Statutory Bodies: The Central Vigilance Commission – CBI – National Human Rights Commission – National Women's Commission – CAG
4	**State and Union Territory Administration:** Differential Administrative systems in Union Territories compared to States Organization of Secretariat – Position of Chief Secretary, Functions and Structure of Departments, Directorates – Ministry of Home Affairs supervision of Union Territory Administration – Position of Lt.Governor in UT – Government of Union Territories Act 1963 – Changing trend in UT Administration in Puducherry and Andaman and Nicobar Island
5	**Emerging Issues in Indian Public Administration** Changing Role of District Collector – Civil Servants – Politicians relationship – Citizens Charter – Public Grievance Redressed mechanisms – The RTI Act 2005 – Social Auditing and Decentralization – Public Private partnership

Text books recommended & reference

Latest editions of the following books

- R. Tyagi, Public Administration, Atma ram sons, New Delhi, 1983.
- Appleby P.H, Policy and Administration, The University of Alabama Press, Alabama, 1949.
- Avasthi and Maheswari,Public Administration in India,Agra:Lakshmi Narain Agarwal,2013
- Gerald. E. Caden. Public Administration. Pablidas Publishers, California, 1982.
- http://cic.gov.in/
- http://www.mha.nic.in/
- http://rti.gov.in/
- http://www.cvc.nic.in/
- R.B.Jain, Public Administration in India, 21st Century Challenges for Good Governance, Deep 2002
- Ramesh K Arora, Indian Public Administration, New Delhi, Wishwa Prakashan
- Ramesh K.Arora, Public Administration, Fresh Perspective. Alekh Publishers, Jaipur.
- Rumki Basu, Public Administration, Concept and Theories, New Delhi. Sterling,2013

Instruction Method: Lectures and seminars Evaluation
Method : Written Tests .

Magnetic Resonance Imaging – PRACTICALS

(BMRIT – 019) *Practical – 100*

Practical:

The students should be able to perform the MRI imaging radiology procedure and to identify the structure and answer

- The abnormality of the structure if necessary
- Gross features, parts
- Location
- Related questions of the given organ

Gross specimen spotter:

Machines, phantoms, injectors, chemicals and the things necessary for positioning, Special Radiography Procedures and MRIT & CT imaging

Viva voce

Student should be able to identify the patient positioning, orientation and steps involved for the safe CT imaging of the structures and the importance of the study.

1. All bones, organs and the major parts of the human body in MRIT medical imaging.
2. Gross specimen, location, parts and answer the related to MRI questions

Distribution of marks in Practical

Practical Marks 75 (Minimum – 37)				Internal Assessment Marks – 25 (Minimum – 12)	Total
Demonstration 20	Skill 20	Viva Voce 20	Presentation 15	25	100

Sixth Semester

Interventional Imaging Technology & Ultrasonography

(BMRIT – 020) *Theory – 90*

Interventional Imaging Technology

SECTION – A *Theory – 50*

Unit	Tiles
1	**Interventional Radiological Procedures** ➢ Seldinger Technique ➢ Overview of procedures ➢ Indications, contra-indications ➢ Procedural and post-procedural care
2	**Arthrography** : ➢ Shoulder, Hip, Knee, Elbow
3	**Angiography** : ➢ Carotid Angiography (4 Vessel angiography) ➢ Thoracic and Arch Aortography ➢ Selective studies: Renal, SMA, Coeliac axis ➢ Vertebral angiography ➢ Femoral arteriography ➢ Angiocardiography
4	**Venography** : ➢ Peripheral Venography ➢ Cerebral Venography ➢ Inferior and Superior Venocavagraphy ➢ Relevant visceral phlebography
5	**Cardiac catheterization procedures:** PTCA, BMV, CAG, Pacemaker, Electrophysiology, etc
6	**Basic angiography and DSA:** ➢ History , technique, patient care ➢ Percutaneous cauterization, catheterization sites, Asepsis ➢ Guide wire, catheters, pressure injectors, accessories ➢ Use of digital subtraction- single plane and bi-plane All forms of diagnostic procedures including angiography, angioplasty, biliary examination, renal evaluation and drainage procedure.

Text books recommended

Latest editions of the following books

- Farr's Physics for Medical Imaging. PA Roberts,J. Williams. Saunders
- Vascular and Interventional Radiology: The Requisites .John A. Kaufman , Michael J. Lee. Mosby
- Handbook of Basic Vascular and Interventional Radiology.Ray Dyer . Churchill Livingstone
- Essentials of Nuclear Medicine Imaging 5th edition .Fred A. Mettler Jr. Milton J. Guiberteau . Saunders

Ultrasonography

SECTION – B *Theory – 40*

Unit	Tiles
1	**Ultrasonography** ➢ Basic Acoustics, Ultrasound terminologies: acoustic pressure, power, intensity, impedance, speed, frequency, dB notation: relative acoustic pressure and relative acoustic intensity
2	**Interaction of US with matter:** ➢ Reflection, transmission, scattering, refraction and absorption, attenuation and attenuation coefficients, US machine controls, US focusing
3	**Production of ultrasound:** ➢ Piezoelectricity, Medical ultrasound transducer: Principle, construction and working, characteristics of US beam
4	Ultrasound display modes: ➢ A, B, M ➢ Real-time ultrasound: Line density and frame rate ➢ Real-time ultrasound transducers: Mechanical and electronic arrays, ultrasound artifacts, ultrasound recording devices, and Distance, area & volume measurements
5	**US techniques** ➢ Imaging different anatomic areas, ultrasound artifacts, biological effects and safety.
6	**Doppler Ultrasound and CT-guided procedures** ➢ FNAC, Biopsy, Drainage ➢ Ultrasound Doppler, Patient preparation for Doppler, Doppler artifacts, vascular sonography ➢ Techniques of sonography – selection – preparation – instructions and positioning of patient for TAS, TVS, TRUS, neck USG and extremities, ➢ Patient care in ultrasound, clinical applications display method, etc ➢ Maintenance protocols

Text books recommended

Latest editions of the following books

- Handbook of Basic Vascular and Interventional Radiology.Ray Dyer . Churchill Livingstone
- Vascular and Interventional Radiology: The Requisites .John A. Kaufman , Michael J. Lee. Mosby
- Essentials of Nuclear Medicine Imaging 5th edition .Fred A. Mettler Jr. Milton J. Guiberteau . Saunders
- Philip W. Ballinger: Atlas of radiographic positioning and Radiological Procedures.
- Stephen Chapman &Richard Nakielny: A Guide to Radiological Procedures (Jaypee Brothers)
- PES Palmer: Manual of Diagnostic Ultrasound(WHO)

Research Methodology, Biostatistics & Principles of Management, Act, Rules and Regulation of Radiology

(BMRIT – 020) *Theory – 80*

Research Methodology & Biostatistics *(BMRIT – 020)*

SECTION – A *Theory – 40*

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

Unit	Tiles
1	**Introduction to research methodology** ➢ Meaning of research, Objective of Research, Motivation in Research ➢ Types of Research & Research approaches ➢ Research Methods Vs Methodology, Criteria for good research ➢ Accessing research literature, Use of databases and other sources
2	**Research Problem** ➢ Identifying research problem, Ethical issues in research, Research design, Basic Concepts of Biostatistics, Types of Data, Research tools and Data collection methods ➢ Sampling methods, Developing a research proposal, ➢ Statement of Research problem, Statement of purpose ➢ 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 design, Basic principles of research design ➢ Qualitative and quantitative methodologies – their differences and potential integration. Evaluating research, and its potential for informing practice. Developing research questions and devising methods for their investigation. Ethical issues in research
4	**Sampling Design** ➢ Criteria for selecting sampling procedure, Implication for sample design ➢ Steps in sampling design, Characteristics for good sample design ➢ Different types of sample design
5	**Measurement & scaling techniques** ➢ Measurement in Research, Measurement scales, Sources of error in measurement ➢ Technique of developing measurement tools, Meaning of scaling and its classification, Important scaling techniques
6	**Methods of Date Collection** ➢ Collection of primary data, Collection data through questionnaires & schedules ➢ Difference between questionnaires & schedules
7	**Processing & analysis of data** ➢ Processing operations, Problems in processing ➢ Types of analysis, Statistics in research ➢ Measures of central tendency, Dispersion asymmetry, relationship ➢ Utilizing appropriate software to assist in the retrieval of information and data analysis, Analysis of qualitative and quantitative data
8	**Testing the Hypothesis** ➢ What is hypothesis, Basic concept of hypothesis, Procedure of hypothesis testing ➢ Measuring the power of hypothesis test, Test of hypothesis ➢ Limitation of the test of hypothesis
9	**Clinical audit**: ➢ Distinctiveness of research and audit processes and their function ➢ Change and Innovation

Text books recommended

Latest editions of the following books

- Research Methodology methods and techniques CR Kothari.
- Essentials of Biostatistics by Indranil Saha, Bobby Paul

Principles of Management, Act, Rules and Regulation of Radiology *(BMRIT – 020)*
SECTION – B *Theory – 40*

Unit	Tiles
1	**Management** The course is intended to provide knowledge about the basic principles of Management. ➢ Introduction to management , Strategic Management ➢ Foundations of Planning, Planning Tools and Techniques ➢ Decision Making, conflict and stress management ➢ Managing Change and Innovation ➢ Understanding Groups and Teams, Leadership ➢ Time Management, Cost and efficiency
2	**Community orientation and clinical Visit** ➢ The objective of this particular section of the foundation course is to sensitize potential learners with essential knowledge; this will lay a sound foundation for their learning across the undergraduate program and across their career. Innovative teaching methods should be used to ensure the attention of a student and make them more receptive such as group activities, interactive for a role plays, and clinical bed-side demonstrations. ➢ The community orientation and clinical visit will include visit to the entire chain of healthcare delivery system -Sub centre, PHC, CHC, SDH, DH and Medical College, private hospitals, dispensaries and clinics. ➢ The student will also be briefed regarding governance at village level including interaction and group discussion with village panchayat and front line health workers. ➢ Clinical visit to their respective professional department within the hospital.
3	**Professionalism values** The module on professionalism will deliver the concept of what it means to be a professional and how a specialized profession is different from a usual vocation. It also explains how relevant is professionalism in terms of healthcare system and how it affects the overall patient environment ➢ Professional values- Integrity, Objectivity, Professional competence and due care, Confidentiality ➢ Personal values- ethical or moral values ➢ Attitude and behavior- professional behavior, treating people equally ➢ Code of conduct , professional accountability and responsibility, misconduct ➢ Differences between professions and importance of team efforts ➢ Cultural issues in the healthcare environment
4	**Act, Rules & Regulations in Diagnostic Radiology & Imaging** ➢ Regulatory Bodies & regulatory Requirements, International Commission on Radiation Protection (ICRP), National Regularity body (AERB - Atomic Energy Regulatory Board) ➢ Responsibilities, organization, Safety Standard, Codes and Guides, Responsibilities of license registrants & employers, Certification Pregnancy ➢ Enforcement of Regulatory requirements ➢ Role of Radiographer in Planning, Role of technologist in radiology departmentQA & Radiation Protection, Personnel and area monitoring, Occupational exposure and protection Tools/devices ➢ Setting up of a new X-Ray unit, Staff requirement ➢ AERB specifications for site planning and mandatory guidelines, NABH guidelines, AERB guidelines, PNDT Act and guidelines ➢ Evaluation of workload versus radiation factors ➢ ICRP, NRPB, NCRP and WHO guidelines for radiation protection, ➢ Planning of X-ray rooms, dark rooms, Inspection of X-Ray installations, Registration of X-Ray equipment installation

Text books recommended
Latest editions of the following books

- Radiation protection in Medical radiography – Mary Alice & ICRP Report 60 and 103
- AERB safety code for Medical diagnostic X–r ay Equipment and installations
- Radiation, People and the Environment. IAEA Publication
- Notification No. GSR 388 on," The Radiation Surveillance Procedures for Medical Applications of Radiation, 1989"

Seminars, Journal Clubs, Group Discussions & Project (Medical Imaging Techniques)

Theory –30 & Practical –60

Each student will be assigned topics for presentations as seminars, will explore recent innovations in MRIT for presenting topics during journal clubs and shall be holding group discussions along with in the presence of MRIT faculty.

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

Project

Theory –20 & Practical –30

Skills based outcomes and monitorable indicators for Medical Radiology and Imaging Technologist

Competency statements

1. Should be able to undertake Mammography, CT scan and MRI procedures independently.
2. Assist in specialized radiological procedures.
3. Able to do the image processing.
4. Should be able to handle all radiological and imaging equipment independently.
5. Should ensure radiation protection and quality assurance
6. Undertake care and maintenance of all radiological and imaging equipment
7. Able to evaluate images for technical quality 8.Able to identify and manage emergency situations.
9. Able to receive and document verbal, written and electronic orders in the patient's medical record.
10. Implements health and safety procedures
11. Demonstrates ability to interpret, apply and disseminate information as a member of the medical imaging team
12. Ensures radiation protection legislation is adhered to
13. Demonstrates knowledge and skills to carry out the daily/weekly Quality Control (QC) checks
14. Participates in research activities

Internship

Minimum of 1080 hours (Calculated based on 6 hours a day for 180 working days per year

Sl. No.	Learning outcomes	Knowledge/comprehension	Applications / synthesis / evaluation	Hours
1	Be able to evaluate a patient	Identify the area for treatment.	Determining X-ray, CT scan or MRI scan needs of patient	100
2	Preparations	Quantify the practical problems associated with machine and accessory equipment limitations	Understand and interpret instructions and requirements documented by the physician in the patient's prescription	100
3	Operation of radiologic equipment	Selecting and performing basic views (projections) and conventional contrast studies using appropriate radiographic parameters and equipment	Reliably perform all non- contrast plain Radiography, conventional contrast studies and non-contrast plain radiography in special situations	200
		Carrying out routine procedures for troubleshooting and maintenance of imaging and processing systems	Control and manipulate parameters associated with exposure and processing to produce a required image of desirable quality. Apply quality control procedures for all radiologic equipment	
4	Be able to transfer all relevant information and complete accurate documentation	Recognize the importance of accurate transfer of information to allow for accurate treatment set-up according to the treatment plan and prescription	Construct the most appropriate device for the individual patient within the context of the protocol	100
		Know what should be included Know to whom or where the documentation and information should be sent Be aware of the legal issues relating to documentation	Apply the necessary precautions in production Implement correct QC, storage and handling procedures for shielding devices	100
5	Be able to prepare the diagnostic Machinery	Know the shielding devices/ methods available	Construct the most appropriate device for the individual patient within the context of the protocol	100
		Know how to use these devices Recognize the associated health and safety issues	Apply the necessary precautions in production Implement correct QC, storage and handling procedures for immobilization devices	
6	Be able to carry out the daily Organization of the treatment unit	Recognize the importance of team interactions	Participate in the organization of the daily work schedule to maximize efficiency	50
		Explain the principles of effective communication Review the individual patient requirements	Inform the patient about the procedure	
7	Be able to accurately and consistently set-up and produce a good quality radiological image	Able to interpret the set-up information	Interpret the diagnostic plan and set-up the patient accordingly	200
		Apply knowledge of radiographic imaging to the production of radiographs and the assessment of image quality	Carrying out quality control tests on images obtained	
8	Be able to complete accurate treatment documentation	Recognize the importance of accurate documentation	Complete the treatment documentation accurately	50
		Know what should be included Be aware of the legal issues relating to treatment documentation List support groups that might benefit patients	Ensure all legal requirements have been met	

Sl. No.	Learning outcomes	Knowledge/comprehension	Applications / synthesis /evaluation	Hours
9	Be able to prepare and position the patient for the procedure	Be familiar with the treatment plan	Explain the anatomic and physiological basis of the procedure to be undertaken	200
		Identify preparatory procedures	Identify and explain the possible side effects to each patient	
		Be familiar with the diagnostic plans for all patients on the treatment unit	Check all preparatory procedures have been completed Identify the patient in accordance with recognized procedures and consistent with the department protocol	
		Recognize the signs and symptoms associated with treatment in different sites Discuss the importance of patient identification and how it should be carried out	Analyze the information and integrate to define the optimal patient position Interpret the diagnostic plan and use the equipment accordingly	
10	Advise patient on appropriate nutrition, sexual function, rest, skin care, nausea and other symptoms	Explain the impact of nutritional status on patient tolerance of treatment	Assess the patient's nutritional status	50
11	Monitor and assure quality	Monitor treatment process/ outcomes	Identify needs and expectations of patient/health care professionals	50
		Identify problems in treatment process/outcomes Know what patient care is relevant for the procedure	Solve treatment process/ outcome problems Evaluate potential solutions thoroughly	
12	Be able to carry out the necessary data transfer checks	Define and explain the data that must be transferred	Check and verify all parameters Confirm approval and signatures	50
13	Be able to process radiographic images	Apply knowledge of radiographic imaging to the production of radiographs and the assessment of image quality	Perform X-ray film / image processing techniques (including dark room techniques)	50
		Control and manipulate parameters associated with exposure and processing to produce a required image of desirable quality	Acquire an appropriate image as per instructions	
14	Recognize contrast induced adverse reactions	Promptly recognize and assess the reactions Taking precautionary measures to avoid the reactions	Know the correct medications and other treatment options Recognise the contra-indications of allergic reactions	50
15	Be able to carry out corrective actions as per instructions	Recognize the critical structures on the verification images Identify the correct imaging protocol	Make corrections in accordance with the protocol Record any corrections	50
16	Be able to implement health and safety procedures	Explain the health and safety issues for patients and staff	Assess the safety features to ensure they are in place and adhered to	50

Sl. No.	Learning outcomes	Knowledge/comprehension	Applications / synthesis /evaluation	Hours
17	Be able to interpret, apply & disseminate information as a member of the medical imaging team	Define and explain the data that must be disseminated	Identify the appropriate personnel to whom specific information should be disseminated	50
			Communicate the correct, relevant and appropriate information	
18	Be able to demonstrate professional behaviour	Explain the legal and ethical guidelines related to the profession	Practice in accordance with legislation regulations and ethical guidelines	100
		Be aware of your own competency levels Identify the elements that reflect professional appearance and manner	Promote collaborative practice	
19	Be able to demonstrate a sensitive and caring attitude to patients	Explain the components of good communication Describe the main personality types	Self-awareness of their own personality traits	50
		Be aware of the patient' gender, age, cultural background, educational level and social situation	Analyze how the differences in personality influence approach	
20	Able to ensure radiation protection legislation adhered to	Describe the radiation hazards and how they are managed Explain the legislation relating to radiation protection	Routinely inspect the area to ensure that radiation protection measures are in place and functional	50
21	Be able to carry out the daily/ weekly Quality Control (QC) checks	Explain Quality Management System (QMS), Quality Assurance (QA) and Quality Control (QC	Perform the daily/ weekly/ monthly QC procedures	50
22	Be able to review the literature	Define search terms for specific treatment sites	Identify the appropriate literature in the area of interest	30
23	Be able to suggest implementation of research findings	Identify relevant sources of Research	Evaluate research with respect to current departmental practice	10
24	Be able to suggest/ initiate topics for medical imaging	Identify literature to support research proposal Define the necessary steps in	Review the literature in the area Formulate a research question	10
25	Research	Preparing and carrying out research		

Total Hours- 1800