



PRAVARA INSTITUTE OF MEDICAL SCIENCES

(DEEMED TO BE UNIVERSITY)

Loni, Tal. Rahata, Dist. Ahmednagar 413736
NAAC Re-accredited with 'A' Grade

SYLLABUS

Degree Programme- Bachelor of Science Honors in Medical Radiology and Imaging Technology (B.Sc. Hons MRIT)

Dept. of Radiodiagnosis,

Dr. Balasaheb Vikhe Patil Rural Medical College

(Under Graduate Curriculum will be implemented with effect from 2024-25 onwards)

Syllabus

Bachelor of Science Honors in Medical Radiology and Imaging Technology (B.Sc. Hons MRIT)

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SECTION II- Syllabus for B.Sc. (HONS) (MRIT)

SECTION I- RULES AND REGULATIONS FOR B.Sc. (HONS) (MRIT) PROGRAM

1. Nomenclature of Degree

Bachelor of Science (HONS) (MRIT) Medical Radiology and Imaging Technology

2. University

Pravara Institute of Medical Sciences, Deemed University

3. Constituent unit

Dept. of Radiodiagnosis, Dr.Balasaheb Vikhe Patil Rural Medical College, Loni

4. Faculty

This program is offered under the “Faculty of Allied Health Sciences”

5. Pattern of the program

The program adopts semester system.

6. Background of the program

This program has been specially designed to meet the ever increasing demand for well trained personnel with advanced & appropriate skills and knowledge of Medical Radiology and Imaging Technology.

7. Duration of the Program

- Duration of this program will be three academic years with six semesters.
- one year of internship.(VII and VIII semester-Thesis and rotatory internship)

8. Medium of instruction- English

9. Program Objective

The objectives of the program are to:

- i. Provide the profession and community with trained qualified Medical radiology and Imaging technologist.

- ii. Provide education a comprehensive program that promotes problem solving, critical thinking and communication skills in the clinical environment
- iii. Students will demonstrate quality patient care skills including professionalism and ethical behaviors as specified in the code of ethics
- iv. Graduate students with specific skills necessary to be competent entry level

10. Expectations from future graduates

Expectation from the future graduate in the providing patient care.

- a. Should be able to undertake Mammography, CT scan and MRI procedures independently.
- b. Assist in specialized radiological procedures.
- c. Able to do the image processing.
- d. Should be able to handle all radiological and imaging equipment independently.
- e. Should ensure radiation protection and quality assurance
- f. Undertake care and maintenance of all radiological and imaging equipment
- g. Able to evaluate images for technical quality
- h. Able to identify and manage emergency situations.
- i. Able to receive and document verbal, written and electronic orders in the patient's medical record.
- j. Should have computer skills.
- k. Should be able to provide empathetic professional patient care.
- l. Able to demonstrate professional growth, sense of professionalism and desire to learn
- m. Able to demonstrate the core values of caring, integrity and discovery.
- n. To exhibit keen interest, initiative & drive in the overall development of the Department and 'Leadership Qualities' for others to follow.
- o. 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.

11. Eligibility for admission -

- Candidate should have passed 10 + 2 with science (PCB). Minimum percentage of marks: 50 % aggregate (45 % for Reserved Category Students).
- The students holding graduate degree in science/technology will be given preference for selection during admission procedure.

12. Selection Procedure

- Admissions will be purely on merit basis, aggregate marks obtained in the qualifying examination will be considered for deciding the merit. In case of equal marks in qualifying exam, the marks for PCB group will be compared for deciding merit.
- The selection procedure will be decided by the university from time to time and will be followed for the selection of candidates.

13. After Selection procedures

- After selection students have to report to the college and submit all necessary documents and pay the desired fees as applicable.
- Annual calendar and schedule will be announced by the university based on the inputs received from Rural Medical College.

14. Procedure for Cancellation of admission

A candidate who has confirmed the admission may cancel it by submitting an application to the Dean, Dr. Balasaheb Vikhe Patil Rural Medical College, Loni through HoD, Dept. of Radiodiagnosis. The admission will be cancelled as per the rules applicable from time to time and as decided by the university.

15. Program structure

Subject code	Title of Paper/ Practical	Subject code	Title of Paper/ Practical
SEMESTER I		SEMESTER II	
BMRIT 101	Introduction to National Healthcare System	BMRIT 201	Basics Physics including Radiological Physics
BMRIT 102	Basic computers and information science	BMRIT 202	Conventional Radiography and equipment
BMRIT 103	Introduction to Quality and patient safety	BMRIT 203	Radiographic and Image processing Techniques
BMRIT 104	Human Anatomy and Physiology Part 1	BMRIT 204	English & Communication skills

BMRIT 111	Practical's based on BMRIT 101 to BMRIT 105	BMRIT 211	Practical's based on BMRIT 201 to BMRIT 205
BMRIT 112	Medical terminologies, Medical Law and Ethics		
SEMESTER III		SEMESTER IV	
BMRIT 301	Human Anatomy and Physiology including Pathology Part-2	BMRIT 401	Physics of Newer Imaging Modalities
BMRIT 302	Clinical Radiography- Positioning Part 1	BMRIT 402	Clinical Radiography Positioning Part 2
BMRIT 303	Modern Radiological & Imaging Equipment including Physics	BMRIT 403	Newer Modalities Imaging Techniques including patient Care
BMRIT 304	Contrast & Special Radiography procedures	BMRIT 404	Quality Control in Radiology and Radiation Safety
BMRIT 311	Practical's based on BMRIT 301 to BMRIT 305	BMRIT 411	Practical's based on BMRIT 401 to BMRIT 405
		BMRIT 412	Environmental Studies
SEMESTER V		SEMESTER VI	
BMRIT 501	Cross sectional anatomy and Physiology	BMRIT 601	Quality Assurance & Radiation Safety (AERB Guidelines) in Diagnostic Radiology Part 2
BMRIT 502	Physics of Advanced Imaging Technology	BMRIT 602	Research methodology
BMRIT 503	Radiographic Techniques of Advanced Imaging Technology	BMRIT 603	Hospital Practice & Care of Patients
BMRIT 504	Regulatory Requirements in Diagnostic Radiology & Imaging, Act and rules, regulations for JCI, NABH, NABHR.	BMRIT 604	Professionalism, Values and Management
BMRIT 511	Practical's based on BMRIT 501 to BMRIT 505	BMRIT 611	Practical's based on BMRIT 601 to BMRIT 605
SEMESTER VII		SEMESTER VIII	
	Thesis		Internship

16. Attendance/Leave/Vacation

The student must meet the requirement of 75% attendance per semester per course for granting the term. The teacher handling a course shall be responsible for maintaining a record of attendance of students who have registered for the program.

All other rules pertaining to the public holidays, Diwali/summer vacation and preparatory leaves will be as per the university guidelines effective from time to time.

17. Assessment /Examination

The final total assessment of the student shall be made in terms of an internal assessment and an external assessment. The internal and external assessment will constitute combine head of passing. For each paper meant for University evaluation, the ratio of marks for internal assessment in relation to external assessment shall be 30:70. The schedule of both the Internal and university examination will be communicated to the students through the academic calendar before starting the semester.

17.1- Internal Assessment (IA).

IA forms the Formative Assessment component of evaluation. It is structured to elicit the Students' domain knowledge, analytical and creativity skills. The IA for each paper will be conducted for 30 marks for theory and 60 marks for practical. The internal assessment will be conducted before the university examination of respective semester. The marks of the IA will be communicated to the university as per the time frame decided by the university. The marks awarded by a teacher in the internal evaluation shall be immediately communicated to the student. The subject BMRIT 112 Medical terminologies, Medical Law and Ethics and BMRIT 412 Environmental Studies will be assessed as an internal subjects for 100 marks and the result will be communicated to the university. These subjects will be shown as Pass/Fail or grades will only appear on the final mark sheet. However, in order to appear for final year examination, the students must pass these subjects.

17.2- External/University Assessment.

The university assessment for theory subjects shall be based upon the written examination to be held at the end of each semester. The written examination will be conducted for 70 marks for theory and 140 marks for practical by the university. The schedule of the examination will be communicated by the university well in advance.

18. Scheme of Examination.

The distribution of the marks for all the courses under B.Sc. MRIT will be as follows.

Subject code	Title of Paper/ Practical	Marks		
		Internal	External	Total
	Semester I			
BMRIT 101	Introduction to National Healthcare System	30	70	100
BMRIT 102	Basic computers and information science	30	70	100
BMRIT 103	Introduction to Quality and patient safety	30	70	100
BMRIT 104	Human Anatomy and Physiology Part 1	30	70	100
BMRIT 111	Practical's based on BMRIT 101 to BMRIT 105	60	140	200
		Total Marks		600
BMRIT 112	Medical terminologies, Medical Law and Ethics <i>(This course will be assessed through internal examination, however passing in this subject is compulsory in order to appear for final year examination)</i>	100		
	Semester II			
BMRIT 201	Basics Physics including Radiological Physics	30	70	100
BMRIT 202	Conventional Radiography and equipment	30	70	100
BMRIT 203	Radiographic and Image processing Techniques	30	70	100
BMRIT 204	English & Communication skills	30	70	100
BMRIT 211	Practical's based on BMRIT 201 to BMRIT 205	60	140	200
		Total Marks		600
	Semester III			
BMRIT 301	Human Anatomy and Physiology including Pathology Part-2	30	70	100

BMRIT 302	Clinical Radiography- Positioning Part 1	30	70	100
BMRIT 303	Modern Radiological & Imaging Equipment including Physics	30	70	100
BMRIT 304	Contrast & Special Radiography procedures	30	70	100
BMRIT 311	Practical's based on BMRIT 301 to BMRIT 305	60	140	200
		Total Marks		600
	Semester IV	Internal	External	Total
BMRIT 401	Physics of Newer Imaging Modalities	30	70	100
BMRIT 402	Clinical Radiography Positioning Part 2	30	70	100
BMRIT 403	Newer Modalities Imaging Techniques including patient Care	30	70	100
BMRIT 404	Quality Control in Radiology and Radiation Safety	30	70	100
BMRIT 411	Practical's based on BMRIT 401 to BMRIT 405	60	140	200
		Total Marks		600
BMRIT 412	Environmental Studies <i>(This course will be assessed through internal examination, however passing in this subject is compulsory in order to appear for final year examination)</i>	100		
	Semester V	Internal	External	Total
BMRIT 501	Cross sectional anatomy and Physiology	30	70	100
BMRIT 502	Physics of Advanced Imaging Technology	30	70	100
BMRIT 503	Radiographic Techniques of Advanced Imaging Technology	30	70	100
BMRIT 504	Regulatory Requirements in Diagnostic Radiology & Imaging, Act and rules, regulations for JCI, NABH, NABHR.	30	70	100

BMRIT 511	Practical's based on BMRIT 501 to BMRIT 505	60	140	200
		Total Marks		600
	Semester VI	Internal	External	Total
BMRIT 601	Quality Assurance & Radiation Safety (AERB Guidelines) in Diagnostic Radiology Part 2	30	70	100
BMRIT 602	Research methodology	30	70	100
BMRIT 603	Hospital Practice & Care of Patients	30	70	100
BMRIT 604	Professionalism, Values and Management	30	70	100
BMRIT 611	Practical's based on BMRIT 601 to BMRIT 605	60	140	200
		Total Marks		600

The pattern of question paper will cover the entire syllabus. The theory paper will consist of MCQ, SAQ and LAQ. However, the practical examination will cover the entire aspects of practicals, field postings, field visits and all other aspects which are not included in theory. Following is the subject wise details of examination scheme.

Theory subjects carrying 70 marks for university examination will be assessed with following method (BMRIT101, BMRIT 102, BMRIT 103, BMRIT 104, BMRIT 201, BMRIT 202, BMRIT 203, BMRIT 204, BMRIT 301, BMRIT 302, BMRIT 303, BMRIT 304, BMRIT 401, BMRIT 402, BMRIT 403, BMRIT 404, BMRIT 501, BMRIT 502, BMRIT 503, BMRIT 504, BMRIT 601, BMRIT 602, BMRIT 603, BMRIT 604)

Section I	Multiple Choice Questions (MCQ's)	20 Marks
	20 MCQs with 1 Mark each (All are compulsory)	20
Section II	Short Answer Questions (SAQ)- (Attempt any four out of five)	20 Marks
Q. 1	Short Answer Question 1	05 Marks
Q. 2	Short Answer Question 2	05 Marks

Q. 3	Short Answer Question 3	05 Marks	
Q. 4	Short Answer Question 4	05 Marks	
Q. 5	Short Answer Question 5	05 Marks	
Section III	Long Answer Questions (LAQ)-Attempt any three out of four		30 Marks
Q. 1	Long Answer Question 1	10 Marks	
Q. 2	Long Answer Question 2	10 Marks	
Q. 3	Long Answer Question 3	10 Marks	
Q. 4	Long Answer Question 3	10 Marks	
	Total Marks		70 Marks

The question paper should give equal weightage to all the topics in the course. The questions can be subdivided as per the demand of syllabus. The time allotted for the theory examination is 3 clock hours.

- **Practical subjects carrying 140 marks for university examination will be assessed with following method** (BMRIT 111, BMRIT 211, BMRIT 311, BMRIT 411, BMRIT 511, BMRIT 611,)

Que.1	Practical Work	60 Marks
A	Practical 1	20 Marks
B	Practical 1	20 Marks
C	Practical 1	20 Marks
Que.2	Spots	20 Marks
	5 spots * 4 Marks	20 Marks
Que. 3	Viva voce	50 Marks
Que.5	Journal	10 Marks

All components of this assessment will be evaluated by two external examiners appointed by the university during the exam. The examiners should have qualification of MD (Radiodiagnosis) qualification and should be associated with teaching institute.

19. Rule of passing.

The student will be declared as pass only when s/he scores minimum 40 % marks in a subject inclusive of internal as well as external examination.

20. Promotion of student to next semester/year.

Students are permitted to carry-over 2 failed courses from first to second year. However, in order to get promoted to third year, students have to pass all subjects of first year and he/she can carry over 2 subjects from second year to third year.

21. Fees and payments.

The students have to pay the tuition fee at the start of respective semester year in order to undertake the program. The fee structure will be decided by the university and will be revised / updated from time to time as and when it is necessary.

22. Maximum Duration for completion of the Programme

The candidate shall complete the Program within maximum period of six academic years from the date of admission. The student will be finally declared as failed if s\he does not pass in all subjects within a total period of six years. After that, such students will have to seek fresh admission as per the admission rules prevailing at that time.

23. Grade/class Improvement

Grade/Class improvement will be as per the university regulations applicable at that time.

24. Saving Clause

In the event of any clarification and interpretation of the content of this curriculum, the Vice Chancellor is empowered to take appropriate decision.

SECTION II- Syllabus**SEMESTER I****BMRIT 101 -Introduction to National Healthcare System**

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

1. Introduction to healthcare delivery system

- a. Healthcare delivery system in India at primary, secondary and tertiary care
- b. Community participation in healthcare delivery system
- c. Health system in developed countries.
- d. Private Sector
- e. National Health Mission
- f. National Health Policy
- g. Issues in Health Care Delivery System in India

2. **National Health Programme-** Background objectives, action plan, targets, operations, achievements and constraints in various National Health Programme.
3. **Introduction to AYUSH system of medicine**
 - a. Introduction to Ayurveda.
 - b. Yoga and Naturopathy
 - c. Unani
 - d. Siddha
 - e. Homeopathy
 - f. Need for integration of various system of medicine
4. **Health scenario of India-** past, present and future
5. **Demography & Vital Statistics-**
 - a. Demography – its concept
 - b. Vital events of life & its impact on demography
 - c. Significance and recording of vital statistics
 - d. Census & its impact on health policy
6. **Epidemiology**
 - a. Principles of Epidemiology
 - b. Natural History of disease
 - c. Methods of Epidemiological studies
 - d. Epidemiology of communicable & non-communicable diseases, disease transmission, host defense immunizing agents, cold chain, immunization, disease monitoring and surveillance.

Practicals-

1. Visit to Sub centre, PHC, CHC, SDH, DH and Medical College, private hospitals, dispensaries and clinics.
2. Clinical visit to the respective professional department within the hospital.

BMRIT 102 -Basic computers and information science

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:

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.

Practical on fundamentals of computers -

1. Learning to use MS office: MS word, MS PowerPoint, MS Excel.
2. To install different software.
3. Data entry efficiency

BMRIT 103 -Introduction to Quality and patient safety

1. **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.

- a. Concepts of Quality of Care
 - b. Quality Improvement Approaches
 - c. Standards and Norms
 - d. Quality Improvement Tools
 - e. Introduction to NABH guidelines
2. **Basics of emergency care and life support skills** - 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

- b. Waste minimization
 - c. BMW – Segregation, collection, transportation, treatment and disposal (including colorcoding)
 - d. Liquid BMW, Radioactive waste, Metals / Chemicals / Drug waste
 - e. BMW Management & methods of disinfection
 - f. Modern technology for handling BMW
 - g. Use of Personal protective equipment (PPE)
 - h. 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 taught 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-**
- a. History of Antibiotics
 - b. How Resistance Happens and Spreads
 - c. Types of resistance- Intrinsic, Acquired, Passive
 - d. Trends in Drug Resistance
 - e. Actions to Fight Resistance
 - f. Bacterial persistence
 - g. Antibiotic sensitivity
 - h. Consequences of antibiotic resistance
 - i. 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-

- a. Fundamentals of emergency management,
- b. Psychological impact management,
- c. Resource management,
- d. Preparedness and risk reduction,
- e. Key response functions (including public health, logistics and governance, recovery, rehabilitation and reconstruction), information management, incident command and institutional mechanisms.

BMRIT 104 -Human Anatomy and Physiology Part –I

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.

Similarly 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.

1. Introduction to the body as a whole
2. The cells, tissues of the body
3. The cell: Structure, multiplication.
4. Tissue: Types, structure, characteristics, functions
5. Epithelium:
6. Simple : Squamous, Cuboidal, columnar, ciliated
7. Compound: Stratified, transitional
8. Connective: Areolar, adipose, fibrous, elastic, Cartilage, blood and bone
9. Muscle: Striated (Voluntary), Smooth (Involuntary, Cardiac)
10. Nervous tissue
11. Fibrous tissue
12. Cell regeneration

13. Membranes: Mucous, Serous, Synovial
14. Osteology (including whole Skelton, bones and joints)
15. Development of bone (ostogenesis) : Cells involved
16. Types and functions of bone, Types of joints and various movements.
17. AXIAL Skelton: Skull : Cranium, face, air sinuses, Vertebral column: regions, movements and characteristics, Sternum, Ribs
18. Appendicular Skelton: Bones involving -Shoulder girdle and Upper limb, Pelvic girdle and lower limb, healing of bones: cellular activity, Factors that delay healing, Diseases of bones and joints.
19. The Respiratory System: Organs: Position and structure, Nose and nasal cavities, Functions: respiratory, Olfactory, Pharynx, and Larynx: Functions - respiratory, vocal, Trachea, Bronchi, lungs: lobes, lobules, pleura, and respiratory functions: External and internal respiration, common terms relating to disease and conditions of the system.

Practical's

1. Study of Human Skeleton parts with skeletal models.
2. Study with charts and models of all organ systems mentioned above.
3. Microscopic slides examination of elementary human tissues, cells.

BMRIT 112 –Medical terminologies, Medical Law and Ethics

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. Spelling is critical and will be counted when grading tests. Topics to be covered under the subject are as follows:

1. Derivation of medical terms.
2. Define word roots, prefixes, and suffixes.
3. Conventions for combined morphemes and the formation of plurals.
4. Basic medical terms.
5. Form medical terms utilizing roots, suffixes, prefixes, and combining roots.
6. Interpret basic medical abbreviations/symbols.
7. Utilize diagnostic, surgical, and procedural terms and abbreviations

related to the integumentary system, musculoskeletal system, respiratory system, cardiovascular system, nervous system, and endocrine system.

8. Interpret medical orders/reports.
9. Data entry and management on electronic health record system.

Medical law and ethics

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:

1. Medical ethics - Definition - Goal - Scope
2. Introduction to Code of conduct
3. Basic principles of medical ethics – Confidentiality
4. Malpractice and negligence - Rational and irrational drugtherapy
5. Autonomy and informed consent - Right of patients
6. Care of the terminally ill- Euthanasia
7. Organ transplantation
8. Medico legal aspects of medical records – Medico legal case and type- Records and document related to MLC - ownership of medical records - Confidentiality Privilege communication - Release of medical information - Unauthorized disclosure - retention of medical records - other various aspects.
9. Professional Indemnity insurance policy
10. Development of standardized protocol to avoid near miss or sentinel events
11. Obtaining an informed consent.

Second Semester

BMRIT 201 -Basic Physics including Radiological Physics

Basic physics

1. **Basic concepts:** Units and measurements-Force, work, power and energy- Temperature and heat-SI units of above parameters. Atomic structure-atom model-Nucleus-electronic configuration-periodic table-Isotopes-Ionization-excitation-Binding energy-electron volt- Electromagnetic radiation- Quantum nature of radiation-mass energy equivalence- Fluorescence-electromagnetic spectrum.
2. **Electricity and magnetism:** Electric charges, Coulomb's law-Unit of charge-Electric potential, unit of potential-Electric induction, capacitance and Capacitors, series and parallel connection-electric current, unit, resistance, ohm's law, electric power, Joule's law. Varying currents- Growth and decay of current in LR circuit time constant, charge and discharge of a Capacitor through a resistance and inductance. Oscillations in an LC circuit. Alternating currents: Peak and RMS values and current and voltage, circuit containing LR, CR and LCR-Power factor, series and parallel LCR circuits, DC circuit, Ohm's law, resistivity, series and parallel combination, EMF, Kirchhoff's law, heating effect of current.
3. **Electromagnetic waves:** Introduction, Maxwell's equation, electromagnetic waves, energy density and intensity, momentum, electromagnetic spectrum and radiation in Atmosphere.
4. **Sound.**
 - a. The nature and propagation of sound wave (the characteristics of sound, wave theory), speed of sound in a material medium, intensity of sound, the decibel, Interference of sound waves, beats, diffraction.
 - b. Doppler's effect, Ultrasonic wave, production of ultrasonic waves (piezo-electric effect) in ultrasonography.
 - c. Use of principle of Doppler's effect in Diagnostic Radiology (e.g. Echo, blood flow measurement).

6 Heat

Definition of heat, temperature, Heat capacity, specific heat capacity, Heat transfer- conduction, convection, radiation, thermal conductivity, equation for thermal conductivity (k), the value of k of various material of interest in radiology, thermal expansion, Newton's law of cooling, Heat radiation, perfect black body, Stefan law, application in Diagnostic Radiology (Heat dissipation in both stationary and rotating X-ray tubes).

7. Electronics.

- a. Semiconductors; Conduction in crystals, Energy bands. Intrinsic and Extrinsic semiconductors n-type and p-type semiconductors, majority and minority carriers.
- b. Semiconductor diodes: p-n junction-properties forward and reverse bias, characteristics of p-n junction Rectifiers-Half-wave and full wave, ripple factor, Efficiency of HW and FW rectifiers. Filter circuits; Zener diode, regulated power supply.
- c. Transistors-Symbols, Transistor connections and characteristics, Transistor as an amplifier, load line analysis, operating point, types of amplifiers-voltage and power amplifiers. Feedback-negative feedback in amplifiers.

8 Basic Radiological Physics

- d. X-rays: Discovery of x-rays-X-ray production and properties: Bremsstrahlung radiations-Characteristics X-Rays, factors affecting X-ray emission spectra, X-ray quality and quantity, HVL measurements, heel effect, soft and hard X-Rays, added and inherent filtration, reflection and transmission targets.
- e. Interaction of ionizing radiation with matter-Types of interactions of X-and gamma radiation, Photoelectric & Compton, Pair production, annihilation radiation.
- f. Interaction of X and gamma rays: Transmission through matter, law of exponential attenuation, half value layer, and linear attenuation coefficient- coherent scattering-photonuclear disintegration-Particle interactions. Interactions of X rays and

- Gamma rays in the body; fat-soft tissue-bone-contrast media-total attenuation coefficient-relative clinical importance.
- g. Exponential attenuation (linear/mass attenuation coefficients), Half Value Thickness (HVT), Tenth Value Thickness (TVT), dependence on energy and atomic number.
 - h. Radiation intensity and exposure, photon flux and energy flux density.
 - i. LET, range of energy relationship for alpha, beta particles with X-Rays.
 - j. X-ray tube: historical aspects, construction of X-ray tubes, requirements for X-ray production (Electron source, target and anode material), tube voltage, current, space charge, early X-ray tubes (Coolidge tubes, tube envelop and housing) cathode assembly, X-ray production efficiency, advances in X-ray tubes, anode angulation and rotating tubes-line focus principle-space charge effect, tube cooling-Modern X-ray tubes-stationary anode, rotating anode, grid controlled X-ray tubes, heel effect, off focus radiation, tube insert and housing-Tube rating- Quality and intensity of x-rays-factors influencing them.
 - k. Grid controlled and high speed tubes, focal spot size, speed of anode rotation, target angle, inherent filtration, radiation leakage and scattered radiation). Interlocking and X-ray tube overload protection.
 - l. Heat dissipation methods, tube rating, heat units, operating conditions and maintenance and Q.A procedures.
 - m. Filament current and voltage, X-ray circuits (primary circuit, auto transformer), types of exposure switch and timers, principle of automatic exposure control (AEC) and practical operation, filament circuit, high voltage circuits, half wave, full wave rectification, three phase circuits. Types of generators, 3 phase, 6 and 12 pulse circuits-high frequency generators-falling load generators, Capacitors discharge and grid control systems.

- n. X-ray generator circuits: Vacuum tube diodes-semi-conductor diodes-transistor- Rectification-half and full wave-self rectification-X-ray generator; filament circuit- kilo Voltage circuit-single phase generator-three phase generator-constant potential generator-Fuses, switches and interlocks-Exposure switching and timers-HT cables-earthing.
- o. Physical quantity, its unit and measurement: Fundamental and derived quantity, SI unit, various physical/radiation quantity used in Diagnostic Radiology and its unit (for example, KVp, mA, mAS, Heat unit(HU).
- p. Radiation quantities and units: Radiation intensity-exposure, roentgen, its limitations-kerma and absorbed dose-electronic equilibrium-rad, gray, conversion factor for roentgen to rad-quality factor-dose equivalent-rem, Sievert. Quality factor, dose equivalent, relationship between absorbed dose and equivalent dose.
- q. Radiation detection and measurements: Principle of radiation detection-Basic principles of ionization chambers, proportional counters, G.M counters and scintillation detectors. Measuring system: free ionization chamber-thimble ion chamber-condenser chamber-secondary standard dosimeter-film dosimeter- chemical dosimeter-Thermo Luminescent Dosimeter-Pocketdosimeter.

BMRIT 202 -Conventional Radiological Equipment

1. Production of x-rays: X-ray tube, gas filled x-ray tube, construction working and limitations; stationary anode x - ray tube; construction, working, methods of cooling the anode, rating chart and cooling chart; rotating anode x - ray tube: construction, working rating chart, speed of anode rotation, angle of anode inclination, dual focus and practical consideration in choice of focus, anode heel effect, grid controlled x - ray tube; effect of variation of anode voltage and filament temperature; continuous and characteristics spectrum of x - rays, inherent filter and added filter, their effect on quality of the spectrum.
2. High tension circuits: H.T. generator for x-ray machines, three phase

rectifier circuits, three phase six rectifier circuit, three phase 12 rectifier circuit, high and medium frequency circuits; capacitance filter control and stabilizing equipment; mains voltage compensator, mains resistance compensator, compensation for frequency variation, control of tube voltage, kV compensator; high tension selector switch, filament circuit, control of tube current, space charge compensation.

3. Meters and exposure timers: Moving coil galvanometer: construction and working/conversion to millimeter, ammeter and voltmeter, meters commonly used in diagnostic x-ray machines, pre reading kV meter and millimeter, digital panel meters. Clockwork timers, synchronous motor timer, electronic timers, photo metric timers (fluorescent and photoelectric effect as applied in timers), ion chamber based timers, integrated timer.
4. Interlocking circuits: Relays: description and working, use of relays in diagnostic machines for over load protection, circuit diagram; simplified circuit and block diagrams illustrating sequence of events from mains supply to controlled emission of x-rays.
5. Control of scattered radiation: Beam limiting devices: cones, diaphragms, light beam collimator, beam centering device, methods to verify beam centering and field alignment; grids; design and control of scattered radiation, grid ratio, grid cut-off, parallel grid, focused grid, crossed grid, grided cassettes, stationary and moving grid potter bucky diaphragms, various types of grid movements; single stroke movement, oscillatory movement and reciprocatory movement.
6. Fluoroscopy: Fluorescence and phosphorescence - description, fluorescent materials used in fluoroscopic screens, construction of fluoroscopic screen and related accessories, tilting table, dark adaptation. Image intensifier - Construction and working, advantages over fluoroscopic device, principles and methods of visualising intensified image, basic principles of closed circuit television camera and picture tube. Vidicon camera, CCD. Automatic brightness control, automatic exposure control, chamber selection during fluoroscopy. Serial radiography: Manual cassette changer, rapid automatic film changer,

basic principles of cine fluoroscopy and angiography use of grid controlled x-ray tube.

Care and Maintenance of X-ray equipment;

General care; functional tests; testing the performance of exposure timers, assessing the MA settings, testing the available KV, measurement of focal spot of an x-ray tube, testing the light beam diaphragm, practical precautions pertaining to Brakes and locks, H.T. cables, meters and controls, tube stands and tracks as well as accessory equipment

BMRIT 203 -Radiographic and Image Processing Techniques

1. Appreciation and application of all the factors listed below will enable the student/technologist to produce X-ray films of good quality and diagnostic value. The lectures to be linked with practical demonstration to illustrate the importance of all that goes to make up correct exposure conditions.
2. Radiographic Film: Structure of film emulsion-film characteristics (speed, base + fog, gamma, 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 use-manufacturing process. Structure, properties of different parts, 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 detail-crossover 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 developer- development time-factors in the use of developer. Fixers-constitution of fixing solution- factors 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.
 - a. Functions of various components.
 - b. Film roller transport-transport time, film feed system.
 - c. Importance and relation to temp, fixed and variable time cycles.
 - d. Care and maintenance (cleaning routine and methods of cleaning).
 10. Radiographic image-components of image quality-unsharpness in radiographic image- contrast of the radiographic image-distinctness of the radiographic image-size, shape and spatial relationships.
 11. 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.
 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.

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.

Dark Room

1. The processing area.
2. Dark room design, construction, illumination, entrance safelighting-types.
3. Room storage, shelving of films.
4. Cleaning and maintenance.

Dark Room Planning:

1. For A Small Hospital, for A Large Hospital Location of Dark Room and construction of Dark Room.
2. Ventilation, Wall Protection Entrance to Dark Room - Single Door, Double Door, Labyrinth.

Dark Room:

1. Instruction to Staff, Dry Bench, Drawer, Cupboard.
2. Loading and Unloading Cassettes.
3. Hangers, Types of Hangers and Storage of Hangers
4. Wet Bench Cleanliness, Control of Dust, Dark Room Sink
5. Hatches and Drier
6. Safe Lights, Direct and Indirect, Uses, Factors Affecting Safelight Performance, Safelight Tests.
7. Viewing Room, Film Dispensing

BMRIT – 204- English and Communication skills:

Preamble:

The purpose of this course is to introduce students to the theory, fundamentals and tools of communication and to develop in them vital communication skills which should be integral to personal, social and professional interactions. One of the critical links among human beings and an important thread that binds society together is the ability to share thoughts, emotions and ideas through various

means of communication: both verbal and non-verbal. In the context of rapid globalization and increasing recognition of social and cultural pluralities, the significance of clear and effective communication has substantially enhanced.

The present course hopes to address some of these aspects through an interactive mode of teaching-learning process and by focusing on various dimensions of communication skills. Some of these are:

Language of communication, various speaking skills such as personal communication, social interactions and communication in professional situations such as interviews, group discussions and office environments, important reading skills as well as writing skills such as report writing, note taking etc.

While, to an extent, the art of communication is natural to all living beings, in today's world of complexities, it has also acquired some elements of science. It is hoped that after studying this course, students will find a difference in their personal and professional interactions.

The recommended readings given at the end are only suggestive; the students and teachers have the freedom to consult other materials on various units/topics given below. Similarly, the questions in the examination will be aimed towards assessing the skills learnt by the students rather than the textual content of the recommended books.

1. Introduction: Theory of Communication, Types and modes of Communication
2. Language of Communication: Verbal and Non-verbal (Spoken and Written)
Personal, Social and Business Barriers and Strategies Intra-personal, Inter-personal and Group communication
3. Speaking Skills: Monologue Dialogue Group Discussion Effective Communication/ Mis- Communication Interview Public Speech
4. Reading and Understanding Close Reading Comprehension Summary Paraphrasing Analysis and Interpretation Translation (from Indian language to English and vice-versa) Literary/Knowledge Texts
5. Writing Skills Documenting Report Writing Making notes Letter writing

Communication and soft skills

1. Basic Language Skills: Grammar and Usage.

2. Business Communication Skills. With focus on speaking - Conversations, discussions, dialogues, short presentations, pronunciation.
3. Teaching 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.
4. Basic concepts & principles of good communication
5. Special characteristics of health communication
6. Types & process of communication
7. Barriers of communication & how to overcome

Third Semester

BMRIT 301- Human Anatomy and Physiology including Pathology Part- 2

Review of types of cells, tissues, bones and joints. Introduction to system and cavities of the body.

1. Heart and blood vessels (Circulatory system):
 - a. Blood vessels: arteries, veins, capillaries, sinusoids, structure and functions
 - b. Heart: Position, structure and functions
 - c. Circulation of blood: pulmonary, systemic, portal, main blood vessels, their origins and distribution. Diseases of blood vessels and heart and conditions of the system
2. The Lymphatic system:
 - a. The parts of the lymphatic system.
 - b. Lymph channels: Capillaries, vessels, ducts structure and functions
 - c. Lymph nodes: position, structure and functions
 - d. Lymphatic tissues: tonsils, adenoids, intestinal nodules
 - e. Spleen: position, structure and functions, diseases and conditions of the system.
3. The digestive system:
 - a. Elementary tract structure:
 - b. Mouth, pharynx, salivary glands, oesophagus, stomach, liver, gall

bladder, small intestine, large intestine: Position, structure and functions of these organs.

- c. Digestion and absorption, Metabolism of carbohydrates. Proteins and fats. Diseases and conditions of the system.

4. The Urinary System

- a. Parts of urinary system
- b. Position, structure and functions
- c. Kidneys, ureters, urinary bladder and urethra
- d. Formation and composition of urine
- e. Water and electrolyte balance
- f. Diseases and conditions of the system

5. The reproductive system:

- a. Female reproductive system:
 - External genitalia: positions and structures and functions.
 - Perineum.
 - Internal organs: positions and structures.
 - Vagina, uterus, uterine tubes, ovaries.
 - Menstrual cycle” stages, hormone control, ovulation.
 - Breasts (Mammary glands)
 - Changes: puberty, in pregnancy, during lactation.
- b. Male reproductive system:
 - Scrotum, testis, epididymis: positions.
 - Spermatogenesis,
 - Spermatic Cords, seminal vesicles,
 - Ejaculatory ducts: position, structure & functions
 - Prostate gland: position
 - Functions of male reproductive system, puberty
 - Diseases of female and male reproductive system.

6. The Endocrine system:

- a. Endocrine glands:
- b. Pituitary and hypothalamus: Position & structure
- c. Thyroid gland, parathyroid glands
- d. Adrenal (supra renal) glands

- e. Pancreases: Position, types of cells
 - f. Hormones: secretion, function and control, pineal gland
 - g. Common terms and diseases related to the system
7. The organs of sense:
- a. Hearing and the ear:
 - b. External, middle and inner ear
 - c. Physiology of hearing and diseases of ear.
 - d. Sight and the eye: position, structure, sclera, cornea, choroid, ciliary body.
 - e. Iris, lens, retina, optic nerves
 - f. Physiology of sight and diseases of the eye.
8. Sense of smell
- a. Olfactory nerves, origins, distribution
 - b. Physiology of smell
 - c. Sense of taste : tongue
9. The nervous system
- a. Neurons: Structure, types and properties
 - b. Central nervous system: neurons, neuralgia meninges.
 - c. Ventricles of brain, CSF
 - d. Brain, spinal cord: structures, functions, peripheral nervoussystem.
 - e. Spinal and cranial nerves: origin distribution and functions.
 - f. Automatic nervous system
 - g. Sympathetic and para sympathetic: origin distribution and function.
 - h. Common diseases of the system.
10. The Skin
- a. Structure of skin
 - b. Epidermis, dermis
 - c. Functions of skin
 - d. Hypothermia
 - e. Wound healing: primary and secondary diseases of skin
11. Cross-sectional anatomy related to Ultrasound, CT and MRI techniques.

Pathology

1. General Pathology Adaptations, Cell Injury and Repair: Hyperplasia, atrophy, metaplasia, necrosis and apoptosis - Differences between apoptosis and necrosis.
2. Acute and Chronic inflammation : Five cardinal signs of inflammation- Outcomes of acute inflammation- Chronic inflammation-Granulomatous inflammation-Acute phase proteins
3. Tissue repair, regeneration and hemodynamic disorders : Cutaneous wound healing- Pathologic aspects of repair-Hyperaemia and congestion- Thrombosis and Virchow triad- Embolism-Infarction-Shock ; Bronchial asthma, COPD - Tumors
4. Diseases of immune system : Hypersensitivity reaction-Type I, II, III, and IV hypersensitivity reactions
5. Neoplasia: Definition of neoplasia. Differences between benign and malignant tumors ; Metastasis ; Carcinogenesis – Causes ; Carcinoma of oral cavity – Causes; Etiology of Carcinoma cervix – type of virus implicated, high risk sero-types, Screening investigations; Breast carcinoma – Risk factors
6. Systemic Pathology
7. RBC and Bleeding disorders: Anaemia – Definition and classification, Haemolytic anaemia, Iron deficiency anemia, Thrombocytopenia, Coagulation disorders – Terminology, Uses of Bleeding Time, PT and a PTT
8. WBC disorders: Leukocytosis, Leukemia – acute and chronic, Causes of splenomegaly
9. Disease of the GIT: Peptic ulcer – causes; Carcinoma stomach – causes; Intestinal obstruction – causes; acute appendicitis – causes; Colonic carcinoma - causes
10. Diseases of Liver, Biliary tract and Pancreas: Jaundice – classification based on pathophysiology; Cirrhosis – Definition and causes; Hepatitis – Types of viral hepatitis and transmission; Portal hypertension – Symptoms; Hepatic failure

11. Endocrine System: Diagnostic criteria of diabetes mellitus, Major subtypes of diabetes mellitus, Differences between type I and Type II diabetes mellitus, Complications of diabetes mellitus
12. Systemic Path emphasis I
13. Blood vessels: Atherosclerosis – Risk factors; American Heart association classification (1995) of Human atherosclerosis ; Hypertension – diagnostic criterion, types and causes ; Varicose veins; Thrombophlebitis and Phlebothrombosis
14. The Heart: Heart failure; congenital heart diseases causing left to right shunt and vice versa; Myocardial infarction – causes, laboratory changes and complications; Cor- pulmonale; Rheumatic fever
15. Diseases of the Lung: Chronic obstructive pulmonary disease; Asthma – pathogenesis; Pneumonia – lobar and bronchopneumonia; Lung carcinoma – Incidence and Causes
16. Systemic Path emphasis II
17. The Kidney and Lower urinary tract: Acute Renal failure – definition and causes of Pre- renal, renal and post-renal ARF ; Chronic renal failure – definition and causes; Acute nephritic syndrome – definition and causes; Nephrotic syndrome – definition and causes; Acute tubular necrosis – definition and causes; Urolithiasis – types of stones
18. Systemic Path emphasis III Female genital tract : Endometriosis – Definition ; Adenomyosis – Definition; Leiomyoma Male genital tract : Carcinoma penis – causes; Testicular tumors – Classification terminology; Prostatic Hyperplasia – Causes, symptoms and PSA screening
19. Systemic Path emphasis IV Nervous system : Intracerebral, Subarachnoid and Subdural haemorrhage, Meningitis and Encephalitis – Bacterial and viral causes and CSF findings; Epilepsy – Causes; Acute brain failure – Coma; Epilepsy – Classification terminology; CNS tumors – Classification terminology

BMRIT- 302 Clinical Radiography-Positioning Part 1

1. Skeletal system:

- a) Upper limb: Technique for hand, fingers, thumb, wrist joint carpal bones, forearm, elbow joint, radio ulnar joints and humerus supplementary techniques for the above.
E.g. Carpal tunnel view, ulnar groove, head of the radius, supracondylar projections.
- b) Lower limb: Technique for foot, toes, great toe, tarsal bones, calcaneum, ankle joint, lower leg, knee, patella & femur. Supplementary techniques: Stress view for torn ligaments,
- Subtalar joint and talo calcaneal joint.
 - Inter condylar projection of the knee.
 - Tibial tubercle.
 - Length measurement technique.
- c) Shoulder girdle and thorax: Technique for shoulder joint, scapular, clavicle, acromio clavicular joints, sternum, ribs, sterno-clavicular joint. Supplementary projections and techniques
- Recurrent dislocation of shoulder.
 - Traumatic dislocation of shoulder.
 - Cervical ribs.
- d) 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
 - Union of spinal graft.
- e) 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.
- f) Skeletal survey: Skeletal survey for metabolic bone disease, metastases, hormonal disorder, renal disorders.
- g) Skull: Basic projections for cranium, facial bones, nasal bones and mandible. Technique for
- Petrous temporal for mastoids. Internal auditory canal. - Accessory nasal sinuses.
 - Temporo - mandibular joint. -Orbits and 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.
 4. Lungs and Mediastinum: 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.
 5. Abdominal viscera- Technique for plain film examination. - Projection for acute abdomen patients. - Technique to demonstrate: Foreign bodies, Imperforate anus.
 6. Radiography using mobile X-ray equipment- Radiography in the ward: Radiography in the specialized unit, such as: Intensive care unit, Coronary care, Neonatal unit.- Radiography in the operating theatre.

Practicals

Radiographic positioning of all parts of the body.

BMRIT 303-Modern Radiological Equipment including Physics

1. Special radiological equipment: Portable and mobile x-ray units, dental x-ray machine, skull table mammographic device - Technical aspects of Mammography; High Tension Generators, x-ray tubes-their types and advancements; Accessories; Resolution; Quality control; Application and role in medicine. , digital radiography equipment, digital subtraction techniques. Tomography: Body section radiography, basic principle and equipment, multi section tomography, various types of tomographic movements, Tomosynthesis, Stich radiography, Dual energy x-ray absorptionmetry (DEXA) scan.
2. Computed radiography: its principle, physics & equipment. Digital Radiography. Flat panel digital fluoroscopy and radiography system, Direct and indirect digital radiography and fluoroscopy systems. Digital radiography and Computed radiography its advantages, disadvantages and applications.
3. Vascular Imaging Equipment: Introduction, historical developments, Principle, scanned projection radiography, digital subtraction angiography, applications and definition of terms,
4. Picture archiving and communication system (PACS)

Practical's

Demonstration of basic procedures in all modern modalities.

BMRIT 304 Contrast & Special Radiography Procedures

For each of the examination the points listed below should be included:

1. Review the anatomy of the area.
2. State the clinical indication for the examination.
3. State contra indication if any for the examination.
4. Describe the preparation of the patient including the pre medication if appropriate.
5. Specify the type and quantity of contrast agent used.
6. Describe the method of introduction of the contrast agent.
7. Describe the series of projections taken during the examination.
8. Indicate the timings of the radiographs in relation to the

administration of contrast agent.

9. Outline the practical problems and the way in which they may be overcome.
10. Explain the choice of exposure factor.
11. Detail the measures that should be taken for radiation protection.
12. Explain the after care of the patient.

Special radiographic procedures

1. Responsibility of Radiographer during Radiological Procedures.
2. Preparation of Patient for Different Procedures.
3. Contrast Media - Positive and Negative, Ionic & Non – Ionic
4. Adverse Reactions To Contrast Media and Patient Management
5. Emergency Drugs in the Radiology Department
6. Emergency Equipment's In the Radiology Department
7. Aseptic technique
8. Indications, contraindications, basic techniques and relationship to other techniques of the following special procedures

a. 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

b. Salivary glands: Routine technique, procedure – sialography

c. Biliary system:

- Plain film radiography
- Intravenous cholangiography
- Percutaneous cholangiography

- Endoscopic retrograde cholangio-pancreatography (ERCP)
 - Operative cholangiography
 - Post-Operative cholangiography (T - tube Cholangiography)
- d. Urinary system:**
- Intravenous urography
 - Retrograde pyelography
 - Antegrade pyelography
 - Cystography and micturating cystouresthrography
 - Urethrography (ascending)
 - Renal puncture
- e. Female reproductive system: Hysterosalpingography.**
- f. Mammography:**
- Mammography: Basic views, special views, wire localization.
 - Ductography.
- g. Respiratory system: Bronchography: Awareness.**
- h. Sinusography: Routine technique and procedure.**
- i. Tomography:**
- General principles.
 - Estimation, selection of depth of layer.
 - Layer thickness required for different examination.
 - Spacing of layers.
 - Types and advantages of various movements.
 - Choice of tomographic movement- exposure factor.
 - Sequential, horizontal and multi section tomography.
 - Application of tomography to specific regions.
- j. Macroradiography:**
- General principles.
 - Requirement.
 - Equipment.
 - Technique.
- k. Soft Tissue Radiography:**
- High and low kilo voltage technique; differential filtration.
 - Non - screen technique - simultaneous screen and non -screen

technique.

- Multiple radiography.
- Uses of soft tissue radiography.

l. 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.

m. Localization of foreign bodies:

- General location principles.
- Ingested; inhaled; inserted; embedded foreign bodies.
- Foreign bodies in eye.
- Preparation of the area to be investigated.
- Appropriate projection for all
- Techniques to locate non-opaque foreign body.

Fourth Semester

BMRIT 401 Physics of Newer Imaging Modalities

1. Computed Tomography its principle, various generations and advancements
2. Magnetic Resonance Imaging- its principle, advancements and applications.
3. Ultrasonography, Color Doppler- its principle, advancements and applications.
4. Digital Radiography and Digital subtraction angiography equipment- principle, advancements and applications.
5. Fusion Imaging including PET-CT, PET- MRI.
6. Digital Mammography, DEXA equipment- principle, advancements and applications.
7. Tele radiology HIS, RIS and PACS,
8. Image processing in digital radiography systems: Post processing techniques in console using CR, DR and flat panel fluoroscopy systems

BMRIT 402 Clinical Radiography Positioning Part- 2

1. Radiography technique comprising of the complete
2. Radiography of Skull and Radiography of cranial bones; including special techniques for sella turcica, orbits, opticforamina, superior orbital fissure and inferior orbital fissure etc.
3. Facial bones; Paranasal sinuses, Temporal bone and Mastoids.
4. Dental Radiography: Radiography of teeth-intra oral, extra oral and occlusal view.
5. Abdomen: Preparation of patient. General abdominal radiography and positioning for fluid and air levels. Plain film examination. Radiography of female abdomen to look for pregnancy. Radiography in case of acute abdomen.
6. Macroradiography: Principle, advantage, technique and applications.
7. Stereography - Procedure - presentation, for viewing, stereoscopes, stereometry.
8. High KV techniques principle and its applications.
9. Soft tissue Radiography including Mammography - its techniques, equipment, advancements and applications.
10. Localization of foreign bodies. Various techniques
11. Ward /mobile radiography - electrical supply, radiation protection, equipment and instructions to be followed for portable/ward radiography.
12. 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.
13. Trauma radiography/Emergency radiography
14. Neonatal and Paediatric Radiography,
15. Tomography and Tomosynthesis
16. Dual energy X-ray absorptiometry
17. Forensic Radiography

BMRIT 403 Newer Imaging Techniques including Patient Care

1. Interventional Radiography: Basic angiography and DSA:
 - a. History , technique, patient care
 - b. Percutaneous catheterisation, catheterization sites, Asepsis
 - c. Guidewire, catheters, pressure injectors, accessories
 - d. Use of digital subtraction- single plane and bi-plane

All forms of diagnostic procedures including angiography, angioplasty, biliary examination, renal evaluation and drainage procedure.
2. Central Nervous System:
 - a. Myelography
 - b. Cerebral studies
 - c. Ventriculography
3. Arthrography: Shoulder, Hip, Knee, Elbow
4. Angiography:
 - a. Carotid Angiography (4 Vessel angiography)
 - b. Thoracic and Arch Aortography
 - c. Selective studies: Renal, SMA, Coeliac axis
 - d. Vertebral angiography
 - e. Femoral arteriography
 - f. Angiocardiography
5. Venography:
 - a. Peripheral venography
 - b. Cerebral venography
 - c. Inferior and superior venocavography
 - d. Relevant visceral phlebography
6. Cardiac catheterization procedures: PTCA, BMV, CAG, Pacemaker, Electrophysiology,

Microbiology

1. Introduction and morphology - Introduction of microbiology, Classification of microorganisms, size, shape and structure of bacteria. Use of microscope in the study of bacteria.
2. Growth and nutrition -nutrition, culture media, types of medium with

example and uses of culture media in diagnostic bacteriology, antimicrobial sensitivity test

3. Sterilization and disinfection - principles and use of equipments of sterilization namely hot air oven, autoclave and serum inspissator, pasteurization, anti-septic and disinfectants.
4. Introduction to immunology, bacteriology, parasitology, mycology

Patient care in Medical Imaging Department

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

1. Hospital procedure: Hospital staffing and organization; records relating to patients and departmental statistics; professional attitude of the technologist to patients and other members of the staff; medico-legal aspects; accidents in the departments, appointments, organization; minimizing waiting time; out-patient and follow-up clinics; stock-taking and stock keeping.
2. 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.
3. 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.
4. Infection: Bacteria, their nature and appearance; spread of infections; auto-infection or cross-infection; the inflammatory process; local tissue reaction,

general body reaction; ulceration; asepsis and antisepsis. Universal precautions, hospital acquired infections- HIV, Hepatitis B, C, and MRSA etc.

5. Principles of asepsis: Sterilization - methods of sterilization; use of central sterile supply department; care of identification of instruments, surgical dressings in common use, including filamented swabs, elementary operating theatre procedure; setting of trays and trolleys in the radio imaging department (for study by radio imaging students only)
6. Departmental procedures: Department staffing and organisations; records relating to patients and departmental statistics; professional attitudes of the technologist to patients and other members of the staff, medico-legal aspects accidents in the department; appointments; organisations; minimizing waiting time; out-patient and follow-up clinics; stock taking and stock keeping
7. Drugs in the department: Storage: classification; labelling and checking, regulations regarding dangerous and other drugs; units of measurement, special drugs, anti- depressive, anti-hypertensive etc.

BMRIT 404 Quality Control in Radiology and Radiation Safety

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.
 5. 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
 6. 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 equipment's; Record keeping and log book maintenance; Reject analysis and objectives of reject analysis programme.
 7. 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.

Radiation safety in diagnostic Radiology

1. 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.
2. 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.

3. Radiation detection and Measurements: Ionization of gases- Fluorescence and Phosphorescence -Effects on photographic emulsion. Ionization Chambers – proportional counters- G.M counters- scintillation detectors – liquid semiconductor detectors – Gamma ray spectrometer. Measuring systems – free air ionization chamber – thimble ion chamber – condenser chamber – Secondary standard dosimeters – film dosimeter – chemical dosimeter- Thermoluminescent Dosimeter. -Pocket dosimeter- Radiation survey meter-wide range survey meter -zone monitor-contamination monitor - their principle function and uses. Advantages & disadvantages of various detectors & its appropriateness of different detectors for different type of radiation measurement. Dose and Dosimetry, CT Dose Index (CTDI, etc.), Multiple Scan Average Dose (MSAD), Dose Length Product (DLP), Dose Profile, Effective Dose, Phantom Measurement Methods, Dose for Different Application Protocols, Technique Optimization. Dose area product in fluoroscopy and angiography systems, AGD in mammography.
4. Radiation protection: Radiation protection of self and patient- Principles of radiation protection, time - distance and shielding, shielding - calculation and radiation survey – ALARA- personnel dosimeters (TLD and film batches) - occupational exposure.
5. Radiation Hazard evaluation and control: Philosophy of Radiation protection, effects of time, Distance & Shielding. Calculation of Work load, weekly calculated dose to radiation worker & General public Good work practice in Diagnostic Radiology. Planning consideration for radiology, including Use factor, occupancy factors, and different shielding material.

BMRIT 412- Environmental Studies

1 Nature and Scope of Environmental Studies –

Definition, Scope, Importance, Multidisciplinary Nature, Need for Public Awareness.

2 Natural Resources-

Renewable and Non-Renewable Natural Resources and associated problems of Forest, Water, Mineral, Energy, Land and food - case studies, Role of Individual in Conservation of resources, Equitable use of resources for sustainable lifestyle

3 Ecosystem-

Types, Characteristics, Structure and function.

4 Biodiversity and its Conservation-

Definition, Genetic, Species and Ecosystem Diversity, Biological Classification of India, Biodiversity at Global, National and Local levels, Conservation of Biodiversity.

5 Environmental Pollution-

Definition, course effects and control measures of air (indoor and outdoor), Water, Soil, Marine, Noise, Thermal, Nuclear. Role of individual in prevention of pollution – Case studies, Disaster management.

6 Social Issues and The Environment-

Urban problems, Resettlement problems, Climate change, Global Warming, Acid Rain, Ozone layer Depletion, Nuclear Accidents, Air act, Environment protection act, Water, Forest, Wildlife act, Public awareness.

7 IT in Environment-

Role of I.T. in Environment and Human health-case studies.

8 Agriculture and Environment-

Integrated Nutrient Management, Integrated Pest Management, Health hazards of Pesticides/Fertilizers in India

9 Environmental Sanitation-

Magnitude of problem of Sanitation in India, Ecofriendly environmental practices

10 Practical

- 1) To Study the Water Quality Analysis and standards
- 2) To Study the Water Treatment technique & process
- 3) To Study the wastewater treatment
- 4) To study the pharmaceutical and therapeutically properties of Medicinal Plants.
- 5) To study the Eco-friendly Practices in agriculture

Fifth Semester

BMRIT 501 -Cross Sectional Anatomy and Physiology

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.

At the completion of this, candidates will be able to:

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

The students will be given a thorough understanding of:

1. Introduction to Sectional Anatomy & Terminology- Sectional planes, Anatomical relationships/terminology
2. Anatomy of the upper thorax- Surface anatomy relationships, Bony structures and muscles, Blood vessels.
3. Divisions of the mid-thorax, heart and great vessels- Lungs, heart and great vessels, Esophagus
4. CT/MRI Images of the Thorax - Normal and pathologic
5. Anatomy of the Abdomen- Major organs and their accessories, Abdominal blood vessels
6. CT/MR Images of Abdomen - Normal and pathologic
7. Anatomy of the Pelvis- Bony structures and associated muscles, Digestive and urinary systems

8. Reproductive Organs
9. CT/MR Images of the Male/Female Pelvis- Normal and pathologic
10. Neuro Anatomy- Scan planes
11. Brain - Cerebral hemispheres, Sinuses, Ventricles, Brainstem and associated parts, Arterial/venous systems, Basal ganglia, Cranial nerves
12. Spine- Vertebra and disc, Spinal cord and meninges
13. Neck- Arterial/venous systems, Muscles, Glands and pharynx

BMRIT 502 Physics of Advanced Imaging Technology

1. Basic Computed Tomography- Basic principles of CT, generations of CT, CT instrumentation, image formation in CT, CT image reconstruction, Hounsfield unit, CT image quality, CT image display
2. Advanced Computed Tomography
Helical CT scan: Slip ring technology, advantages, multi detector array helical CT, cone – beam geometry, reconstruction of helical CT images, CT artifact, CT angiography, CT fluoroscopy, HRCT, post processing techniques: MPR, MIP, Min IP, 3D rendering: SSD and VR, CT Dose, patient preparation, Imaging techniques and protocols for various parts of body, CT contrast enhanced protocols – CT angiography – (Aortogram, selective angiogram head, neck and peripheral) image documentation and Filing, maintenance of equipment and accessories.
3. Advanced technique & instrumentation of MRI
 - a. Basic Principles: Spin – precession – relaxation time – pulse cycle – T1 weighted image – T2 weighted image – proton density image.
 - b. 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.
 - c. MR Instrumentation: Types of magnets – RF transmitter – RF receiver – Gradient coils – shim coils – RF shielding – computers.
 - d. Image formation: 2D Fourier transformation method – K-space representation – 3D Fourier imaging – MIP.
 - e. MR contrast media – MR angiography – TOF & PCA – MR Spectroscopy – functional MRI

4. Ultrasonography

- a. Basic Acoustics, Ultrasound terminologies: acoustic pressure, power, intensity, impedance, speed, frequency, dB notation: relative acoustic pressure and relative acoustic intensity.
- b. Interaction of US with matter: reflection, transmission, scattering, refraction and absorption, attenuation and attenuation coefficients, US machine controls, US focusing.
- c. Production of ultrasound: Piezoelectricity, Medical ultrasound transducer: Principle, construction and working, characteristics of US beam.
- d. Ultrasound display modes: A, B, M
- e. 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.
- f. Techniques for imaging different anatomic areas, ultrasound artifacts, biological effects and safety.
- g. Doppler Ultrasound- Patient preparation for Doppler, Doppler artifacts, vascular sonography,

BMRIT 503 Radiographic Techniques in Advanced Imaging Technology

1. Ultrasonography/ Doppler studies: Techniques of sonography-selection-Preparations - instructions and positioning of patient for TAS, TVS, TRUS, neck USG and extremities- patient care and maintenance protocols clinical applications display methods –quality image reproducible extend – biopsy procedures, assurance to patients.2. CT scan studies acquisition/ protocols /techniques: CT of head and neck – thorax – abdomen – pelvis – musculo skeletal system – spine – PNS. Anatomy – clinical indications and contraindications – patient preparation – technique – contrast media-types, dose, injection technique; timing, sequence - image display – patient care – utilization of available techniques & image processing facilities to guide the clinician- CT anatomy and pathology of different organ systems.
2. 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.

BMRIT 504 Regulatory Requirements in Diagnostic Radiology

1. 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 licenses, registrants & employers and Enforcement of Regulatory requirements.
2. Role of Radiographer in Planning, QA & Radiation Protection: Role of technologist in radiology department - Personnel and area monitoring., Setting up of a new X-Ray unit, staff requirement, AERB specifications for site planning and mandatory guidelines – Planning of X-ray rooms, dark rooms – Inspection of X-Ray installations - Registration of X-Ray equipment installation- Certification - Evaluation of workload versus radiation factors – Occupational exposure and protection Tools/devices. ICRP, NRPB, NCRP and WHO guidelines for radiation protection, pregnancy and radiation protection. NABH guidelines, AERB guidelines, PNDT Act and guidelines.

Sixth Semester

BMRIT 601 -Quality Control in Radiology and Radiation Safety Part 2

Quality Assurance and quality control of Modern Radiological and Imaging Equipment which includes Digital Radiography, Computed Radiography, CT scan, MRI Scan, Ultrasonography and PACS related. Image artifacts their different types, causes and remedies, Newer Radiation safety protocols and recent advances in radiation safety including AERB guidelines.

Internship (One year)

Sixth Semester

- Thesis

Seventh Semester

- Rotatory Internship

BMRIT 602 -Research Methodology

1. Accessing research literature:

Use of databases and other sources

2. Understanding 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

3. Analysis:

Analysis of qualitative and quantitative data. Utilization of appropriate software to assist in the retrieval of information and data analysis

4. Clinical audit:

Distinctiveness of research and audit processes and their function

5. Research Skills and Management:

The role of evidence based practice within health and welfare

BMRIT 603 -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 Haemeatasis status.

Body temp, respiratory rate, pulse, blood pressure, oxygen therapy, oxygen devices, Chest tubes and lines. First aid - shock, electrical shock, haemorrhage, 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 infectious patients in the department or in the ward. Regulation of dangerous drugs. Trolley set up for special x-ray examinations, Radiation hazardous and protective measures.

BMRIT 604- Professionalism, Values and Management

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.

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

Principals of Management

The course is intended to provide knowledge about the basic principles of Management.

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

Semester VII and Semester VIII

One year of internship.(VII and VIII semester-Thesis and rotatory internship)

INTERNSHIP SCHEDULE

Students have to undertake the rotational postings during which students have to work under supervision of an experienced staff. As per PCPNDT Act Interns are not allowed to touch the ultrasonography probe and will assist Radiologist in all postings/ Machines related to PCPNDT Act.

SN	Postings	Duration
1	Conventional radiography	2months
2	Radiographic special procedures including diagnostic and Therapeutic Interventional Procedures	2 months
3	CR, DR and PACS	2 month
4	Ultrasonography	1 month
5	Doppler/Small parts Imaging	1 month
6	Computed Tomography	2 months
7	Magnetic Resonance Imaging	2 months

A) INTERNSHIP DURATION

365 days. During Internship training period no C-off /night off is allowed as per rule.


B) RULES & REGULATION OF INTERNSHIP

- 1) Internship shall not be started without the log book. Wearing of 'Apron' along with 'Name Plate' is compulsory during duty hours.
- 2) Before starting the internship, the orientation program will be organized by the department. Attendance to the **intern's orientation programme is Mandatory**
- 3) After the posting orders are issued by the department, the Intern must report to the concerned.
- 4) The intern must attend the posting regularly and punctually
- 5) On the first day of the posting itself the intern must obtain the unit head (staff I/C) signature at the appropriate place in the log book
- 6) The intern must sign the attendance register daily at the proper time either in the unit head's office or department office as the case may be.
- 7) The nature of duties to be performed by the Intern during the training pertains to either

the minimum required by PIMS or that prescribed by the H.O.D. The Intern must abide by these.

- 8) **'Work done record'** has to maintain by the intern, in which daily work done has to be mentioned and must be signed by appropriate authority.
- 9) The interns are entitled for 1 day **casual leave (CL)** in a month (Total 12 CL during entire internship). They cannot go on leave without prior permission from Unit head/HOD of respective department. If intern is found to be absent without prior permission s/he will be marked absent and **7 days extension** will be given to the concerned intern.
- 10) After approval of casual leave from respective department interns should take counter signature of In-charge Internship, on the same day.
- 11) Under special circumstances, extended casual leave may be given with sole discretion of, HOD & Internship in-charge.
- 12) On completion of the posting, intern must obtain the signature of Unit Head and HOD on the last day and complete the completion process as per rule.
- 13) On successful completion of all postings/rotations, logbook must be submitted within stipulated period in the department for issuing of internship completion process.
- 14) For any extension of postings, fresh posting orders must be obtained from the Department.
- 15) The interns have no authority to issue any report or certificate to patient or sign a medico-legal document.
- 16) Rules and Regulations are subject to change as per amendments of PIMS time to time.




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