# SCHOOL OF MEDICAL AND PARAMEDICAL SCIENCES

# MIZORAM UNIVERSITY

# AIZAWL, MIZORAM

## Continuous Assessment and Grade Point System

### Syllabus For

## Four Years Degree

## Bachelor of Science in

## Medical Radiology and Imaging Technology

## (BMRIT)

***Regional Institute of Paramedical and Nursing Sciences (RIPANS)***

***Aizawl, Mizoram***

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*This curriculum was approved on _____ for B.Sc. in Medical Radiology and Imaging Technology, RIPANS. This was prepared based on the model curriculum handbook for Medical Radiology and Imaging Technology – Allied Health Section 2015-16 issued by the Ministry of Health and Family Welfare, Government of India.*

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## CONTENTS

**RULES AND REGULATIONS FOR CONTINUOUS ASSESSMENT AND GRADE POINT (CAGP)**
**B. SC. in MEDICAL RADIOLOGY AND IMAGING TECHNOLOGY (BMRIT)**

## INTRODUCTION

Medical Radiology and Imaging Technology is the health profession which concerns with direct application of radiation/ primarily x-rays, in disease diagnosis, injury assessment and treatment by employing different imaging techniques and modalities to produce high quality images using X-rays, Mammography, Fluoroscopy, CT, MRI, Nuclear medicine, Angiography, etc. to assist medical specialists and doctors for diagnosis and monitoring of patient's illness and treatment.

**Program Educational Objectives (PEOs): After completion of this program, the graduates will be able to:**

**PEO-01:** Practice profession with confidence and make intellectual contribution to the community.

**PEO-02:** Pursue a lifelong professional career with superior work ethics and behaviour.

**PEO-03:** Aware of radiation safety issues and quality assurance.

**PEO-04**: Pursue advanced study and project work at graduate level.

**Program Specific Outcomes (PSOs):**

| | |
|---|---|
| **PSO-1** | Ability to understand the basic principles of healthcare professionalism with a knowledge on computer, environmental issues, disaster management, communication and project works development skills. |
| **PSO-2** | Ability to apply knowledge of understanding on anatomy, physiology and pathology in the field of Radiology. |
| **PSO-3** | Ability to apply imaging techniques with maintenance of various imaging modalities. |
| **PSO-4** | Ability to identify and manage on skills gap for quality improvement processes. |

**Program Outcomes (POs):**

| POs Identifier | Outcome | CO Identifier |
|---|---|---|
| **PO-01** | Applying the knowledge on radiology, radiological image formation, contrast reaction and management, techniques involving in radiography procedures. | CO 203: 1-5<br>CO 204: 1-5<br>CO 302: 1-3 |
| **PO-02** | Understanding the professional and ethical responsibility | CO 102: 1-4 |
| **PO-03** | Applying the ability to function on multi-disciplinary health team | CO 101: 1-5 |
| **PO-04** | Able to communicate effectively and apply the knowledge and understating on the environmental issues- bio medical waste management, health system and drugs related resistance and infection control. | CO 205: 1-4<br>CO 107: 1-2<br>CO 108: 1-3 |
| **PO-05** | Applying the knowledge and understanding of anatomy, physiology and pathology in the field of radiology | CO 201: 1-5<br>CO 202: 1-5<br>CO 304: 1-5 |
| **PO-06** | Applying the knowledge on digital systems of Radiology department, Mammography and Ultrasonography | CO 402: 1-7<br>CO 403: 1-7<br>CO 404: 1-6 |
| **PO-07** | Applying the techniques, regulations and maintenance for Radiation Safety and Quality Assurance. | CO 305: 1-6<br>CO 405: 1-5<br>CO 501: 1-4 |
| **PO-08** | Applying the principles of modern Advanced Practices and techniques on MRI, CT, Nuclear Medicine, Angiography, etc.<br>Creating lifelong learning and continuous improvement in skills and knowledge while harnessing modern tools and technology. | CO 503: 1-6<br>CO 504: 1-3<br>CO 505: 1-3<br>CO 601: 1-4<br>CO 602: 1-4<br>CO 603: 1-4<br>CO 604: 1-5<br>CO 605: 1-4 |
| **PO-09** | Applying the ability to design and conduct project works to analyse and interpret on case-to-case basis. | CO 109: 1-3 |

## Short Title Commencement

- The regulation shall be called the Regulation for Continuous Assessment and Grade Point (CAGP) B.Sc. in Medical Radiology and Imaging Technology (BMRIT) Course of the Mizoram University, Aizawl, Mizoram.
- This shall come into force from the Academic Year 2024

**Definition:**

a) **Semester**- Each semester duration is 6 months
b) **Total Semester**- Total semester will be eight (8)
c) **Duration** – Six (6) Semesters and 1 year Internship (VII & VIII Semesters of Hospital/Institutional Clinical Posting/Internship)
d) **Continuous Assessment** – Theory and Practical Examinations conducted by the Department concerned including overall assessment of the conduct of the individual students recorded by the Department.
e) **Semester Examination** – Examination conducted by the Department/University for the first six (6) semesters and Continuous Evaluation without End Semester examination for VII and VIII semesters as part of an Internship Program.

The regulation framed has been subjected to be modified/amendment /added and deleted from time to time by BUGS/Academic Council of Mizoram University.

**1. Academic Program**

- Bachelor of Science in Medical Radiology and Imaging Technology shall be a full-time course.
- During an Academic Year (Semester), a candidate shall be enrolled only for one programme of studies and shall not appear in any other examination of this or any other university.

**2. Duration of the Course**

Duration of the course: 4 years or 8 semesters. (1350 hours of Theory & 900 hours of Practical) and 2400 hours of Internship

**Total hours – 4650 hours**

**3. Medium of Instruction:**

English language shall be the medium of instruction, teaching and examination.

**4. Eligibility for Admission:**

**Selection procedure:**

a) The candidates should pass the Higher Secondary (10+2) or equivalent examination recognized by any Indian University or a duly constituted Board with pass marks in Physics, Chemistry and Biology.
    i. OR
    ii. Diploma in Medical Radiology and Imaging Technology after completing 12$^{th}$ 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.

b) Candidates who have studied abroad and have passed the equivalent qualification as determined by the Association of Indian Universities will form the guidelines to determine the eligibility and must have passed in the subjects of Physics, Chemistry, Biology and English up to 12th Standard level.

c) Candidates who have passed the Senior Secondary school Examination of National Open School with a minimum of 5 subjects with any of the following group subjects.
    1. English, Physics, Chemistry, Botany, Zoology
    2. English, Physics, Chemistry, Biology and any other language

d) Candidate should attain the age of 17 years as on - (current year) & maximum age limit is 30 years.

e) Candidate have to furnish at the time of submission of application form, a certificate of Physical fitness from a registered medical practitioner and two references from persons other than relatives testifying to satisfactory general character.

f) Admission to B.Sc. in Medical Radiology and Imaging Technology course shall be made on the basis of eligibility and an entrance test must be conducted for the purpose. No candidates will be admitted on any ground unless he/she has appeared in the admission test and interview.

**5. Provision of Lateral Entry**:

Lateral entry to second year for allied and healthcare science courses for candidates who have passed diploma program 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 diploma level.

***There may be a need of deliberation on the inclusion of a few bridging courses are advisable for those having less qualified subjects.***

**6. Intake Capacity**: 40

**7. Commencement of the Course:** 1st July of each academic year

**8. Commencement of Examination**: Date of examination will be fixed by the University afterdue consultation with the concerned Head of Institution.

**9. Working Days**: Each semester shall consist of 6 months.

**10. Eligibility for appearing the Semester Examination:**

- **Attendance**:

  A candidate has to secure minimum 75% attendance in overall with at least-

  1. 75% attendance in theoretical
  2. 75% in practical for qualifying to appear for the final examination.

  No relaxation, whatsoever, will be permissible to this rule under any ground includingindisposition etc.

**11. Assessment:**

Assessments should be completed by the academic staff, based on the compilation of the student's theoretical & clinical performances throughout the training program. Student must attain at least 50% scale in Theory (aggregate of CA and End Semester) and Practical (aggregate of CA and End Semester) independently/separately for each individual subject.

**12. Examination:** Semester system of examination for evaluation of the students.

a) The Semester Examinations will be conducted by the University as per the existing/standing rules of the University. Any student who fails in any subject will repeat the examination along with the next semester exams in the particular subject where the student has failed.
b) Non-appearance in regular semester examination shall be treated as losing the first chance.
c) The duration of Semester Examination in theory paper and practical will be 3 hours.
d) Maximum number of chances of examinations permitted for each paper is 4 including the first chance.
e) The maximum period to complete the course will be 8 years.
f) A student shall not be declared to have passed the examination unless he/she secures at least 50% marks in each paper. (Theory and Practical independently/separately)
g) Mode of Improvement/Re-evaluation will be as per existing MZU (Mizoram University) guidelines.

**13. External Examiners**

External Examiners as and when necessary are to be appointed by the Mizoram University from the panel of external examiners approved by the relevant academic bodies.

**14. Internal Examiners**

The University shall appoint the Internal Examiners on subject wise from the Institution in consultation with Head of Department/ Head of Institution.

**15. (a) Date of Examination**:

Semester Examination date will be notified by the University in consultation with Head of theInstitution/HOD.

**(b) Question Papers**:

- **Theory Papers**: Each theory paper in the semester examination will be set by examiners chosen from an approved panel by the concerned department of the institution as per guidelines
- The marks for internal assessment will be awarded by the concerned department of the institution as per guidelines
- **Practical Papers**: Practical exams will be conducted by external examiners and internal examiners as appointed by Mizoram University from approved panel and marks awarded as per guidelines.

**16. Promotion to next higher class**

- Any candidate securing 50% marks in each paper of a semester rexamination will be declared pass and grade will be allotted.
- No grade will be allotted in the event of a student securing less than 50% marks in any paper (Theory and Practical independently/separately).
- Any candidate failing in any paper will be entitled to sit in the Failed Paper as a non-regular student.
- They will continue to attend classes with their regular batch for all the semesters including internship.
- Degree certificate will be awarded only after successfully clearing all the papers.
- Maximum chance in any paper is 4 (one regular + three additional).
- Maximum time to clear all papers is 8 years.
- In the event of any student not clearing any paper in maximum 4 chances or in the

event of any student not clearing all papers within the stipulated time of 8 years will have to leave the course uncompleted and no degree certificate will be awarded.

**17. Grading of performances**

a) Based on the performance of the student in each semester, the grade shall be awarded on a10-point scale as per CGPA system:

| **Marks range (Out of 100)** | **Grade** | **Grade Points performance** | **Description** |
|---|---|---|---|
| 90-100 | O | 10 | Outstanding |
| 81- Below 90 | A+ | 9 | Excellent |
| 71- Below 80 | A | 8 | Very Good |
| 61- Below 70 | B+ | 7 | Good |
| 50-Below60 | B | 6 | Average |
| **<50** | **-** | **Not to be considered for awarding Grade** | |

The minimum pass marks in each paper for Theory (aggregate of CA and End Semester) and Practical (aggregate of CA and End Semester) shall be 50% marks in a Semester Examination.

b) Based on the performance of the students, Division shall be awarded as per the CGPAacquired for both semester and the entire programme.

| **CGPA** | **Division** |
|---|---|
| 8.0-10 | Distinction |
| 7.0- Below 8 | 1st |
| 6.0- Below 7 | 2nd |
| Below 6 | Fail |

- At the end of each semester examinations, a student shall be awarded a SemesterGrade Point Average which will be calculated as:

$$SGPA = \frac{\text{Total Credit Points per semester}}{\text{Total Credits per Semester}}$$

- At the end of the entire programme, a student shall be awarded a CumulativeGrade Point Average which will be calculated as:

$$CGPA = \frac{\text{Sum of total credit points for the programme}}{\text{Sum of total credit for the entire programme}}$$

- Conversion formula of CGPA to percentage of marks:

  Percentage of marks = (CGPA x 10) - 5, if CGPA < 9
  Percentage of marks = (CGPA x 15) - 50, if CGPA ≥ 9

c) Award of Rank:
   - Rank will be awarded as per Mizoram University rules.
   - Students who failed to complete internship within one year after publication of 6th semester result will not be considered for awarding rank.

d) A candidate securing 8 and above Grade Point in any papers (Theory & Practical separately) will be awarded 'Honor's in that paper or papers as per Mizoram University rule. This is applicable only to students that appear on regular exam (1st chance) / re-evaluated regular exam (1st chance).

**18. Registration**: A candidate admitted to the course shall be registered with the Mizoram University by remitting the prescribed fees along with the application form for registration duly filled in and forwarded to the University through Head of Institution within the stipulated time.

**19. Practical Training / Internship**:
A practical training of 1 year counted as semesters VII and VIII in a designated institution or hospital will be compulsory as an internship.

Completion of Internship: Students before obtaining certificate and mark sheets should obtain satisfactory *Internship Completion Certificate* indicating that the internee has completed the minimum mentioned hours required to complete their internship from the Head of Department of the Institute/Hospital.

**20. Re-evaluation of Answer papers**: Re-evaluation of answer papers will be as per the Rules and Regulations of Mizoram University.

**21. Admission Procedure**: As envisaged in the constitution of RIPANS, admission will be on the basis of nomination from the respective North Eastern States and outside North East as per the quota allotted to each of them.

**22.** Notwithstanding above, Vice Chancellor, Mizoram University, is empowered to solve any problem under statutory removal of difficulties.

## DISTRIBUTION OF SUBJECTS AND MARKS

### I Semester

| Course No. | Subject | Mark Scale | | | Credit Distribution | | | Credit |
|---|---|---|---|---|---|---|---|---|
| | | *C/A* | *End Sem.* | *Total* | *L* | *T* | *P* | |
| **THEORY** | | | | | | | | |
| BMRIT/101T | Healthcare Delivery System in India | 25 | 75 | 100 | 2 | 1 | 0 | **3** |
| BMRIT/102T | Information Technology | 25 | 75 | 100 | 2 | 1 | 0 | **3** |
| BMRIT/103T | Communication Skills | 15 | 35 | 50 | 1 | 0 | 0 | **1** |
| BMRIT/104T | Principles of Management | 15 | 35 | 50 | 2 | 0 | 0 | **2** |
| BMRIT/105T | Medical Terminology and Record Keeping | 15 | 35 | 50 | 1 | 0 | 0 | **1** |
| BMRIT/106T | Medical Law and Ethics | 15 | 35 | 50 | 1 | 0 | 0 | **1** |
| BMRIT/107T | Patient Safety | 15 | 35 | 50 | 1 | 0 | 0 | **1** |
| BMRIT/108T | Infection Prevention and Control | 15 | 35 | 50 | 1 | 0 | 0 | **1** |
| BMRIT/109T | Research Methodology and Biostatistics | 15 | 35 | 50 | 2 | 0 | 0 | **2** |
| **PRACTICAL** | | | | | | | | |
| BMRIT/110P | Healthcare Delivery System in India | 15 | 35 | 50 | 0 | 0 | 1 | **1** |
| BMRIT/111P | Information Technology | 15 | 35 | 50 | 0 | 0 | 1 | **1** |
| BMRIT/112P | Communication Skills | 15 | 35 | 50 | 0 | 0 | 1 | **1** |
| BMRIT/113P | Principles of Management | 15 | 35 | 50 | 0 | 0 | 1 | **1** |
| BMRIT/114P | Research Methodology and Biostatistics | 15 | 35 | 50 | 0 | 0 | 1 | **1** |
| | **Total marks** | **230** | **570** | **800** | **Total Credit** | | | **20** |

### II Semester

| Course No. | Subject | Mark Scale | | | Credit Distribution | | | Credit |
|---|---|---|---|---|---|---|---|---|
| | | *C/A* | *End Sem.* | *Total* | *L* | *T* | *P* | |
| **THEORY** | | | | | | | | |
| BMRIT/201T | Human Anatomy | 25 | 75 | 100 | 2 | 1 | - | **3** |
| BMRIT/202T | Physiology and Pathology | 25 | 75 | 100 | 2 | 1 | - | **3** |
| BMRIT/203T | Radiological Physics | 25 | 75 | 100 | 2 | 1 | - | **3** |
| BMRIT/204T | Image Processing Techniques | 25 | 75 | 100 | 2 | 1 | - | **3** |
| BMRIT/205T | Environmental Studies | 25 | 75 | 100 | 2 | 1 | - | **3** |
| **PRACTICAL** | | | | | | | | |
| BMRIT/206P | Human Anatomy | 25 | 75 | 100 | - | - | 1 | **1** |
| BMRIT/207P | Physiology and Pathology | 25 | 75 | 100 | - | - | 1 | **1** |
| BMRIT/208P | Radiological Physics | 25 | 75 | 100 | - | - | 1 | **1** |
| BMRIT/209P | Image Processing Techniques | 25 | 75 | 100 | - | - | 1 | **1** |
| BMRIT/210P | Environmental Studies | 25 | 75 | 100 | - | - | 1 | **1** |
| | **Total marks** | **250** | **750** | **1000** | **Total Credit** | | | **20** |

### III Semester

| Course No. | Subject | Mark Scale | | | Credit Distribution | | | Credit |
|---|---|---|---|---|---|---|---|---|
| | | *C/A* | *End Sem.* | *Total* | *L* | *T* | *P* | |
| **THEORY** | | | | | | | | |
| BMRIT/301T | Clinical Radiography - I | 25 | 75 | 100 | 2 | 1 | - | **3** |
| BMRIT/302T | Special Radiography Procedures | 25 | 75 | 100 | 2 | 1 | - | **3** |
| BMRIT/303T | Clinical Imaging - Chest andAbdomen | 25 | 75 | 100 | 2 | 1 | - | **3** |
| BMRIT/304T | Cross-Sectional Anatomy | 25 | 75 | 100 | 2 | 1 | - | **3** |
| BMRIT/305T | Radiation Hazards and Protection | 25 | 75 | 100 | 2 | 1 | - | **3** |
| **PRACTICAL** | | | | | | | | |
| BMRIT/306P | Clinical Radiography - I | 25 | 75 | 100 | - | - | 1 | **1** |
| BMRIT/307P | Special Radiography Procedures | 25 | 75 | 100 | - | - | 1 | **1** |
| BMRIT/308P | Clinical Imaging - Chest andAbdomen | 25 | 75 | 100 | - | - | 1 | **1** |
| BMRIT/309P | Cross-Sectional Anatomy | 25 | 75 | 100 | - | - | 1 | **1** |
| BMRIT/310P | Radiation Hazards and Protection | 25 | 75 | 100 | - | - | 1 | **1** |
| | **Total marks** | **250** | **750** | **1000** | **Total Credit** | | | **20** |

### IV Semester

| Course No. | Subject | Mark Scale | | | Credit Distribution | | | Credit |
|---|---|---|---|---|---|---|---|---|
| | | *C/A* | *End Sem.* | *Total* | *L* | *T* | *P* | |
| **THEORY** | | | | | | | | |
| BMRIT/401T | Clinical Radiography- II | 25 | 75 | 100 | 2 | 1 | - | **3** |
| BMRIT/402T | Medical Imaging Informatics | 25 | 75 | 100 | 2 | 1 | - | **3** |
| BMRIT/403T | Mammography | 25 | 75 | 100 | 2 | 1 | - | **3** |
| BMRIT/404T | Ultrasonography and Echocardiography | 25 | 75 | 100 | 2 | 1 | - | **3** |
| BMRIT/405T | Quality Assurance and Control | 25 | 75 | 100 | 2 | 1 | - | **3** |
| **PRACTICAL** | | | | | | | | |
| BMRIT/406P | Clinical Radiography- II | 25 | 75 | 100 | - | - | 1 | **1** |
| BMRIT/407P | Medical Imaging Informatics | 25 | 75 | 100 | - | - | 1 | **1** |
| BMRIT/408P | Mammography | 25 | 75 | 100 | - | - | 1 | **1** |
| BMRIT/409P | Ultrasonography and Echocardiography | 25 | 75 | 100 | - | - | 1 | **1** |
| BMRIT/410P | Quality Assurance and Control | 25 | 75 | 100 | - | - | 1 | **1** |
| | **Total marks** | **250** | **750** | **1000** | **Total Credit** | | | **20** |

### V Semester

| Course No. | Subject | Mark Scale | | | Credit Distribution | | | Credit |
|---|---|---|---|---|---|---|---|---|
| | | *C/A* | *End Sem.* | *Total* | *L* | *T* | *P* | |
| **THEORY** | | | | | | | | |
| BMRIT/501T | Regulatory Requirement and Preventive Maintenance | 25 | 75 | 100 | 2 | 1 | - | **3** |
| BMRIT/502T | Hospital Practice and Patient Care | 25 | 75 | 100 | 2 | 1 | - | **3** |
| BMRIT/503T | Molecular Advanced Imaging | 25 | 75 | 100 | 2 | 1 | - | **3** |
| BMRIT/504T | CT Radiographic Techniques - I | 25 | 75 | 100 | 2 | 1 | - | **3** |
| BMRIT/505T | CT Radiographic Techniques - II | 25 | 75 | 100 | 2 | 1 | - | **3** |
| **PRACTICAL** | | | | | | | | |
| BMRIT/506P | Regulatory Requirement and Preventive Maintenance | 25 | 75 | 100 | - | - | 1 | **1** |
| BMRIT/507P | Hospital Practice and Patient Care | 25 | 75 | 100 | - | - | 1 | **1** |
| BMRIT/508P | Molecular Advanced Imaging | 25 | 75 | 100 | - | - | 1 | **1** |
| BMRIT/509P | CT Radiographic Techniques - I | 25 | 75 | 100 | - | - | 1 | **1** |
| BMRIT/510P | CT Radiographic Techniques - II | 25 | 75 | 100 | - | - | 1 | **1** |
| | **Total marks** | **250** | **750** | **1000** | **Total Credit** | | | **20** |

### VI Semester

| Course No. | Subject | Mark Scale | | | Credit Distribution | | | Credit |
|---|---|---|---|---|---|---|---|---|
| | | *C/A* | *End Sem.* | *Total* | *L* | *T* | *P* | |
| **THEORY** | | | | | | | | |
| BMRIT/601T | Interventional Radiology and Angiography | 25 | 75 | 100 | 2 | 1 | - | **3** |
| BMRIT/602T | Clinical Cardiac Radiology | 25 | 75 | 100 | 2 | 1 | - | **3** |
| BMRIT/603T | Clinical Neuro Imaging | 25 | 75 | 100 | 2 | 1 | - | **3** |
| BMRIT/604T | MRI Radiographic Techniques - I | 25 | 75 | 100 | 2 | 1 | - | **3** |
| BMRIT/605T | MRI Radiographic Techniques - II | 25 | 75 | 100 | 2 | 1 | - | **3** |
| **PRACTICAL** | | | | | | | | |
| BMRIT/606P | Interventional Radiology and Angiography | 25 | 75 | 100 | - | - | 1 | **1** |
| BMRIT/607P | Clinical Cardiac Radiology | 25 | 75 | 100 | - | - | 1 | **1** |
| BMRIT/608P | Clinical Neuro Imaging | 25 | 75 | 100 | - | - | 1 | **1** |
| BMRIT/609P | MRI Radiographic Techniques - I | 25 | 75 | 100 | - | - | 1 | **1** |
| BMRIT/610P | MRI Radiographic Techniques - II | 25 | 75 | 100 | - | - | 1 | **1** |
| | **Total marks** | **250** | **750** | **1000** | **Total Credit** | | | **20** |

### VII Semester

| Course No. | Subject | Mark Scale | | | Credit Distribution | | | Credit |
|---|---|---|---|---|---|---|---|---|
| | | *C/A* | *End Sem.* | *Total* | *L* | *T* | *P* | |
| BMRIT/701P | BMRIT Internship I | 50 | 50 | 100 | - | - | 20 | **20** |
| **Total marks** | | 50 | 50 | 100 | **Total Credit** | | | **20** |

### VIII Semester

| Course No. | Subject | Mark Scale | | | Credit Distribution | | | Credit |
|---|---|---|---|---|---|---|---|---|
| | | *C/A* | *End Sem.* | *Total* | *L* | *T* | *P* | |
| BMRIT/801P | BMRIT Internship II | 50 | 50 | 100 | - | - | 20 | **20** |
| **Total marks** | | 50 | 50 | 100 | **Total Credit** | | | **20** |

## OVERALL DISTRIBUTION OF MARKS AND CREDIT POINTS:

| Semester | Marks | Credit Points |
|---|---|---|
| I | 800 | 20 |
| II | 1000 | 20 |
| III | 1000 | 20 |
| IV | 1000 | 20 |
| V | 1000 | 20 |
| VI | 1000 | 20 |
| VII | 100 | 20 |
| VIII | 100 | 20 |
| **TOTAL** | **6000** | **160** |

## CREDIT AND HOURS CALCULATION:

| HOURS | CREDIT |
|---|---|
| 1 hour lecture/tutorial per week | 1 credit |
| 2 hours of laboratory/practical per week | 1 credit |

## INTERNAL ASSESMENT CRITERIA

### I. FOR 15- SCALE EACH ON THEORY AND PRACTICAL:

#### (a) Continuous Assessment (Theory)

<table>
<tr><td rowspan="8">➢ C1 and C2 indicates the Continuous Assessment of Scales which is internal examinations.<br>• C1A, C1B, C1C, C1D and C1E indicates the Unit Test, which is the Scale Parameters for C1.<br>• C2A and C2B indicates the Internal Exams which is the Scale Parameters for C2.<br>➢ C3 indicates the regularity in the class (Attendance)</td><td rowspan="5">C1</td><td>C1A – 10 scale</td></tr>
<tr><td>C1B – 10 scale</td></tr>
<tr><td>C1C – 10 scale</td></tr>
<tr><td>C1D – 10 scale</td></tr>
<tr><td>C1E – 10 scale</td></tr>
<tr><td rowspan="2">C2</td><td>C2A – 10 scale</td></tr>
<tr><td>C2B – 10 scale</td></tr>
<tr><td>C3</td><td>5 scale</td></tr>
</table>

#### (b) Calculation of Continuous Assessment (Theory)

<table>
<tr><td>C1A – 10 scale</td><td rowspan="5">C1</td><td rowspan="2">The average mark scale of C1 and C2 is taken as:<br>C1A+C1B+C1C+C1D+C1E+C2A+C2B/ 7<br>= 70/7<br>= 10 scale</td><td rowspan="3">** The sum of the Average mark scale of C1 and C2 (10 scale) and C3 (5 scale) are taken as the total Continuous Assessment marks.</td></tr>
<tr><td>C1B – 10 scale</td></tr>
<tr><td>C1C – 10 scale</td><td rowspan="3">Scale marks of C3 is taken as:<br><table><tr><th>Percentage of attendance</th><th>Mark scale distribution</th></tr><tr><td>96-100</td><td>5</td></tr><tr><td>91-95</td><td>4</td></tr><tr><td>86-90</td><td>3</td></tr><tr><td>81-85</td><td>2</td></tr><tr><td>75-80</td><td>1</td></tr></table></td></tr>
<tr><td>C1D – 10 scale</td></tr>
<tr><td>C1E – 10 scale</td></tr>
<tr><td>C2A – 10 scale</td><td rowspan="2">C2</td><td rowspan="2">C2B – 10 scale</td></tr>
<tr><td>C3 – 5 scale</td><td>C3</td></tr>
</table>

#### (c) Continuous Assessment (Practical)

<table>
<tr><td rowspan="5">➢ C1 and C2 indicates the Continuous Assessment of Scales which is internal practical examinations.<br>• C1 indicates the presentation skills/assignment/attainments of the students.<br>• C2A and C2B indicates the Internal practical Exams (viva) which is the Scale Parameters for C2.<br>➢ C3 indicates the regularity in the class (Attendance)</td><td>C1</td><td>10 scale</td></tr>
<tr><td rowspan="2">C2</td><td>C2A – 10 scale</td></tr>
<tr><td>C2B – 10 scale</td></tr>
<tr><td>C3</td><td>5 scale</td></tr>
</table>

### Calculation of Continuous Assessment (Practical)

<table>
<tr><td>C1</td><td>C1</td><td rowspan="2">The average mark scale of C1 and C2 is taken as:<br><br>C1+C2A+C2B/ 3<br>= 30/3<br>= 10 scale</td><td rowspan="3">** The sum of the Average mark scale of C1 and C2 (10 scale) and C3 (5 scale) are taken as the total Continuous Assessment marks.</td></tr>
<tr><td>C2A – 10 scale<br>C2B – 10 scale</td><td>C2</td></tr>
<tr><td>C3 – 5 scale</td><td>C3</td><td>Scale marks of C3 is taken as:<br><br><table><tr><th>Percentage of attendance</th><th>Mark scale distribution</th></tr><tr><td>96-100</td><td>5</td></tr><tr><td>91-95</td><td>4</td></tr><tr><td>86-90</td><td>3</td></tr><tr><td>81-85</td><td>2</td></tr><tr><td>75-80</td><td>1</td></tr></table></td></tr>
</table>

## II. FOR 25 SCALE EACH ON THEORY AND PRACTICAL

### (a) Continuous Assessment (Theory)

<table>
<tr><td rowspan="8">➢ C1 and C2 indicates the Continuous Assessment of Scales which is internal examinations.<br>• C1A, C1B, C1C, C1D and C1E indicates the Unit Test, which is the Scale Parameters for C1.<br><br>• C2A and C2B indicates the Internal Exams which is the Scale Parameters for C2.<br><br>➢ C3 indicates the regularity in the class (Attendance)</td><td rowspan="5">C1</td><td>C1A – 20 scale</td></tr>
<tr><td>C1B – 20 scale</td></tr>
<tr><td>C1C – 20 scale</td></tr>
<tr><td>C1D – 20 scale</td></tr>
<tr><td>C1E – 20 scale</td></tr>
<tr><td rowspan="2">C2</td><td>C2A – 20 scale</td></tr>
<tr><td>C2B – 20 scale</td></tr>
<tr><td>C3</td><td>5 scale</td></tr>
</table>

### (b) Calculation of Continuous Assessment (Theory)

<table>
<tr><td>C1A – 20 scale<br>C1B – 20 scale<br>C1C – 20 scale<br>C1D – 20 scale<br>C1E – 20 scale</td><td>C1</td><td rowspan="2">The average mark scale of C1 and C2 is taken as:<br><br>C1A+C1B+C1C+C1D+C1E+C2A+C2B/ 7<br>= 140/7<br>= 20-mark scale</td><td rowspan="3">** The sum of the Average mark scale of C1 and C2 (20 scale) and C3 (5 scale) are taken as the total Continuous Assessment marks.</td></tr>
<tr><td>C2A – 20 scale<br>C2B – 20 scale</td><td>C2</td></tr>
<tr><td>C3 – 5 scale</td><td>C3</td><td>Scale marks of C3 is taken as:<br><br><table><tr><th>Percentage of attendance</th><th>Mark scale distribution</th></tr><tr><td>96-100</td><td>5</td></tr><tr><td>91-95</td><td>4</td></tr><tr><td>86-90</td><td>3</td></tr><tr><td>81-85</td><td>2</td></tr><tr><td>75-80</td><td>1</td></tr></table></td></tr>
</table>

### (c) Continuous Assessment (Practical)

<table>
<tr><td rowspan="4"><ul><li>C1 and C2 indicates the Continuous Assessment of Scales which is internal practical examinations.<ul><li>C1 indicates the presentation skills which has to be done for every paper.</li><li>C2A and C2B indicates the Internal practical Exams (viva) which is the Scale Parameters for C2.</li></ul></li><li>C3 indicates the regularity in the class (Attendance)</li></ul></td><td>C1</td><td>20 scale</td></tr>
<tr><td rowspan="2">C2</td><td>C2A – 20 scale</td></tr>
<tr><td>C2B – 20 scale</td></tr>
<tr><td>C3</td><td>5 scale</td></tr>
</table>

### (d) Calculation of Continuous Assessment (Practical)

<table>
<tr><td>C1</td><td>C1</td><td rowspan="2">The average mark scale of C1 and C2 is taken as:<br><br>C1+C2A+C2B/ 3<br>= 60/3<br>= 20 scale</td><td rowspan="3">** The sum of the Average mark scale of C1 and C2 (20 scale) and C3 (5 scale) are taken as the total Continuous Assessment marks.</td></tr>
<tr><td>C2A – 20 scale<br>C2B – 20 scale</td><td>C2</td></tr>
<tr><td>C3 – 5 scale</td><td>C3</td><td>Scale marks of C3 is taken as:<br><br><table><tr><th>Percentage of attendance</th><th>Mark scale distribution</th></tr><tr><td>96-100</td><td>5</td></tr><tr><td>91-95</td><td>4</td></tr><tr><td>86-90</td><td>3</td></tr><tr><td>81-85</td><td>2</td></tr><tr><td>75-80</td><td>1</td></tr></table></td></tr>
</table>

**III. FOR 50 SCALE EACH ON VII AND VIII SEMESTERS**

| Semester | C1 |
|---|---|
| VII – Internship I | Performance Report -50 scale |
| VIII- Internship II | Performance Report -50 scale |

*Evaluation for Performance parameter:*

| Sl. No. | Parameters |
|---|---|
| 1. | Regularity/ Punctuality |
| 2. | Behavior/ Sincerity |
| 3. | Interactive Skills |
| 4. | Technical Skills |
| 5. | Productivity |

- Each Parameters will carry 10 scales.
- Performance Report will be evaluated by the Head Technician/ HOD of the respective Hospital/ Department based on the mentioned parameters duly signed by the HOD.
- Performance Evaluation Report has to be submitted to the institute's Head of Department.

## END SEMESTER EXAMINATION PATTERN

### I. FOR 35 SCALE EACH ON THEORY AND PRACTICAL

#### (a) End Semester Exam Pattern (Theory) Duration- 2 Hours

- **Objective questions** consisting of five (5) questions -1 question from each unit carrying one (1) mark each.
- **Short Answer Type** questions consisting of five (5) questions -1 question from each unit carrying three (3) marks each.
- **Descriptive Type** questions consisting of 5 questions-1 question from each unit carrying 5 marks each and students will have to answer any three (3) questions.

| | |
|---|---|
| *Objective Type (1x5)* | *5 marks* |
| *Short Answer (3x5)* | *15 marks* |
| *Descriptive Type (5x3)* | *15marks* |

#### (b) End Semester Exam Pattern (Practical) Duration- 2 Hours

- At the end of the semester a practical exam will be conducted jointly by the external and internal examiners.

| | |
|---|---|
| *Spotting /Practical* | *15 marks* |
| *Viva-Voce* | *15 marks* |
| *Record* | *5 marks* |

### II. FOR 75 SCALE EACH ON THEORY AND PRACTICAL

#### (a) End Semester Exam Pattern (Theory) Duration-3 Hours

- **Objective questions** consisting of ten (10) questions -2 questions from each unit carrying one (1) mark each.
- **Short Answer Type** questions consisting of ten (10) questions -2 questions from each unit carrying five (5) marks each and students will have to answer any seven (7) questions.
- **Descriptive Type** questions consisting of 5 questions-1 question from each unit carrying 10 marks each and students will have to answer any three (3) questions.

| | |
|---|---|
| *Objective Type (1x10)* | *10 marks* |
| *Short Answer (5x7)* | *35 marks* |
| *Descriptive Type (10x3)* | *30 marks* |

### (b) End Semester Exam Pattern (Practical) Duration- 3 hours

- At the end of the semester a practical exam will be conducted jointly by the external and internal examiners.

| | |
|---|---|
| *Spotting /Practical* | *40 marks* |
| *Viva-Voce* | *25 marks* |
| *Record* | *10 marks* |

## III. FOR 50 SCALE EACH ON VII & VIII SEMESTERS

### (a) VII Semester – Internship I

- Viva voice will be conducted in online mode for students outside Mizoram.

| **End Semester** |
|---|
| Viva Voice- 50 Scale |

### (b) VIII Semester- Internship II

- Soft Copy and Hard Copy of Project work has to be submitted within the last month of Internship to the Institute's Head of Department.

| **End semester** | | |
|---|---|---|
| Project work | Viva Voice | Presentation |
| 25 Scale | 15 Scale | 10 Scale |

## I SEMESTER-THEORY

**Course No** **: BMRIT/101T**

**Course Title** **: Healthcare Delivery System in India**

**Credit** **: 3 (2-1-0)**

**Course Description:** This course is developed to understand the basic features of Indian health care delivery system and to provide cost effective and equitable AYUSH health care by improving access to the services.

**Course Outcome**: At the end of the course, a student should be able to explain his knowledge and understanding on

- CO101:1 Indian health care delivery system and how it compares with the other systems of the world.
- CO101:2 Various targets and operations of National Health Programme
- CO101:3 Demography
- CO101:4 Epidemiology
- CO101:5 Disease transmission

**Course Outline**:

**Mode of Teaching and Learning: Lecture, Tutorial**
**Evaluation of Course Outcome: Internal Assessment and End Semester Examination**

| UNIT | TOPICS | Hours |
|---|---|---|
| I | Healthcare Delivery system in India, Public Health Sector, Private Sector, Healthcare delivery system – Central, State, District Levels; Brief points on National Health Programmes; Introduction of Ayurveda, Yoga and Naturopathy, Unani, Siddha, Homeopathy (AYUSH). | 7 |
| II | Community Health – Dimensions of Health, Health Determinants, Indicators of Health, Levels of Health Care (Primary, Secondary and Tertiary level health care); Primary health care – elements and principles. | 8 |
| III | Demography & amp; Vital Statistics – Definition of demography, Demographic cycle, Effects of over-population, Definition of Vital Statistics, Sources, Health Information and its sources. | 10 |
| IV | Epidemiology – Definition, aims & objectives, principles, tools of measurement, uses of epidemiology, spectrum of disease, Disease Cycle and levels of prevention of disease | 10 |
| V | Disease Transmission – Direct and Indirect Transmission, Immunity – Natural & Acquired, Immunizing Agents, Cold Chain, Control of Infectious Disease, Disinfection and its types. | 10 |

**Textbooks:**

- ***Parks Textbook of Preventive and Social Medicine 27th Edition 2023***, K Park

**Reference Books**:

- ***Basic Life Support (BLS) Provider Manual***, Channing L. Bete, 1st Edition, 2016, Channing L. Bete Co Inc.
- ***Patient safety and Quality Improvement in Health Care***, Rahul K. Shah, Sandip A. Godambe, Latest Edition, Springer Nature Switzerland AG

## I SEMESTER-PRACTICAL

**Course No** **: BMRIT/110P**
**Course Title** **: Healthcare Delivery System in India**
**Credit** **: 1 (0-0-1)**

Practical will include the following and additional as prescribes to cover all theoretical aspects.

1. Community orientation and clinical visit
2. Presentation on related topics

## I SEMESTER-THEORY

**Course No** : **BMRIT/102T**

**Course Title** : **Information Technology**

**Credit** : **3 (2-1-0)**

**Course Description:** This course is designed for students to develop basic understanding of computer, and its application. Computer is one of the major developments of the time and has an important role in each profession. During this course the students will be given the basic knowledge on computer and practical session in the computer centre to make the students qualify in their medical profession having general idea on computer, its applications and be able to tackle any type of modernization through information technology in the future.

**Course Outcome**: At the end of the course, a student should be able to explain his knowledge and understanding on

- CO102:1 The basic concepts of computer
- CO102:2 Components of computer system
- CO102:3 Operating system and its type
- CO102:4 Applications of IECT, e-governance
- CO102:5 Applications of MS-office
- CO102:6 Basics of Computer Networks with web browsing software

**Course Outline**:

| **Mode of Teaching and Learning: Lecture, Tutorial**<br>**Evaluation of Course Outcome: Internal Assessment and End Semester Examination** | | |
|---|---|---|
| **UNIT** | **TOPICS** | **Hours** |
| I | Introduction to computer: Introduction, characteristics of computer, block diagram of computer, Basic Applications of Computer Components of Computer System: Central Processing Unit, storage 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). | 9 |
| II | Operating system, Types of Operating system. Basics of popular operating system (LINUX, WINDOWS) The User Interface, Task Bar, Icons, Start Menu, Running an Application, Operating System Simple Setting, Changing System Date And Time, Changing Display Properties, To Add Or Remove A Windows Component, Changing Mouse Properties, Installation of software, Adding and removing Printers, File and Directory Management Concept of Hardware and Software, Representation of Data/Information, Concept of Data processing, Applications of IECT , e-governance | 9 |
| III | 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. Introduction to Introduction to MS-Excel: introduction, about worksheet, entering information, saving workbooks and formatting, printing the worksheet, creating graphs. Introduction to MS-power-point: introduction, creating and manipulating presentation, views, formatting and enhancing text, slide with graphs. | 9 |
| IV | Basics of Computer Networks, Local Area Network (LAN), Wide Area Network (WAN), Concept of Internet, Basics of Internet Architecture, Services on Internet, World Wide Web and Websites, Communication on Lecture 2 Internet, file sharing, Hospital Network, Application of Computers in clinical settings. Introduction to cybersecurity, cloud computing, cloud storage etc. | 9 |
| V | Web Browsing Software, Popular Web Browsing Software, Configuring Web Browser, Search Engines, Popular Search Engines / Search for content , Accessing Web Browser, Using Favourites Folder, Downloading Web Pages, Printing Web Pages Basics of E-mail, Email Addressing, Configuring Email Client, Using Emails, Opening Email Client, Mailbox: Inbox and Outbox, Creating and Sending a new E-mail, Replying to an E-mail | 9 |

| | | |
|---|---|---|
| | message, Sorting and Searching emails, Advance email features, Sending document by E-mail, Activating Spell checking, Sending Softcopy as attachment, Handling SPAM | |

**Textbooks:**

- ***Computer Fundamentals,*** P.K Sinha, Priti Sinha, 6th Edition, BPB Publication

**Reference Books**:

- ***Fundamentals of Computer,*** V Rajaraman, latest edition, Eastern Economy Edition

## I SEMESTER-PRACTICAL

**Course No** **: BMRIT/111P**
**Course Title** **: Information Technology**
**Credit** **: 1 (0-0-1)**

Practical will include the following and additional as prescribed to cover all theoretical aspects

1. MS-word
2. MS- Excel
3. MS- PowerPoint
4. Cloud Computing, data entry efficiency, etc.
5. Exposure to servers – offline and online, etc.
6. Presentation on related topics

## I SEMESTER-THEORY

**Course No** : **BMRIT/103T**

**Course Title** : **Communication Skills**

**Credit** : **1 (1-0-0)**

**Course Description:** This course introduces the basic knowledge of communication skills as English language to enhance the quality of care, improve outcomes and work effectively with all health care team and public.

**Course Outcome**: At the end of the course, a student should be able to explain his knowledge and understanding on

- CO103:1 Importance of communication skills
- CO103:2 Basic language skills

**Course Outline**:

| **Mode of Teaching and Learning: Lecture**<br>**Evaluation of Course Outcome: Internal Assessment and End Semester Examination** | | |
|---|---|---|
| **UNIT** | **TOPICS** | **Hours** |
| I | Basic Language Skills: Grammar and Usage. | 3 |
| II | Business Communication Skills. With focus on speaking - Conversations, discussions, dialogues, short presentations, pronunciation. | 3 |
| III | Letter writing, E-mails, note making, etc. Basic compositions, journals, with a focus on paragraph form and organization | 3 |
| IV | Basic concepts & principles of good communication. Special characteristics of health communication. Types and process of communication. | 3 |
| V | Barriers of communication & how to overcome | 3 |

**Textbooks:**

- ***Communication Skills ,*** Dua and Kumar Dr Pragi Arora, Varun Arora, S Vikas and Company (PV)
- ***Communication Skills,*** Sanjay Kumar Pushp Lata, 2nd Edition Oxford University Press

**Reference Books:**

- ***Effective Communication and Soft Skills,*** Nitin Bhatnagar, 1st Edition, Pearson Education India 2011
- ***Communication N Soft Skills,*** Niraj Kumar, Chetan Srivastava

## I SEMESTER-PRACTICAL

**Course No** : **BMRIT/112P**

**Course Title** : **Communication Skills**

**Credit** : **1 (0-0-1)**

Practical will include the following and additional as prescribed to cover all theoretical aspects

1. Speaking-conversations, discussion
2. Presentation
3. Letter writing, etc.

## I SEMESTER-THEORY

**Course No : BMRIT/104T**

**Course Title : Principles of Management**

**Credit : 2 (2-0-0)**

**Course Description:** This course introduces the basic elements of management to help them in understanding the basic concepts of quality in health care and develop skills to implement sustainable quality management program in health system.

**Course Outcome**: At the end of the course, a student should be able to explain his knowledge and understanding on

- CO104:1 The basic concepts of quality in health care
- CO104:2 Develop skills to implement sustainable quality management program in health system
- CO104:3 Basics of emergency care and life support skills
- CO104:4 Airways management and chest compression

**Course Outline**:

| **Mode of Teaching and Learning: Lecture**<br>**Evaluation of Course Outcome: Internal Assessment and End Semester Examination** | | |
|---|---|---|
| **UNIT** | **TOPICS** | **Hours** |
| I | Introduction to management. Strategic Management. Foundations of Planning. Planning Tools and Techniques Decision Making, conflict and stress management. | 6 |
| II | Managing Change and Innovation. Understanding Groups and Teams, Leadership, Time Management, Cost and efficiency | 6 |
| III | Quality assurance and management - Concepts of Quality of Care, Quality Improvement Approaches, Standards and Norms, Quality Improvement Tools, Introduction to NABH guidelines. | 6 |
| IV | Vital signs and primary assessment .Basic First aid and triage, ventilations including use of bag-valve –masks (BVMs). Managing an emergency including moving patient. | 6 |
| V | Basics of emergency care and life support skills- immediate recognition of sudden cardiac arrest (SCA), stroke and activation of the emergency response system. Early cardiopulmonary resuscitation (CPR) and rapid defibrillation with automated external defibrillator (AED). | 6 |

**Text books:**

**Reference Books**:

- ***Introduction to Health Care Management, Fourth Edition***, Sharon B. Buchbinder, Nancy H. Shanks, Bobbie J Kite
- ***First Aid for the Basic Sciences: General Principles, Third Edition,*** Tao Le, William Hwang, Luke Pike

## I SEMESTER-PRACTICAL

**Course No : BMRIT/113P**

**Course Title : Principles of Management**

**Credit : 1 (0-0-1)**

Practical will include the following and additional as prescribed to cover all theoretical aspects

1. Visits to hospital/radiology department to understand and observing the work flow in radiology departments.
2. Demonstration of principles of first aid and management of hospital/department
3. Presentation on related topics

## I SEMESTER-THEORY

**Course No** : **BMRIT/105T**

**Course Title** : **Medical Terminology and Record Keeping**

**Credit** : **1 (1-0-0)**

**Course Description:** This course introduces the basic medical terminology and record keeping. 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.

**Course Outcome**: At the end of the course, a student should be able to explain his knowledge and understanding on

- CO105:1 Familiarity with medical words through roots, prefixes and suffixes.
- CO105:2 Utilize diagnostic, surgical, and procedural terms and abbreviations
- CO105:3 Interpret basic medical abbreviations/ symbols.
- CO105:4 Interpret medical orders/reports
- CO105:5 Data entry and management on physical/electronic health record system

**Course Outline**:

| **Mode of Teaching and Learning: Lecture**<br>**Evaluation of Course Outcome: Internal Assessment and End Semester Examination** | | |
|---|---|---|
| **UNIT** | **TOPICS** | **Hours** |
| I | Medical Terminology: Derivation of medical terms.<br>Define word roots, prefixes, and suffixes. | 3 |
| II | Conventions for combined morphemes and the formation of plurals. | 3 |
| III | Basic medical terms. Forming medical terms utilizing roots, suffixes, prefixes, and combining roots. Interpret basic medical abbreviations/ symbols. | 3 |
| IV | Record Keeping: Utilize diagnostic, surgical, and procedural terms and abbreviations related to the integumentary system, musculoskeletal system, respiratory system, cardiovascular system, nervous system, and endocrine system.<br>Interpret medical orders/reports | 3 |
| V | Data entry and management on physical/electronic health record system | 3 |

**Text Books:**

**Reference Books**:

- ***Medical Terminology, Kiran Bharadwaj, 2020,*** Emmess Medical
- ***Medical Records Organisation and Management, 2nd Edition,*** Mogli Gd, Jaypee Brothers Medical Publishers

## I SEMESTER-THEORY

**Course No** **: BMRIT/106T**

**Course Title** **: Medical Law and Ethics**

**Credit** **: 1 (1-0-0)**

**Course Description:** This course introduces the basic understanding of medical law and ethics to improve the quality of patient care by identifying, analysing and attempting to resolve the ethical problems that arise in practice.

**Course Outcome**: At the end of the course, a student should be able to explain his knowledge and understanding on

- CO106:1 Medical ethics , code of conduct
- CO106:2 Autonomy and informed consent - Right of patients
- CO106:3 Medico legal case and type
- CO106:4 Professional Indemnity insurance policy

**Course Outline**:

| **Mode of Teaching and Learning: Lecture**<br>**Evaluation of Course Outcome: Internal Assessment and End Semester Examination** | | |
|---|---|---|
| **UNIT** | **TOPICS** | **Hours** |
| I | Medical ethics - Definition - Goal – Scope. Introduction to Code of conduct. | 3 |
| II | Basic principles of medical ethics – ConfidentialityMalpractice and negligence - Rational and irrational drug therapy. | 3 |
| III | Autonomy and informed consent - Right of patients. Care of the terminally ill- Euthanasia. Organ transplantation | 3 |
| IV | 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 | 3 |
| V | Professional Indemnity insurance policy. Development of standardized protocol to avoid near miss or sentinel events. Obtaining an informed consent | 3 |

**Text Books:**

**Reference Books**:


- ***Ethics & Basic Law for Medical Imaging Professionals,*** Bettye G. Wilson
- ***Introduction to Health Care Management, Fourth Edition,*** Sharon B. Buchbinder, Nancy H. Shanks, Bobbie J Kite

## I SEMESTER-THEORY

**Course No : BMRIT/107T**

**Course Title : Patient Safety**

**Credit : 1 (1-0-0)**

**Course Description:** This course introduces the basic knowledge on the principles of onsite disaster management and to prevent harm to workers, property, environment and the general public.

**Course Outcome**: At the end of the course, a student should be able to explain his knowledge and understanding on

- CO107:1 The basic concepts of disaster preparedness and management
- CO107:2 The basic concepts of biomedical waste management

**Course Outline**:

| **Mode of Teaching and Learning: Lecture**<br>**Evaluation of Course Outcome: Internal Assessment and End Semester Examination** | | |
|---|---|---|
| **UNIT** | **TOPICS** | **Hours** |
| I | Disaster preparedness and management- Fundamentals of emergency management, psychological impact management, Resource management, | 3 |
| II | Preparedness and risk reduction, Key response functions (including public health, logistics and governance, recovery, rehabilitation and reconstruction), information management, incident command and institutional mechanisms. | 3 |
| III | Bio medical waste management and environment safety- Definition of Biomedical Waste, Waste minimization, BMW – Segregation, collection, transportation, treatment and disposal (including colour coding) | 3 |
| IV | Liquid BMW, Radioactive waste, Metals / Chemicals / Drug waste, BMW Management & methods of disinfection | 3 |
| V | Modern technology for handling BMW | 3 |

**Text Books:**

- ***Patient safety and Quality improvement in Health Care,*** Rahul K. Shah, Sandip A. Godambe, Latest Edition, Springer Nature Switzerland AG

**Reference Books**:

- ***Environmental and Disaster Management,*** D.R Khullar, Jacs Rao, 3rd Edition, McGraw Hill Education India Private Limited

## I SEMESTER-THEORY

**Course No** **: BMRIT/108T**

**Course Title** **: Infection Prevention and Control**

**Credit** **: 1 (1-0-0)**

**Course Description:** This course introduces the basic knowledge on the principles of infection prevention and control to reduce the incidence of hospital acquired infection and improve health outcomes.

**Course Outcome**: At the end of the course, a student should be able to explain his knowledge and understanding on

- CO108:1 The basic concepts of infection prevention and control
- CO108:2 Guidelines for hospital infection control
- CO108:3 The basic concepts of antibiotics and its resistance

**Course Outline**:

| **Mode of Teaching and Learning: Lecture**<br>**Evaluation of Course Outcome: Internal Assessment and End Semester Examination** | | |
|---|---|---|
| **UNIT** | **TOPICS** | **Hours** |
| I | Infection prevention and control - Evidence-based infection control principles and practices such as sterilization, disinfection, effective hand hygiene and use of Personal protective equipment (PPE) | 3 |
| II | Prevention & control of common healthcare associated infections, Components of an effective infection control program, and Guidelines (NABH and JCI) for Hospital Infection Control | 3 |
| III | Antibiotic Resistance-History of Antibiotics, How Resistance Happens and Spreads, Types of resistance- Intrinsic, Acquired, Passive | 3 |
| IV | Trends in Drug Resistance, Actions to Fight Resistance, Bacterial persistence, Antibiotic sensitivity | 3 |
| V | Consequences of antibiotic resistance, Antimicrobial Stewardship- Barriers and opportunities, Tools and models in hospitals. | 3 |

**Text Books:**

**Reference Books**:

- ***Essentials of Hospital Infection Control,*** Apurba S Sastry, Deepashree R
- ***Infection Control & Safety,*** Pamela Shalini Joseph, MS. Sudha Gautam,MS. Tanima Verma

## I SEMESTER-THEORY

**Course No** **BMRIT/109T**

**Course Title** **: Research Methodology and Biostatistics**

**Credit** **: 2 (2-0-0)**

**Course Description:** This course introduces the basis of research methodology and biostatistics to help students in the development of professionalism

**Course Outcome**: At the end of the course, a student should be able to explain his knowledge and understanding on

- CO109:1 Basic concepts of research and methods
- CO109:2 Basic concepts of biostatistics
- CO109:3 Ability to write dissertation/project work

**Course Outline**:

| **Mode of Teaching and Learning: Lecture**<br>**Evaluation of Course Outcome: Internal Assessment and End Semester Examination** | | |
|---|---|---|
| **UNIT** | **TOPICS** | **Hours** |
| I | Introduction to research methods. Identifying research problem. Ethical issues in research and research design. | 6 |
| II | Basic Concepts of Biostatistics. | 6 |
| III | Types of Data Research tools and Data collection methods. Sampling methods<br>Developing a research proposal | 6 |
| IV | Accessing research literature: Use of databases and other sources<br>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.<br>Ethical issues in research | 6 |
| V | Analysis: Analysis of qualitative and quantitative data. Utilization of appropriate software to assist in the retrieval of information and data analysis<br>Clinical audit: Distinctiveness of research and audit processes and their function<br>Research Skills and Management: The role of evidence-based practice within health and welfare | 6 |

**Textbooks:**

- **Biostatistics: Basic Concepts and Methodology for the Health Sciences (10th Edition):** Wayne W. Daniel, Chad L. Cross

**Reference Books**:

- ***Fundamentals of Mathematical Statistics (12th Edition):*** VK Kapoor, SC Gupta
- ***Fundamentals of Applied Statistics:*** VK Kapoor, SC Gupta

## I SEMESTER-PRACTICAL

**Course No** **: BMRIT/114P**

**Course Title** **: Research Methodology and Biostatistics**

**Credit** **: 1 (0-0-1)**

Practical will include the following and additional as prescribed to cover all theoretical aspects

1. Identifying research problems
2. Understanding the basic concepts of biostatistics
3. Developing sample research proposal/project work
4. Presentation on related topics.

## II SEMESTER-THEORY

**Course No** : **BMRIT/201T**

**Course Title** : **Human Anatomy**

**Credit** : **3 (2-1-0)**

**Course Description:** This course deals with the anatomical details of the human body. Particular emphasis is laid on the various bones and types of joints. All the systems are covered including Central nervous System, Cardio-Vascular system, Respiratory system, Gastro-intestinal tract, Genito-Urinary tract, Hormone secreting glands, etc.

**Course Outcome**: At the end of the course, a student should be able to demonstrate his knowledge and understanding on

- CO201:1 Surface anatomy of the body
- CO201:2 Types of bones, names of bones and joints
- CO201:3 Types of muscles, ligaments and tendons
- CO201:4 Anatomical aspect of the various systems of the body
- CO201:5 Various types of tissues in the body

***Pre-requisite:*** *Higher secondary level (Science) with good knowledge on Biology.*

**Course Outline**:

**Mode of Teaching and Learning: Lecture, Tutorial**
**Evaluation of Course Outcome : Internal Assessment and End Semester Examination**

| UNIT | TOPICS | Hours |
|---|---|---|
| I | Introduction of human body, cells and tissue, anatomical positions, terms and description. Basic embryology and development. Musculo-skeletal system of body- structure of bones, vertebral column, joints, types ofjoints, trunk, muscles, types of muscles.<br>Upper and lower limbs – structure, blood supply, nerve supply, venous drainage,lymphatic etc. | 9 |
| II | Cardiovascular system including the heart and circulatory system, major blood vessels, arteries, veins, capillaries, lymphatics<br>Respiratory system including the lungs, trachea, bronchus, Broncho-pulmonary segments, alveoli, arterial supple, venous drainage, lymphatics, capillaries. | 9 |
| III | Central Nervous System including the brain, spinal cord, central and peripheral nervous systems, autonomic nervous system, brachial plexus, sacral plexus, cranial nerves.<br>Head and neck including the skull, ears, middle ear cavity, temporal bone, para nasal sinuses, pharynx, larynx, oral cavity, face, tongue, nasal cavity, eyes and other sensory organs | 9 |
| IV | Gastro-intestinal tract including the esophagus, stomach, small intestine, large intestine, cecum, appendix, anal canal.<br>Hepato-biliary system including the Liver, Gall bladder, biliary tree, pancreas, spleen, canaliculi | 9 |
| V | Genito-Urinary, excretory system including kidneys, ureters, urinary bladder, urethra, prostate.<br>Male and female reproductive system including the testes, seminal vesicles, uterus,cervix, fallopian tubes, ovaries.<br>Endocrinal system including the pituitary, thyroid, hormones etc. | 9 |

**Textbooks:**

- ***Anatomy & Physiology,*** Ross & Wilson
- ***Text book of Anatomy*** B.D. Chaurasia

**Reference Books**:

- ***Text book of Radiology for Technicians,*** Dr.Satish Bhargava
- ***Clinical Anatomy,*** Richard Snell

## II SEMESTER-PRACTICAL

**Course No** **: BMRIT/206P**
**Course Title** **: Human Anatomy**
**Credit** **: 1 (0-0-1)**

Practical will include the following and additional as prescribed to cover all theoretical aspects

1. Identification of bones, joints, anatomical position, etc.
2. Identification of GI tract, respiratory system, cardio-vascular system and human reproductive systems, etc.
3. Identification of anatomical landmarks, etc.
4. Presentation on related topics

## II SEMESTER-THEORY

**Course No** : **BMRIT/202T**

**Course Title** : **Physiology and Pathology**

**Credit** : **3 (2-1-0)**

**Course Description:** This course deals with the basics of the physiology of human body including all the systems. It also deals with the basic pathological process of disease with particular emphasis on infective processes and tumours – both benign and malignant.

**Course Outcome**: At the end of the course, a student should be able to demonstrate his knowledge and understanding on

- CO202:1 Functions of the various systems of the human body
- CO202:2 Functions of various cells including blood cells, lymph and various tissues
- CO202:3 Basic pathological processes involved in the body
- CO202:4 Types of tumours and names of various tumours
- CO202:5 Benign and malignant tumours.

***Pre-requisite:*** *Higher secondary level (Science) with good knowledge on Biology.*

**Course Outline**:

**Mode of Teaching and Learning : Lecture, Tutorial**
**Evaluation of Course Outcome : Internal Assessment and End Semester Examination**

| UNIT | TOPICS | Hours |
|---|---|---|
| I | Introduction, functional organization of body structures, musculoskeletal systemBlood cells, plasma, blood groups, lymphatic's etc. Physiology of cardiovascular system including heart and circulation, blood pressure,arteries, veins | 9 |
| II | Physiology of respiration including lungs, trachea, larynx, bronchus, Broncho-pulmonary segments. Physiology of the excretory system including formation and excretion of urine, reabsorption of water, functional unit of kidneys, process of micturition. Male and female reproductive system. | 9 |
| III | Physiology of the hepato-biliary system including production and circulation of bile,storage of bile, portal circulation. Physiology of the Gastro-intestinal tract including stomach, digestive system, enzymesincluding pancreatic enzymes excretory function of colon, water reabsorption. Function of the nervous system including sensory and motor nervous system, neuron, peripheral nerves, autonomic nervous system, brain, production and circulation of CSF | 9 |
| IV | Basic Pathology – introduction to pathological condition, cellular structure, metabolism, pathogenesis of disease. Inflammation – definition, types, degeneration, cell death, granulomatous inflammationetc. Regeneration and healing process. | 9 |
| V | Tumors, definition, benign, malignant, tumors affecting various systems – neoplasia. Hypersensitivity, infection, infestation<br>Hemodynamic disorders, hemorrhage, ischemia, infection. | 9 |

**Textbooks:**

- ***Anatomy & Physiology,*** Ross & Wilson

**Reference Books**:

- ***Basic Pathology, Cotran, Kumar, Robbins***
- ***Text book of Radiology for Technicians,*** Dr.Satish Bhargava

## II SEMESTER-PRACTICAL

**Course No** **: BMRIT/207P**
**Course Title** **: Physiology and Pathology**
**Credit** **: 1 (0-0-1)**

Practical will include the following and additional as prescribed to cover all theoretical aspects

1. Identification of bones, joints, anatomical position, etc.
2. Identification of GI tract, respiratory system, cardio-vascular system, human reproductive systems, etc.
3. Identification of anatomical landmarks, etc.
4. Presentation on related topics

## II SEMESTER-THEORY

**Course No** : **BMRIT/203T**

**Course Title** : **Radiological Physics**

**Credit** : **3 (2-1-0)**

**Course Description:** This course deal with Radiological Physics and includes all aspects of Physics involved in the generation of X-rays, tube technology, optimizing KVp, mA, exposure techniques, interaction of rotation with matter and various physical and radiation units.

**Course Outcome**: At the end of the course, a student should be able to demonstrate his knowledge and understanding on

- CO203:1 Basic principle of Physics with particular emphasis on nuclear and radiation physics
- CO203:2 Production of X-rays
- CO203:3 Operating X-rays machines
- CO203:4 Optimizing image quality
- CO203:5 Beam collimation methods and techniques
- CO203:6 X-rays machine, ratings, generator

***Pre-requisite:*** *Higher secondary level (Science) with good knowledge on Physics.*

**Course Outline**:

| **Mode of Teaching and Learning : Lecture, Tutorial**<br>**Evaluation of Course Outcome : Internal Assessment and End Semester Examination** | | |
|---|---|---|
| **UNIT** | **TOPICS** | **Hours** |
| I | Units and measurements-Force, work, power and energy-Temperature and heat. Electricity and magnetism, Electromagnetic waves, Sound, Heat, Semiconductors, Semiconductor diodes, Transistors, High tension Circuits<br>Filament current and voltage, X-ray circuits, Types of generators, 3 phase, 6 and 12 pulse circuits-high frequency generators-falling load generators, Capacitors discharge and grid control systems. X-ray generator circuits | 9 |
| II | Atoms, Nucleus, Structure and property of nucleus, nuclear forces, binding energy, radioactive decay, charge of radionuclides, alpha, beta, positron, gamma and X radiation, modes of decay, auger electrons, electron capture, isomeric transitions, internal conversions, naturally occurring radio-nuclides. Electromagnetic radiation, ionizing and non-ionizing radiation. Interaction of radiation with matter, Photoelectric effect, Compton scattering, pair production | 9 |
| III | 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, heel effect, soft and hard X-Rays, added and inherent filtration, reflection and transmission targets<br>X-ray tube: historical aspects, construction of X-ray tubes, requirements for X-ray production, tube voltage, current, space charge, cathode assembly, X-ray production efficiency, Quality and intensity of x-rays-factors influencing them. Interlocking and X-ray tube overload protection. Heat dissipation methods, tube rating, heat units, operating conditions and maintenance | 9 |
| IV | Image and its characteristics: Formation of radiological image, latent image, intensifying screens, factors affecting image quality, radiographic image contrast, density, sharpness, magnification, distortion of image, noise, blurs.<br>Interaction of ionizing radiation with matter-<br>Exponential attenuation (linear/mass attenuation coefficients), HVT, TVT, dependence on energy and atomic number. Radiation intensity and exposure, photon flux and energy flux density. | 9 |
| V | Scattered radiation, Control of scattered radiation Effects of scatter radiation on radiograph image quality, patient dose and occupational exposure, appliances to reduce scattered | 9 |

| | | |
|---|---|---|
| | radiation, grids – stationary and moving, use of cones, diaphragm, light beam devices, Umbra, Penumbra, collimation<br>Physical quantity, its unit and measurement: Fundamental and derived quantity, SI unit, various physical/radiation quantity used in Diagnostic Radiology and its unit, | |

**Textbooks:**

- ***Basic Radiological Physics***. K Thayalan
- ***Text book of Radiology for Technicians,*** Dr. Satish Bhargava

**Reference Books**:

- ***Christensen's Physics of Diagnostic Radiology,*** Thomas S, Curry, James Z. Dowdey, Robert C, Murray, Jr, 1990 Edition, Lea & Febiger,U.S.
- ***Essentials of Radiologic Science,*** Robert Fosbinder, Denise Orth

## II SEMESTER-PRACTICAL

**Course No** **: BMRIT/208P**
**Course Title** **: Radiological Physics**
**Credit** **: 1 (0-0-1)**

Practical will include the following and additional as prescribed to cover all theoretical aspects

1. Verification of Ohm's Law
2. Verify the rules of series and parallels, combination and resistance
3. Study of potential drop across different resistance
4. Construction of a rectifying circuit with the help of diode valve / semi-conductor diode
5. Verification of Kirchhoff's Voltage Law and Current Law.
6. To Study Logic gates and finding their Truth Tables
7. Demonstration of tubes and its various types
8. Identification of parts of X-Ray machines and its function
9. Demonstration of film focus distance and magnification and its use in radiography
10. Demonstrate use of grids, improving radiographic contrast.
11. Demonstration of kV, mA and S in Radiography machines
12. Demonstration of use of intensifying screen and intensifying effect by fluorescence
13. Verification of Inverse Square Law (ISL)
14. Presentation on related topics

## II SEMESTER-THEORY

**Course No** : **BMRIT/204T**

**Course Title** : **Image Processing Techniques**

**Credit** : **3 (2-1-0)**

**Course Description:** This course deals with techniques that involves in the process of film development, conventional and automatic processing of films. It also deals with the aspects of Image construction and Quality. Layout of darkroom as well as presentation of radiograph.

**Course Outcome**: At the end of the course, a student should be able to demonstrate his knowledge and understanding on

- CO204:1 Construction of film and radiographic images
- CO204:2 Radiographic image processing
- CO204:3 Unloading and loading of cassette
- CO204:4 Optimizing image quality
- CO204:5 Darkroom layout

***Pre-requisite:*** *Higher secondary level (Science) with good knowledge on Physics.*

**Course Outline**:

**Mode of Teaching and Learning : Lecture, Tutorial**
**Evaluation of Course Outcome : Internal Assessment and End Semester Examination**

| UNIT | TOPICS | Hours |
|---|---|---|
| I | Radiographic Film Construction, Types, Handling of exposed and unexposed films. Types, applications, advantages/limitations of different types, safe light requirements.Storage of X-ray film.<br>Presentation of radiographs-opaque letters and markers-Identification of dental films-preparation of stereo radiographs-viewing conditions | 9 |
| II | 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. Film-screen imaging.<br>Cassettes: Structure and function-Types-single, gridded, film holder-Design features and consideration with loading/unloading-Care and maintenance (cleaning).<br>Photochemistry. Processing: manual processing -automatic processor Automatic Film Processor | 9 |
| III | Radiographic image- of image quality-unsharpness in radiographic image- contrast of the radiographic image-distinctness of the radiographic image-size, shape andspatial relationships. Artefacts prevention. Sensitometer- Photographic density-characteristic curve-information from the characteristic curve-speed Vs definition. | 9 |
| IV | Optical density-image contrast. Scattered radiation, Grids, collimation- Effects on image quality<br>Film fog-types and causes. Artefacts. Effect of temperature in image processing, improper storage. | 9 |
| V | Dark Room: The processing area, Dark room design and planning, construction, layout, illumination, entrance safe lighting-types, Room storage, shelving of films, Cleaning and maintenance.<br>Dry Bench, Loading and Unloading Cassettes. Hangers, Wet Bench Cleanliness, Control of Dust, Dark Room Sink Hatches and Drier, Safe Lights, Direct and Indirect, Uses, Factors Affecting Safelight Performance, Safelight Tests. Viewing Room, Film Dispensing | 9 |

**Textbooks:**

- ***Text book of Radiology for Technicians,*** Dr. Satish Bhargava

**Reference Books**:

- ***Clark's Positioning in Radiology, Steward Whitley,*** 13th edition, CRC Press

## II SEMESTER-PRACTICAL

**Course No** **: BMRIT/209P**
**Course Title** **: Image Processing Techniques**
**Credit** **: 1 (0-0-1)**

Practical will include the following and additional as prescribed to cover all theoretical aspects

1. Demonstration of working of intensifying screen, latent image formation
2. Visit to darkroom and room layout
3. Film handling and storage
4. Preparation of developer, fixer and replenisher solution
5. Care of cassettes
6. Artefacts in radiography and prevention
7. Presentation on related topics

## II SEMESTER-THEORY

**Course No** : **BMRIT/205T**

**Course Title** : **Environmental Studies**

**Credit** : **3 (2-1-0)**

**Course Description:** Environmental studies has been included on the compulsory core Course as the importance of Environmental Studies cannot be disputed. The subject will aware the students about the deteriorating condition of our environment and how the degradation is linked to continuing problems of pollution in various sectors, loss of forests, issues related to economic productivity, and national as well as ecological security and learn about the sustainable development as well as conservation of natural resources.

**Course Outcome**: At the end of the course, a student should be able to demonstrate his knowledge and understanding on

- CO205:1 Environmental structures and functions
- CO205:2 Environmental allied problems
- CO205:3 Role of mankind in conservation of environment
- CO205:4 Available laws and policies related to the environment

**Course Outline**:

**Mode of Teaching and Learning : Lecture, Tutorial**
**Evaluation of Course Outcome : Internal Assessment and End Semester Examination**

| UNIT | TOPICS | Hours |
|---|---|---|
| I | Introduction to Environmental studies: Multidisciplinary nature, scope & importance, Ecosystems- structure & function; Energy flow; food chain; food webs & ecological succession. Forestecosystem, Grassland ecosystem, Desert ecosystem, Aquatic ecosystem, Tundra ecosystem. | 9 |
| II | Natural Resources: Renewable & Non- renewable Resources Land resources & land use change, Land degradation, soil erosion & desertification. Deforestation: Causes & impacts due to mining, dam building on environment, forests, biodiversity & tribal populations Water: Use & over exploitation of surface & ground water, floods, droughts,Energy resources: Renewable & non-renewable, use of alternate energy sources, growing energy needs | 9 |
| III | Biodiversity & Conservation<br>Levels of biological diversity: genetic, species & ecosystem diversity; bio-geographic zones of India; biodiversity patterns and global biodiversity hotspots.India as a mega- diversity nation; endangered & endemic species of IndiaThreats to biodiversity: Habitat loss, poaching of wildlife, man- wildlife conflicts, biological invasions; Conservation of biodiversity: in-situ & ex-situ | 9 |
| IV | Environmental pollution. Types, causes, effects & controls; Air, water, soil & noise pollution.nuclear hazards & nuclear health risks. Solid waste management: control measures of urban & industrial waste | 9 |
| V | Environmental Policies & Practices, Sustainable & sustainable development, Climate change, global warming, ozone layer depletion, acid rain & impacts on human communities and agriculture, greenhouse effect, Environmental Laws: Environment Protection Act, Wildlife Protection Act, Forest Conservation Act. Environmental movements: Chipko movement, Silent Valley, Bishnois of Rajasthan, | 9 |

**Textbooks:**

- ***Text Book for Environmental Studies for UG Courses,*** Erach Bharucha, 3rd Edition, 2021, Orient Blackswan Pvt Ltd.

**Reference Books**:

- ***Solid Waste Management,*** M.S Bhatt, Asheref Illiyan, 2012, Synergy Books India

## II SEMESTER-PRACTICAL

**Course No** **: BMRIT/210P**
**Course Title** **: Environmental Studies**
**Credit** **: 1 (0-0-1)**

Practical will include the following and additional as prescribed to cover all theoretical aspects

1. Visit to an area to document environmental assets: river/ forests/ flora/ fauna etc.
2. Study of common plants, insects, birds and basic principles of identification
3. Biodiversity conservation method
4. Study of pollutants present in water
5. Sampling method of air pollution
6. Presentation on related topics

## III SEMESTER-THEORY

**Course No** : **BMRIT/301T**

**Course Title** : **Clinical Radiography- I**

**Credit** : **3 (2-1-0)**

**Course Description** This course deals with the aspects of Clinical Radiography. Types of projections used for different parts of the body, aspects of patient positioning, instruction, beam centering, exposure factors, co-relation of anatomical knowledge with surface anatomy to obtain images of area of interest.

**Course Outcome**: At the end of the course, a student should be able to demonstrate his knowledge and understanding on

- CO301:1 Radiological anatomy of parts of the body
- CO301:2 Patient positioning in different part of the body
- CO301:3 Exposure setting in relation to various tissues
- CO301:4 Surface landmarks for central ray focusing.

***Pre-requisite:*** *Thorough understanding of BMRIT/201T, BMRIT/204T*

**Course Outline**:

| **Mode of Teaching and Learning : Lecture, Tutorial, Continuous interactive learning & e-learning**<br>**Evaluation of Course Outcome : Internal Assessment and End Semester Examination** | | |
|---|---|---|
| **UNIT** | **TOPICS** | **Hours** |
| I | Skull:Basic projections for cranium, facial bones, nasal bones and mandible. Technique for: Petrous temporal for mastoids. Internal auditory canal. - Accessory nasal sinuses., Tempero - mandibular joint. - Orbits and optic foramen. - Zygomatic arches., Styloid process. - Pituitary fossa. - Jugular foramen, Radiography of Skull and Radiography of cranial bones; including special techniques for sella turcica, orbits, optic foramina, superior orbital fissure and inferior orbital fissure etc. Facial bones; Paranasal sinuses, Temporal bone and Mastoids. | 9 |
| II | Dental Radiography- Technique for intra oral full mouth. - Occlusal projections. – Extra oral projections including orthopantomography. - Supplementary techniques Dental Radiography: Radiography of teeth-intra oral, extra oral and occlusal view<br>Shoulder girdle: 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. | 9 |
| III | 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. Radiography of soft tissue of neck – special considerations | 9 |
| IV | Upper respiratory system- Technique for post nasal airways, larynx, trachea, thoracic inlet,Valsalva manoeuvre. - Phonation. 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. | 9 |
| V | Abdomen: Preparation of patient. General abdominal radiography and positioning for fluid and air levels. Plain film examination<br>Radiography in case of acute abdomen. Abdominal viscera- Technique for plain film examination. - Projection for acute abdomen patients. - Technique to demonstrate: Foreign bodies, Imperforate anus. | 9 |

**Textbooks:**

- ***Clark's Positioning in Radiology,*** Steward Whitley, 13th edition, CRC Press

**Reference Books**:

- ***Text book of Radiology for Technicians***, Dr. Satish Bhargava

## III SEMESTER-PRACTICAL

**Course No** **: BMRIT/306P**
**Course Title** **: Clinical Radiography- I**
**Credit** **: 1 (0-0-1)**

Practical will include the following and additional as prescribed to cover all theoretical aspects

1. Skull, head and neck radiography
2. Upper Extremities radiography
3. Respiratory system radiography
4. Dental radiography
5. Abdominal radiography
6. Presentation on related topics

## III SEMESTER-THEORY

**Course No** : **BMRIT/302T**

**Course Title** : **Special Radiography Procedures**

**Credit** : **3 (2-1-0)**

**Course Description** This course deals with diagnostic and minimally invasive procedure branch of Radiology used for evaluation and treatment of many medical conditions. This method involves studying organs using X-ray and the administration of a special dye (contrast media) to evaluate structure of the human body

**Course Outcome**: At the end of the course, a student should be able to demonstrate his knowledge and understanding on

- CO302:1 Contrast reaction and management
- CO302:2 Procedure for evaluating Gastrointestinal Tract
- CO302:3 Salivary glands, Biliary system, Respiratory system and soft tissue Radiography

***Pre-requisite****: Thorough understanding of BMRIT/201T, BMRIT/204T*

**Course Outline**:

| **Mode of Teaching and Learning : Lecture, Tutorial, Continuous interactive learning & e-learning**<br>**Evaluation of Course Outcome : Internal Assessment and End Semester Examination** | | |
|---|---|---|
| **UNIT** | **TOPICS** | **Hours** |
| I | Introduction to contrast media, oral and iv contrast agents, new generation contrast agents.<br>Reaction to contrast agents and management of reaction to contrast agents.<br>Drugs and emergencies in radiology department. | 9 |
| II | Basics of Fluoroscopy, IITV and its use, advantages and disadvantages.<br>Spot films, video recording of fluoroscopy procedures, archiving.<br>Special investigative procedures:<br>- Sialography, Myelography, Arthrography<br>- Dacryo-cysto rhinography ( DCR)<br>- Laryngography, Bronchography<br>- Lymphangiography<br>- Fistulogram<br>- Loopogram | 9 |
| III | Methods of imaging the hepato-biliary system including<br>- Oral cholecystography<br>- T-Tube cholangiography / Intravenous cholangiography<br>- Endoscopic Retrograde Cholangio pancreatography ( ERCP)<br>- Percutaneous transhepatic cholangiography ( PTCA)<br>- Biliary drainage including PTBD. | 9 |
| IV | Methods of imaging the gastro intestinal tract including<br>- Barium swallow<br>- Barium meal<br>- Hypotonic duodenography<br>- Barium meal follow through and Enteroclysis<br>- Barium enema including instant enema.<br>- Therapeutic barium enema / reduction of intussusceptions | 9 |
| V | Procedures in imaging the Genito-urinary system including.<br>- Intra-venous urography ( IVU)<br>- Retrograde Urography ( RGU) and Urethrogram<br>- Micturating Cysto-Urethrography ( MCU)<br>- Percutaneous nephrostomy<br>- Hystero-salpingography ( HSG). | 9 |

**Textbooks:**

- ***Radiological Procedures*:** A Guideline, Dr. Bhushan N Lakhkar, 3rd Edition, Arya Publications

**Reference Books**:

- ***Text book of Radiology for Technicians***, Dr. Satish Bhargava

## III SEMESTER-PRACTICAL

**Course No** **: BMRIT/307P**
**Course Title** **: Special Radiography Procedures**
**Credit** **: 1 (0-0-1)**

Practical will include the following and additional as prescribed to cover all theoretical aspects

1. Administration of contrast media
2. Dry demonstration and observation of various procedures covered in theory
3. Presentation on related topics.

## III SEMESTER-THEORY

**Course No** **: BMRIT/303T**

**Course Title** **: Clinical Imaging - Chest and Abdomen**

**Credit** **: 3 (2-1-0)**

**Course Description:** This course deals with several different technologies that are used to view human body in order to diagnose, monitor, or treat medical conditions involving Chest & Abdomen.

**Course Outcome**: At the end of the course, a student should be able to demonstrate his knowledge and understanding on

- CO303:1 Pathology involving Chest & Abdomen
- CO303:2 Radiological anatomy of Chest & Abdomen in relation to USG, CT & MRI
- CO303:3 Radiographic techniques and the diagnosis of Chest & Abdomen pathology

***Pre-requisite:*** *Thorough understanding of BMRIT/201T, BMRIT/202T, BMRIT/204T*

**Course Outline**:

**Mode of Teaching and Learning : Lecture, Tutorial, Continuous interactive learning, e-learning**

**Evaluation of Course Outcome : Internal Assessment and End Semester Examination**

| UNIT | TOPICS | Hours |
|---|---|---|
| I | Introduction to Role of Radiology in Chest and Abdominal Imaging. Introduction to important diseases involving the Chest and Abdomen Clinical Features of diseases of Chest and Abdomen | 9 |
| II | Radiological anatomy of the Chest and Abdomen – X-Ray, USG, CT and MRI corelation | 9 |
| III | Emergency imaging of Chest diseases and findings<br>Imaging of Chest diseases using various Radiographic techniques | 9 |
| IV | Emergency imaging of Abdominal Diseases. Imaging of Abdominal diseases using various Radiographic techniques | 9 |
| V | Radiological Interventions in Chest and Abdominal imaging | 9 |

**Textbook:**

- ***Case Studies in Chest Imaging,*** Rita Joardar, Neil Crundwell, 2012

## III SEMESTER-PRACTICAL

**Course No** **: BMRIT/308P**

**Course Title** **: Clinical Imaging - Chest and Abdomen**

**Credit** **: 1 (0-0-1)**

Practical will include the following and additional as prescribed to cover all theoretical aspects

1. Clinical visit
2. Presentation on related topics

## III SEMESTER-THEORY

**Course No** : **BMRIT/304T**

**Course Title** : **Cross-Sectional Anatomy**

**Credit** : **3 (2-1-0)**

**Course Description:** This course deals with 2 Dimensional axial images of gross anatomical structure seen in transverse planes which are obtained by taking imaginary slices perpendicular to the main axis of organs, vessels, nerves, bones, soft tissue or even the entire human body.

**Course Outcome**: At the end of the course, a student should be able to demonstrate his knowledge and understanding on

- CO304:1 Sectional planes, Anatomical relationships/terminology
- CO304:2 Anatomy of the Head
- CO304:3 Anatomy of the thorax
- CO304:4 Anatomy of the Abdomen and Pelvis
- CO304:5 Anatomy of the upper and lower limb

***Pre-requisite:*** *Thorough understanding of BMRIT/201T*

**Course Outline**:

| **Mode of Teaching and Learning : Lecture, Tutorial, Continuous interactive learning, e-learning**<br>**Evaluation of Course Outcome : Internal Assessment and End Semester Examination** | | |
|---|---|---|
| **UNIT** | **TOPICS** | **Hours** |
| I | Introduction to Sectional Anatomy & Terminology- Sectional planes, Anatomica l relationships/terminology | 9 |
| II | Anatomy of the Head- Surface anatomy relationships, Bony structures and muscles, Blood vessels | 9 |
| III | Anatomy of the thorax, Surface anatomy relationships, Bony structures organs and muscles, Blood vessels | 9 |
| IV | Anatomy of the Abdomen and Pelvis, urinary system including reproductive organs- Bony structures, Major organs and their accessories, Abdominal blood vessels | 9 |
| V | Anatomy of the upper and lower limb- Bony structures, organs and muscles | 9 |

**Textbook:**

- ***Fundamentals of Sectional Anatomy and Imaging Approach*****,** Denise L. Lazo, 2004, Delmar Cengage Learning

**Reference Books:**

- ***Cross Sectional Anatomy CT and MRI,*** Govind Chavhan, Bhavin Jankharia

## III SEMESTER-PRACTICAL

**Course No** : **BMRIT/309P**

**Course Title** : **Cross-Sectional Anatomy**

**Credit** : **1 (0-0-1)**

Practical will include the following and additional as prescribed to cover all theoretical aspects

1. Demonstration and observation of cross-sectional anatomy mentioned in theory.
2. Presentation on related topics

## III SEMESTER-THEORY

**Course No** : **BMRIT/305T**

**Course Title** : **Radiation Hazards and Protection**

**Credit** : **3 (2-1-0)**

**Course Description**: This course deals with the aspects of adverse effects of radiation, use of radiation in diagnostic radiology and the aspects of radiation protection in relation to patient, worker and public in general. Guidelines issued by AERB and adherence of guidelines are also taught

**Course Outcome**: At the end of the course, a student should be able to demonstrate his knowledge and understanding on

- CO305:1 Use of Radiation in Diagnostic Radiology
- CO305:2 Hazards of radiation and types of hazards
- CO305:3 Prescribed limit of exposure for public, workers and patients
- CO305:4 Principles of Radiation Protection, ALARA
- CO305:5 Dose optimization and minimizing exposure for patients and public
- CO305:6 Knowledgeable about various Guidelines issued by AERB and adherence to the guidelines

***Pre-requisite:*** *Thorough understanding of BMRIT/203T, BMRIT/204T*

**Course Outline**:

| **Mode of Teaching and Learning : Lecture, Tutorial, Continuous interactive learning, e-learning**<br>**Evaluation of Course Outcome : Internal Assessment and End Semester Examination** | | |
|---|---|---|
| **UNIT** | **TOPICS** | **Hours** |
| I | Radioactivity- Sources of radiation - natural radioactive sources, ionizing and non-ionizing radiation. Source of exposure to ionizing radiation, Units of radiation including SI units, activity, exposure, dose, absorbed dose, equivalent dose, effective dose, Patient dose, occupational exposure, population exposure, LET, RBE<br>Biological Effects of radiation: Ionization, Biological effects of non-ionizing radiation like ultrasound, lasers, IR, UV and magnetic fields. | 9 |
| II | Interaction of radiation with Tissue, Biological effects of radiation, excitation and free radical formation<br>Radiation induced DNA damage and response, Chromosome aberrations, RNA, tissue radio sensitivity, factor affecting radio sensitivity. Effects of ionizing radiation, Hematopoietic syndrome, GI Syndrome, CNS syndrome, somatic and genetic effect, stochastic and non-stochastic effects, mean and lethal dose. | 9 |
| III | 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.<br>Radiation Hazard evaluation and control<br>Types of Medical X-ray Imaging facilities, Protection during fluoroscopic procedures, angiographic procedures, interventional procedures, protection of patient. Dose and Dosimetry, CT Dose Index Dose area product in fluoroscopy and angiography systems, AGD in mammography | 9 |
| IV | Personal monitoring devices, film Badge, Thermoluminescent detector, Optically Stimulated Luminescent dosimeter, pocket dosimeter, occupational hazards and | 9 |

| | | |
|---|---|---|
| | precautions, personal shielding – lead apron, thyroid shield, limb shields, Gas filled detectors – Ionization chamber, GM Counter, PP Counter. Protective barriers, methods, lead equivalent. Shielding requirements for films, safety of radiation workers in diagnostic radiology | |
| V | Structural shielding of Imaging facilities, Room layout, construction and installation, source of exposure, shielding materials, computation of X-ray shielding requirement, CT shielding requirement,<br>Radiation protection in mobile units, exposure during pregnancy, Imaging of pregnant and potentially pregnant patients, 10-day rule. Medical emergencies involving ionizing radiation, Radioactive waste disposal | 9 |

**Textbooks:**

- **Text Book of Radiology for Technicians**, Dr. Satish Bhargava
- **Radiation Protection on Medical Radiography,** Mory Alice, Paula J Viscent

**Reference Books:**

- **Patient safety and Quality improvement in Health Care,** Rahul K. Shah, Sandip A. Godambe, Latest Edition, Springer Nature Switzerland AG
- **Christensen's Physics of Diagnostic Radiology**

## III SEMESTER-PRACTICAL

**Course No** **: BMRIT/310P**
**Course Title** **: Radiation Hazards and Protection**
**Credit** **: 1 (0-0-1)**

Practical will include the following and additional as prescribed to cover all theoretical aspects

1. Visit to installation of diagnostic radiology and adherence of guidelines
2. Checking of lead aprons and glass – ordinary and lead
3. Survey of X-ray rooms for radiation leakage
4. Demonstration and visit to agencies responsible to ensure radiation protection
5. Practical knowledge of planning and installation of radiology equipment
6. Use and care of personal monitoring devices
7. Use of tools used to measure radiation in diagnostic installations
8. Demonstration of techniques in relation to minimizing public exposure
9. Demonstration on the biological and physical hazards of radiation
10. Demonstration and use of shielding devices and aprons and its care
11. Presentation on related topics

## IV SEMESTER-THEORY

**Course No** : **BMRIT/401T**

**Course Title** : **Clinical Radiography - II**

**Credit** : **3 (2-1-0)**

**Course Description:** Clinical Radiography is a course that deals with providing various routine projections and special projections for different parts of the body. Details of patients positioning, preparation, instruction, beam angulation, beam cantering, technical factors, co-relation of anatomical knowledge with surface anatomy to obtain images of region of interest, use of X-ray equipment in different unit, Radiation protection, general precaution, Tomography and Dual energy.

**Course Outcome**: At the end of the course, a student should be able to explain his knowledge and understanding on

- CO401:1 Radiological anatomy of parts of the body.
- CO401:2 Patient positioning in different parts of the body
- CO401:3 Radiographic technique in relation to various anatomy
- CO401:4 Principle of stereography, Dual energy & Tomography

***Pre-requisite****: Thorough understanding of BMRIT/201T, BMRIT/203T, BMRIT/204T*

**Course Outline**:

| **Mode of Teaching and Learning : Lecture, Tutorial, Continuous interactive learning, e-learning**<br>**Evaluation of Course Outcome : Internal Assessment and End Semester Examination** | | |
|---|---|---|
| **UNIT** | **TOPICS** | **Hours** |
| I | Vertebral column: Technique for atlanto-occipital joint, cervical spine, cervico thoracic spine, thoracic spine, thoraco- lumber spine, lumbo sacral spine, sacrum and coccyx. Supplementary techniques to demonstrate: Scoliosis, Kyphosis, Spondylolisthesis, disc lesion, Union of spinal graft<br>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. | 9 |
| II | 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<br>Lateral projections for hip joints to show femoral head and neck relationship.<br>Skeletal survey: Skeletal survey for metabolic bone disease, metastases, hormonal disorder, renal disorders. | 9 |
| III | Radiography using mobile X-ray equipment- Radiography in the ward: Radiography in the specialized unit, such as: Intensive care unit, Coronary care, Neonatal unit. - Radiography in the operating theatre. awareness, case studies (Ward /mobile radiography) electrical supply, radiation protection, equipment and instructions to be followed for portable/ward radiography.<br>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. | 9 |
| IV | Macro-radiography: Principle, advantage, technique and applications.<br>Stereography - Procedure - presentation, for viewing, stereoscopes, stereometry.<br>High KV techniques principle and its applications.<br>Soft tissue Radiography including Mammography - its techniques, equipment, advancements and applications. Localization of foreign bodies. Various techniques. | 9 |

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|---|---|---|
| V | Trauma radiography/Emergency radiography. Neonatal and Pediatric Radiography, Tomography and Tomosynthesis. Dual energy X-ray absorptiometry. Forensic Radiography. Conventional Tomosynthesis. Xeroradiography | 9 |

**Textbooks**:

- ***Clark's Positioning in Radiology,*** Steward Whitley, 13th edition, CRC Press

## IV SEMESTER-PRACTICAL

**Course No** **: BMRIT/406P**
**Course Title** **: Clinical Radiography - II**
**Credit** **: 1 (0-0-1)**

Practical will include the following and additional as prescribes to cover all theoretical aspects.

1. Lower Extremities radiography
2. Spinal column radiography
3. Pelvic radiographic examinations
4. Demonstration and observation of patient preparation, techniques involved in topics covered in theory
5. Demonstration of traumatic patient radiography
6. Observation of Forensic radiography
7. Presentation on related topics

## IV SEMESTER-THEORY

**Course No** : **BMRIT/402T**

**Course Title** : **Medical Imaging Informatics**

**Credit** : **3 (2-1-0)**

**Course Description**: Medical Imaging informatics is a field that address the gathering, transfer, storage, display, perception and use of information in radiology. It discusses digital radiographic image, digital computers, digital information technology and computer network. It addresses picture archiving and communication systems and image processing methods

**Course Outcome**: At the end of the course, a student should be able to explain his knowledge and understanding on

- CO402:1 Digital radiology – CR and DR systems.
- CO402:2 Newer methods of recording and printing images.
- CO402:3 DICOM format for storage and transfer of images
- CO402:4 Various types of non-conventional films – advantages and disadvantages
- CO402:5 Methods of storage using computer technology
- CO402:6 Electronic devices and computers in the use of archiving, PACS
- CO402:7 Transmission of studies and Teleradiology

***Pre-requisite**: Thorough understanding of BMRIT/102T, BMRIT/301T, BMRIT/401T*

**Course Outline**:

| **Mode of Teaching and Learning : Lecture, Tutorial, Continuous interactive learning, e-learning**<br>**Evaluation of Course Outcome : Internal Assessment and End Semester Examination** | | |
|---|---|---|
| **UNIT** | **TOPICS** | **Hours** |
| I | Introduction to digital Radiography and PACS: Analog representation of Data, Digital representation of data, analog to digital conversion, Conventional film/ screen radiography, digital radiography, Photostimulable Phosphor, Flat panel detectors, Picture archiving and communication systems, transitioning from Film/screen to digital imaging | 9 |
| II | Basics principles of Digital Imaging: Analog image vs digital image, characteristic of a digital image, pixel, matrix size, FOV, Image quality characteristics, brightness, contrast Resolution, spatial resolution, Noise, Exposure latitude, defective quantum efficiency<br>Digital Image Processing and manipulation: Image sampling, Nyquist theorem, aliasing, Quality control workstation function, contrast manipulation, spatial frequency resolution, image manipulation, Image management. | 9 |
| III | Digital Image Acquisition: Imaging plate, acquiring and forming of image, reader, signal digitization, Image data recognition and preprocessing, artifacts.<br>TFT Flat-panel Array Image Acquisition: Active-matrix flat panel imager (AMFPI), flat panel array design and performance, artifacts<br>CCD/CMOS Image Capture: Charge-coupled devices (CCDS), advantages and disadvantages, Complementary metal Oxide semiconductor (CMOS) system, comparison between CCDS and CMOS technology. | 9 |
| IV | Picture Archiving and Communication Systems (PACS): Computer network, network communication medium, application interfacing, DICOM, HIS, RIS.<br>PACS fundamentals: Image acquisition, Archive servers, PACS Workflow, system architecture: client/server-based system, distributed system, web-based system, workstation, common function of PACS workstation, advanced workstation function.<br>PACS Archiving and peripherals: Archiving components, image manager, Image storage, RAID, disk, tape, ASP. Film digitizers, wet/dry imagers, CD/DVD Burners. | 9 |
| V | Quality Control and Quality Management: PACS equipment QC, daily/monthly, quarterly monitor QC, Daily/weekly QC of wet and dry laser imager, workstation processing and image transfer speed, data integrity and compression recall, PACS CQI,<br>Tele-radiology, remote servicing, remote reporting. | 9 |

**Textbook:**

- ***Digital radiography and PACS,*** Christi Carter, Beth Veale

**Reference Books**:

- ***The essential Physics of Medical Imaging*** Jerrold T Bushberg, J Anthony Seibert, Edwin M Leidholdt, John M Boone

## IV SEMESTER-PRACTICAL

**Course No** **: BMRIT/407P**
**Course Title** **: Medical Imaging Informatics**
**Credit** **: 1 (0-0-1)**

Practical will include the following and additional as prescribed to cover all theoretical aspects

1. Demonstration on use of different types of computers in Radiology department
2. Demonstrations, use and care of Computerized Radiography equipment and cassettes
3. Demonstration on use of Digital Radiography machines
4. Use of DICOM and its usefulness in Radiology
5. Demonstration on use of PACS
6. Demonstration on use of Teleradiology and Remote reporting
7. Use of Internet technology / Cloud Computing and Intra net in Radiology
8. Demonstration on various types of Printers – Analog and Digital
9. Demonstration of Image post processing and reconstruction techniques
10. Demonstration on remote servicing of equipment using internet technology
11. Presentation on related topics

## IV SEMESTER-THEORY

**Course No** : **BMRIT/403T**

**Course Title** : **Mammography**

**Credit** : **3 (2-1-0)**

**Course Description**: This course is to enable students to focus on mammography and learn the different types of mammography techniques and views. It will also help them to learn the anatomy of breasts, maintain the equipment and gain exposure to advancement in breast cancer imaging as well as different image guided-procedures.

**Course Outcome**: At the end of the course, a student should be able to explain his knowledge and understanding on

- CO403:1 Mammography techniques, equipment and basic protocols.
- CO403:2 Newer methods of recording and printing images.
- CO403:3 DICOM format for storage and transfer of images
- CO403:4 Various types of non-conventional films – advantages and disadvantages
- CO403:5 Methods of storage using computer technology
- CO403:6 Electronic devices and computers in the use of archiving, PACS
- CO403:7 Transmission of studies and Teleradiology

***Pre-requisite****: Thorough understanding of BMRIT/203T*

**Course Outline**:

| **Mode of Teaching and Learning : Lecture, Tutorial, Continuous interactive learning, e-learning**<br>**Evaluation of Course Outcome : Internal Assessment and End Semester Examination** | | |
|---|---|---|
| **UNIT** | **TOPICS** | **Hours** |
| I | Mammography-<br>History and introduction<br>Its techniques, equipment advancements and applications, Computed Mammography, Digital Mammography,<br>Basic Standard views, Different type of supplementary views, Evaluation of male breasts. | 9 |
| II | Radiation dose and screening issues- specificity and sensitivity, advantages, hazards of screening. Current trends in screening of breast cancer, Evaluation of palpable lesions, Self-examination vs mammographic screening,<br>Sonomammography: USG screening of breasts, role of Colour Doppler, Elastography safety., | 9 |
| III | Tomosynthesis: Technique, image acquisition, Advantages and disadvantages, dose. MR mammography – indications, technique, Planning and sequences,<br>Artefacts encountered in mammography | 9 |
| IV | Breast cancer screening, BI-RADS classification.<br>Different pathologies of the breast,<br>Role of radiographer, quality assurance in screening programs | 9 |
| V | Image Guided Special procedures (USG Guided FNAC, Biopsy, Wire localization, marker placement), Stereotactic biopsy, pre and post procedural care, Vacuum Assisted Biopsy | 9 |

**Textbooks:**

- ***Breast Cancer Screen and Diagnosis,*** Mahesh K. Shetty, 2015, Springer
- ***Digital Mammography,*** Perter Hogg, Judith Kelly, Claire Mercer, 2015, Springer
- ***Digital Breast Tomosynthesis,*** Alberto Tagliafico, Nehmat Houssami, Massimo Calabrese, 2016, Springer

**Reference Books**:

- ***Breast Cancer,*** Darius S. Francescatti, Melvin J. Silverstein, 2014, Springer
- ***Breast Imaging Essentials,*** Niketa Chotai, Supriya Kurkarni, 2020, Springer

## IV SEMESTER-PRACTICAL

**Course No** **: BMRIT/408P**
**Course Title** **: Mammography**
**Credit** **: 1 (0-0-1)**

Practical will include the following and additional as prescribed to cover all theoretical aspects

1. Demonstration and handling of mammography machine
2. Different mammography imaging techniques ie standard and supplementary
3. Recognizing artefacts in mammography
4. Techniques of sonomammography
5. Planning and scanning of MR Mammography
6. Presentation on related topics

## IV SEMESTER-THEORY

**Course No** : **BMRIT/404T**

**Course Title** : **Ultrasonography and Echocardiography**

**Credit** : **3 (2-1-0)**

**Course Description**: This course is designed to provide students with a basic understanding of Ultrasound, its different equipment features and handling and care. The students are also introduced to routine ultrasonography scans, Doppler studies and different USG-guided special procedures.

**Course Outcome**: At the end of the course, a student should be able to explain his knowledge and understanding on

- CO404:1 Use of ultrasound in diagnostic radiology.
- CO404:2 Handling of equipment's and their maintenance
- CO404:3 Different USG scans done in the department
- CO404:4 Use of Doppler and Elastography.
- CO404:5 Recording and archiving scanned images and printing
- CO404:6 Echocardiography techniques.

***Pre-requisite****: Thorough understanding of BMRIT/201T, BMRIT/204T*

**Course Outline**:

**Mode of Teaching and Learning : Lecture, Tutorial, Continuous interactive learning, e-learning**
**Evaluation of Course Outcome : Internal Assessment and End Semester Examination**

| UNIT | TOPICS | Hours |
|---|---|---|
| I | -Basic physics of ultrasound Imaging and principles terminology.<br>-Transducer technology, components of transducer, types,<br>-Ultrasound machine and its components<br>-Formation of ultrasound image, Scan converter & display.<br>-Interactions between ultrasound & matter. | 9 |
| II | -Routine abdomen,<br>-Pelvic<br>-Obstetric scan.<br>-USG of small parts, testes, breasts, neonatal brain, thyroid, neonatal brain.<br>-Musculoskeletal<br>-Ultrasound guided interventional procedures.<br>For image guidance in aspiration (Pleural & ascitic fluid), FNAC, percutaneous catheter placement / per-cutaneous nephrostomy (Pig Tail) , therapeutic aspiration of cyst (Pancreatic / ovarian etc), Obstructive biliary drainage etc.<br>-Basic ultrasound anatomy and pathology | 9 |
| III | -Recent advances in USG technology.<br>Tissue harmonic imaging, Ultrasound contrast agents, Elastography etc.<br>-Ultrasound in trauma and emergencies.<br>FAST Scan & extended FAST Scan.<br>-PC & PNDT act and its sensitization<br>-Portable sonography / bedside sonography.<br>-Artefacts in ultrasonography.<br>-Biological effects & safety measures in ultrasonography. | 9 |
| IV | -Basic Principles of color Doppler & Doppler shift equation.<br>-Different Doppler techniques: Pulsed Doppler, Continuous wave Doppler, Duplex scanner & Doppler Color flow imaging, its<br>-Advantages & disadvantages.<br>-Application of doppler ultrasound - Vascular study<br>Carotid Doppler, Renal artery Doppler, Upper limb & lower limb Doppler study, Spleno-portal axis Doppler, Abdominal aorta & Obstetric Doppler study. | 9 |

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|---|---|---|
| | -Application of doppler ultrasound - non-vascular study.<br>Tumour / carcinoma, Thyroid, breast, Liver, Scrotum & Testis, uterine & adnexal masses etc. | |
| V | Echocardiography.<br>M-mode, 2D/ 3D echocardiography<br>Visualization of valves, morphology, flow pattern in echocardiography. | 9 |

**Textbooks:**

- ***Essentials of Ultrasound Physics* –** James A Zagzebski
- ***Christensen's Physics of Diagnostic Radiology*-** TS Curry III, TE Dowdy (4th Edition)

**Reference Books**:

- ***Radiologic Science for Technologists-Physics Biology and Protection*-** SC Bushong (10th Edition)

## IV SEMESTER-PRACTICAL

**Course No : BMRIT/409P**
**Course Title : Ultrasonography and Echocardiography**
**Credit : 1 (0-0-1)**

Practical will include the following and additional as prescribed to cover all theoretical aspects

1. Demonstration of various types of USG equipment and handling of different probes/transducer
2. Demonstration of color Doppler and its uses in vascular and non-vascular imaging
3. Uses od different types of probes
4. Demonstration and handling of patients for USG scans
5. Maintenance of USG records, archiving and printing devices.
6. Presentation on related topics

## IV SEMESTER-THEORY

**Course No** : **BMRIT/405T**

**Course Title** : **Quality Assurance and Control**

**Credit** : **3 (2-1-0)**

**Course Description**: This course deals with the various Quality Assurance and Quality control procedure in Radiology department starting from equipment selection phase to various QA test and maintenance procedure. It deals with the study of various rules and regulatory requirement published by various Regulatory Bodies and the role and responsibilities of radiographer/technologist in planning, QA and radiation protection

**Course Outcome**: At the end of the course, a student should be able to explain his knowledge and understanding on

- CO405:1 Various QA procedure
- CO405:2 QA programme and test in X-ray, mammography, CT, Ultrasound and MRI.
- CO405:3 Routine maintenance of various types of machines, record keeping and log book maintenance
- CO405:4 Rules, regulation and guidelines published by various Regulatory bodies
- CO405:5 Role of radiographer/technologist in radiology department

***Pre-requisite**: Thorough understanding of BMRIT/203T, BMRIT/305T*

**Course Outline**:

| **Mode of Teaching and Learning : Lecture, Tutorial, Continuous interactive learning, e-learning**<br>**Evaluation of Course Outcome : Internal Assessment and End Semester Examination** | | |
|---|---|---|
| **UNIT** | **TOPICS** | **Hours** |
| I | Aims and objectives of Quality assurance and quality control. Benefits of QA, Various QA/QC testing instruments, Quality assurance activities: Equipment selection, installation and acceptance phase; Operational phase<br>Quality assurance of Image display, Cassettes and film processing: Sensitometry; Characteristic curve; Storage of films, chemicals and self-life Resolution; Distortion; Artifacts of films and image recording. Monitor calibration. SMPTE pattern, Light leak test, Laser printer Quality Control | 9 |
| II | Quality assurance of Radiography and fluoroscopy equipment: Purpose, Common QC tests, Visual and mechanical inspection, Congruence of radiation and optical field, X-ray and light beam centering, SID indicator accuracy constancy, Accuracy of Accelerating potential (KVp), Exposure timer accuracy, Total filtration, effective focal spot size measurement, Output consistency, linearity of mA and timer, leakage radiation measurement, Dark noise, Image receptor dose, Image uniformity and artifacts, low contrast resolution test, AEC system KV and thickness compensation. AERB guideline | 9 |
| III | Quality assurance of Mammography unit : Mammography QC test, visual inspection and unit checklist, correspondence between X-ray field and Image reception area, collimation test, compression test, effective focal spot size measurement, Output consistency, accuracy of accelerating potential, linearity of mA and timer, total filtration, AEC reproducibility, AEC breast thickness compensation, phantom image quality evaluation, image receptor uniformity test, measurement of mean glandular dose, radiation leakage and survey. AERB guideline | 9 |
| IV | Quality assurance of Computed Tomography unit: Purpose, visual checklist, CT phantoms, ACR phantom, CT number for water and standard deviation ( Noise), CT light alignment accuracy, Coronal and sagittal plane light alignment, gantry tilt, table travel accuracy, collimation test, slice width measurement, CT number accuracy and linearity, low contrast and high contrast resolution, accuracy of Tube voltage (kV), accuracy of timer, linearity of X-ray tube current (mA), total filtration, consistency of radiation output, measurement of computed tomography dose index, radiation leakage and survey. AERB guideline | 9 |
| V | Quality assurance of ultrasound and MRI unit: Purpose, Cleanliness and safety, image display | 9 |

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|---|---|---|
| | and performance, ultrasound phantom testing, Transducer Uniformity, Maximum depth of visualization, Distance measurement accuracy, spatial and contract resolution.<br>QC in MRI, MRI phantom test, geometric accuracy measurement, high contrast spatial resolution, magnetic field homogeneity, slice thickness and position accuracy, RF coil testing. | |

**Suggested readings**:

- ***Atomic Energy (Radiation Protection) Rules, 2004***
- ***Radiation Safety Training Module: AERB publication***
- ***ICRP, NRPB, NCRP and WHO publication***

## IV SEMESTER-PRACTICAL

**Course No** **: BMRIT/410P**
**Course Title** **: Quality Assurance and Control**
**Credit** **: 1 (0-0-1)**

Practical will include the following and additional as prescribed to cover all theoretical aspects

1. Quality Assurance procedure in diagnostic X-Ray
2. Quality Assurance procedure in CT
3. Quality Assurance procedure in Mammography
4. Quality Assurance procedure in USG & MRI
5. Presentation on related topics

## V SEMESTER-THEORY

**Course No** : **BMRIT/501T**

**Course Title** : **Regulatory Requirement and Preventive Maintenance**

**Credit** : **3 (2-1-0)**

**Course Description**: This course deals with the study of various rules and regulatory requirement published by various Regulatory Bodies and the role and responsibilities of radiographer/technologist in preventive maintenance and radiation protection in a radiology department.

**Course Outcome**: At the end of the course, a student should be able to explain his knowledge and understanding on

- CO501:1 Various regulatory requirements published by regulatory bodies
- CO501:2 AERB publication
- CO501:3 Maintenance and care of equipment
- CO501:4 Preventive maintenance

***Pre-requisite****: Thorough understanding of BMRIT/203T, BMRIT/305T, BMRIT/405T*

**Course Outline**:

| **Mode of Teaching and Learning : Lecture, Tutorial, Continuous interactive learning, e-learning**<br>**Evaluation of Course Outcome : Internal Assessment and End Semester Examination** | | |
|---|---|---|
| **UNIT** | **TOPICS** | **Hours** |
| I | Role of Radiographer in Planning, QA & Radiation Protection, Role of technologist in radiology department 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 | 9 |
| II | Regulatory Bodies & regulatory Requirements:<br>AERB - Atomic Energy Regulatory Board)- Atomic Energy Act, Responsibilities, organization, Safety Standard, Codes and Guides, Enforcement of Regulatory requirements. Assignment /responsibilities of Owner, Vendor, Licensee, Radiologist, Radiographer, Medical Physicist, RSO etc. | 9 |
| III | International Commission on Radiological Protection (ICRP)<br>, National Radiological Protection Board (NRPB), National Council on Radiation Protection & Measurements (NCRP) and world Health Organization (WHO) guidelines for radiation protection, pregnancy and radiation protection. NABH guidelines, PNDT Act and guidelines | 9 |
| IV | 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; Record keeping and log book maintenance; Reject analysis and objectives of reject analysis programme. | 9 |
| V | Preventive maintenance, daily, weekly, quarterly, annually. Decommissioning, Medical emergencies involving ionizing radiation, Radioactive waste disposal | 9 |

**Suggested readings**:

- ***ICRP, NRPB, NCRP and WHO publication***

## V SEMESTER-PRACTICAL

**Course No** **: BMRIT/506P**
**Course Title** **: Regulatory Requirement and Preventive Maintenance**
**Credit** **: 1 (0-0-1)**

Practical will include the following and additional as prescribed to cover all theoretical aspects

1. Practical aspect following of AERB guidelines
2. Visit to various installation of diagnostic radiology
3. Demonstration of various shielding devices and barriers
4. Demonstration on guidelines and practice methods issued and revised by AERB from time to time.
5. ELORA – E licensing of Radiological Appliances and guidelines to use ELORA for Diagnostic Radiology installations

## V SEMESTER-THEORY

**Course No** : **BMRIT/502T**

**Course Title** : **Hospital Practice and Patient Care**

**Credit** : **3 (2-1-0)**

**Course Description**: This course deals with the basics of care of patients in relation to Radiology, special care for patients with special needs, basic principles of hospital practices, health, hygiene, ethical aspects of health care and legal and financial aspects of Radiological practice.

**Course Outcome**: At the end of the course, a student should be able to explain his knowledge and understanding on

- CO502:1 NABH vision and mission
- CO502:2 Hospital and departmental procedure under NABH guideline
- CO502:3 Preliminaries required before conducting an examination, patient preparation, consent
- CO502:4 Basis of emergency care and life support skills
- CO502:5 Principles of maintaining cleanliness and hygiene and asepsis
- CO502:6 Professional ethics and values. Clinical, ethical, legal responsibilities of technologists
- CO502:7 Lifesaving drugs and essential drugs in the department

***Pre-requisite****: Thorough understanding of BMRIT/101T, BMRIT/104T, BMRIT/106T*

**Course Outline**:

| **Mode of Teaching and Learning : Lecture, Tutorial, Continuous interactive learning, e-learning**<br>**Evaluation of Course Outcome : Internal Assessment and End Semester Examination** | | |
|---|---|---|
| **UNIT** | **TOPICS** | **Hours** |
| I | NABH guidelines, Hospital procedure: Hospital staffing and organization; medico- legal aspects; stock-taking and stock keeping. Department staffing and organizations; records relating to patients and departmental statistics; professional attitudes of the technologist to patients and other members of the staff, medico-legal aspects accidents in the department; General preliminaries to the exam patient preparation, consent- informed and applied. | 9 |
| II | Basics of emergency care and life support skills, First aid: Aims and objectives of first aid; Emergency treatment to the collapsed patient. Artificial respiration and resuscitation. First aid - shock, electrical shock, hemorrhage, burns, Asphyxia, fractures, loss of consciousness | 9 |
| III | General principles of hygiene- personal hygiene, patient hygiene, departmental hygiene. Special care in reference to communicable diseases, AIDS, universal precautions, handling of infectious patients, preventing cross-infection. Asepsis in department, procedures, importance of aseptic environment, handling of syringes, needles, personal protection Infection prevention and control: Universal precautions,hospital acquired infections- HIV, Hepatitis B, C, and MRSA etc. Principles of asepsis: Sterilization | 9 |
| IV | 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. Administration of drugs and contrast media. | 9 |
| V | Professional values-Integrity, Objectivity, Competence and confidentiality. Personal values-ethical/moral values. Attitude and behavior, code of conduct, responsibility, importance of team efforts. Cultural issues in healthcare environment. | 9 |

**Textbooks:**

- ***Concise textbook on Hospital Management and Patient Care in Diagnostic Radiology*****,** Dr. NK Kardam, Lalit Agarwal, 1st Edition 2020, JBD Publications

**Reference Books**:

- ***Text book of Radiology for Technicians,*** Satish Bhargava
- ***Diagnostic Radiology*** – Grainger, Allison
- ***Introduction to Health Care Management, Fourth Edition,*** Sharon B. Buchbinder, Nancy H. Shanks, Bobbie J Kite

## V SEMESTER-PRACTICAL

**Course No** **: BMRIT/507P**
**Course Title** **: Hospital Practice and Patient Care**
**Credit** **: 1 (0-0-1)**

Practical will include the following and additional as prescribed to cover all theoretical aspects

1. Visit to hospital/Radiology department
2. Demonstration of drugs in radiology department
3. Introduction and demonstration of basic first aid
4. Maintenance of hygiene and asepsis including personal protection
5. Handling of emergencies in radiology department
6. Professional values
7. Presentation on related topics

## V SEMESTER-THEORY

**Course No** : **BMRIT/503T**

**Course Title** : **Molecular Advanced Imaging**

**Credit** : **3 (2-1-0)**

**Course Description**: This course deals with the introduction of Advance Molecular Imaging and its uses on modern Healthcare delivery system. To study various imaging system like SPECT, PET, PET-CT, PET-MRI and pathophysiology of various cancer.

**Course Outcome**: At the end of the course, a student should be able to explain his knowledge and understanding on

- CO503:1 Molecular imaging and its uses
- CO503:2 Role of Radio Imaging in early detection and management
- CO503:3 Various molecular imaging equipment
- CO503:4 Pathophysiology of various cancer
- CO503:5 General approach to clinical diagnosis of various tumors.
- CO503:6 SPECT, PET, PET-CT, PET-MRI

***Pre-requisite****: Thorough understanding of BMRIT/202T, BMRIT/203T, BMRIT/402T*

**Course Outline**:

| **Mode of Teaching and Learning : Lecture, Tutorial, Continuous interactive learning, e-learning**<br>**Evaluation of Course Outcome : Internal Assessment and End Semester Examination** | | |
|---|---|---|
| **UNIT** | **TOPICS** | **Hours** |
| I | Introduction to Advanced Molecular imaging and its uses in modern health care delivery system. Role of Radio imaging in early detection and curative management of diseases by early detection<br>Pathophysiology of Various diseases processes with particular emphasis on Pathophysiology of Various Cancers | 9 |
| II | Diagnostic Onco imaging – Multimodality approach in benign and malignant conditions –Role of Radiology and Various Imaging techniques<br>General approach to clinical diagnosis of various tumours | 9 |
| III | Interventions in Oncology management and various Radiographic procedures for management of various cancers – Curative and palliative management | 9 |
| IV | Nuclear Medicine: Radioactivity and nuclear transformation, Radio nuclide production, radiopharmaceuticals | 9 |
| V | Nuclear Imaging: Scintillation camera, Single Photon emission computed tomography, Positron emission tomography, Hybrid Imaging/Dual modality imaging – SPECT-CT, PET-CT, PET - MRI | 9 |

**Textbooks:**

- ***Molecular Diagnostics: Fundamentals, Methods and Clinical Applications***, Lela Buckingham, 3rd Edition, 2019, FA Davis Company

**Reference Books**:

- ***The essential Physics of Medical Imaging*** Jerrold T Bushberg, J Anthony Seibert, Edwin M Leidholdt, John M Boone

## V SEMESTER-PRACTICAL

**Course No** **: BMRIT/508P**
**Course Title** **: Molecular Advanced Imaging**
**Credit** **: 1 (0-0-1)**

Practical will include the following and additional as prescribe to cover all theoretical aspects.

1. Clinical visit
2. Presentation on related topics

## V SEMESTER-THEORY

**Course No** : **BMRIT/504T**

**Course Title** : **CT Radiographic Techniques - I**

**Credit** : **3 (2-1-0)**

**Course Description**: This course deals with CT scan. The students are taught about the physics and technical aspects of CT scan including room layout, radiation safety and maintenance of quality assurance according to AERB guidelines. Use and administration of contrast (Oral and IV) including pressure injector.

**Course Outcome**: At the end of the course, a student should be able to explain his knowledge and understanding on

- CO504:1 Technical aspects (parameters) of CT scan examination and components in CT scan room.
- CO504:2 Radiation protection and quality assurance (Role of radiographers) according to AERB
- CO504:3 Post processing and archiving.

***Pre-requisite****: Thorough understanding of BMRIT/203T, BMRIT/402T, BMRIT/501T*

**Course Outline**:

| **Mode of Teaching and Learning : Lecture, Tutorial, Continuous interactive learning, e-learning**<br>**Evaluation of Course Outcome : Internal Assessment and End Semester Examination** | | |
|---|---|---|
| **UNIT** | **TOPICS** | **Hours** |
| I | Basic Computed Tomography- Basic principles of CT, history, CT machine and its components, generations of CT, Data acquisition, Advantages and disadvantages of CT | 9 |
| II | CT image reconstruction and display parameters, CT Image quality and Image Resolution | 9 |
| III | Post processing, Recording CT images, digital archiving | 9 |
| IV | Contrast agents- pressure injector mode of administration, management of adverse reaction | 9 |
| V | Housing transport, requirements, AERB guidelines for CT techniques to reduce patient dose and radiation protection, artifacts in CT and techniques to minimize artifacts | 9 |

**Textbooks:**

- ***Computed Tomography,*** Ehsan Samei, Norbart J. Pelc, 2020, Springer
- ***Step by Step CT,*** D.Karphikeyan and Deepa Chegu

**Reference Books**:

- ***CT Colonography for Radiographers,*** Joel H. Bortz, Arrthi Ramlaul, 2016, Springer
- ***CT of the Acute Abdomen,*** Patrice Taourel, 2011, Springer
- ***Cardiac CT,*** Marc Dewey, 2011, Springer

## V SEMESTER-PRACTICAL

**Course No** : **BMRIT/509P**

**Course Title** : **CT Radiographic Techniques - I**

**Credit** : **1 (0-0-1)**

Practical will include the following and additional as prescribed to cover all theoretical aspects

1. Demonstration of parts of CT scan machine
2. Use of contrast in CT imaging
3. Demonstration of image archiving in CT
4. Presentation on related topics

## V SEMESTER-THEORY

**Course No** : **BMRIT/505T**

**Course Title** : **CT Radiographic Techniques - II**

**Credit** : **3 (2-1-0)**

**Course Description**: This course deals with clinical application of CT scan. The students are taught about the clinical application of CT scan. Use and administration of contrast (Oral and IV) including CT guided procedures.

**Course Outcome**: At the end of the course, a student should be able to explain his knowledge and understanding on

- CO505:1 Clinical application of CT scan in diagnosis of various disease
- CO505:2 Dosage and administration of contrast
- CO505:3 Safety measures and precaution in CT scan.

***Pre-requisite****: Thorough understanding of BMRIT/203T, BMRIT/402T, BMRIT/501T*

**Course Outline**:

| **Mode of Teaching and Learning : Lecture, Tutorial, Continuous interactive learning, e-learning**<br>**Evaluation of Course Outcome : Internal Assessment and End Semester Examination** | | |
|---|---|---|
| **UNIT** | **TOPICS** | **Hours** |
| I | CT Head, Chest, Abdomen, Head and Neck, Chest. CT Musculoskeletal Imaging | 9 |
| II | Normal anatomy and pathologic in CT images | 9 |
| III | CT guided intervention guided procedures | 9 |
| IV | Recent advanced techniques in CT Scan, Dual source system, Virtual endoscopy, PET – CT Fusion, Dynamic computed tomography | 9 |
| V | CT Radiation Dose Reduction and Radiation protection equipments, application and management of contrast media | 9 |

**Textbooks:**

- ***CT Colonography for Radiographers,*** Joel H. Bortz, Arrthi Ramlaul, 2016, Springer
- ***CT of the Acute Abdomen,*** Patrice Taourel, 2011, Springer
- ***Cardiac CT,*** Marc Dewey, 2011, Springer Course Outline

**Reference Books**:

- ***Computed Tomography,*** Ehsan Samei, Norbart J. Pelc, 2020, Springer
- ***CT and MRI Pathology,*** Michael L Grey and Jagan N Ailnani

## V SEMESTER-PRACTICAL

**Course No** : **BMRIT/510P**
**Course Title** : **CT Radiographic Techniques - II**
**Credit** : **1 (0-0-1)**

Practical will include the following and additional as prescribed to cover all theoretical aspects

1. Demonstration and performing of various examinations covered in theory
2. Visits to hospital/radiology department
3. Presentation on related topics

## VI SEMESTER-THEORY

**Course No** : **BMRIT/601T**

**Course Title** : **Interventional Radiology and Angiography**

**Credit** : **3 (2-1-0)**

**Course Description**: This course is design to expose the students that Interventional Radiology is a medical sub-specialty of radiology utilizing minimally invasive image – guided procedure to diagnose and treat disease. Basic principle and technique of angiography and DSA, equipment and accessories used in IR, various diagnostic and angiography procedure, use of DSA and angiography.

**Course Outcome**: At the end of the course, a student should be able to explain his knowledge and understanding on

- CO601:1 Basic principles of IR
- CO601:2 Various diagnostic and angiography procedure
- CO601:3 Equipment and accessories used in IR
- CO601:4 Uses of angiography and DSA

***Pre-requisite****: Thorough understanding of BMRIT/201T, BMRIT/202T, BMRIT/203T, BMRIT/402T*

**Course Outline**:

| **Mode of Teaching and Learning : Lecture, Tutorial, Continuous interactive learning, e-learning**<br>**Evaluation of Course Outcome : Internal Assessment and End Semester Examination** | | |
|---|---|---|
| **UNIT** | **TOPICS** | **Hours** |
| I | Basic angiography and DSA: History, technique, patient care, Percutaneous catheterization, catheterization sites, Asepsis, Guidewire, catheters, pressure injectors, accessories, Use of digital subtraction- single plane and bi-plane. | 9 |
| II | Diagnostic procedures including angiography, angioplasty, billary examination, renal evaluation and drainage procedure. Central Nervous System: Myelography, Cerebral studies, Ventriculography | 9 |
| III | Arthrography: Shoulder, Hip, Knee, Elbow | 9 |
| IV | Carotid Angiography (4 Vessel angiography)<br>Thoracic and Arch Aortography, Selective studies: Renal, SMA, Coeliac axis, Vertebralangiography, Femoral arteriography, Angiocardiography<br>DSA -indications, use, techniques | 9 |
| V | Venography: Peripheral venography, Cerebral venography, Inferior and superior venocavography, Relevant visceral phlebography<br>Cardiac catheterization procedures: PTCA, BMV, CAG, Pacemaker, Electrophyiology | 9 |

**Textbooks:**

- ***Handbook of Interventional Radiologic Procedures, 5th Edition,*** Krishna Kandarpa, Lindsay Machan, Janett D. Durham

**Reference Books**:

- ***CT and MR Guided Interventions in Radiology,*** Andreas H. Mahnken, Kai E. Wilhelm, Jeans Ricke, 2014, Springer
- ***Diagnostic and Interventional Radiology,*** Thomas J. Vogl, Wolfgang Reith, Ernst J. Rummeny, 2016, Springer

## VI SEMESTER-PRACTICAL

**Course No** **: BMRIT/606P**
**Course Title** **: Interventional Radiology and Angiography**
**Credit** **: 1 (0-0-1)**

Practical will include the following and additional as prescribed to cover all theoretical aspects

1. Dry demonstration of various interventional techniques
2. Observation and assisting procedures
3. Demonstration and usage of various types of interventional accessories
4. Demonstration of angiographic techniques
5. Demonstration of vascular interventional techniques
6. Presentation on related topics

## VI SEMESTER-THEORY

**Course No** : **BMRIT/602T**

**Course Title** : **Clinical Cardiac Radiology**

**Credit** : **3 (2-1-0)**

**Course Description**: This course deals with the study of heart disease, heart valves and defects in the size and shape of the heart. Here, the students will be taught about the basics of heart disease involving the lifestyle as well as the radiology anatomy of the heart using various imaging modalities. It will also help them to understand the role of DSA and Cath lab.

**Course Outcome**: At the end of the course, a student should be able to explain his knowledge and understanding on

- CO602:1 Radiology anatomy of the heart using various imaging modalities
- CO602:2 Important disease involving the heart and lifestyle induced disease
- CO602:3 Vascular Imaging of the heart – Intervention
- CO602:4 Role of DSA and Cath Lab

***Pre-requisite**: Thorough understanding of BMRIT/201T, BMRIT/202T, BMRIT/505T*

**Course Outline**:

| **Mode of Teaching and Learning : Lecture, Tutorial, Continuous interactive learning, e-learning**<br>**Evaluation of Course Outcome : Internal Assessment and End Semester Examination** | | |
|---|---|---|
| **UNIT** | **TOPICS** | **Hours** |
| I | Introduction to Role of Radiology in Cardiology<br>Introduction to important diseases involving the Heart with emphasis on Lifestyle induced diseases | 9 |
| II | Basic Radiological anatomy and pathology of the cardiovascular studies using various modalities – X-Ray, Echo, Color Doppler, CT and MRI | 9 |
| III | Emergency imaging of heart diseases<br>Imaging of heart X-Ray, Echo, Color Doppler, CT and MRI | 9 |
| IV | Vascular imaging of the heart. Indications for angiography and viability studies and various techniques | 9 |
| V | Interventions in cardiology and vascular imaging.Role of DSA and Cath lab | 9 |

**Textbook**:

- ***Cardiac CT and MR for Adult Congenital Heart Disease***, Farhood Saremy, 2014, Springer

## VI SEMESTER-PRACTICAL

**Course No** : **BMRIT/607T**

**Course Title** : **Clinical Cardiac Radiology**

**Credit** : **1 (0-0-1)**

Practical will include the following and additional as prescribes to cover all theoretical aspects.

1. Clinical visit
2. Presentation on related topics

## VI SEMESTER-THEORY

**Course No** : **BMRIT/603T**

**Course Title** : **Clinical Neuro Imaging**

**Credit** : **3 (2-1-0)**

**Course Description**: The syllabus deals with basic concept of neuroradiology, the students and taught about the technical aspects of various machine, its uses in diagnostic radiology as a cross sectional imaging (CT and MRI) including newer advanced imaging techniques as functional MRI, diffusion weighted imaging and perfusion imaging as well as interventional guided procedure along with recording and archiving issue in Neuroradiology

**Course Outcome**: At the end of the course, a student should be able to explain his knowledge and understanding on

- CO603:1 To understand the basic principle of Neuro radiology
- CO603:2 Various clinical application studies by using CT, MRI and Interventional studies etc.
- CO603:3 To understand the important disease in CNS
- CO603:4 Post processing and archiving techniques

***Pre-requisite****: Thorough understanding of BMRIT/201T, BMRIT/202T, BMRIT/304T*

**Course Outline**:

| **Mode of Teaching and Learning : Lecture, Tutorial, Continuous interactive learning, e-learning**<br>**Evaluation of Course Outcome : Internal Assessment and End Semester Examination** | | |
|---|---|---|
| **UNIT** | **TOPICS** | **Hours** |
| I | Introduction to Role of Radiology in Neurology<br>Introduction to important diseases involving the CNS | 9 |
| II | Radiological anatomy of the Brain and Spine and the peripheral nerves using various techniques. | 9 |
| III | Emergency imaging of Brain and Head and Neck with emphasis on trauma<br>Imaging of Brain including the central nervous system and various techniquesImaging of the head and neck – various techniques | 9 |
| IV | Emergency imaging of Spine with emphasis on traumaImaging techniques for Spine<br>Imaging of the Peripheral Nervous system | 9 |
| V | Interventions in Neurology – Role of DSA and various interventional techniques<br>Role of intra-operative imaging | 9 |

**Textbook**:

- ***Clinical Neurology and Neuro Anatomy: A localization- Based Approach, 2nd edition Aaron*** Berkowitz, Edition, 2022

## VI SEMESTER-PRACTICAL

**Course No** : **BMRIT/608T**

**Course Title** : **Clinical Neuro Imaging**

**Credit** : **1 (0-0-1)**

Practical will include the following and additional as prescribes to cover all theoretical aspects.

1. Clinical visit
2. Presentation on related topics

## VI SEMESTER-THEORY

**Course No** : **BMRIT/604T**

**Course Title** : **MRI Radiographic Techniques - I**

**Credit** : **3 (2-1-0)**

**Course Description**: This course deals with MRI. Here, the students will be taught about the various physical aspects of MRI, its use in diagnostic radiology, performing of studies, recording and archiving along with factors affecting strong magnetic safety uses in MRI.

**Course Outcome**: At the end of the course, a student should be able to explain his knowledge and understanding on

- CO604:1 Basic principles of MRI
- CO604:2 Various sequences, standard and special sequences
- CO604:3 Clinical applications of MRI
- CO604:4 Dosage and administration of contrast
- CO604:5 Post processing and archiving of MRI studies

***Pre-requisite****: Thorough understanding of BMRIT/201T, BMRIT/202T, BMRIT/304T*

**Course Outline**:

| **Mode of Teaching and Learning : Lecture, Tutorial, Continuous interactive learning, e-learning**<br>**Evaluation of Course Outcome : Internal Assessment and End Semester Examination** | | |
|---|---|---|
| **UNIT** | **TOPICS** | **Hours** |
| I | Introduction to MRI and history, Magnets – types of magnets, Superconductor MRI and newer developments field strength – tesla | 9 |
| II | Basic physics of MRI, Basic sequences, data acquisition<br>Effect of magnetic field on cells | 9 |
| III | MRI machine instrumentation and its components. | 9 |
| IV | Image formation: 2D Fourier transformation method – K-space representation – 3D Fourier imaging – MIP. | 9 |
| V | MRI room design and installation, shielding, requirements, uses, practical aspects.Effect of shielding on image quality, Safety factors in MRI. Precautions in MRI. MRI artefacts (technique to minimise/avoid artefacts. | 9 |

**Textbooks:**

- ***MRI Made Easy (for beginners),*** Govind B Chavhan
- ***Text book of Radiology for Technicians,*** Dr. Satish Bhargava

**Reference Books**:

- ***Magnetic Resonance Angiography,*** James C. Carr, Timothy J. Carroll, 2012, Springer
- ***Cross Sectional Anatomy CT and MRI,*** Govind Chavhan, Bhavin Jankharia
- ***Clinical Functional MRI,*** Christoph Stippich, 2022, Springer
- ***Diffusion Weighted MR Imaging,*** Dow-mu koh, Harriet K. Theony, 2010, Springer
- ***MRI in Practice,*** Catherine Westbrook, John Talbot, 2011, Wiley-Blackwell

## VI SEMESTER-PRACTICAL

**Course No** **: BMRIT/609T**
**Course Title** **: MRI Radiographic Techniques - I**
**Credit** **: 1 (0-0-1)**

Practical will include the following and additional as prescribed to cover all theoretical aspects

1. Visits to MRI unit for demonstration and observation of MRI machine
2. Demonstration of various MR equipment
3. Demonstration and observation of MRI room design and installation
4. Presentation on related topics

## VI SEMESTER-THEORY

**Course No** : **BMRIT/605T**

**Course Title** : **MRI Radiographic Techniques - II**

**Credit** : **3 (2-1-0)**

**Course Description**: The course deals with MRI, various sequence use in clinical MRI examinations including recent advance techniques as functional MRI, spectroscopy, contrast management, adverse effect study and the basic normal and pathologic studies

**Course Outcome**: At the end of the course, a student should be able to explain his knowledge and understanding on

- CO605:1 Various clinical examinations (including sequence, positioning, immobilization etc)
- CO605:2 Understand the common pathology in MRI image
- CO605:3 Use and management of contrast studies
- CO605:4 Technique to minimize artifacts

***Pre-requisite****: Thorough understanding of BMRIT/201T, BMRIT/202T, BMRIT/304T*

**Course Outline**:

| **Mode of Teaching and Learning : Lecture, Tutorial, Continuous interactive learning, e-learning**<br>**Evaluation of Course Outcome : Internal Assessment and End Semester Examination** | | |
|---|---|---|
| **UNIT** | **TOPICS** | **Hours** |
| I | Various clinical application of Pulse sequences used in MRI. | 9 |
| II | MRI Head and Neck, Breast, Thorax,Cardiac, Abdomen, Urinary system Musculoskeletal System imaging | 9 |
| III | Normal and pathologic images in MRI | 9 |
| IV | Diffusion MRI and echo-planar imaging<br>Use of MRI in Interventional MRI, MRI operation suite | 9 |
| V | Recent advances in MRI -MR contrast media – MR angiography – MR Spectroscopy – functionalMRI etc | 9 |

**Textbooks:**

- ***MRI in Practice,*** Catherine Westbrook, John Talbot, 2011, Wiley-Blackwell
- ***Text book of Radiology for Technicians,*** Dr. Satish Bhargava

**Reference Books**:

- ***Clinical Functional MRI,*** Christoph Stippich, 2022, Springer
- ***Diffusion Weighted MR Imaging,*** Dow-mu koh, Harriet K. Theony, 2010, Springer
- ***Magnetic Resonance Angiography,*** James C. Carr, Timothy J. Carroll, 2012, Springer

## VI SEMESTER-PRACTICAL

**Course No** : **BMRIT/610T**

**Course Title** : **MRI Radiographic Techniques - II**

**Credit** : **1 (0-0-1)**

Practical will include the following and additional as prescribed to cover all theoretical aspects

1. Visits to hospital/radiology department
2. Demonstration and performing of examinations covered in theory
3. Presentation on related topics

## VII SEMESTER

**Course No** : **BMRIT/701P**

**Course Title** : **BMRIT Internship I**

**Credit** : **20 (0-0-20)**

## VIII SEMESTER

**Course No** : **BMRIT/801P**

**Course Title** : **BMRIT Internship II**

**Credit** : **20 (0-0-20)**

**INTERNSHIP I & II** –***Students have to undertake the rotational postings for minimum of 2400 total hours (calculated based on 8 hours per day of 300 working days in a year) during which students have to work under supervision of an experienced staff inthe following areas. Duty shift/timing will be arranged by the respective hospital/department.***

| Sl.No | Postings | Duration in months | Minimum hours |
|---|---|---|---|
| 1 | Conventional radiography including CR, DR | 2 months | 400 hours |
| 2 | Radiographic special procedures including diagnostic and Therapeutic Interventional Procedures | 2 months | 400 hours |
| 3 | Mammography | 1 month | 200 hours |
| 4 | Ultrasonography & Doppler Imaging | 1 month | 200 hours |
| 5 | Computed Tomography | 3 months | 600 hours |
| 6 | Magnetic Resonance Imaging | 3 months | 600 hours |