

Baba Farid University of Health Sciences



Ordinances & Syllabus

**Bachelor of Science in Medical Radiography and Imaging Technology
(B.Sc. (MRIT))
(3 years Degree Programme)**

(Applicable w.e.f. academic session 2019-20)

Faridkot -151203

B.Sc. Medical Radiography and Imaging Technology
B.Sc. (MRIT)

1. Duration of course

Duration of course shall be 3 years.

2. Admission criteria and qualifications:

The students shall be admitted as per the admission criteria and qualifications prescribed in the Notification issued by the Government of Punjab or by Baba Farid University of Health Sciences, from time to time.

3. Medium of Instructions

The medium of instruction during the course and examinations shall be English.

4. Examination Schedule

4.1 The examination shall be held twice a year in the months of May/June and November/December or on such other dates as may be decided by the Board of Management on the recommendation of Faculty of Medical Sciences and Academic Council.

4.2 Normally, the University shall conduct not more than two examinations in a year, for any subject, with an interval of not less than four and not more than six months between the two examinations.

4.3 The last dates for receipt of examination form and late fee in the University Office shall be as under:-

Examination Session	Date for late fee without fee	Date with late fee of Rs.200/-	Date with late fee of Rs.500/-	Date with late fee of Rs.1500/-
May/June	March 1	March 15	March 31	April 15
Nov./Dec.	Sept. 15	Sept. 30	Oct. 15	Oct. 31

4.4 In the case of late declaration of result due to any reason, the last dates for receipt of examination form and fee in the University Office shall be as under:-

Up to 15 days from the date of declaration of result	Up to 30 days from the date of declaration of result	Up to 45 days from the date of declaration of result	Up to 60 days from the date of declaration of result
Without Late Fee	With a late fee of Rs.200/-	With a late fee of Rs.500/-	With a late fee of Rs.1500/-

- Note:
1. Examination Fee including cost of form should be submitted in the shape of Demand Draft in favour of "The Registrar, BFUHS" payable at Faridkot.
 2. The Vice-Chancellor may permit acceptance of admission form and fee ten days before the commencement of examination with a late fee of Rs.5000/.

5. First Year B.Sc.(MRIT) Examination:

The First Year B.Sc.(MRIT) Examination shall be open to a person who

- a) has been enrolled for one academic year preceding the examination in a College of Health Sciences affiliated to this University.
- b) has his/her name submitted to the Registrar by the Principal of the college with the following certificates:-
 - i) of having attended separately in theory and practical/clinical not less than 75% of the lectures delivered and practicals conducted in each of the subjects prescribed for the examination provided that deficiency in the number of lectures delivered and practicals conducted may be condoned by the Principal to the extent of 5% of the lectures delivered.
 - ii) of having secured at least 35% marks of the total marks fixed for internal assessment in each subject, separately, in order to be eligible to appear in all University examinations.
 - iii) of good moral character.

Note: If a candidate fulfils the condition laid down in clause 5(a) & (b) above for one or more subject (s) he/ she may be allowed to take the examination in such subject (s) in which he/ she fulfils the requirements.

- (c) The First Year B.Sc.(MRIT) Annual Examination shall be held in May/June and the supplementary within six months of the annual examinations.
- d) The First Year B.Sc. (MRIT) examination shall be in the following subjects and candidate shall be required to pass all the subjects:-

Sr. No.	Subject	Theory				Practical			Grand Total
		Marks	Int. Assessment	Oral/Viva	Total	Marks	Int. Assessment	Total	
1.	Anatomy	80	20	20	120	60	20	80	200
2.	Physiology	80	20	20	120	60	20	80	200
3.	Radiographic Photography	80	20	20	120	60	20	80	200
4.	Radiographic Techniques – I	80	20	20	120	60	20	80	200
5.	English*	80	20	-	100	-	-	-	100

*Note: The Examination in the subject of English will be conducted at College level and minimum pass marks shall be 35% and marks will be sent to the University for final inclusion in the result.

6. Second Year B.Sc.(MRIT) Examination:

The Second Year B.Sc.(MRIT) Examination shall be open to a person who

- a) has been enrolled for one academic year preceding the examination in a College of Health Sciences affiliated to this University.
- b) has previously passed the First Year B.Sc.(MRIT) examination of this University or an examination of any other recognized University/Institution in India considered equivalent for the purpose by the University.
- c) has his/her name submitted to the Registrar by the Principal of the college with the following certificates:-
 - i) of having attended separately in theory and practical/clinical not less than 75% of the lectures delivered and practicals conducted in each of the subjects prescribed for the examination provided that deficiency in the number of lectures delivered and practicals conducted may be condoned by the Principal to the extent of 5% of the lectures delivered.
 - ii) of having secured at least 35% marks of the total marks fixed for internal assessment in each subject, separately, in order to be eligible to appear in all University examinations.
 - iii) of good moral character.

Note: If a candidate fulfils the condition laid down in clause 6(a), (b) & (c) above for one or more subject (s) he/ she may be allowed to take the examination in such subject (s) in which he/ she fulfils the requirements.

- (d) The Second Year B.Sc. (MRIT) Annual Examination shall be held in May/June and the supplementary within six months of the annual examinations.
- (e) The Second Year B.Sc.(MRIT) examination shall be in the following subjects and candidate shall be required to pass all the subjects:-

Sr. No.	Subject	Theory				Practical			Grand Total
		Marks	Int. Assessment	Oral/Viva	Total	Marks	Int. Assessment	Total	
1.	Basic Radiation Physics	80	20	20	120	60	20	80	200
2.	Conventional Radiological Equipments	80	20	20	120	60	20	80	200
3.	Radiographic Techniques – II	80	20	20	120	60	20	80	200
4.	Radiological Physics including Radiation protection	80	20	20	120	60	20	80	200

7. Third Year B.Sc.(MRIT) Examination:

The Third Year B.Sc.(MRIT) Examination shall be open to a person who

- a) has been enrolled for one academic year preceding the examination in a College of Health Sciences affiliated to this University.
- b) has previously passed the Second Year B.Sc.(MRIT) examination of this University or an examination of any other recognized University/Institution in India considered equivalent for the purpose by the University.
- c) his/her name submitted to the Registrar by the Principal of the college with the following certificates:-
 - i) of having attended separately in theory and practical/clinical not less than 75% of the lectures delivered and practicals conducted in each of the subjects prescribed for the examination provided that deficiency in the number of lectures delivered and practicals conducted may be condoned by the Principal to the extent of 5% of the lectures delivered.
 - ii) of having secured at least 35% marks of the total marks fixed for internal assessment in each subject, separately, in order to be eligible to appear in all University examinations.
 - iii) of good moral character.

Note: If a candidate fulfils the condition laid down in clause 7 (a), (b) & (c) above for one or more subject (s) he/ she may be allowed to take the examination in such subject (s) in which he/ she fulfils the requirements.

- (d) The Third Year B.Sc.(MRIT) Annual Examination shall be held in May/June and the supplementary within six months of the annual examinations.
- (e) The Third Year B.Sc.(MRIT) examination shall be in the following subjects and candidate shall be required to pass all the subjects:-

Sr. No.	Subject	Theory				Practical			Grand Total
		Marks	Int. Assessment	Oral/Viva	Total	Marks	Int. Assessment	Total	
1.	Special Radiological Procedures including Pathology	80	20	20	120	60	20	80	200
2.	Radiological Equipment - Newer Imaging Modalities including Computers	80	20	20	120	60	20	80	200
3.	Quality Assurance and Quality Control	80	20	20	120	60	20	80	200
4.	Hospital Practice and Care of Patient	80	20	20	120	60	20	80	200

8. Internal Assessment

- i) Internal Assessment shall be submitted to the University at least two weeks before the commencement of theory examinations or within one week from the issuance of Roll Numbers by the University. All the colleges shall adopt uniform criteria for Internal Assessment as follows:-
 - a) Attendance above 90% to be acknowledged with 10% extra weight-age for Internal Assessment.
 - b) At least two tests to be held in each year in addition to the pre-final (send up) examination. The Internal Assessment should be the average of all awards of these tests taken together.
 - c) Criteria for calculation of Internal Assessment
 - i) House Examinations - 80%
 - ii) Attendance (above 90%) - 10%
 - iii) Subject assessment (candidate's conduct and extra curricular participation) - 10%
 - d) Additional mandatory requirement for Internal Assessment to be observed by all colleges.
 - i) All test marks obtained by candidates will be displayed on Notice Boards of respective departments as and when they are awarded.
 - ii) All computations of Internal Assessment of the entire class made by the HOD of the department shall be displayed on the notice board of the department showing individual test marks, advantage of all tests, attendance advantage and subjective assessment and the total Internal Assessment thus derived for at least one week before sending the awards to the Principal's office.
 - iii) Professor Incharge/HOD preparing Internal Assessment shall certify that the detailed assessment of the entire class has been displayed on the department Notice Board for at least one week prior to its being submitted for onward transmission to the University and that adequate opportunity has been given to all the students to file any objections and that the same have been addressed satisfactory.
 - iv) The Principal forwarding the Internal Assessment to the University shall countersign the above referred certificate of the HOD/Professor Incharge preparing the Internal Assessment.
 - e) The re-appear/fail students may be re-assessed for improvement in the Internal Assessment and awards of Internal Assessment of all the re-appear/fail students will be submitted to the University every time.

9. Promotion and number of attempts allowed

- a) A candidate who fails in all the subjects in the First Year B.Sc. (MRIT) examination shall not be promoted to Second Year class.
- b) The candidate who will absent himself/herself from the examination will be deemed to have been failed in that subject.
- c) A candidate who passes in at least one subject of University level First Year B.Sc. (MRIT) examination will be permitted to attend classes of Second Year. However, he/she will be allowed to appear in the Second Year B.Sc. (MRIT) examination only after passing all the subjects of First Year B.Sc. (MRIT) Examination.
- d) Candidate who passes in one or more subjects of First Year B.Sc. (MRIT) examination shall be exempted from appearing in these subject at a subsequent examination, but the candidate must pass the examination in a maximum of four attempts (including first attempt, as a regular candidate), failing which he/ she shall not be allowed to continue his studies.
- e) A candidate who fails in all the subjects in the Second Year B.Sc. (MRIT) examination shall not be promoted to Third Year class.
- f) A candidate who passes in at least one subject of University level Second Year B.Sc. (MRIT) examination will be permitted to attend classes of Third Year. However, he/she will be allowed to appear in the Third Year B.Sc. (MRIT) examination only after passing all the subjects of Second Year B.Sc. (MRIT) Examination.
- g) Candidate who passes in one or more subjects of Second Year B. Sc. (MRIT) examination shall be exempted from appearing in these subject at a subsequent examination, but the candidate must pass the examination in a maximum of four attempts including first attempt, as a regular candidate plus one mercy chance at the discretion of the Vice-Chancellor, failing which he/ she will have to appear in all the subjects of the examination.
- h) Candidate who passes in one or more subjects of Third Year B.Sc.(MRIT) examination shall be exempted from appearing in these subject at a subsequent examination, but the candidate must pass the examination in a maximum of four attempts (including first attempt, as a regular candidate), failing which he/ she will have to appear in all the subjects.

10. Appointment of Examiners:

The examiners shall be appointed by the University on the recommendations of the Board of Studies in Medical Sciences (Undergraduates)/Faculty of Medical Sciences.

- i) There shall be four examiners – two internal and two external.
- ii) Professor & Head of the Department shall be the Convener. The second Internal Examiner will be appointed by annual rotation from amongst the Professors/Associate Professors/Assistant Professor with at least 3 years post PG teaching experience. In case of non-availability of Professors/Associate Professors/Assistant Professor in the department the teacher working in another Medical College affiliated to this University, who fulfils the minimum requirements as per MCI norms for appointment as examiner may be appointed as Internal Examiner.

- iii) The examiners shall be appointed by the University from the teachers working in the Medical Colleges affiliated to it, preferably from the colleges where this course is being run, on the recommendations of the Board of Studies in Medical Sciences and Faculty of Medical Sciences.
- iv) In case of non-availability of External Examiners from amongst the affiliated colleges of BFUHS, External Examiners may be appointed from the colleges which are not affiliated to BFUHS, Faridkot, in and outside the State of Punjab.

11. Paper setting and moderation of Question Papers

Each theory paper shall be of three hours duration. The paper setting and moderation of Question Papers will be got done under the direction of the Vice-Chancellor, if necessary.

The question paper covering the entire course shall be divided into two sections.

Section A:

Question 1: This will consist of five short answer questions with answer to each question up to 250 words in length. All questions will be compulsory. Each question will carry 5 marks total weight-age being 25 marks.

Question 2: This will consist of two long answer questions with answer to each question up to 1000 words in length in length. Two questions will be set by the examiner and the candidate will be required to attempt one. Each question will carry 15 marks.

Section B

Question 1: This will consist of five short answer questions with answer to each question up to 250 words in length. All questions will be compulsory. Each question will carry 5 marks total weight-age being 25 marks.

Question 2: This will consist of two long answer questions with answer to each question up to 1000 words in length. Two questions will be set by the examiner and the candidate will be required to attempt one. Each question will carry 15 marks.

12. Evaluation of Answer Books

The answer books shall be got evaluated by putting fictitious roll numbers thereon or spot evaluation (table marking) or any other method under the direction of the Vice-Chancellor.

13. Minimum pass marks:

The minimum number of marks to pass the examination shall be 50% in theory including Internal Assessment & Oral/Viva and 50% in practical including Internal Assessment in each subject separately except in the subject of English where minimum pass marks shall be 35%.

A successful candidate on the basis of theory and practical marks taken together shall be classified as under: -

Second Class : A candidate obtaining 50% or more marks but less than 60% marks

First Class : A candidate obtaining 60% or more marks

First Class : A candidate obtaining 80% or more marks

with Distinction

14. Grace Marks:

That the grace marks up to 5 (five) be given to the best advantage of the students irrespective of Theory or Practical examinations.

15. Declaration of Result

The Registrar/Controller of Examinations shall publish the result after the examination. The candidates shall be issued Detailed Marks Certificate through their Principals.

16. Award of Degree

On successfully passing the Third Year B.Sc.(MRIT) examination the students shall be awarded the Degree of Bachelor of Sciences Medical Radiography and Imaging Technology.

SYLLABUS
B.Sc. Medical Radiography and Imaging Technology
B.Sc. (MRIT)

A THREE YEAR PROGRAMME

INTRODUCTION:

In the modern concept of medical science, the importance of the support from paramedical professional cannot be over emphasized. It is for this reason that the Institute attaches great value to these disciplines and organizes the training programmes within its fold with provision to review and update the course outlines and syllabi periodically to keep pace with the newer developments taking place in these fields. B.Sc. Medical Radiography and Imaging Technology is one such training programme, which has an important role to play in the service of suffering humanity.

The training of the candidates registering for B.Sc. Medical Radiography and Imaging Technology course is aimed at equipping them adequately to carry out all the routine as well as some of the modern sophisticated diagnostic and imaging procedures in a modern hospital apart from handling all the radiological and imaging equipments with special care of quality control and radiation safety aspects.

The basis for the training is “in-service training”, supplemented by a series of lectures cum demonstrations on the theoretical aspects of various subjects.

The students are posted by rotation in all the diagnostic and imaging sections and rooms.

The students are evaluated by a system of internal assessment and three annual examinations. The final examination at the end of the third year is a comprehensive one.

TRAINING:

The training is spread over three years and includes both lectures and practicals. For the practical training, the students are posted in various sections and rooms in Radiodiagnosis and imaging deptt. and they engage themselves in the day work together with the employed technologists under the control of tutor technologists and supervisors. Students participate in seminars, journal clubs, group discussion and maintain daily work book to keep record of their day to day practical work/clinical posting which is signed both by the technologist Incharge of the xray room of their posting and countersigned by the tutors/lectures.

SYLLABUS**FIRST YEAR B.Sc. (MRIT)****Paper – I : ANATOMY**

Theory: 70 Hours
Practical: 20 Hours

Theory:**1. Introduction:**

- Definition of anatomy and its divisions, Terms of location, positions and planes.
- Cell and its organelles, Tissues & its classification, Glands.

2. Musculoskeletal system:

- Structure of Bone & its types.
- Joints- Classification of joints with examples; details of synovial joint.
- Bones & joints of upper limb, lower limb and their movements.
- Axial skeleton & appendicular skeleton.
- Skull, spine & its movements, intervertebral disc.
- Muscles & its types.
- Muscles of the upper limb, lower limb, trunk and neck.

3. Cardiovascular System:

- Arteries & veins, Capillaries & arterioles.
- Heart- size, location, chambers, blood supply of heart, pericardium.
- Systemic & pulmonary circulation.
- Major blood vessels of Heart- Aorta, pulmonary artery, common carotid artery, subclavian artery, axillary artery, brachial artery, common iliac artery, femoral artery.
- Inferior vena cava, portal circulation, great saphenous vein.

4. Lymphatic System:

- Lymph & Lymph vessels.
- Structure of lymph node, names of regional lymphatics, auxiliary and inguinal lymph nodes.

5. Gastro-intestinal System:

- Parts of GIT, structure of tongue, pharynx, salivary glands.
- Location & Gross structure of Oesophagus, stomach, intestine (small and large), liver, gall bladder, pancreas, spleen.

6. Respiratory system:

- Parts of Respiratory system; Structure of nose, nasal cavity, larynx, trachea, lungs, pleura, bronchopulmonary segments.

7. Urinary System:

- Parts of Urinary system, location and gross structure of kidney, ureter, urinary bladder, urethra.

8. Reproductive system:

- Parts of male reproductive system, gross structure of testis, vas deferens, epididymis, prostate.
- Parts of female reproductive system, gross structure of uterus, ovary, fallopian tube, mammary gland.

9. Endocrine glands:

- Name of all endocrine glands, gross structure & functions of pituitary gland, adrenal gland, thyroid gland and parathyroid gland.

10. Nervous system:

- Neuron, classification of NS.
- Meninges, ventricles, CSF.
- Gross features of cerebrum, midbrain, pons, medulla oblongata, cerebellum, name of basal nuclei.
- Blood supply of brain, cranial nerves.
- Spinal cord and spinal nerves.
- Autonomic nervous system.
- Visual & auditory pathways

11. Sensory Organs:

- Skin & its appendages.
- Structure of eye & lacrimal apparatus, name of extraocular muscles.
- Structure of ear: external, middle & inner ear.

Practical:

Demonstration of all bones AND organs of the human body.

Histology:

- Epithelium: Simple (squamous, cuboidal, columnar, ciliated), Stratified, Transitional
- Bone, muscles (skeletal, smooth, cardiac)
- Cartilage (hyaline, elastic, fibro cartilage).
- Connective Tissue (loose and dense).
- Arteries (large & medium sized), Veins.

Radiographs:

Normal Radiographs of Chest, Upper Limb, Lower Limb, pelvis & spine.

Reference Books

1. Ross and Wilson, Anatomy and Physiology, Churchill Livingstone.
2. Companion Pocketbook for quick review
3. B.D. Chaurasia's Human Anatomy -Vol. (1,2,3)
4. Anatomy for B.Sc. Nursing – Dr Renu Chauhan

SYLLABUS**FIRST YEAR B.Sc. (MRIT)****Paper – II : PHYSIOLOGY**

Theory: 70 Hours
Practical: 20 Hours

Theory:**1. Blood**

- Red Blood Cells- Functions, count, Physiological variations. Erythropoiesis-stages
- Hemoglobin-Functions, Physiological variations.
- White Blood cells-Functions, count, morphology.
- Platelets-count, morphology, functions. Hemostasis-Definition, Mechanism, clotting factors.
- Blood groups-ABO system, Rh system, Blood transfusion- Indication, transfusion reactions.
- Anaemias-classification, morphological and Etiological, effects of anaemia on body.

2. Cardiovascular System

- Heart-Physiological Anatomy, Nerve supply, Properties of cardiac muscle.
- Cardiac Cycle-Events –systole, diastole
- Cardiac Output-Definition and factors affecting it.
- Heart sounds-normal heart sounds, its causes, areas of auscultations.
- Blood Pressure-Definition, normal value, Physiological variations, its measurement.
- ECG- normal waves.
- Shock-Definition, Types.

3. Gastrointestinal System

- Physiological Anatomy, functions of GIT.
- Salivary Gland-functions of saliva.
- Stomach- structure and functions, Gastric secretions-composition, functions, Mechanism
- Pancreas- structure, functions, composition of Pancreatic juice.
- Liver-Functions of liver.
- Bile-Composition, functions.
- Jaundice-Types and its causes.
- Gall Bladder- Functions
- Intestine- Movements of small and large intestine.
- Digestion and Absorption of Carbohydrates, Proteins, Fats.
- Hormones of GIT- Functions of Gastrin, Secretin, CCK-Pz.

4. Respiratory System

- Physiological Anatomy, Functions of the respiratory system.
- Types of respiration, respiratory membrane.
- Lung volumes and capacities, vital capacity and factors affecting it.
- Transport of Oxygen-Forms of transportation, Oxy-hemoglobin dissociation curve

and factors affecting it.

- Transport of Carbon-Dioxide- Forms of transportation.
- Hypoxia-Definition, types, effects of hypoxia.
- Cyanosis-Definition and types.
- Artificial Respiration- CPR

5. Endocrine System

- Classification of Endocrine glands and their hormones.
- Thyroid Gland-Physiological Anatomy, hormones secreted, functions, disorders- Hypo and hyper secretion of hormone.
- Adrenal Gland-Adrenal Cortex-Physiological Anatomy, its hormones and functions.
- Adrenal Medulla-Hormones, functions.
- Pituitary Gland- Anterior and posterior pituitary hormones and their functions, disorders.
- Pancreas- Hormones and their functions, Diabetes Mellitus-types, pathophysiology, signs and symptoms.
- Parathyroid Gland- Hormones and their functions.

6. Central Nervous System

- Structure of neuron, functions of nervous system.
- Classification and properties of nerve fibres
- Synapse- structure and types
- Receptors-Definition, classification, properties, Reflex Arc
- Ascending and Descending tracts- names and functions
- Functions of Hypothalamus
- Functions of Cerebellum and Basal Ganglia
- Functions of Cerebral Cortex
- **Autonomic Nervous System-** Actions of sympathetic and parasympathetic system and their comparison.
- **Special Senses-**Eye-structure, functions of different parts, Visual acuity, Refractive errors
Ear-structure, functions, General mechanism of hearing

7. Excretory System

- Kidneys-structure of nephron, functions of kidney
- Glomerular filtration Rate(GFR) and factors affecting it
- Counter Current Mechanism
- Bladder-its innervation, micturition reflex

8. Reproductive System

- Male Reproductive System-Stages of spermatogenesis, function of Testosterone
- Female Reproductive System-Ovulation, menstrual cycle, functions of Estrogen and progesterone

9. Nerve Muscle Physiology

- Classification of Muscle, structure of skeletal muscle
- Neuromuscular Junction
- Excitation Contraction Coupling

Practicals:

- Estimation of Hemoglobin Concentration
- Determination of Bleeding Time and Clotting Time
- Determination of Blood Groups
- Recording of normal Blood Pressure
- Clinical Examination of Arterial Pulse
- Determination of Vital Capacity

SYLLABUS**FIRST YEAR B.Sc. (MRIT)****Paper – III : Radiographic Photography**

Theory: 70 Hours
Practical: 20 Hours

1. The photographic process: Introduction, visible light, images produced by radiation, light sensitive photographic materials.
2. Image characteristic: Real and mental images, reflected, transmitted and emitted light images Photographic emulsions. The photographic latent image. Positive process.
3. Film materials in X-ray departments, history, structure of an xray film, single and double emulsion films, types of films, cross over effect.
4. Spectral sensitivity of film material, graininess of film material, speed and contrast of photographic materials.
5. Sensitometry: Photographic density, characteristic curves, features of the characteristic curve.
6. Variation in the characteristic curve with the development. Comparison of emulsions by their characteristic curves. Information from the characteristic curve.
7. The storage of film materials and radiograph; Storage of unprocessed films, storing of radiographs-expiry date, shelflife, storage condition, stock control.
8. Intensifying screens and cassettes. Luminescence: fluorescence and phosphorescence. Construction of an intensifying screen.
9. The fluorescent materials. Types of intensifying screens, intensification factor. The influence of KV, scattered radiation. Detail, sharpness and speed , size of the crystals, reciprocity failure, quantum mottle.
10. Cassette design, care of cassettes, types of cassettes, mounting of intensifying screens, loading and unloading of cassettes.
11. Care of intensifying screens, tests to check screen film contact and light leakage.
12. Film processing: Development. The nature of development-manual or automatic. The PH scale.
13. The constitution of developing solutions both in manual and automatic processing and properties of developing chemicals.
14. The development time, factors in the use of a developer, developer activity.
15. Film processing: fixing and role of a fixing solution. Constitution of the fixing solutions and properties of the constituents.
16. Fixer used in automatic processors. Factors affecting the use of the fixer.
17. Regeneration of fixing solution. Silver recovery from waste fixer or from scrap film and its various methods.
18. Rinsing, washing and drying. Objects of rinsing and washing, methods employed. Methods of drying films.
19. Preparation of solutions and making stock solution.
20. Processing equipment: materials for processing equipment, processors for manual operation, hangers, control of chemicals temperature by heating and thermostate, immersion heaters as well as cooling faults.
21. Dark Room: Layout and planning. Dark room construction-Nature of floor, walls, ceiling and radiation protection.
22. Type of entry, door design. Dark room illuminations-white light and safe lighting.
23. Dark room equipment and its layout. Location of pass through boxes or cassette hatches.

24. Systems for daylight film handling. Daylight systems using cassettes and without cassettes.
25. The radiographic image: components in image quality-density, contrast and detail.
26. Unsharpness in the radiographic image. Various factors contributing towards unsharpness – geometric, photographic; motion, mottle, graininess, distortion.
27. The presentation of the radiograph. Identification markers and orientation. Documentary preparation.
28. Viewing accessories: Viewing boxes, magnifiers, viewing conditions.
29. Light images and their recording. The laser imager, CRT cameras, Video-imagers, dry silver imaging.
30. Photo fluorography: cine cameras. Cine fluorography, cine film, derail cameras, processing of cine films, fluorographic films.
31. Cameras for photo fluorography. Sensitometric response of fluorography film.
32. Some special imaging processes, Xero-radiography its meaning, technique and applications.
33. Subtraction: its techniques applied to radiography as well as its applications.
34. Common film faults due to manufacturing as well as due to chemical processing.
35. Management of the quality of the Radiographic images and image quality control.
36. Practicals: (i) test to check the x-ray films and screen contact in the cassette and (ii) test to check light leakage in the cassette. (iii) to prepare a characteristic curve of a radiographic film (iv) to check the effect of safe light on exposed as well as unexposed x-ray film.

SYLLABUS
FIRST YEAR B.Sc. (MRIT)

Paper – IV : Radiographic Techniques – I

Theory: 70 Hours
Practical: 20 Hours

Radiography techniques of whole skeleton comprising of:

Whole Upper limb with special reference to hand, wrist joint, forearm, elbow joint and upper arm. Supplementary techniques for carpal tunnel, scaphoid bone fracture, head of radius and supra-condylar fracture.

Whole Lower limb which includes all the bones with special reference to foot, ankle joint, lower leg, knee joint, patella and upper leg. Supplementary techniques for calcaneum bone, for flat foot, intercondylar notch and head of femur etc.

Shoulder girdle and humerus.

Whole vertebral column, cervical, thoracic, lumbar spine, sacrum and coccyx with special techniques for intervertebral foramina, cervico-dorsal, dorso lumbar,

Lumbosacral joint and S.I. joints.

Pelvic girdle and hip region.

Thorax-complete chest radiography for both the lungs-apical, lordotic and oblique views. Techniques to demonstrate fluid levels/effusion in the thoracic cavity-decubitus AP and lateral views.

SYLLABUS
FIRST YEAR B.Sc. (MRIT)

Paper – V

ENGLISH

Theory : 35 hours

Communication:-

Role of communication Defining Communication Classification of communication Purpose of communication
Major difficulties in communication Barriers to communication
Characteristics of successful communication – The seven Cs Communication at the work place
Human needs and communication “Mind mapping” Information communication

Comprehension passage:-

Reading purposefully
Understanding what is read
Drawing conclusion
Finding and analysis

Explaining:-

How to explain clearly
Defining and giving reasons
Explaining differences
Explaining procedures
Giving directions

Writing business letters:-

How to construct correctly
Formal language
Address
Salutation
Body
Conclusion

Report writing:-

Reporting an accident
Reporting what happened at a session
Reporting what happened at a meeting

SYLLABUS
SECOND YEAR B.Sc. (MRIT)

Paper – I : Basic Radiation Physics

Theory: 70 Hours

Practical: 20 Hours

Properties of matter, heat, light, magnetism, electricity and electromagnetism applied in radiological instruments. Physical principles in the design and working of x-ray tube technology. Construction and working principals of transformers and autotransformers used in xray circuits. Measuring instruments voltage of KV meters. Measurement of tube current in milli and micro amperes. Principles of thermionic emission and rectification in xray technology. High voltage circuits in x-ray Units. Electrical hazards and safety. X-ray tube rating in imaging and therapy xray tube and distance, KV, MA. Introduction to electromagnetic spectrum, definition of wave length and its quantum relationship with peak kilovoltage physical principles of radiation and optical field coverage and the factors affecting the field projected on patient during x-ray imaging. Exponential and trigonometric functions used in radiological calculations.

SYLLABUS**SECOND YEAR B.Sc. (MRIT)****Paper – II : Conventional Radiological Equipment**

Theory: 70 Hours
 Practical: 20 Hours

Electrical system and mains supply:

The electrical system, generation of electricity, distribution of electric energy, use, of electric energy,

High Tension Generators: Rectifications- Types of rectifier-valve and solid state. Self rectified high tension circuit. Half wave, four valve full wave, three phase, full wave rectified circuit voltage wave forms in high tension generators. Constant potential circuits. High frequency generators, falling load generators, Anatomically programmed generators and modular generators.

The X-ray Tube: Historical developments including

General features of the X-ray tube. The fixed anode, rotating anode xray tube. Rating of X-ray tubes, focal spot sizes. Methods of heat dissipation in xray tubes, common tube faults. Developments in the rotating anode tube. Tube stands and ceiling tube supports. Mammography tubes and equipment, accessories. Different types of tubes and choice of an x-ray tube.

Fuses, switches and interlocks: fuses, switches and circuit breakers, interlocking circuits.

Components and controls in the X-ray circuits:

The high tension transformer, the rectification of high tension. The control of kilovoltage, kolovoltage indication. The filament circuit and control of the tube current . Milliamperes indications. Main voltage compensation. Mains supply and the xray set.

Exposure Switches and Exposure Timers: Switching systems timing system, exposure switching and its radiographic applications

The control of scattered Radiation:

Significance of scatter. Beam limiting devices-cones, diaphragm(collimeters) .Beam centring devices . The secondary radiation grid: its types, components of grid, grid movements. The assessment of grid functions, grid-errors, other Scatter reduction methods-air gap technique.

Mains requirements. Portable x-ray machines, Mobile X-ray equipment, Capacitor discharge mobile x-ray unit and x-ray equipment for operation Theatre and for ward radiography.

Fluoroscopic Equipment:

Structure of a fluorescent screen. The fluoroscopic image. The fluoroscopic table, spot film devices and explorators. Protective measures and physiology of vision, image quality.

Image Intensifiers (I.I.T.V. System):

An Image intensifier tube, its design, its application. The television process and television tube its various types. Recording of the intensified image. T.V.monitor, video tape recording, cine radiographic cameras, Remote Control table.

Tomographic Equipment:

Principal of tomography. Various types of tomographic movements, multi-section radiography. Transverse axial tomography. Equipment for tomography.

Equipment for Rapid Serial radiography and angiography:

Rapid film changer. Rapid cassette changer, X-ray generator, x-ray tube, angiographic tables, contrast medium injection device.

Equipment for cranial and Dental Radiography:

The skull table, general dental X-ray equipment, specialized dental X-ray equipment.

Equipment for mammography-general or dedicated

Care, maintenance and tests of X-ray equipment:

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

SYLLABUS**SECOND YEAR B.Sc. (MRIT)****Paper – III : Radiographic Techniques – Part II**

Theory: 70 Hours

Practical: 20 Hours

RADIOGRAPHY TECHNIQUE COMPOSING OF THE COMPLETE

Radiography of Skull and Radiography of cranial bones; including special techniques for sella turcica, orbits, opticforamina, superior orbital fissure and inferior orbital fissure etc.

Facial bones: Paranasal sinuses , Temporal bone and Mastoids.

Dental Radiography: Radiography of teeth-intra oral, extraoral and occlusal view.

Abdomen: Preparation of patient. General abdominal radiography and positioning for fluid and air levels. Plain film examination. Radiography of female abdomen to look for pregnancy. Radiography in case of acute abdomen .

Macroradiography: Principle, advantage, technique and applications.

Tomography - Principle and applications

Stereography – procedure- presentation, for viewing, stereoscopes, stereometry.

High KV techniques principle and its applications.

Soft tissue Radiography including mammography-its techniques, equipment and applications.

Localization of foreign bodies. Various techniques

Ward/mobile radiography- electrical supply, radiation protection, equipment and instructions to be followed for portable/ward radiography.

Operation theatre techniques: General precautions, Aspesis in techniques-checking of mains supply and functions of equipment, selection of exposure factors, explosion risk, radiation protection and rapid processing techniques.

Trauma radiography/Emergency radiography and Paediatric Radiography

SYLLABUS**SECOND YEAR B.Sc. (MRIT)****Paper – IV: Radiological Physics including Radiation Protection**

Theory: 70 Hours

Practical: 20 Hours

Atomic structure as applied to generation of X-rays and radioactivity. Spectrum of diagnostic imaging and therapy X-rays. Production of X-rays and properties of X-rays. Effects of variation of tube voltage, current, filtration, HT waveform and target material on X-ray production. Interaction of X-ray and gamma radiation with matter. Attenuation, absorption and scattering phenomenon. Photoelectric absorption, Compton scattering, pair production and annihilation process. Dependence on the nature and atomic number of the absorber on radiation quality. Transmission of X-ray through body tissues. Linear energy transfer. Range of secondary electrons and electrons build up. Relative amounts of scatter from homogeneous and heterogeneous beam during the passage through a patient. Physical requirement of beam defining devices e.g. cones, diaphragm, collimators etc. Units of radiation measurements. Specification of quality and half-value thickness (HVT) and its measurements. Filters and filtration. Measurement of radiation and dosimetric procedures. Radiation detectors and their principles of working. Physical properties of phantoms, phantom materials.

Basics of Radiation protection principles and Practice

Nature of ionizing radiation, Biological effects of ionizing radiation, sources and magnitude of ionizing exposure.

Quantities and Units relevant to radiological protection

Exposure, absorbed dose, kerma/air kerma, integral dose, equivalent dose, effective dose

Detection and measurement of ionizing /radiation:

Field survey instrument, GM survey instruments, personnel monitoring devices film badge, TLD, pocket dosimeter, pulsed optically stimulated Luminescence dosimeter (POS) etc.

Radiation Protection Procedures for Patients and Personnel

Advisory Group & Regulatory Agencies- ICRP, NCRP, UNSCEAR, AERB.

Limiting exposure to ionizing radiation- Dose limits, ICRP recommendations ALARA principle.

Protection of Personnel- Principles of personnel exposure. Reduction-Time, distance, shielding, protective barriers, protective devices.

Protection of the patient

Beam limitation, technique selection, general shielding, grids, image receptors, projection, repeat radiography etc.

Radiation exposure and pregnancy- ALARA and Pregnancy, the pregnant. Radiation worker, patient and radiation exposure standards.

SYLLABUS**THIRD YEAR B.Sc. (MRIT)****Paper – I : Special Radiological Procedures including Pathology**

Theory: 70 Hours

Practical: 20 Hours

Radiological procedures pertaining to salivary glands, lacrimal system, bronchography, arthrography and hysteron salpangiography-various requirement, trolley set up, indications and contraindications, contrast media radiographic positioning and patient preparation etc.

Ventriculography and encephalography – Technique, contrast media used, film sequence, indication and contra indications.

Myelography Technique, contrast media used, injection of contrast media, indications and contra indications.

I.V.U., cystography, cystourethorography and RGU, MCU etc. patient preparation, Techniques, film sequence, indications and contra indications.

Intra venous cholangiography, T. Tube, Cholangiography, preoperative cholangiography, procedure, contrast media, indications and contra indications.

Upper & Lower G.I. tract studies: Braium swallow, meal, follow through including double contrast barium studies (small bowel enema, Ba Enema etc.) Procedure, requirements, indications, contra indications and contrast media used and the radiographic techniques.

Angiography: Cerebral, cardiac, abdominal. Aortography – general, renal, renal and selective renal procedure, indications, contra indication, contrast media, technique films sequence & post care.

Splenoportovenography: Peripheral Arterial and Venous angiography, precautions, radiation protection, film changers, manual or automatic biplane, contrast media, injection procedure and technique.

Intraventional radiological procedures:

PTC, PTBD, ERCP, fine needle aspiration cytology, percutaneous nephrostomy.

Cardiac catheterization-embolization, dilation etc.

MRI, US, CT Imaging techniques related pathology including cross sectional anatomy.

SYLLABUS**THIRD YEAR B.Sc. (MRIT)****Paper – II : Radiological equipment- Newer Imaging Modalities and Computers**

Theory: 70 Hours

Practical: 20 Hours

Computed tomography: historical development, its principle, physics & equipment and various generations and definition of terms including applications.

Diagnostic Ultrasound including doppler: Its principle, applications and role in medicine. Various types of transducers and definition of terms.

Digital Radiography and Vascular Imaging Equipment: Introduction, historical developments, Principle, scanned projection radiography, digital subtraction angiography, applications and definition of terms, Computed radiography its advantages, disadvantages.

M.R.I.: Physics of magnetic Resonance, Production of the MR image and MRI equipment and Principle, applications, its advantage over computed tomography or ultrasonography: Its limitations and uses.

Computer : (Fundamentals & applications in Radiology)

Computer Systems- definition, introduction, Hardware organization, software concepts.

Computer Architectures and Processing capabilities- Types, Terminology

Data Storage Technologies – Secondary storage – magnetic Tape, Magnetic disk, Redundant Array of independent disks, optical disk storage and storage capacity.

Data Communication: Data transmission media, Data communications, hardware, Network Topologies

The Internet – Major Components and Types

Applications:

Imaging applications

Non Imaging applications

Information system

Picture Archiving and communication system

Communication protocol standards used in medicine

SYLLABUS**THIRD YEAR B.Sc. (MRIT)****Paper – III : Quality assurance and Quality Control**

Theory: 70 Hours
Practical: 20 Hours

Aim of quality assurance in medical care and radiodiagnosis.

Regulations and Accreditation.

Purchasing Equipment

Identification of imaging requirements

Developments of equipment specifications.

Selection of equipment

Installations Acceptance testing of equipment

Continuing education

Monitoring Equipment Performance

Routine checks of all radiological and imaging equipment including CT & MRI

Routine checks of film processing systems

Measure the quality of external radiation beams and

Specify faults within these systems to allow corrective measures to be taken

Responsibility

Processor Monitoring, External beam evaluation

Routine checks of Diagnostic radiographic system like-focal spot size determination, half value layer, collimator, check, central ray and Bucky tray accuracy, distance and centering indicators accuracy, Angulator or protector accuracy, KV accuracy, MA accuracy, exposure timer accuracy, resolution, exposure reproduceability.

Ancillary Equipment Monitoring : Cassette cleaning and inspection, film/screen contact, view box uniformity.

Repeat Film analysis : Cause of reject, documentation

Troubleshooting

SYLLABUS**THIRD YEAR B.Sc. (MRIT)****Paper – IV : Hospital practice and care of the patient**

Theory: 70 Hours

Practical: 20 Hours

Hospital staffing and administration, records, professional, ethics , co-operation with other staff and departments, Departmental organization. Handling of the patients, seriously ill and traumatized patients, visually impaired, speech and hearing impaired, mentally impaired, drug addicts and non-english speaking patients. Understanding patient needs- patient dignity of inpatient and out patient. Interaction with the patients relatives and visitors. Methods of effective communication- verbal skills, body language, professional appearance, visual contact etc. Elementary personal and departmental hygiene, dealing with receptacles, bed pans and urinal etc. General preliminaries to the exam. Moving chair and stretcher, patient. Unconscious patient general comfort and reassurance for the patient. Vital signs and oxygen-patient's Haemostasis status. Body temp. respiratory rate, pulse blood pressure, oxygen therapy, oxygen devices, chest tubes and lines. First aid- shock, electrical shock, haemorrhage, burns, Asphyxia, fractures, loss of consciousness. Emergency treatment to the collapsed patient. Artificial respiration and resuscitation. Preparation of patient for general and special radiological examinations. Supervision of patients undergoing special examination. Administration of drugs and contrast media. Aseptic and sterile procedures. Handling of infectious patients in the department or in the ward. Regulation of dangerous drugs. Trolley set up for special xray examinations, Radiation hazardous and protective measures.

N.B.: This subject will be taught during 1st year of training and examination will be conducted in the 3rd year.

BOOK RECOMMENDED FOR READING :

Title of the Book (Edition/ Year)	Name (s) of Authors(s)	Publishers
The Basic physics of Radiation Therapy	Joseph Selman	J.B. Lippincott
Basic medical Techniques and patient care for Radiological Technologists	Torrer, L.S.	J.B. Lippincott
Fuch's Principles of Radiographic Exposures, Processing and Quality Control	Carroll, Quinn B.	Charles C. Thomas
Physical Principles of Diagnostic Radiology	Sprawis	University Park Press
Foundations of Anatomy and physiology	Ross and Wilson	Churchill Livingstone
An Atlas of Radiological Anatomy	Weir and Abrahms	Pitman Medical
Assurance of Quality in the Diagnostic X-ray Depth. The Report of the BIR Diagnostic Methods Committee	J.A. Garrett et al	British Institute of Radiology
Essential physics for Radiographers	Ball and Moore	Blackwell Scientific Wreight
Surface Anatomy for Radiographers	Mekears and Owen	-do-
Radiographic Anatomy of the Human Skelton	Bryan, G.	-do-
X-ray Equipments for Students Radiographers	Chesney D.N. & Chesney M.O.	-do-
Fundamental Physics for Radiology	Meredith and Massey	Wright
Medical X-ray Techniques in Diagnostic Radiology	Vander Plaats	Macmillan
Radiographic Photography and Imaging Processes	Jenkins D.j.	Churchill Livingston
An Introduction to the Physics of Diagnostic Radiology	Christensen et al	Lea and Febiger (India Ed. K.M. Verghese (Co.)
The Science of Photography	Baines, H.	Halstead Press
Clark's Positioning in Radiography	Kreel	Heinemann
Principles of Radiotherapy	Paterson	
X-ray Physics and Equipment	Ashworth	Blackwell Scientific Publishers
Physics of Radiology	Johns Charles Thomas	Springfield, U.S.A.
Care of the patient in diagnostic Radiography	Chesney D.N. & Chesney M.O.	Blackwell Scientific
Radiographic Anatomy of the Human Skelton	Bryan.G	Livingstone
Radiographic Photography	Chesney D.N. & Chesney M.O.	Blackwell Scientific

Radiographic Photography and Imaging Processes	Jenkins D.J.	Churchill Livingstone
Special Techniques in Orthopaedic Radiography	Stripp. W.	Churchill Livingstone
Introduction to Radiation protection	Markin and harbison	
Chesney's Radiographic Imaging	John Ball and Tony Price	Blackwell Science Ltd., U.K.
Chesney's care of the patient in Diagnostic Radiography	Pauline J. Culmer	Blackwell Science Ltd., U.K.
Chesney's Equipment for student Radiographers	PH Carter, Am Paterson, M.L. Thornton, A.P. Hyatt, A. Milne, J.R. Pirrie	Blackwell Science Ltd., U.K.
Essential physics for Radiographers	JL Ball and A.D. Moorie	Blackwell science Ltd., U.K.
Radiographic Imaging & Exposure	Terri L. Fauber	Mosby, USA
Radiological Science for Technologist	Stewart C Bushong	Mosby, USA
Physics for Diagnostic Radiology	PP Deny, B. Heaton,	Institute of Physics publishing U.K.
Computed Tomography	Euclid Seeram	W.B. Saunder's Company
MRI In Practic	Catherine West brook and Carolyn kaut	
Hand book of MRI Techniques	Catherine West book	
Introduction to Radiography and patient care	Arlene M Adler, FAERS	W.B. Saundererm
Principles of Radiographic Imaging: An art and a science	Richard R Carlton, Arlene M Adler	
Text book of Radiographic Positioning and related anatomy	Kanneth L Bontragger	Mosby, USA
