Annexure-4 B

MGM SCHOOL OF BIOMEDICAL SCIENCES

(A constituent unit of MGM INSTITUTE OF HEALTH SCIENCES)

(Deemed University u/s 3 of UGC Act 1956)

Grade "A" Accredited by NAAC

Sector 1, Kamothe Navi Mumbai-410209,

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CHOICE BASED CREDIT SYSTEM (CBCS)

(Academic Year 2018 - 19)

Curriculum for

B.Sc. Allied Health Sciences

B.Sc. Medical Radiology and Imaging Technology

OUTLINE OF COURSE CURRICULUM

B.Sc. Medical Radiology and Imaging Technology

Semester I

Code No.	Core Subjects	Credits/Week				Hrs/Semester				Marks		
		Lecture (L)	Tutorial (T)	Practical (P)	Total Credits (C)	Lecture (L)	Tutorial (T)	Practical (P)	Total hrs.	Internal Assessment	Semester Exam	Total
Theory												
BMRIT 101 L	Human Anatomy Part I	3	-	-	**3**	45	-	-	**45**	20	80	**100**
BMRIT 102 L	Human Physiology Part I	3	-	-	**3**	45	-	-	**45**	20	80	**100**
BMRIT 103 L	General Biochemistry Nutrition	3	1	-	**4**	45	15	-	**60**	20	80	**100**
BMRIT 104 L	Introduction to National Health Care System (Multidisciplinary/ Interdisciplinary)	3	-	-	**3**	45	-	-	**45**	20	80	**100**
Practical												
BMRIT 101 P	Human Anatomy Part I	-	-	4	-	-	-	60	**60**	-	-	-
BMRIT 102 P	Human Physiology Part I	-	-	4	-	-	-	60	**60**	-	-	-
BMRIT 103 P	General Biochemistry	-	-	4	-	-	-	60	**60**	-	-	-
BMRIT 105 P	Community Orientation & Clinical Visit (Including related practicals to the Parent course)	-	-	8	-	-	-	120	**120**	-	-	-
Ability Enhancement Elective Course												
AEC 001 L	English & Communication skills	3	-	-	**3**	45	-	-	**45**	100	-	**100**
AEC 002 L	Envioronmental Sciences											
Total		**15**	**1**	**20**	**16**	**225**	**15**	**300**	**540**	**180**	**320**	**500**

OUTLINE OF COURSE CURRICULUM

B.Sc. Medical Radiology and Imaging Technology

Semester II

Code No.	Core Subjects	Credits/Week				Hrs/Semester				Marks		
		Lecture (L)	Tutorial (T)	Practical (P)	Total Credits (C)	Lecture (L)	Tutorial (T)	Practical (P)	Total hrs.	Internal Assessment	Semester Exam	Total
Theory												
BMRIT 106 L	Human Anatomy Part II	2	-	-	**2**	30	-	-	**30**	10	40	**50**
BMRIT 107 L	Human Physiology Part II	2	-	-	**2**	30	-	-	**30**	10	40	**50**
BMRIT 108 L	General Microbiology	3	-	-	**3**	45	-	-	**45**	20	80	**100**
BMRIT 109 L	Basic Pathology & Hematology	3	1	-	**4**	45	15	-	**60**	20	80	**100**
BMRIT 110 L	Introduction to Quality and Patient safety (Multidisciplinary/Interdisciplinary)	3	-	-	**3**	45	-	-	**45**	20	80	**100**
Practical												
BMRIT 106 P	Human Anatomy Part II	-	-	4	-	-	-	60	**60**	-	-	-
BMRIT 107 P	Human Physiology Part II	-	-	2	-	-	-	30	**30**	-	-	-
BMRIT 108 P	General Microbiology	-	-	4	-	-	-	60	**60**	-	-	-
BMRIT 109 P	Basic Pathology & Hematology	-	-	4	-	-	-	60	**60**	-	-	-
BMIT 111 P	Community Orientation & Clinical Visit (Including related practicals to the parent course)	-	-	8	-	-	-	120	**120**	-	-	-
Skill Enhancement Elective Course												
SEC 001 L	Medical Bioethics & IPR	3	-	-	**3**	45	-	-	**45**	100	-	**100**
SEC 002 L	Human Rights & Professional Values											
Total		**16**	**1**	**22**	**17**	**240**	**15**	**330**	**585**	**180**	**320**	**500**

OUTLINE OF COURSE CURRICULUM

B.Sc. Medical Radiology and Imaging Technology

Semester III

Code No.	Core Subjects	Credits/Week					Hrs/Semester					Marks		
		Lecture (L)	Tutorial (T)	Practical (P)	Clinical Posing/ Rotation	Total Credits (C)	Lecture (L)	Tutorial (T)	Practical (P)	Clinical Posing/ Rotation	Total hrs.	Internal Assessment	Semester Exam	Total
Theory														
BMRIT 112 L	Physics for Medical Imaging - 1	3	1	-	-	**4**	45	15	-	-	**60**	20	80	**100**
BMRIT 113 L	Radiographic Techniques - 1	3	-	-	-	**3**	45	-	-	-	**45**	20	80	**100**
BMRIT 114 L	Dark Room Techniques	3	-	-	-	**3**	45	-	-	-	**45**	20	80	**100**
BMRIT 115 CP	MRIT Directed Clinical Education - 1	-	-	-	21	**7**	-	-		315	**315**	50	-	**50**
Practical														
BMRIT 112 P	Physics for Medical Imaging - 1	-	-	4	-	**2**	-	-	60	-	**60**	10	40	**50**
BMRIT 113 P	Radiographic Techniques - 1	-	-	4	-	**2**	-	-	60	-	**60**	10	40	**50**
Generic Elective Course														
GEC 001 L	Pursuit of Inner Self Excellence (POIS)	3	-	-	-	**3**	45	-	-	-	**45**	100	-	**100**
GEC 002 L	Organisational Behaviour													
Total		**12**	**1**	**8**	**21**	**24**	**180**	**15**	**120**	**315**	**630**	**230**	**320**	**550**

OUTLINE OF COURSE CURRICULUM

B.Sc. Medical Radiology and Imaging Technology

Semester IV

Code No.	Core Subjects	Credits/Week					Hrs/Semester					Marks		
		Lecture (L)	Tutorial (T)	Practical (P)	Clinical Posing/ Rotation	Total Credits (C)	Lecture (L)	Tutorial (T)	Practical (P)	Clinical Posing /Rotation	Total hrs.	Internal Assessment	Semester Exam	Total
Theory														
BMRIT 116 L	Physics for Medical Imaging - 2	3	1	-	-	**4**	45	15	-	-	**60**	20	80	**100**
BMRIT 117 L	Radiographic Techniques - 2	3	-	-	-	**3**	45	-	-	-	**45**	20	80	**100**
BMRIT 118 L	Digital Imaging	3	-	-	-	**3**	45	-	-	-	**45**	20	80	**100**
BMRIT 119 CP	MRIT Directed Clinical Education - 2	-	-	-	21	**7**	-	-	-	315	**315**	50	-	**50**
Practical														
BMRIT 116 P	Physics for Medical Imaging - 2	-	-	4	-	**2**	-	-	60	-	**60**	10	40	**50**
BMRIT 117 P	Radiographic Techniques - 2	-	-	4	-	**2**	-	-	60	-	**60**	10	40	**50**
Ability Enhancement Elective Course														
AEC 003 L	Computer and Applications	3	-	-	-	**3**	45	-	-	-	**45**	100	-	**100**
AEC 004 L	Biostatistics and Research Methodology													
Total		**12**	**1**	**8**	**21**	**24**	**180**	**15**	**120**	**315**	**630**	**230**	**320**	**550**

OUTLINE OF COURSE CURRICULUM

B.Sc. Medical Radiology and Imaging Technology

Semester V

Code No.	Core Subjects	Credits/Week					Hrs/Semester					Marks		
		Lecture (L)	Tutorial (T)	Practical (P)	Clinical Posing/ Rotation	Total Credits (C)	Lecture (L)	Tutorial (T)	Practical (P)	Clinical Posing/ Rotation	Total hrs.	Internal Assessment	Semester Exam	Total
Theory														
BMRIT 120 L	Advanced Radiographic Techniques	3	1	-	-	**4**	45	15	-	-	**60**	20	80	**100**
BMRIT 121 L	Equipment for Medical Imaging	4	-	-	-	**4**	60	-	-	-	**60**	20	80	**100**
BMRIT 122 L	Special Procedures in Medical Imaging	3	-	-	-	**3**	45	-	-	-	**45**	20	80	**100**
BMRIT 123 CP	MRIT Directed Clinical Education - 3	-	-	-	30	**10**	-	-	-	450	**450**	50	-	**50**
Practical														
BMRIT 120 P	Advanced Radiographic Techniques	-	-	4	-	**2**	-	-	60	-	**60**	10	40	**50**
BMRIT 121 P	Equipment for Medical Imaging	-	-	4	-	**2**	-	-	60	-	**60**	10	40	**50**
Core Elective Course														
CEC 005 L	Basics of Clinical Skill Learning	3	-	-	-	**3**	45	-	-	-	**45**	100	-	**100**
CEC 006 L	Hospital Operation Management													
Total		**13**	**1**	**8**	**30**	**28**	**195**	**15**	**120**	**450**	**780**	**230**	**320**	**550**

OUTLINE OF COURSE CURRICULUM

B.Sc. Medical Radiology and Imaging Technology

Semester VI

Code No.	Core Subjects	Credits/Week					Hrs/Semester					Marks		
		Lecture (L)	Tutorial (T)	Practical (P)	Clinical Posing/ Rotation	Total Credits (C)	Lecture (L)	Tutorial (T)	Practical (P)	Clinical Posing/ Rotation	Total hrs.	Internal Assessment	Semester Exam	Total
Theory														
BMRIT 124 L	Quality Assurance in Medical Imaging	3	1	-	-	**4**	45	15	-	-	**60**	20	80	**100**
BMRIT 125 L	Modern Technologies in Imaging	4	-	-	-	**4**	60	-	-	-	**60**	20	80	**100**
BMRIT 126 L	Protection	3	-	-	-	**3**	45	-	-	-	**45**	20	80	**100**
BMRIT 127 CP	MRIT Directed Clinical Education - 4	-	-	-	30	**10**	-	-	-	450	**450**	50	-	**50**
Practical														
BMRIT 124 P	Quality Assurance in Medical Imaging	-	-	4	-	**2**	-	-	60	-	**60**	10	40	**50**
BMRIT 125 P	Modern Technologies in Imaging	-	-	4	-	**2**	-	-	60	-	**60**	10	40	**50**
Total		**10**	**1**	**8**	**30**	**25**	**150**	**15**	**120**	**450**	**735**	**130**	**320**	**450**

OUTLINE OF COURSE CURRICULUM

B.Sc. Medical Radiology and Imaging Technology (Internship)

Semester VII & Semester VIII

Code No.	Core Subjects	Credits/Week				Hrs/Semester				
		Lecture (L)	Tutorial (T)	Practical (P)	Clinical Posing/ Rotation	Lecture (L)	Tutorial (T)	Practical (P)	Clinical Posing/ Rotation	Total hrs.
	Sem VII (Internship)	-	-	-	720	-	-	-	720	**720**
	Sem VIII (Internship)				720				720	**720**
Total		**0**	**0**	**0**	**1440**	**0**	**0**	**0**	**1440**	**1440**

B.Sc. Allied Health Sciences

DIRECTOR'S DESK

In 2007 the school of Biomedical Sciences was established with a mission of building up well qualified Allied Health Care professionals. The faculty set out to design an ideal biomedical graduate program which met the demands and expectations of the education system of our country. The college has been amending its perspective plan, which means extensive preparations for taking over the construction of the academic system including designing of courses, adopting the semester system over the existing pattern of annual system, continuous internal assessment and active industrial visits/Hospital Visits as the part of curriculum and implementing Credit base choice system to all the courses offered.

The School offers 7 UG Courses viz; B.Sc. Operation Theatre and Anaesthesia technology, Dialysis Technology, Medical Radiology &Imaging Technology, Medical Laboratory Technology, Perfusion Technology, Cardiac Care Technology and Optometry.

The college adopts the national qualification frame work for the degree programs in terms of duration and levels of studies. The curricula is updated to make our education comparable to and compatible and in accordance with those of others and also to facilitate the mobility of our graduates for further studies and for employment both within and outside the country. The programs designed are the perfect embodiment of the vision, mission and core values of the college and are designed in such a way that students are commensurate to face the global employment opportunities.

ABOUT MGM SCHOOL OF BIOMEDICAL SCIENCES

Mission

To improve the quality of life, both at individual and community levels by imparting quality medical education to tomorrow's doctors and medical scientists and by advancing knowledge in all fields of health sciences though meaningful and ethical research.

Vision

By the year 2020, MGM Institute of Health Sciences aims to be top-ranking Centre of Excellence in Medical Education and Research. Students graduating from the Institute will have the required skills to deliver quality health care to all sections of the society with compassion and benevolence, without prejudice or discrimination, at an affordable cost. As a research Centre, it shall focus on finding better, safer and affordable ways of diagnosing, treating and preventing diseases. In doing so, it will maintain the highest ethical standards.

About – School of Biomedical Sciences

MGM School of Biomedical Sciences is formed under the aegis of MGM IHS with the vision of offering basic Allied Science and Medical courses for students who aspire to pursue their career in the Allied Health Sciences, teaching as well as research.

School of Biomedical Sciences is dedicated to the providing the highest quality education in basic medical sciences by offering a dynamic study environment with well equipped labs. The school encompasses 21 courses each with its own distinct, specialized body of knowledge and skill. This includes 7 UG courses and 14 PG courses. The college at its growing years started with mere 100 students has recorded exponential growth and is now a full-fledged educational and research institution with the student strength reaching approximately 581 at present.

Our consistent theme throughout is to encourage students to become engaged, be active learners and to promote medical research so that ultimately they acquire knowledge, skills, and understanding so as to provide well qualified and trained professionals in Allied Health Sciences to improve the quality of life.

As there is increased need to deliver high quality, timely and easily accessible patient care system the collaborative efforts among physicians, nurses and allied health providers become ever more essential for an effective patient care. Thus the role of allied health professionals in ever-evolving medical system is very important in providing high-quality patient care.

Last but by no means least, School of Biomedical Sciences envisions to continuously grow and reform. Reformations are essential to any growing institution as it fulfills our bold aspirations of providing the best for the students, for us to serve long into the future and to get ourselves updated to changing and evolving trends in the health care systems.

Name of the Degree: B.Sc. Medical Radiology and Imaging Technology

Duration of Study:

The duration of the study for B.Sc. Medical Radiology and Imaging Technology will be of 4 years 3 years Academics +1 year Internship).

Program pattern:

- First Semester: July
- Second Semester: January
- Third Semester: July
- Fourth Semester: January
- Fifth Semester- July
- Sixth Semester- January

Eligibility Criteria:

- He/she has passed the Higher Secondary (10+2) with Science (PCB) or equivalent examination recognized by any Indian University or a duly constituted Board with pass marks in Physics, Chemistry, and Biology or 50% of marks in mathematics separately
- Minimum percentage of marks: 45% aggregate.

Medium of Instruction:

- English shall be the Medium of Instruction for all the Subjects of study and for examinations.

For any query visit the website: www.mgmsbsnm.edu.in

Preamble

India is one of the rising countries in providing medical and para medical facilities for the patients. There are all most more than 200 medical colleges and equivalent paramedical institutions which have potential to provide skill training to millions of youth through their own facilities and/or by establishing extension centres in collaboration with government medical colleges (AIIMS, NIMHANS etc.,) and Research Centres(ICMR, DBT,BARC, NIRRH, etc.,) or Vocational Skill Knowledge providers, NGOs. The high quality of medical care we enjoy today is built upon years of effort by Physicians, Nurses, Physiotherapist, Research Scholars and other medical professionals investigating the causes of and potential treatments for disease. The tireless effort of countless medical professionals has made many life-threatening diseases and conditions a faded memory**.**

India faces an acute shortage of over 64 lakh skilled human resource in the health sector.Although occupational classifications vary across the globe, little has been done in India to estimate the need and to measure the competency of health care providers beyond the doctors and nurses. As Indian government aims for Universal Health Coverage, the lack of skilled human resource may prove to be the biggest impediment in its path to achieve targeted goals. The benefits of having AHPs in the healthcare system are still unexplored in India.

Allied and healthcare professionals (AHPs) includes individuals involved with the delivery of health or healthcare related services, with qualification and competence in therapeutic, diagnostic, curative, preventive and/or rehabilitative interventions. They work in multidisciplinary health teams in varied healthcare settings including doctors (physicians and specialist), nurses and public health officials to promote, protect, treat and/or manage a person('s) physical, mental, social, emotional, environmental health and holistic well-being.'

This prompted the Ministry of Health and Family Welfare to envisage the creation of national guidelines for education and career pathways of allied and healthcare professionals, with a structured curriculum based on skills and competencies which is competence enough to face the challenges. The curriculum represents a conscious and systematic selection of knowledge, skills and values: a selection that shapes the way teaching, learning and assessment processes are organized.

MGM School Of Bio-Medical Sciences (Declared Under Section 3 Of The UGC Act, 1956) Accredited By NAAC with "A" Grade, Kamothe, Navi Mumbai, MGM University Regulations on "Choice Based Credit System - 2017"

Our MGMSBS institute is established with the goal to achieve the same and to initiate the patient's care at the hospital for a high level of health and medical services, which are unusually complex, scientifically advanced, and costly in nature, to meet his special needs. Allied health professionals are very crucial part of evolving health care system as they support diagnosis, recovery, and quality of life. The scope of allied health professionals is profound as they provide direct patient care in virtually at every step. They provide critical care support in intensive care units, deliver scientific support in clinical laboratories, offer numerous rehabilitation services, manage and provide data critical to seamless patient care and diagnosis, operate sophisticated diagnostic equipment and contribute to broader public health outcomes.

In addition, the practice of the faculty is important to the community as teaching students are in the forefront of the knowledge of medical sciences and at MGMSBS.

MGMSBS is at par with any other MCI recognized medical colleges with the following available resources:

- Well equipped with physical facilities such as spacious and well furnished class rooms ,laboratories ,Skill centres ,Library and Hostels for enriching knowledge and to serve rural community and slums dwellers through this knowledge.
- We have qualified and trained faculty who can foster research in different discipline and well versed to scientifically formulate, implement and monitor community oriented programs and projects especially where the level of involvement in adoption of innovative and appropriate technologies involved.

Students of MGMSBS will be of tremendous help in making meaningful contribution to community and rural development. The involvement of allied health in implementing the Scheme of Community Development through Paramedics is need of the time.

The Chairman, University Grants Commission (UGC) has in his letter D.O.No.F.1- 1/2015 (CM) dated 8th January, 2015 has communicated the decision of the Ministry of Human Resources Development to implement Choice Based Credit System (CBCS) from the academic session 2015-2016 in all Indian

Universities to enhance academic standards and quality in higher education through innovation and improvements in curriculum, teaching learning process, examination and evaluation systems. UGC, subsequently, in its notification No.F.1-1/2015 (Sec.) dated 10/4/15 has provided a set of, Model curricula and syllabi for CBCS programmes under the Faculties of Arts, Humanities and Sciences providing the academic flexibility for Universities.

MGMSBS has taken the proactive lead in bringing about the academic reform of introducing CBCS for semester wise pattern for the B.Sc. Allied Health Science courses and MS.c Courses

CBCS – Definition and benefits: Choice Based Credit System is a flexible system of learning. The distinguishing features of CBCS are the following:

- It permits students to learn at their own pace.
- The electives are selected from a wide range of elective courses offered by the other University Departments.
- Undergo additional courses and acquire more than the required number of credits.
- Adopt an inter-disciplinary and intra-disciplinary approach in learning.
- Make best use of the available expertise of the faculty across the departments or disciplines
- Has an inbuilt evaluation system to assess the analytical and creativity skills of students in addition to the conventional domain knowledge assessment pattern.

Definitions of Key Words:

i. **Academic Year:** Two consecutive (one odd + one even) semesters constitute one academic year.Choice Based Credit System (CBCS).

ii. The CBCS provides choice for students to select from the prescribed courses (core, elective or minor or soft skill courses).

iii. **Course**: Usually referred to, as “papers” is a component of a programme. All courses need not carry the same weight. The courses should define learning objectives and learning outcomes. A course may be designed to comprise lectures/ tutorials/ laboratory work/ outreach activities/

project work/ viva/ seminars/ term papers/assignments/ presentations/ self-study etc. or a combination of some of these.

iv. **Credit Based Semester System (CBSS):** Under the CBSS, the requirement for awarding a degree or diploma or certificate is prescribed in terms of number of credits to be completed by the students.

v. **Credit:** A unit by which the course work is interpreted. It functions the number of hours of instructions required per week. One credit is equivalent to one hour of teaching (lecture or tutorial) or two hours of practical work/field work per week.

vi. **Cumulative Grade Point Average (CGPA):** It is a measure of overall cumulative performance of a student over all semesters. The CGPA is the sum total of the credit points obtained by the student in various courses in all semesters and the sum of the total credits of all courses in all the semesters.

vii. **Grade Point:** It is a numerical marking allotted to each letter grade on a 10-point scale.

viii. **Letter Grade:** It is an appreciated point of the student's performance in a selected course. Grades are denoted by letters O, A+, A, B, C and RA x. Programme: An educational programme leading to award of a Degree certificate.

ix. **Semester Grade Point Average (SGPA):** It is index of performance of all performance of work in a semester. Its total credit points obtained by a student in various courses registered in a semester and the total course credits taken during that semester. It shall be expressed up to two decimal places.

x. **Semester:** Each semester will consist of minimum of 180 working days. The odd semester may be scheduled from June/ July to December and even semester from December/ January to June.

Semester System and Choice Based Credit System:

The semester system initiates the teaching-learning process and screws longitudinal and latitudinal mobility of students in learning. The credit based semester system provides flexibility in designing curriculum and assigning credits based on the course content and hours of teaching. The choice based credit system provides a sun shone‟ type approach in which the students can take choice of courses, learn and adopt an interdisciplinary approach of learning.

Semesters:

An academic year consists of two semesters:

	UG	**PG**
Odd Semester 1st semester	July – December	July – December
Odd Semester 3rd, 5thsemesters	June – October/ November	
Even Semester 2nd, 4th, 6thsemesters	December –April	December - June

Credits:

Credit defines the coefficient of contents/syllabus prescribed for a course and determines the number of hours of instruction required per week. Thus, normally in each of the courses, credits will be assigned on the basis of the number of lectures/ tutorial laboratory work and other forms of learning required, to complete the course contents in a 15-20 week schedule:

a. ***1 credit*** **=** 1 hour of lecture per week
b. ***3 credits*** = 3 hours of instruction per week
   - ✓ Credits will be assigned on the basis of the lectures (L) / tutorials (T) / Clinical Training (CR) / laboratory work (P) / Research Project (RP) and other forms of learning in a 15-20 week schedule L - One credit for one hour lecture per week
c. **P/T -** One credit for every two hours of laboratory or practical
d. **CR -** One credit for every three hours of Clinical training/Clinical rotation/posting
e. **RP -** One credit for every two hours of Research Project per week – Max Credit 20- 25

	Lecture - L	**Tutorial - T**	**Practical - P**	**Clinical Training/ Rotation– CT/CR**	**Research Project– RP***
1 Credit	1 Hour	2 Hours	2 Hours	3 Hours	2 Hours
RP*	Maximum Credit 20 – 25 / Semester				

Types of Courses: Courses in a programme may be of three kinds:

- **Core Course**
- **Elective Course**

Core Course: A course, which should compulsorily be studied by a candidate as a basic requirement is termed as a Core course. There may be a Core Course in every semester. This is the course which is to be compulsorily studied by a student as a basic requirement to complete programme of respective study.

Elective Course: A course which can be chosen from a very specific or advanced the subject of study or which provides an extended scope or which enables an exposure to some other domain or expertise the candidates ability is called an Elective Course.

Discipline Specific Elective (DSE) Course: Elective courses offered by the main subject of study are referred to as Discipline Specific Elective. The University / Institute may also offer discipline related Elective courses of interdisciplinary nature. An elective may be "Discipline Specific Electives (DSE)" gazing on those courses which add intellectual efficiency to the students.

Dissertation / Project: An Elective/Core course designed to acquire special / advanced knowledge, such as supplement study / support study to a project work, and a candidate studies such a course on his own with an advisory support by a teacher / faculty member is called dissertation / project.

Generic Elective (GE) Course: An elective course chosen generally from an unrelated discipline/subject, with an intention to seek exposure is called a Generic Elective. P.S.: A core course offered in a discipline / subject may be treated as an elective by other discipline / subject and vice versa and such electives may also be referred to as Generic Elective.

Assigning Credit Hours per Course: While there is flexibility for the departments in allocation of credits to various courses offered, the general formula would be:

All core course should be restricted to a maximum of 4 credits.

- All electives should be restricted to a maximum of 3 credits.
- All ability enhancement course should be restricted to a maximum of 2 credits.
- Projects should be restricted to a maximum of 20-25 credits.

Programme Outcome:

- Students are expected to have an understanding of and implement various advanced image processing algorithms and analyse their performance on datasets to make improvements.
- This is achieved through a series of hands on assignments and projects.

Programme Specific Outcome:

After taking this course...

- The student will learn principles of tomographic imaging with different modalities such as x-ray, PET and SPECT, NMR/MRI, ultra sound and optical with non-diffracting and diffracting energy sources.
- Learn principles of non-invasive medical imaging techniques and non destructive techniques for industrial imaging.
- Understand projections and projection slice theorem
- Various types of data acquisition in tomography - parallel beam, fan-beam and cone-beam as well as circular and helical trajectories of the source and detectors. First to 4th generation of CT.
- Learn transform domain non-iterative 2D and 3D reconstruction techniques for non diffracting radiation sources
- Learn the statistical nature of the radiation energy generation, propagation, and detection. The errors and artifacts due to the practical limitations of these processes.
- Exposed to a class of Algebraic Reconstruction Techniques (ART) and its variants.
- Some applications of Tomographic principles in signal processing and image processing.
- After completion of this curriculum, a Medical Radiology & Imaging Technologist gets opportunities to work at various health care institutes under designations as:
- Radiographer
- Radiological Technologist
- X-ray Technologist
- CT scan Technologist
- MRI Technologist
- Mammography Technologist
- Applications Specialist
- Quality control Technologist

FIRST YEAR

B.Sc. Medical Radiology & Imaging Technology

SEMESTER-I

Code No.	Core Subjects
Theory	
BMRIT101L	Human Anatomy Part I
BMRIT 102 L	Human Physiology Part I
BMRIT103 L	General Biochemistry &Nutrition
BMRIT 104 L	Introduction to National HealthCare System (Multidisciplinary/ Interdisciplinary)
Practical	
BMRIT 101 P	Human Anatomy Part I
BMRIT 102 P	Human Physiology Part I
BMRIT103 P	General Biochemistry
BMRIT 105 P	Community Orientation & Clinical Visit (Including related practical to the parent course)
Ability Enhancement Elective Course	
AEC 001L	English &Communication Skills
AEC 002L	Environmental Sciences

Name of the Programme	**B.Sc. Medical Radiology & Imaging Technology**
Name of the Course	**Human Anatomy- Part I**
Course Code	**BMRIT 101 L**

Teaching Objective	• To introduce the students to the concepts related to General anatomy, Muscular, Respiratory, Circulatory, Digestive and Excretory system
Learning Outcomes	• Comprehend the normal disposition, interrelationships, gross, functional and applied anatomy of various structures in the human body. • Demonstrate and understand the basic anatomy of Respiratory and Circulatory system • Demonstrate and understand the basic anatomy of Digestive and Excretory system

Sr.No.	Topics	No. of Hrs.
1	**Introduction to Anatomy , Terminology, Cell and Cell division, Tissues of body, Skin**	5
2	**Skeletal System** - Classification of bones, Parts of developing long bone and its blood supply, JointsI- Classification of joints, Joints II- Synovial Joint, Appendicular skeleton I- Bones of upper Limb, Appendicular skeleton II- Bones of lower limb, Axial skeleton-I , Axial skeleton-II	8
3	**Muscular System** - Muscle I-Types, Muscle II- Muscle groups and movements, Muscles of Upper limb, Muscles of lower limb, Muscles of Neck, Muscles of back , Muscles of abdomen	7
4	**Joints** – Shoulder, Hip , Knee , Movements and muscle groups producing movements at other joints	4
5	**Respiratory System** - Introduction to Respiratory system, Larynx, Thoracic cage and diaphragm, Lung & Pleura , Trachea &Bronchopulmonary segments , Mediastinum	6
6	**Circulatory System** - Types of blood vessels, Heart& Pericardium, Coronary Circulation, Overview of mediastenum , Blood vessels of Thorax	5
7	**Digestive System** - GIT I- Pharynx, Oesophagus, GIT II-Stomach, GIT III- Small and Large Intestine, GIT IV-Liver &Gall Bladder, GIT V- Spleen, GIT VI-Pancreas , Salivary glands	7
8	**Excretory System** - Kidney, Ureter, Bladder, Urethra, Pelvis dynamic	3
Total		**45hrs**

BMRIT 101 P - Human Anatomy Part I- (Demonstration)

Sr.No.	Topics	No of Hrs
1	**Introduction to Anatomy, Terminology, Cell and Cell division, Tissues of body, Skin**	60
2	**Skeletal System** - Classification of bones, Parts of developing long bone and its blood supply, JointsI- Classification of joints, Joints II- Synovial Joint, Appendicular skeleton I- Bones of upper Limb, Appendicular skeleton II- Bones of lower limb, Axial skeleton-I , Axial skeleton-II	
3	**Muscular System** - Muscle I-Types, Muscle II- Muscle groups and movements, Muscles of Upper limb, Muscles of lower limb, Muscles of Neck, Muscles of back , Muscles of abdomen	
4	**Joints** – Shoulder, Hip ,Knee , Movements and muscle groups producing , movements at other joints	
5	**Respiratory System** - Introduction to Respiratory system, Larynx, Thoracic cage and diaphragm, Lung & Pleura , Trachea &Bronchopulmonary segments , Mediastinum	
6	**Circulatory System** - Types of blood vessels, Heart& Pericardium, Coronary Circulation, Overview of mediastenum , Blood vessels of Thorax	
7	**Digestive System** - GIT I- Pharynx, Oesophagus, GIT II-Stomach, GIT III- Small and Large Intestine, GIT IV-Liver &Gall Bladder, GIT V- Spleen, GIT VI-Pancreas , Salivary glands	
8	**Excretory System** - Kidney, Ureter, Bladder, Urethra, Pelvis dynamic	
Total		**60 hrs**

Text Books :

1. Manipal Manual of Anatomy for Allied Health Sciences courses:Madhyastha S.
2. G.J. Tortora& N.P Anagnostakos: Principles of Anatomy and Physiology
3. B.D. Chaurasia: Handbook of General Anatomy

Reference books:

1. B.D. Chaurasia : Volume I-Upper limb & Thorax,
   Volume II- Lower limb, Abdomen & Pelvis
   Volume III- Head, Neck, Face
   Volume IV- Brain-Neuroanatomy
2. Vishram Singh: Textbook of Anatomy Upper limb & Thorax
   Textbook of Anatomy Abdomen & Lower limb
   Textbook of Head neck and Brain
3. Peter L. Williams And Roger Warwick:- Gray's Anatomy - Descriptive and Applied, 36th Ed; Churchill Livingstone.
4. T.S. Ranganathan : Text book of Human Anatomy
5. Inderbirsingh, G P Pal : Human Embryology
6. Textbook of Histology, A practical guide:- J.P Gunasegaran

Name of the Programme	**B.Sc. Medical Radiology & Imaging Technology**
Name of the Course	**Human Physiology Part I**
Course Code	**BMRIT 102 L**

Teaching objective	• To teach basic physiological concepts related to General physiology, Haematology, Nerve-Muscle physiology, Cardiovascular ,Digestive & Respiratory physiology
Learning outcomes	• To understand the basic physiological concepts of General physiology • To understand the basic physiological concepts of Hematology • To understand the basic physiological concepts of Nerve-Muscle physiology • To understand the basic physiological concepts of Respiratory physiology • To understand the basic physiological concepts of Cardiovascular physiology

Sr.No.	Topics	No. of Hrs.
1	**General Physiology-** Introduction to physiology, Homeostasis, Transport Across cell membrane	3
2	**Blood - Composition, properties and functions of Blood,** Haemopoesis , Haemogram (RBC, WBC, Platelet count, Hb Concentrations), Blood Groups - ABO and RH grouping, Coagulations & Anticoagulants, Anaemias: Causes, effects & treatment, Body Fluid: Compartments, Composition, Immunity – Lymphoid tissue	10
3	**Cardio vascular system -** Introduction, general organization, functions & importance of CVS , Structure of heart, properties of cardiac muscle, Junctional tissues of heart & their functions, Origin & spread of Cardiac Impulse, cardiac pacemaker, Cardiac cycle & E C G, Heart Rate & its regulation, Cardiac output,Blood Pressure definition & normal values, Physiological needs & variation, regulation of BP	10
4	**Digestive system -** General Introduction, organization, innervations & blood supply of Digestive system, Composition and functions of all Digestive juices,Movements of Digestive System (Intestine), Digestion & Absorption of Carbohydrate, Proteins & Fats	6
5	**Respiratory System -**Physiologic anatomy, functions of respiratory system, non respiratory functions of lung, Mechanism of respiration, Lung Volumes & capacities, Transport of Respiratory GasesO_2, Transport of Respiratory Gases CO_2, Regulation of Respiration.	10
6	**Muscle nerve physiology -** Structure of neuron & types, Structure of skeletal Muscle, sarcomere, Neuromuscular junction& Transmission. Excitation & contraction coupling (Mechanism of muscle contraction)	6
Total		**45 hrs**

BMRIT 102 P - Human Physiology Part I (Demonstration)

Sr. No.	Topics	No. of Hrs.
1	Study of Microscope and its use, Collection of Blood and study of Haemocytometer	60
2	Haemoglobinometry	
3	White Blood Cell count	
4	Red Blood Cell count	
5	Determination of Blood Groups	
6	Leishman's staining and Differential WBC Count	
7	Determination of Bleeding Time, Determination of Clotting Time	
8	Pulse & Blood Pressure Recording, Auscultation for Heart Sounds	
9	Artificial Respiration –Demonstration, Spirometry-Demonstration	
Total		**60 hrs**

Textbooks

1. Basics of medical Physiology –D Venkatesh and H.H Sudhakar, 3rd edition.
2. Principles of Physiology – DevasisPramanik, 5th edition.
3. Human Physiology for BDS –Dr A.K. Jain, 5th edition.
4. Textbook of human Physiology for dental students-Indukhurana 2nd edition.
5. Essentials of medical Physiology for dental students –Sembulingum.

Reference books

1. Textbook of Medical Physiology, Guyton , 2nd South Asia Edition.
2. Textbook of Physiology Volume I & II (for MBBS) – Dr. A. K. Jain.
3. Comprehensive textbook of Medical Physiology Volume I & II – Dr. G. K. Pal.

Name of the Programme	**B.Sc. Medical Radiology & Imaging Technology**
Name of the Course	**General Biochemistry & Nutrition**
Course Code	**BMRIT 103 L**

Teaching Objective	At the end of the course, the student demonstrates his knowledge and understanding on: • Structure, function and interrelationship of biomolecules and consequences of deviation from normal. • Integration of the various aspects of metabolism, and their regulatory pathways. • Principles of various conventional and specialized laboratory investigations and instrumentation, analysis and interpretation of a given data. • to diagnose various nutritional deficiencies • Identify condition and plan for diet • Provide health education base on the client deficiencies
Learning Outcomes	• Define "biochemistry." • Identify the five classes of polymeric biomolecules and their monomeric building blocks. • Explain the specificity of enzymes (biochemical catalysts), and the chemistry involved in enzyme action. • Explain how the metabolism of glucose leads ultimately to the generation of large quantities of ATP. • Describe how fats and amino acids are metabolized, and explain how they can be used for fuel. • Describe the structure of DNA, and explain how it carries genetic information in its base sequence. • Describe DNA replication. • Describe RNA and protein synthesis. • Explain how protein synthesis can be controlled at the level of transcription and translation. • Summarize what is currently known about the biochemical basis of cancer.

Sr. No.	Topics	No. of Hrs.
1	Introduction and scope of biochemistry	1
2	**Chemistry of carbohydrates, proteins, lipids and nucleic acid–** **Chemistry of Carbohydrates**: Definition, Functions, Properties, Outline of classification with eg.(Definition of Monosaccharides, Disaccharides, Polysaccharides and their examples). **Chemistry of Proteins:**Amino acids (total number of amino acids, essential and non essential amino acids) .Definition, Classification of Proteins Structural orgnisation of protein, Denaturation of Proteins. **Chemistry of Lipids:** Definition, functions, Classification (Simple Lipids, Compound Lipids, Derived Lipids.) Essential Fatty Acids. **Chemistry of Nucleic acid**:Nucleosides and Nucleotides, Watson and Crick model of DNA, **RNA**- it's type along with functions	12
3	**Elementary knowledge of enzymes -** Classification, mechanism of enzyme action, Factors affecting activity of enzymes, enzyme specificity, Enzyme inhibition, Isoenzymes and their diagnostic importance.	8
4	**Biological oxidation** - Brief concept of biological oxidation: Definition of Oxidative phospoylation Electron transport chain. Inhibitors and Uncouplers briefly	5
5	**Metabolism of Carbohydrate**:Glycolysis, TCA cycle, Definition and significance of glycogenesis and glycogenolysis. Definition and significance of HMP shunt, definition and significance of gluconeogenesis. Regulation of blood Glucose level, Diabetes Mellitus, Glycosuria.Glucose Tolerance Test. **Metabolism of Proteins**: Transamination, Transmethylation reactions. Urea cycle, Functions of glycine, tyrosine, phenylalanine, tryptophan and Sulphur containing aminoacids. **Metabolism of Lipid:**Outline of beta oxidation with energetic, Ketone bodies (Enumerate) and its importance. Functions of cholesterol and its biomedical significance. Lipid profile and its diagnostic importance. Fatty liver, lipotropic factor, atherosclerosis. **Metabolism of Nucleic acid**:Purine catabolism (Formation of uric acid), Gout	14
6	**Vitamins and Minerals-** RDA, Sources, functions and deficiency manifestations of Fat soluble vitamins. RDA, sources, functions and deficiency manifestations of Water soluble vitamins. RDA, Sources, functions and deficiency manifestations of Calcium, Phosphorous, Iron, Iodine	5
7	**Principle and applications of :** Colorimeters, pH Meter	5
8	**Pre examination Skills -** Collection and preservation of samples (Anticoagulants), transportation & separation of biological specimens, Sample rejection criteria, Disposal of biological Waste materials.	5
9	**Nutrition:** History of Nutrition, Nutrition as a science, Food groups, RDA, Balanced diet, diet planning, Assessment of nutritional status, **Energy:** Units of energy, Measurements of energy and value of food, Energy expenditure, Total energy/calorie	5

	requirement for different age groups and diseases, Satiety value, Energy imbalance-obesity, starvation, Limitations of the daily food guide, Role of essential nutrients in the balanced diet	
Total		**60 hrs**

BMRIT 103 P – General Biochemistry (Demonstration)

Sr. No.	Topics	No. of Hrs
1	Introduction to Personnel protective equipments used in laboratory and their importance (LCD)	60
2	Handling of colorimeters – operation and maintenance (LCD)	
3	Serum electrolytes measurement (only demo)	
4	Demonstration of semi automated / fully automated blood analyser	
5	Demonstration of tests for carbohydrates (Monosacchrides, disaccharides and polysaccharides)	
6	Precipitation Reactions of protein (only demonstration)	
7	Test on bile salts (only demonstration)	
8	Tests on Normal constituents of Urin (only demo)	
9	Tests on Abnormal constituents of Urin (only demo)	
Total		**60 hrs**

Textbooks:

1. Textbook of Medical Laboratory Technology, Volume 1, 3rd Edition by PrafulGhodkar
2. Textbook of Medical Laboratory Technology, Volume 2, 3rd Edition by PrafulGhodkar
3. Medical Laboratory Technology (Volume 1): Procedure Manual for Routine Diagnostic, Kanai Mukharjee
4.Medical Laboratory Technology (Volume 2): Procedure Manual for Routine Diagnostic, Kanai Mukharjee
5.Medical Laboratory Technology (Volume 3): Procedure Manual for Routine Diagnostic, Kanai Mukharjee
6. Essentials of Biochemistry, Second Edition, Dr.(Prof) Satyanarayana
7. Essentials of Biochemistry, 2nd Edition, Dr. PankajaNaik
8. Principles and Techniques of Biochemistry and Molecular Biology, 5Th Edition, Wilson &Walker

Reference books:

1. An Introduction to Chemistry, 8th Edition by Mark Bishop
2. Clinical Chemistry made easy, 1stEidtion by Hughes
3. Tietz Fundamentals of Clinical Chemistry , 7th Edition by Carl Burtis

Name of the Programme	**B.Sc. Medical Radiology & Imaging Technology**
Name of the Course	**Introduction to National Health Care System (Multidisciplinary/Interdisciplinary)**
Course Code	**BMRIT 104 L**

Teaching Objective	• To teach the measures of the health services and high-quality health care • To understand whether the health care delivery system is providing high-quality health care and whether quality is changing over time. • To provide to National Health Programme- Background objectives, action plan, targets, operations,in various National Heath Programme. • To introduce the AYUSH System of medicines.
Learning Outcomes	• The course provides the students a basic insight into the main features of Indian health care delivery system and how it compares with the other systems of the world.

Sr. No.	Topics	No. of Hrs.
1	**Introduction to healthcare delivery system** - Healthcare delivery system in India at primary, secondary and tertiary car; Community participation in healthcare delivery system; Health system in developed countries; Private / Govt Sector; National Health Mission; National Health Policy; Issues in Health Care Delivery System in India	10
2	**National Health Programme-** Background objectives, action plan, targets, operations, achievements and constraints in various National Heath Programme.	8
3	**Introduction to AYUSH system of medicine -** Introduction to Ayurveda; Yoga and Naturopathy; Unani; Siddha; Homeopathy; Need for integration of various system of medicine	8
4	**Health Scenario of India-** past, present and future	4
5	**Demography & Vital Statistics-** Demography – its concept; Census & its impact on health policy	5
6	**Epidemiology -** Principles of Epidemiology; Natural History of disease; Methods of Epidemiological studies; Epidemiology of communicable & non-communicable diseases, disease, transmission, host defense immunizing agents, cold chain, immunization, disease, monitoring and surveillance.	10
Total		**45 hrs**

Books:

1. National Health Programs Of India National Policies and Legislations Related to Health: 1 J. Kishore (Author)
2. A Dictionary of Public Health Paperback by J Kishor
3. Health System in India: Crisis & Alternatives , National Coordination Committee, Jan Swasthya Abhiyan
4. In search In Search of the Perfect Health System
5. Central Bureau of Health Intelligence (1998). Health Information of India, Ministry of Health and Family Welfare, New Delhi.
6. Goyal R. C. (1993). Handbook of Hospital Personal Management, Prentice Hall of India, New Delhi, 17–41. Ministry of Health and Family Welfare (1984). National Health Policy, Annual Report (1983–4), Government of India, New Delhi
7. Historical Development of Health Care in India, Dr. Syed Amin Tabish,
8. cultural Competence in Health Care by Wen-Shing Tseng (Author), Jon Streltzer (Author)
9. Do We Care: India's Health System by K. Sujatha Rao (Author)

BMRIT 105 P - Community Orientation &Clinical Visit (including related practical's to the parent course) (Total -120 hrs.)

ABILITY ENHANCEMENT ELECTIVE COURSE

Name of the Programme	**B.Sc. Medical Radiology & Imaging Technology**
Name of the Course	**English and Communication Skills**
Course Code	**AEC 001 L**

Teaching Objective	• This course deals with essential functional English aspects of the of communication skills essential for the health care professionals. • To train the students in oral presentations, expository writing, logical organization and Structural support.
Learning Outcomes	• Able to express better. • Grow personally and professionally and Developconfidence in every field

Sr. No.	Topics	No. of Hrs.
1	**Basics of Grammar** - Vocabulary, Synonyms, Antonyms, Prefix and Suffix, Homonyms, Analogies and Portmanteau words	6
2	**Basics of Grammar – Part II** - Active, Passive, Direct and Indirect speech, Prepositions, Conjunctions and Euphemisms	6
3	**Writing Skills** - Letter Writing, Email, Essay, Articles, Memos, one word substitutes, note making and Comprehension	3
4	Writing and Reading, Summary writing, Creative writing, news paper reading	3
5	Practical Exercise, Formal speech, Phonetics, semantics and pronunciation	5
6	**Introduction** to communication skills - Communication process, Elements of communication, Barriers of communication and how to overcome them, Nuances for communicating with patients and their attenders in hospitals	6
7	**Speaking** - Importance of speaking efficiently, Voice culture, Preparation of speech. Secrets of good delivery, Audience psychology, handling , Presentation skills, Individual feedback for each student, Conference/Interview technique	4
8	**Listening** - Importance of listening , Self assessment, Action plan execution, Barriers in listening, Good and persuasive listening	4
9	**Reading** - What is efficient and fast reading , Awareness of existing reading habits, Tested techniques for improving speed, Improving concentration and comprehension through systematic study	4
10	**Non Verbal Communication** - Basics of non-verbal communication, Rapport building skills using neuro- linguistic programming (NLP), Communication in Optometry practice	4
Total		**45 hrs**

Text books:

1. Graham Lock, Functional English Grammar: Introduction to second Language Teachers.Cambridge
   University Press, New York, 1996.
2. Gwen Van Servellen. Communication for Health care professionals: Concepts,practice and evidence,
   Jones & Bartlett Publications, USA, 2009

Name of the Programme	**B.Sc. Medical Radiology & Imaging Technology**
Name of the Course	**Environmental Sciences**
Course Code	**AEC 002 L**

Teaching Objective	• To understand and define terminology commonly used in environmental science • To teach students to list common and adverse human impacts on biotic communities, soil, water, and air Quality. • To understand the processes that govern the interactions of organisms with the biotic and abiotic. • Understand the relationship between people and the environment; Differentiate between key ecological terms and concepts
Learning Outcomes	• Current environmental issues and highlight the importance of adopting an interdisciplinary approach. • Sample an ecosystem to determine population density and distribution. • Create food webs and analyse possible disruption of feeding relationships.

Sr. No.	Topics	No. of Hrs.
1	**Components of Environment** – Hydrosphere, lithosphere, atmosphere and biosphere – definitions with examples; Interaction of man and environment;	4
2	**Ecosystem** : Basic concepts, components of ecosystem, Tropic levels, food chains and food webs, Ecological pyramids, ecosystem functions, Energy flow in ecological systems, Characteristics of terrestrial fresh water and marine ecosystems,	5
3	**Global Environmental Problems** – Green House Effect, Acid rain, El Nino, Ozone depletion, deforestation, desertification, salination, biodiversity loss; chemical and radiation hazards.	4
4	**Environmental pollution and degradation** – Pollution of air, water and land with reference to their causes, nature of pollutions, impact and control strategies; perspectives of pollution in urban, industrial and rural areas. Habitat Pollution by Chlorinated Hydrocarbons (DDT, PCBs, Dioxin etc, Endocrine disrupting chemicals, Nutrient pollution.	8
5	**Environmental Management** – Concept of health and sanitation, environmental diseases – infectious (water and air borne) and pollution related, spread and control of these diseases, health hazards due to pesticide and metal pollution, waste treatment, solid waste management, environmental standards and quality monitoring.	6
6	**Environmental Protection Act** – Environmental Laws, national movements, environmental ethics – holistic approach of environmental protection and conservation, IUCN – role in environmental protection. Concept with reference to UN – declaration, aim and objectives of human right policies with reference to India, recent north-south debate on the priorities of implementation, Environmental Protection Agency (EPA)	10
7	**Bioremediation** – Oil spills, Wastewater treatment, chemical degradation, heavy Metals.	8
Total		**45 hrs**

Books:

1. Carson, R. 2002. Silent Spring. Houghton Mifflin Harcourt.
2. Gadgil, M., & Guha, R. 1993. This Fissured Land: An Ecological History of India. Univ. of California Press.
3. Gleeson, B. and Low, N. (eds.) 1999. Global Ethics and Environment, London, Routledge.
4. Gleick, P. H. 1993. Water in Crisis. Pacific Institute for Studies in Dev., Environment & Security. Stockholm Env. Institute, Oxford Univ. Press.
5. Groom, Martha J., Gary K. Meffe, and Carl Ronald Carroll. Principles of Conservation Biology. Sunderland: Sinauer Associates, 2006.
6. Grumbine, R. Edward, and Pandit, M.K. 2013. Threats from India's Himalaya dams. Science, 339: 36-37.
7. McCully, P. 1996. Rivers no more: the environmental effects of dams (pp. 29-64). Zed Books.
8. McNeill, John R. 2000. Something New Under the Sun: An Environmental History of the Twentieth Century.
9. Odum, E.P., Odum, H.T. & Andrews, J. 1971. Fundamentals of Ecology. Philadelphia: Saunders.
10. Pepper, I.L., Gerba, C.P. & Brusseau, M.L. 2011. Environmental and Pollution Science. Academic Press.
11. Rao, M.N. & Datta, A.K. 1987. Waste Water Treatment. Oxford and IBH Publishing Co. Pvt. Ltd.
12. Raven, P.H., Hassenzahl, D.M. & Berg, L.R. 2012. Environment. 8th edition. John Wiley & Sons.
13. Rosencranz, A., Divan, S., & Noble, M. L. 2001. Environmental law and policy in India. Tripathi 1992.
14. Sengupta, R. 2003. Ecology and economics: An approach to sustainable development. OUP.
15. Singh, J.S., Singh, S.P. and Gupta, S.R. 2014. Ecology, Environmental Science and Conservation. S. Chand Publishing, New Delhi.
16. Sodhi, N.S., Gibson, L. & Raven, P.H. (eds). 2013. Conservation Biology: Voices from the Tropics. John Wiley & Sons.
17. Thapar, V. 1998. Land of the Tiger: A Natural History of the Indian Subcontinent.
18. Warren, C. E. 1971. Biology and Water Pollution Control. WB Saunders.
19. Wilson, E. O. 2006. The Creation: An appeal to save life on earth. New York: Norton.
20. World Commission on Environment and Development. 1987. Our Common Future. Oxford University Press

FIRST YEAR

B.Sc. Medical Radiology & Imaging Technology

SEMESTER- II

Code No.	Core Subjects
Theory	
BMRIT 106 L	Human Anatomy Part II
BMRIT 107 L	Human Physiology Part II
BMRIT 108 L	General Microbiology
BMRIT 109 L	Basic Pathology & Hematology
BMRIT 110 L	Introduction to Quality and Patient safety (Multidisciplinary/Interdisciplinary)
Practical	
BMRIT 106 P	Human Anatomy Part II
BMRIT 107 P	Human Physiology Part II
BMRIT108 P	General Microbiology
BMRIT 109 P	Basic Pathology & Hematology
BMRIT 111 P	Community Orientation & Clinical Visit (Including related practical's to the parent course)
Skill Enhancement Elective Course	
SEC 001 L	Medical Bioethics & IPR
SEC 002 L	Human Rights & Professional Values

Name of the Programme	**B.Sc. Medical Radiology & Imaging Technology**
Name of the Course	**Human Anatomy- Part II**
Course Code	**BMRIT 106 L**

Teaching Objective	• To teach the students the basic anatomy of Reproductive , Lymphatic Endocrine ,Nervous system and Special senses
Learning Outcomes	• Demonstrate and understand the basic anatomy of Reproductive and Lymphatic system. • Demonstrate and understand the basic anatomy of Endocrine,Nervous system • Demonstrate and understand the basic anatomy of Special senses

Sr. No.	Topics	No. of Hrs.
1	**Reproductive system -** Male- Testis, Spermatic Cord, Female- Ovaries & Fallopian tube, Uterus	6
2	**Lymphatic system -** Lymphoid Organs, Lymph node groups- Cervical, Axillary, Inguinal	5
3	**Endocrine system -** Thyroid, Parathyroid, Adrenal, Pitutary	4
4	**Nervous system -** Introduction to nervous system(Neuron, ANS, PNS) Meninges, Cerebrum I, Cerebrum II, Cerebellum, Blood supply of Brain, Brain stem, Spinal cord, Cranial and peripheral nerves, CSF & Ventricles	12
5	**Sensory system -** Eye (Gross anatomy), Ear	3
Total		**30 hrs**

BMRIT 106 P - Human Anatomy Part II (Demonstration)

Sr. No.	Topics	No. of Hrs.
1	**Reproductive system -** Male- Testis, Spermatic Cord, Female- Ovaries & Fallopian tube, Uterus	60
2	**Lymphatic system -** Lymphoid Organs, Lymph node groups- Cervical, Axillary, Inguinal	
3	**Endocrine system -** Thyroid, Parathyroid, Adrenal, Pitutary	
4	**Nervous system -** Introduction to nervous system(Neuron, ANS, PNS) Meninges, Cerebrum I, Cerebrum II, Cerebellum, Blood supply of Brain ,Brain stem, Spinal cord, Cranial and peripheral nerves, CSF & Ventricles	
5	**Sensory system -** Eye (Gross anatomy), Ear	
Total		**60 hrs**

Textbooks:

1. Manipal Manual of Anatomy for Allied Health Sciences courses:Madhyastha S.
2. G.J. Tortora& N.P Anagnostakos: Principles of Anatomy and Physiology
3. B.D. Chaurasia: Handbook of General Anatomy

Reference books:

1. B.D. Chaurasia : Volume I-Upper limb & Thorax,
   Volume II- Lower limb, Abdomen & Pelvis
   Volume III- Head, Neck, Face
   Volume IV- Brain-Neuroanatomy
2. Vishram Singh: Textbook of Anatomy Upper limb & Thorax
   Textbook of Anatomy Abdomen & Lower limb
   Textbook of Head neck and Brain
3. Peter L. Williams And Roger Warwick:- Gray's Anatomy - Descriptive and Applied, 36th Ed; Churchill Livingstone.
4. T.S. Ranganathan : Text book of Human Anatomy
5. Inderbirsingh, G P Pal : Human Embryology
6. Textbook of Histology, A practical guide:- J.P Gunasegaran

Name of the Programme	B.Sc. Medical Radiology & Imaging Technology
Name of the Course	Human Physiology Part II
Course Code	BMRIT 107 L

Teaching Objective	• To teach basic physiological concepts related to Renal physiology, Endocrinology& Reproductive physiology, CNS, Special senses
Learning Outcomes	• To understand the basic physiological concepts of Renal physiology • To understand the basic physiological concepts of Endocrinology & Reproductive physiology • To understand the basic physiological concepts of CNS, Special senses

Sr. No.	Topics	No. of Hrs.
1	**Nervous system** -Functions of Nervous system , Neuron – Conduction of Impulses, factors affecting, Synapse- transmission, Receptors, Reflexes Ascending tracts, Descending tracts, Functions of various parts of the Brain.Cerebro-Spinal Fluid (CSF): Composition, functions & Circulation, Lumbar Puncture, Autonomic Nervous System (ANS): Functions.	10
2	**Special senses**- Vision: Structure of Eye, functions of different parts, Refractive errors of Eye and correction, Visual Pathway, Colour vision & tests for colour Blindness, Hearing: Structure and function of ear, Mechanism of Hearing, Tests for Hearing (Deafness)	6
3	**Skin** - Structure and function, Body temperature,Regulation of Temperature & fever.	4
4	**Endocrine System** - Short description of various endocrine glands and their functions	2
5	**Reproductive systems** - Structure & Functions of Reproductive system, Male Reproductive System: spermatogenesis, Testosterone, Female reproductive system: Ovulation, Menstrual cycle, Oogenesis, Tests for Ovulation, Oestrogen & Progesterone , Pregnancy test, Parturition. Contraceptives, Lactation: Composition of Milk, advantages of breast Feeding.	4
6	**Excretory System** General Introduction, structure & functions of kidney, Renal circulation, Glomerular filtration & tubular reabsorption, Nephron, Juxta Glomerular Apparatus,Mechanism of Urine formation, Micturition, Cystomatrogram.Diuretics, Artificial Kidney.	4
Total		**30 hrs**

BMRIT 107 P - Human Physiology Part II –(Demonstration)

Sr. No.	Topics	No. of Hrs.
1	Recording of body temperature	30
2	Examination of sensory system	
3	Examination of motor system	
4	Examination of Eye	
5	Examination of ear	
Total		**30 hrs**

Textbooks:

1. Basics of medical Physiology –D Venkatesh and H.H Sudhakar, 3rd edition.
2. Principles of Physiology – DevasisPramanik, 5th edition.
3. Human Physiology for BDS –Dr A.K. Jain, 5th edition.
4. Textbook of human Physiology for dental students-Indukhurana 2nd edition.
5. Essentials of medical Physiology for dental students –Sembulingum.

Reference books:

1. Textbook of Medical Physiology, Guyton , 2nd South Asia Edition.
2. Textbook of Physiology Volume I & II (for MBBS) – Dr. A. K. Jain.
3. Comprehensive textbook of Medical Physiology Volume I & II – Dr. G. K. Pal.

Name of the Programme	**B.Sc. Medical Radiology & Imaging Technology**
Name of the Course	**General Microbiology**
Course Code	**BMRIT 108 L**

Teaching Objective	• To introduce basic principles and then applies clinical relevance in four segments of the academic preparation for paramedical: immunology, bacteriology, mycology, and virology. This rigorous course includes many etiological agents responsible for global infectious diseases.
Learning Outcomes	• Upon completion, students should be able to demonstrate knowledge of microorganisms and the disease process as well as aseptic and sterile techniques. • Perform microbiological laboratory procedures according to appropriate safety standards

Sr. No.	Topics	No. of Hrs.
1	**Concepts and Principles of Microbiology -** Historical Perspective, Koch's Postulates, Importance of Microbiology, Microscopy, Classification of Microbes.	4
2	**General Characters of Microbes -** Morphology, staining methods, Bacterial growth & nutrition, Culture media and culture methods +ABS, Collection of specimen, transport and processing, Antimicrobial mechanism and action, Drug Resistance minimization.	6
3	**Sterilization and Disinfection -** Concept of sterilization, Disinfection asepsis,Physical methods of Sterilization, Chemical methods (Disinfection), OT Sterlization, Biological waste and Biosafety & Biohazard.	5
4	**Infection and Infection Control -** Infection, Sources, portal of entry and exit, Standard (Universal) safety Precautions & hand hygiene, Hospital acquired infections & Hospital Infection Control	3
5	**Immunity -** Types Classification, Antigen, Antibody – Definition and types, Ag-Ab reactions – Types and examples, Procedure of Investigation & Confidentiality, Immunoprophylaris – Types of vaccines, cold chain, Immunization Schedule.	6
6	**Systemic Bacteriology (Morphology, diseases caused, specimen collection & lists of laboratory tests) –** Introduction, Gram Positive Cocci & Gram Negative Cocci, Enterobacteraecea & Gram negative bacilli, Mycobacteria, Anaerobic bacteria & Spirochaetes, Zoonotic diseases, Common Bacterial infections of eye.	7
7	**Mycology -** Introduction, Classification, outline of lab diagnosis, List of Fungi causing:Common fungal infections of eyes, Superficial Mycoses, Deep mycoses & opportunistic , Fungi.	3
8	**Virology -** Common Viral infection of eye, Introduction, General Properties, outline of lab diagnosis& Classification, HIV Virus, Hepatitis -B Virus.	4
9	**Parasitology** – Morphology, Life Cycle & Outline of Lab Diagnosis & Classification, Common parasite infection of eye, Protozoa- E, histolytica,Malarial Parasite, General properties, classification, list of diseases caused by:Cestodes and Trematodes, Intestinal Nematodes& Tissue Nematodes, Vectors.	7
Total		**45 hrs**

BMRIT 108 P - General Microbiology (Demonstration)

Sr. No.	Topics	No. of Hrs.
1	Concepts and Principles of Microbiology	60
2	General Characters of Microbes	
3	Sterilization and Disinfection	
4	Infection and Infection Control	
5	Immunity	
6	Systemic Bacteriology (Morphology, diseases caused, specimen collection & lists of laboratory test)	
7	Mycology	
8	Virology	
9	Parasitology	
Total		**60 hrs**

Text Book:

1. Text Book of Microbiology for Nursing Students, AnantNarayan Panikar
2. Text Book of Ophthalmology, Khurana

Reference Book:

1. Text Book of Microbiology, Baveja.

Name of the Programme	**B.Sc. Medical Radiology & Imaging Technology**
Name of the Course	**Basic Pathology & Hematology**
Course Code	**BMRIT 109 L**

Teaching Objective	• Understand the importance of clinical information in supporting a timely, accurate pathological diagnosis. • Describe normal and disordered hematopoiesis • Develop implement and monitor a personal continuing education strategy and critically appraise sources of pathology related medical information.• Describe mechanisms of oncogenesis&demonstrate an understanding of genetics and cytogenetics pertaining to hematology
Learning Outcomes	• The student should submit the appropriate tissue sections per protocol to demonstrate the lesion and other clinically-relevant information needed for the final pathologic report • To aid hematology in the reference ranges for hemoglobin, hematocrit, erythrocytes, and leukocytes in infants, children and adult.

Sr. No.	Topics	No. of Hrs.
1	Introduction to Pathology	1
2	Working and maintenance of instruments	2
3	General principles of Haematology techniques, blood collection, anticoagulants, fixation, processing, routine staining, Haemoglobin, TLC, DLC, Peripheral smear (CBC report), platelet counts, cell counter working	10
4	Generalprinciplesof Histopathologytechniques collection, fixation, processing & routine staining	3
5	General principles of Cytopathology techniques collection, fixation, processing & routine staining	5
6	General principles of Clinical Pathology techniques samplecollection, processingforroutine test, normal urine & urine examination, urine strip, introductions to body fluids (Distinguish between Transudate and exudate)	10
7	Generalprinciplesof Blood Bank techniques antigen, antibody, ABO & Rh system	5
8	General principles of Autopsy & Museum	4
9	**GeneralPathologyincludingintroductionto :** I)Cell Injury (Reversible, Irreversible cell injury) II)Inflammation(Acute inflammation, cells, Chronic inflammation, granuloma and examples III)Circulatorydisturbances(Thrombosis, Embolism ,Edema- ascetic, pleural, pericardial- effusions, Shock, Allergy, Anaphylaxis-Definition, Morphological features, And distinguishing features) IV)Neoplasia (Definition of Anaplasia, dysplasia, metaplasia and metastasis and difference between benign and malignant lesions)	8

10	**Systemicpathologybasis andmorphologyof common disorders like** I)Anemia(types-Iron deficiency, megaloblastic, Aplastic-Etiology, Pathogenesis Investigation)- II)Leukemia (Acute and chronic, Peripheral smear), AIDS(Definition, Pathogenesis, Mode of transmission, Two Confirmatory test Tridot, Western blot), Hepatitis (Types, Etiology, Mode of spread) III)Malaria-(Mode of spread IV)Tuberculosis-(Primary and secondary tb, Granuloma formation, Mode of transmission, Organs involved	8
11	Maintenance and medicolegal importance of records and specimens, Lab information system(LIMS)	3
12	Biomedical Waste, Universal Safety Precaution(Protocol to be followed after -Needle injury, chemical injury	1
Total		**60 hrs**

BMRIT 109 P – Basic Pathology & Hematology (Demonstration)

Sr. No.	Topics	No. of Hrs.
1	Working and maintenance of instruments,	60
2	General principles of Haematology techniques, blood collection, anticoagulants, fixation, processing, routine staining, Haemoglobin, TLC, DLC, Peripheral smear (CBC report), platelet counts, cell counter working	
3	Generalprinciplesof Histopathologytechniques collection, fixation, processing & routine staining	
4	General principles of Cytopathology techniques collection, fixation, processing & routine staining	
5	General principles of Clinical Pathology techniques samplecollection, processingforroutine test, normal urine & urine examination, urine strip, introductions to body fluids (Distinguish between Transudate and exudate)	
6	Generalprinciplesof BloodBanktechniques antigen, antibody, ABO & Rh system	
7	General principles of Autopsy & Museum	
Total		**60 hrs**

Reference Books:

1. A *Handbook of Medical* Laboratory (Lab) Technology: *Editor*) *Second Edition*. *V.H. Talib* (Ed.).
2. Comprehensive Textbook Of Pathology For Nursing: Pathology Clinical Pathology Genetics. Ak Mandal Shramana Choudhury, Published by Avichal Publishing Compnay | Language English
3. Textbook of Medical Laboratory Technology- PrafulB. Godkar, Darshan P. Godkar
4. Medical Laboratory Technology. Methods and Interpretations – RamnikSood (volume 1&2)
5. Medical Laboratory technology a procedure manual for routine diagnostic test – vol – I, II, III. Kanai L. Mukharjee Tata Mc graw hill pub. New Delhi.
6. Practical Pathology P. Chakraborty Gargi Chakraborty New Central Book Agency, Kolkata.
7. Theory & Practice of Histological Techniques John D. Bancroft et.al. Churchill Livingstone Printed in China.
8. Histochemistry in Pathology M.I. Filipe et.al. Churchill Livingstone, London
9. Hand Book of Histopathological & Histochemical Techniques C.F.A. Culling Butterworths Company Ltd. London.
10. A Handbook of Medical Laboratory (Lab) Technology. By V.H Talib.

Name of the Programme	**B.Sc. Medical Radiology & Imaging Technology**
Name of the Course	**Introduction to Quality and Patient safety**
Course Code	**BMRIT 110 L**

Teaching Objective	• The objective of the course is to help students understand the basic concepts of quality in health Care and develop skills to implement sustainable quality assurance program in the health system. • To understand the basics of emergency care and life support skills. • To Manage an emergency including moving a patient • To help prevent harm to workers, property, the environment and the general public. • To provide a broad understanding of the core subject areas of infection prevention and control. •To provide knowledge on the principles of on-site disaster management
Learning Outcomes	• Upon completion, Students should be able to apply healthcare quality improvement and patient safety principles, concepts, and methods at the micro-, meso-, and macro-system levels.

Sr. No.	Topics	No. of Hrs.
1	**Quality assurance and management** – Concepts of Quality of Care, Quality Improvement Approaches, Standards and Norms, Introduction to NABH guidelines	7
2	**Basics of emergency care and life support skills** - Basic life support (BLS), Vital signs and primary assessment, Basic emergency care – first aid and triage, Ventilations including use of bag-valve-masks (BVMs), Choking, rescue breathing methods, One- and Two-rescuer CPR	7
3	**Bio medical waste management and environment safety** -Definition of Biomedical Waste, Waste minimization, BMW – Segregation, collection, transportation, treatment and disposal (including color coding), Liquid BMW, Radioactive waste, Metals/ Chemicals / Drug waste, BMW Management & methods of disinfection, Modern technology for handling BMW, Use of Personal protective equipment (PPE), Monitoring & controlling of cross infection (Protective devices)	8
4	**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)],Prevention & control of common healthcare associated infections, Components of an effective infection control program, Guidelines (NABH and JCI) for Hospital Infection Control	8
5	**Antibiotic Resistance** - History of Antibiotics, How Resistance Happens and Spreads, Types of resistance- Intrinsic, Acquired, Passive, Trends in Drug Resistance, Actions to Fight Resistance, Bacterial persistence, Antibiotic sensitivity, Consequences of antibiotic resistance	8
6	**Disaster preparedness and management** - Fundamentals of emergency management, Psychological impact management, Resource management, Preparedness and risk reduction, information management, incident command and institutional mechanisms.	7
Total		**45 hrs**

Reference Books:

1. Washington Manual of Patient Safety and Quality Improvement Paperback – 2016 by Fondahn (Author)
2. Understanding Patient Safety, Second Edition by Robert Wachter (Author)
3. Handbook of Healthcare Quality & Patient Safety Author : Girdhar J Gyani, Alexander Thomas
4. Researching Patient Safety and Quality in Healthcare: A Nordic Perspective Karina Aase, Lene Schibevaag
5. Old) Handbook Of Healthcare Quality & Patient Safety by Gyani Girdhar J (Author)
6. Handbook of Healthcare Quality & Patient Safety by .Gyani G J/Thomas A
7. Quality Management in Hospitals by S. K. Jos

BMRIT 111 P - Community orientation & clinical visit (including related practicals to the parent course) (Total -120 hrs)

SKILL ENHANCEMENT ELECTIVE COURSE

Name of the Programme	**B.Sc. Medical Radiology & Imaging Technology**
Name of the Course	**Medical Bioethics & IPR**
Course Code	**SEC 001L**

Teaching Objective	• To introduce the wide range of ethical issues in health care. • To provide basic skills in: A) Approaching ethical issues. B) Analysis and statement of issues. C) Understanding the relevant ethical principles invoked. • Imparting knowledge and skills that will enable students to develop ethical answers to these issues • To acquire acquire specialized knowledge of law and IPR. •The main objective of the IPR is to make the students aware of their rights for the protection of their invention done in their project work.
Learning Outcomes	• Upon successful completion of the course, students will be able to: Recognize what constitutes an ethical concern in health care •Understanding ethical issues in Health care. • Understand better the complexity and multi-dimensionality of medical ethical concerns and uniqueness of each problem. • Capacity to rationally justify your decision • Develop the ability to reason through difficult medical/clinical ethical issues both orally, in the context of a group of their peers, and through written • The students get awareness of acquiring the patent and copyright for their innovative works. •They also get the knowledge of plagiarism in their innovations which can be questioned legally.

Sr. No.	Topics	No. of Hrs.
1	**Introduction to Bioethics** Bioethical issues related to Healthcare & medicine .	5
2	**Anatomy** - Cadaver ethics, Human dignity, PNDT, Disposal of cadaver, Genetic Counselling	7
3	**Physiology** - Animal ethics, Health policy privacy	7
4	**Biochemistry & Pathology** - Prudence of investigation confidentiality, Patients bill of rights, Disposal of investigative material, Integrity, Blood transfusion	5
5	**Pharmacology** - Rational drug prescribing, Clinical trials, Risk minimization, Animal ethics	5
6	**Microbiology** - Hand wash, Drug resistance minimization, Prudence of investigation confidentiality, Sterilization procedure, Biosafety and bio hazard	5
7	**Medicolegal aspects of medical records**	3
8	**Introduction to Intellectual Property**: Concept of Intellectual Property Kinds of Intellectual Property Patents, CopyrightsDesigns, Trademarks,Geographical Indication, Infringement of IPR, Its protection and Remedies Licensing and its types	8
Total		**45 hrs**

Reference Books:

1. Contemporary issues in bioethics – Beauchamp & walters (B&W) 4th edition.
2. Classic philosophical questions by Gloud (8th Edition)
3. Case book series and booklets by UNESCO Bioethics Core curriculum 2008
4. Encyclopedia of Bioethics 5 vol set, (2003) ISBN-10: 0028657748
5. Intellectual property rights- Ganguli-Tat McGrawhill. (2001) ISBN-10: 0074638602,
6. Intellectual Property Right- Wattal- Oxford Publicatiopn House.(1997) ISBN:0195905024.

Name of the Programme	**B.Sc. Medical Radiology & Imaging Technology**
Name of the Course	**Human Rights &Professional Values**
Course Code	**SEC 002 L**

Teaching Objective	• To understand interaction between society and educational institutions. • To sensitize the citizens so that the norms and values of human rights and duties of education programme are realized. • To encourage research activities. • To encourage research studies concerning the relationship between Human Rights and Duties Education.
Learning Outcomes	•This course will aim at making the learners acquire conceptual clarity and develop respect for norms and values of freedom, equality, fraternity and justice. • It will include awareness of civil society organizations and movements promoting human rights. • This will make the students realize the difference between the values of human rights and their duties

Sr. No.	Topics	No. of Hrs.
1	**Background -** Introduction, Meaning, Nature and Scope, Development of Human Rights, Theories of Rights, Types of Rights	6
2	**Human rights at various level**- Human Rights at Global Level UNO, **Instruments**: U.N. Commission for Human Rights,European Convention on Human Rights.	6
3	**Human rights in India -** Development of Human Rights in India, Human Rights and the Constitution of India, Protection of Human Rights Act 1993- National Human Rights Commission, State Human Rights Commission, Composition Powers and Functions, National Commission for Minorities, SC/ST and Woman	7
4	**Human Rights Violations** -Human Rights Violations against Women, Children, Violations against Minorities SC/ST and Trans-genders, Preventive Measures.	6
5	**Professional values**- Integrity, Objectivity, Professional competence and due care, Confidentiality	6
6	**Personal values**- ethical or moral values, Attitude and behavior- professional behavior, treating people equally	6
7	**Code of conduct-** professional accountability and responsibility, misconduct, Cultural issues in the healthcare environment	8
Total		**45 hrs**

Reference Books:

1. Jagannath Mohanty Teaching of Human sRights New Trends and Innovations Deep & Deep Publications Pvt. Ltd. New Delhi2009
2. Ram Ahuja: Violence Against Women Rawat Publications Jewahar Nager Jaipur.1998.
3. Sivagami Parmasivam Human Rights Salem 2008
4. Hingorani R.C.: Human Rights in India: Oxford and IBA New Delhi.

SECOND YEAR

B.Sc. Medical Radiology & Imaging Technology

SEMESTER-III

Code No.	Core Subjects
Theory	
BMRIT 112L	Physics for Medical Imaging - 1
BMRIT 113L	Radiographic Techniques - 1
BMRIT 114L	Dark Room Techniques
BMRIT 115CP	MRIT Directed Clinical Education - 1
Practical	
BMRIT 112P	Physics for Medical Imaging - 1
BMRIT 113P	Radiographic Techniques - 1
Generic Elective Course	
GEC 001L	Pursuit of Inner Self Excellence (POIS)
GEC 002L	Organizational Behavior

Name of the Programme	**B.Sc. Medical Radiology & Imaging Technology**
Name of the Course	**Physics for Medical Imaging - 1**
Course Code	**BMRIT 112 L**

Teaching Objective	• To educate the student in Basic Physics as applied • To perform procedures in Medical Imaging like X-Ray, Ultrasonography, Computed Tomography & Magnetic Resonance Imaging • Production of x rays. • Quality and quantity of radiation and its application in radiology
Learning Outcomes	• After successful accomplishment of the course, the students would be able to describe the applied physics and correlate it with technical procedures. Students should understand Concepts of Physics to be applied for learning various Imaging Modalities. • The student must able to correlate the knowledge with the technical procedures.

Sr. No.	Topics	No. of Hrs.
1	**Radiation Physics** **Production of X-rays:** History, Introduction, Equipment, X-ray Tube, Anode(Stationary Anode, Rotating Anode,Anode Heel Effect), Cathode, Focussing Cup, Bremsstrahlung Radiation; **Interaction of X-rays with matter,:** Coherent Scattering, Compton Scattering, Photoelectric Absorption; **Properties of X-rays,:** Nature of X-rays, Production of X-rays, Absorption of X-rays; **Effect of Scattered Radiation,:** Factors affecting Scattered radiation(Kilo Voltage, Part Thickness, Field Size)**;Magnification, Distortion, Unsharpened and blurring**	25
2	**X-ray Tubes:** **Introduction of X-ray tubes:** History, Introduction; **Types of X-ray Tubes,:** Rotating Anode Tube, Crookes Tube(Cold Cathode Tube), Coolidge Tube, Stationay Tube; **Attenuation of X-ray by the patient,:** Attenuation, Factors Affecting Attenuation(Energy of radiation, Density, Atomic Number)	15
3	**Radiography with Flims and Grids** **Introduction to X-ray Films, Types of X-ray Films:** Introduction, Basic Film Structure, Single coated films and Double coated films, Cross sectional Diagram of Films, cassette without window, Cassette with black, light leakproof window For ID; **Introduction to X-ray Cassette,:** History, Introduction, Types(Standard cassette without window, Cassette with black, light leakproof Window For ID use); **Introduction to Grids, Types of Grids,:** Introduction, Working, Use in diagnostic Radiology, Types(Parallel, Criss-Cross, Focused, Moving,); **Radiographic Contrast**	20
Total		**60 hrs**

BMRIT 112 Physics for Medical Imaging- I

Sr. No.	Topics	No. of Hrs.
	Student should prepare a journal which will contain the procedures adopted in Imaging Radiographs:	
1	Cross sectional diagram of X-ray Film.	60
2	Cross sectional diagram of Intensifying Screen.	
3	Characteristic Curve.	
4	X-ray Tube.	
Total		**60 hrs**

Reference:

1. The Physics of Diagnostic Imaging, 1st Edition, 1998, Dowsett, Kenny Johnston.
2. Physical Principles of Diagnostic Radiology, Sprawls.
3. Essential Physics for Radiographers, Ball, Moor.
4. Radiological Science for Technologist: Physics, Biology and Protection, 8th Edition, 2004, Bushong, Stewart C.
5. X-ray Physics and Equipment, Ashuworth.
6. Computed Radiography, M J Brooker.
7. The Fundamentals of X-ray and radium Physics, 6th Edition, Selman.
8. The MRI Manual, 2nd Edition, 1998, Robert b Lufkin.
9. Clinical Sonography, A Practical guide, 1998, Roger C Sanders.
10. MRI in Practice, 3rd Edition, 2005, Westbook, Rath.

Name of the Programme	**B.Sc. Medical Radiology and Imaging Technology**
Name of the Course	**Radiographic Techniques – 1**
Course Code	**BMRIT 113 L**

Teaching Objective	• To enable the students to interpret the radiographic images & find out the abnormalities if any like fractures, tumors etc. • To help students have a better understanding of the medical conditions and to perform the duties more efficiently. • To help students to produce better images and understand the images when produced.
Learning Outcomes	• The students will be able to know the normal structure of the skeletal system and be able to correlate the abnormalities in diseases. • The students will be able to diagnose abnormalities, diseases, physiological and pathological conditions on X-rays.

Sr. No.	Topics	No. of Hrs.
1	**Radiographic Positioning Terminology** **Basic Terms:** Anterior, Posterior, Superior, Inferior, Medial, Lateral, Proximal, Distal, Deep, Ipsilateral, Contralateral;**Types of planes,:** Coronal, Sagital and Axial(Transverse); Body Positions: Erect, Decubitus, Supine, Prone, Lateral Decubitus; Movements: Flexion, Extension, Abduction, Adduction, Pronation, Supination, Elevation, Depression, Eversion, Inversion	5
2	**Accessories and Instruments:** Lead aprons, Sand Bags, Lead Scale, etc; CT, Fluroscopy,Ultrasound, Portable X-ray, Mammography, C-arm	5
3	**Chest:** Posterior to Anterior, Anterior to Posterior; Lateral ; Lordotic, Apical, Ribs, High KV	10
4	**Upper Limb:** Shoulder Joint; Humerus, Elbow, Forearm; Wrist, Scaphoid, Hand	10
5	**Lower Limb** Hip Joints; Thigh; Knee, Leg; Ankle, Foot, Calcaenum	15
Total		**45 hrs**

BMRIT 113P Radiographic Techniques

Sr. No.	Topics	No. of Hrs.60hrs
	Student should prepare a journal which will contain the procedures adopted in Imaging Radiographs:	
1	Chest	60
2	Upper Extremities	
3	Lower Extremities	
4	Shoulder Girdle	
Total		**60 hrs**

Reference:

1. Merrill's Atlas of Radiographic Positioning & Procedures, 11th Edition, 2007, Frank, long, Smith.
2. Clark's positioning in Radiology, 12th Edition, 2005, Clark.
3. Medical X-ray Techniques in Diagnostic Radiology, Vander Plaals
4. Radiographic Anatomy and Positioning: An integrated approach, 1998, Comuelle, Andrea Gauthier
5. Special Techniques in Orthopedic Radiology, Stripp W

Name of the Programme	**B.Sc. Medical Radiology and Imaging Technology**
Name of the Course	**Dark Room Techniques**
Course Code	**BMRIT 114 L**

Teaching Objective	• To introduce the student to the physical principles associated with the construction of Scanners and image formation. • To educate the students in detail about various photographic processes, image standard, radiographic quality, imaging standard, quality management and various exposure systems.
Learning Outcomes	• The students would be able to understand image processing and understand the concepts.

Sr. No.	Topics	No. of Hrs.
1	**The Photographic Process:** Visible Light Images; Images Produced by X-radiation; Light Sensitive Photographic materials; Photographic Emulsions,: List of emulsion materials: Oil In water emulsions and Water in oil emulsions; The Photographic Latent image	10
2	**Film materials in x-ray departments:** Single & Double coated films; Speed and contrast of photographic materials; Storage of film materials and radiographs,: Temperature, Place, Light, Storage Boxes	10
3	**Intensifying screens and cassettes:** Construction of Intensifying screens; The Fluorescent material; The intensification factor; The influence of kilo voltage and scattered radiation; Cassette design and care of cassettes; Different types of Intensifying Screens	10
4	**Film processing:** Developing, Fixing, Rinsing, Washing and Drying; Constitution of Developing and Fixing materials; Manual& Automatic processing; Processing area and equipment, Dark room layout	5
5	**Radiographic image:** Components in image quality; The contrast, Un-sharpness and blurring effect; Size, shape and spatial relationships	10
Total		**45 hrs**

Reference:

1. Radiographic Imaging, 4th Edition, 1987, D N Chesney, M O Chesney.
2. Principles of Radiographic Imaging, 3rd Edition, 2001, Carlton, Adler.
3. The Science of Photography, Braines H.

BMRIT 115 CP Directed Clinical Education – I

Students will gain additional skills in clinical procedures, interaction with patients and professional personnel. Students will apply knowledge from clinical learning experience under the supervision of a radiologist or senior technologist Students are tested on intermediate clinical radiological skills.
(Total-315 hrs.)

GENERIC ELECTIVE COURSE

Name of the Programme	**B.Sc. Medical Radiology and Imaging Technology**
Name of the Course	**Pursuit of Inner Self Excellence (POIS)**
Course Code	**GEC 001 L**

Teaching Objective	• To inculcate moral values in students – Self-Discipline , Time Management, Develop attitude of Service with humility, Empathy, Compassion, brotherhood, Respect for teachers, colleagues & society members. • Develop Effective means of communication & presentation skills in students • To develop wisdom in students for deciding their career based on their areas of interest and inner skills. • Introduce techniques for Relaxation, Meditation & Connecting with innerself. • Rejuvenation Techniques which can be used by students to distress themselves • To improve performance of students during various assignments, projects, elocutions, events, quiz, interviews.
Learning Outcomes	• Students will become self dependent, more decisive and develop intuitive ability for their study and career related matter. • Student's ability to present their ideas will be developed. • Enhanced communication skills, public speaking & improved Presentation ability. • Students will be able to explore their inner potential and inner ability to become a successful researcher or technician & hence become more focused. • Students will observe significant reduction in stress level. • With the development of personal attributes like Empathy, Compassion, Service, Love & brotherhood, students will serve the society and industry in better way with teamwork and thus grow professionally.

Sr. No.	Topics	No. of Hrs.
1	**Spiritual Values for human excellence :** The value of human integration; Compassion, universal love and brotherhood (Universal Prayer) ; Heart based living ; Silence and its values, Peace and non-violence in thought, word and deed ; Ancient treasure of values - Shatsampatti , Patanjali's Ashtanga Yoga ,Vedic education - The role of the Acharya , values drawn from various cultures and religious practices - Ubuntu, Buddism, etc.; Why spirituality? Concept – significance ; Thought culture	10
2	**Ways and Means :** Correlation between the values and the subjects ;Different teaching techniques to impart value education; Introduction to Brighter Minds initiative;	15

	Principles of Communication; Inspiration from the lives of Masters for spiritual values - Role of the living Master	
3	**Integrating spiritual values and life:** Relevance of VBSE (Value Based Spiritual Education) in contemporary life ; Significant spiritual values ; Spiritual destiny ; Principles of Self-management; Designing destiny	10
4	**Experiencing through the heart for self-transformation (Heartfulness Meditation):** Who am I? ; Introduction to Relaxation; Why, what and how HFN Meditation?; Journal writing for Self-Observation ; Why, what and how HFN Rejuvenation (Cleaning)? ; Why, what and how HFN connect to Self (Prayer)?; Pursuit of inner self excellence ; Collective Consciousness-concept of *egregore effect;*	10
Total		**45 hrs**

Books:

- The Art of Learning: **A Journey in the Pursuit of Excellence,** Josh Waitzkin, Simon and Schuster, 2007
- Reality at Dawn. By Shri Ram Chandra, Published by ISRC

Name of the Programme	**B.Sc. Medical Radiology and Imaging Technology**
Name of the Course	**Organizational Behavior**
Course Code	**GEC 002 L**

Teaching Objective	• To understand the initial insights into underlying principles and fundamental theories of organizational behaviour. • The Student should develop a sense of what falls under the domain of organizational behaviour. • He should develop an understanding of academic views on the behaviour and motivations of people in organizations and the purposes of organizations. • This course clearly takes an academic and scientific lens with the aim of understanding human behaviour in organizations.
Learning Outcomes	• Describe and apply motivation theories to team and organizational scenarios in order achieve a team's or an organization's goals and objectives. • Explain the effect of personality, attitudes, perceptions and attributions on their own and other's behaviours in team and organizational settings. • Explain types of teams and apply team development, team effectiveness, and group decision making models and techniques. Analyse and apply leadership theories and better understand their own leadership style.

Sr. No.	Topics	No. of Hrs.
1	Organizational Behavior - Definition - Importance - Historical Background - Fundamental concepts of OB - 21st Century corporate - Different models of OB i.e. autocratic, custodial, supportive	6
2	**Organization Structure and Design** - Authority and Responsibility Relationships - Delegation of Authority and Decentralization - Interdepartmental Coordination - Emerging Trends in Corporate Structure, Strategy and Culture - Impact of Technology on Organizational design - Mechanistic vs Adoptive Structures – Formal and Informal Organization	8
3	Perception Process - Nature & Importance - Perceptual Selectivity - Perceptual Organization - Social Perception - Impression Management	6
4	Learning - Process of Learning - Principles of Learning - Organizational Reward Systems - BehavioralManagement	6
5	Motivation - Motives - Characteristics - Classification of motives - Primary Motives - Secondary motives - Morale - Definition and relationship with productivity - MoraleIndicators	6
6	Leadership - Definition - Importance - Leadership Styles - Models and Theories of LeadershipStyles	7
7	Conflict Management - Traditional vis-a-vis Modern view of conflict - Constructive and Destructive conflict - Conflict Process - Strategies for encouraging constructive conflict - Strategies for resolving destructiveconflict	6
Total		**45 hrs**

Books:

1. Organizational Behavior, 9th Ed. - Stephen Robbins
2. Human Behaviour at work - Davis and Newstorm
3. Organizational Behaviour - Uma Sekaran
4. Organizational Behaviour - Fred Luthans
5. Organizational Behaviour - K.Aswathappa
6. Human Behaviour at Work - Keith Davis
7. Organizational Behaviour - Jit S.Chandran
8. Human Relations & Organizational Behaviour - R.S.Dwivedi
9. Organizational Behaviour - McShane

SECOND YEAR

B.Sc. Medical Radiology & Imaging Technology

SEMESTER-IV

Code No.	Core Subjects
Theory	
BMRIT 116 L	Physics for Medical Imaging - 2
BMRIT 117 L	Radiographic Techniques - 2
BMRIT 118 L	Digital Imaging
BMRIT 119 CP	MRIT Directed Clinical Education - 2
Practical	
BMRIT 116P	Physics for Medical Imaging - 2
BMRIT 117P	Radiographic Techniques - 2
Ability Enhancement Elective Course	
AEC 003 L	Computer and Applications
AEC 004 L	Biostatistics and Research Methodology

Name of the Programme	**B.Sc. Medical Radiology and Imaging Technology**
Name of the Course	**Physics for Medical Imaging Technology – 2**
Course Code	**BMRIT 116 L**

Teaching Objective	• To educate the student in Basic Physics as applied to procedures in Medical Imaging like X-Ray, Ultrasonography, Computed Tomography & Magnetic Resonance Imaging. • Production of x rays. • Quality and quantity of radiation and its application in radiology
Learning Outcomes	• After successful accomplishment of the course, the students would be able to describe the applied physics and correlate it with technical procedures. Students should understand Concepts of Physics to be applied for learning various Imaging Modalities. • The student must able to correlate the knowledge with the technical procedures.

Sr. No.	Topics	No. of Hrs.
1	**Fluoroscopy, Digital Imaging and Computed Tomography:** Introduction to Fluoroscopy, Concept, Purpose and Procedures, Introduction to Digital Imaging, Definition and Concept, Introduction to Computed Tomography, Concept, Purpose and Procedure	25
2	**Basic Physics of Ultrasound:** Definition, History, Nature of Propagation, Probes, Piezoelectric Effect, Display Modes A-mode, B mode, Real Time Imaging, M-mode, Doppler Mode	10
3	**Magnetic Resonance Imaging:** Types of Magnets: Permanent & Super Conducting Magnets, Magnetism: Introduction, Defination, Uses In MRI, Spining Proton, Larmor Frequency, Radiofrequency Pulse, T1,T2, TR, TE, Characteristics of MRI, Coils, Quality Assurance, Hazards, Safety	25
Total		**60 hrs**

BMRIT 116 P: Physics for Medical Imaging Technology – 2

Sr. No.	Topics	No. of Hrs.
1. 2. 3.	Student should prepare a journal which will contain the procedures adopted in Imaging Radiographs CT scan Tube. MRI Basics, Name Of Sequesces in Different Machines Fluoroscopy	60
Total		**60 hrs**

Reference:

1. The Physics of Diagnostic Imaging, 1st Edition, 1998, Dowsett, Kenny Johnston.
2. Physical Principles of Diagnostic Radiology, Sprawls.
3. Essential Physics for Radiographers, Ball, Moor.
4. Radiological Science for Technologist: Physics, Biology and Protection, 8th Edition, 2004, Bushong, Stewart C.
5. X-ray Physics and Equipment, Ashuworth.
6. Computed Radiography, M J Brooker.
7. The Fundamentals of X-ray and radium Physics, 6th Edition, Selman.
8. The MRI Manual, 2nd Edition, 1998, Robert b Lufkin.
9. Clinical Sonography, A Practical guide, 1998, Roger C Sanders.
10. MRI in Practice, 3rd Edition, 2005, Westbook, Rath.

Name of the Programme	**B.Sc. Medical Radiology and Imaging Technology**
Name of the Course	**Radiographic Techniques – 2**
Course Code	**BMRIT 117 L**

Teaching Objective	• To enable the students to interpret the radiographic images & find out the abnormalities if any like fractures, tumors etc. • To help students have a better understanding of the medical conditions and to perform the duties more efficiently. • To help students to produce better images and understand the images when produced.
Learning Outcomes	• The students will be able to know the normal structure of the skeletal system and be able to correlate the abnormalities in diseased. • The students will be able to diagnose abnormalities, diseases, physiological and pathological conditions on X-rays.

Sr. No.	Topics	No. of Hrs.
1	**Pelvic Girdle and Hip Region:** Pelvis, Sacrum, S.I Joints and Hip Joints, Special views	10
2	**Spine:** Cervical Spine, Dorsal Spine, Lumber Spine, Sacrum	10
3	**Skull:** Skull AP, Lateral, PA, Mastoids	5
4	**Facial Bones:** Para Nasal Sinuses, Orbits, Mandible, Maxilla, Nasal Bones	10
5	**Skeletal Survey:** Radiography associated with Skeletal Survey: Preparation, Views, Positions	10
Total		**45 hrs**

BMRIT 117 P: Radiographic Techniques – 2

Sr. No.	Topics	No. of Hrs.
	Student should prepare a journal which will contain the procedures adopted in Imaging Radiographs	
1	Pelvic Region	60
2	Skull	
3	Facial Bones	
4	Skeletal Survey	
5	Vertebral Column	
Total		**60 hrs**

Reference:

1. Merrill's Atlas of Radiographic Positioning & Procedures, 11th Edition, 2007, Frank, long, Smith.
2. Clark's positioning in Radiology, 12th Edition, 2005, Clark.
3. Medical X-ray Techniques in Diagnostic Radiology, Vander Plaals
4. Radiographic Anatomy and Positioning: An integrated approach, 1998, Comuelle, Andrea Gauthier
5. Special Techniques in Orthopedic Radiology, Stripp W

Name of the Programme	**B.Sc. Medical Radiology and Imaging Technology**
Name of the Course	**Digital Imaging**
Course Code	**BMRIT 118 L**

Teaching Objective	• To Introduce the Students to the world of Digital Radiography. • To educate them about the Dicom, Pacs, LAN, WAN, MAN Connections. • To make them Understand about RIS and HIS Systems. • To give the students' knowledge about Post Processing Techniques in Imaging Technology.
Learning Outcomes	• The Students will know about Post processing Techniques in imaging technology. • They will know about Radiological Information Systems and Hospital Information Systems. • They will know about Digital Radiography.

Sr. No.	Topics	No. of Hrs.
1	**The Basics of:** Binary Code, The Digital Image, The Image file, Magnetic domain theory, Bandwidth, Digital imaging and dose.	10
2	**Introduction and knowledge of Interface Standards:** General considerations for standards, Data components – DICOM & HL7.	5
3	**Introduction and knowledge of Networking and Interfacing:** Networking: LAN, WAN, MAN, Interfacing	5
4	**Introduction of Radiology Information System:** RIS and HIS, RIS and PACS, RIS and order communications.	5
5	**Image Processing:** Image representation, Post Processing of Images, Compression.	5
6	**Common Preset Functions and Parameters:** Workstation parameters, Reporting workstation functions.	10
7	**Future of Digital Imaging:** Electronic Patient Record, Rights of Access for Levels of staff, Rights of Access for Patients, Rights of Access for Research, Compression, Data Transfer, Tele-Radiology, Wireless Systems, Viruses	5
Total		**45 hrs**

Reference:

1. Computed Radiography for Radiographers, 1986, M J Brooker.
2. Digital Imaging, 1st Edition, 2003, Jason Oakley.
3. PACS and Imaging Informatics, Huang H K.

BMRIT119CP Directed Clinical Education – 2

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

(Total – 315 hrs.)

ABILITY ENHANCEMENT ELECTIVE COURSE

Name of the Programme	**B.Sc. Medical Radiology and Imaging Technology**
Name of the Course	**Computer and Applications**
Course Code	**AEC 003 L**

Teaching Objective	• Learn IT applications in medicine and allied health care field. • Introduction to health informatics. • Understand the theories and practices adopted in Hospital Information Systems in the light of medical standards, medical data formats and recent trends in Hospital Information Systems.
Learning Outcomes	• Discuss about health informatics and different IT applications in allied health care. • Explain the function of Hospital Information Systems • Analyze medical standards

Sr. No.	Topics	No. of Hrs.
1	Introduction to computer: Introduction, characteristics of computer, block diagram of computer, generations of computer, computer languages.	1
2	Input output devices: Input devices(keyboard, point and draw devices, data scanning devices, digitizer, electronic card reader, voice recognition devices, vision-input devices), output devices(monitors, pointers, plotters, screen image projector, voice response systems).	3
3	Processor and memory: The Central Processing Unit (CPU), main memory.	4
4	Storage Devices: Sequential and direct access devices, magnetic tape, magnetic disk, optical disk, mass storage devices.	3
5	Introduction of windows: History, features, desktop, taskbar, icons on the desktop, operation with folder, creating shortcuts, operation with windows (opening, closing, moving, resizing, minimizing and maximizing, etc.).	5
6	Introduction to MS-Word: introduction, components of a word window, creating, opening and inserting files, editing a document file, page setting and formatting the text, saving the document, spell checking, printing the document file, creating and editing of table, mail merge.	5
7	Introduction to Excel: introduction, about worksheet, entering information, saving workbooks and formatting, printing the worksheet, creating graphs.	5
8	Introduction to power-point: introduction, creating and manipulating presentation, views, formatting and enhancing text, slide with graphs.	5
9	Introduction of Operating System: introduction, operating system concepts, types of operating system.	4
10	Computer networks: introduction, types of network (LAN, MAN, WAN, Internet, Intranet), network topologies (star, ring, bus, mesh, tree, hybrid), components of	5

	network.	
11	Internet and its Applications: definition, brief history, basic services (E-Mail, File Transfer Protocol, telnet, the World Wide Web (WWW)), www browsers, use of the internet.	4
12	Application of Computers in clinical settings.	1
Total		**45 hrs**

Text books:

(1) Mausner & bahn : Epidemiology-An Introductory text, 2nd Ed.,W.B.Saunders Co.
(2) Richard f. Morton & j. Richard hebd : A study guide to Epidemiology and Biostatistics, 2nd Ed., University Park Press, Baltimore.
(3) Sylvia W Smoller, J Smoller, Biostatistics & Epidemiology A Primer for health and Biomedical professionals, 4th edition, Springs, 2015

Name of the Programme	**B.Sc. Medical Radiology and Imaging Technology**
Name of the Course	**Biostatistics and Research Methodology**
Course Code	**AEC 004 L**

Teaching Objective	• To enable students to present, analyze and interpret data. • To enable students to use concepts of probability in business situations. • To enable students to make inferences from samples drawn from large datasets. • To enable students to apply univariate and multivariate statistical techniques.
Learning Outcomes	• To understand the importance & Methodology for research • To learn in detail about sampling, probability and sampling distribution, significance tests correlation and regression, sample size determination, study design and multivariate analysis.

Sr. No.	Topics	No. of Hrs.
1	Introduction to research methods	5
2	Identifying research problem	5
3	Ethical issues in research	5
4	Research design	5
5	Basic Concepts of Biostatistics	5
6	Types of Data	5
7	Research tools and Data collection methods	5
8	Sampling methods	5
9	Developing a research proposal	5
Total		**45 hrs**

Text books:

(1) Mausner & bahn : Epidemiology-An Introductory text, 2nd Ed.,W.B.Saunders Co.
(2) Richard f. Morton & j. Richard hebd : A study guide to Epidemiology and Biostatistics, 2nd Ed., University Park Press, Baltimore.
(3) Sylvia W Smoller, J Smoller, Biostatistics & Epidemiology A Primer for health and Biomedical professionals, 4th edition, Springs, 2015

THIRD YEAR

B.Sc. Medical Radiology & Imaging Technology

SEMESTER-V

Code No.	Core Subjects
Theory	
BMRIT 120L	Advanced Radiographic Techniques
BMRIT 121L	Equipment for Medical Imaging
BMRIT 122L	Special Procedures in Medical Imaging
BMRIT 123CP	MRIT Directed Clinical Education - 3
Practical	
BMRIT 120P	Advanced Radiographic Techniques
BMRIT 121P	Equipment for Medical Imaging
Core Elective Course	
CEC 005 L	Basics of Clinical Skills Learning
CEC 006 L	Hospital Operation Management

Name of the Programme	**B.Sc. Medical Radiology and Imaging Technology**
Name of the Course	**Advanced Radiographic Techniques**
Course Code	**BMRIT 120 L**

Teaching Objective	• Correctly Identify the Anatomy to me Imaged. • To properly position the patient for Imaging. • Correctly select appropriate projection/projections to demonstrate the area of interest. • Use appropriate radiographic parameters to produce a radiograph with satisfactory results. • Use Special techniques in Wards, ICU, and Operation Theatres.
Learning Outcomes	• The student will be able to identify the anatomy to be imaged • The student would learn how to give proper positioning to the patient for the imaging • The student will be able to probe the patient properly to give proper projection/projections • Use of proper radiographic exposures to get proper x-rays • He will be able to know how to handle the patients in the ICU,Ward,OT and to use special techniques to the imaging.

Sr. No.	Topics	No. of Hrs.
1	**Dental Radiography**: Radiography of teeth-intra oral, extra oral and occlusal view, Orthopantomogram (OPG).	15
2	**Macro Radiography**: Principal, advantage, technique and applications	10
3	**Soft Tissue Techniques**: Mammography, Localization of foreign bodies.	10
4	**Ward Mobile Radiography**: Electrical supply, radiation protection equipment and instructions to be followed for portable radiography.	15
5	**Operation Theatre Techniques**: General precautions, Aspects in techniques - Checking of mains supply and functions of equipment, selection of exposure factors, explosion risks, radiation protection and rapid processing techniques.	10
Total		**60 hrs**

BMRIT 120 P: Advanced Radiographic Techniques

Sr. No.	Topics	No. of Hrs.
	Student should prepare a journal which will contain the procedures adopted in Imaging Radiographs.	
1	OPG and Dental radiography.	
2	Portable radiography.	60
3	Radiography in ICU.	
4	Radiography in Casualty / Trauma center.	
5	Radiography in operation theatre.	
Total		**60 hrs**

Reference:

1. Radiographic Imaging, 4th Edition, 1987, D N Chesney, M O Chesney.
2. Principles of Radiographic Imaging, 3rd Edition, 2001, Carlton, Adler.
3. The Science of Photography, Braines H.
4. Clark's positioning in Radiology, 12th Edition, 2005, Clark.
5. Medical X-ray Techniques in Diagnostic Radiology, Vander Plaals
6. Radiographic Anatomy and Positioning: An integrated approach, 1998, Comuelle, Andrea Gauthier
7. Special Techniques in Orthopedic Radiology, Strip

Name of the Programme	**B.Sc. Medical Radiology and Imaging Technology**
Name of the Course	**Equipment for Medical Imaging**
Course Code	**BMRIT 121 L**

Teaching Objective	• Describe the construction and operation of full range of radiographic equipment including those designed for special procedures and modern Imaging modalities. • Practice the procedures employed in producing a modern imaging. • Carry out routine procedures associated with maintenance of various modern imaging modalities.
Learning Outcomes	• After successful accomplishment of the course, the students would be able to describe the applied physics and correlate it with technical procedures. Students should understand Concepts of Physics to be applied for learning various Imaging Modalities. • The student must able to correlate the knowledge with the technical procedures

Sr. No.	Topics	No. of Hrs.
1	**Computed Tomography (CT):** Historical developments, Principle and applications, Various generations, Definition of terms.	15
2	**Magnetic Resonance Imaging (MRI):** Principles and Applications, MRI Coils, Its advantage over computed tomography, Its limitations and uses	15
3	**Digital Radiography:** Principles and Applications, Scanned projection radiography, Digital subs traction angiography, Definition of terms.	10
4	**Nuclear Imaging and PET Scan:** Its principle, applications and role in medicine, Fusion Technology	10
5	**Diagnostic Ultrasound:** Historical developments, Its principle, applications and role in medicine, Various types of transducers: Their features and applications, Definition of terms.	10
Total		**60 hrs**

BMRIT 121P: Equipment for Medical Imaging

Sr. No.	Topics	No. of Hrs.
	Student should prepare a journal which will contain the procedures Adopted in operations of the Machines.	60
1	Multislice CT scan machine.	
2	MRI machine.	
3	DSA machine.	
4	C-arm machine. (Single/ dual arm DSA machine.)	
Total		**60 hrs**

Reference:

1. The Physics of Diagnostic Imaging, 1st Edition, 1998, Dowsett, Kenny Johnston.
2. Physical Principles of Diagnostic Radiology, Sprawls.
3. Essential Physics for Radiographers, Ball, Moor.
4. Radiological Science for Technologist: Physics, Biology and Protection, 8th Edition, 2004, Bushong, Stewart C.
5. X-ray Physics and Equipment, Ashuworth.
6. Computed Radiography, M J Brooker.
7. The Fundamentals of X-ray and radium Physics, 6th Edition, Selman.
8. The MRI Manual, 2nd Edition, 1998, Robert b Lufkin.
9. Clinical Sonography, A Practical guide, 1998, Roger C Sanders.
10. MRI in Practice, 3rd Edition, 2005, Westbook, Rath.

Name of the Programme	**B.Sc. Medical Radiology and Imaging Technology**
Name of the Course	**Special Procedures in Medical Imaging**
Course Code	**BMRIT 122 L**

Teaching Objective	• On completion of this subject, students shall be able to gain the knowledge about basic and technological aspects of Special procedures in Radiology. • It will Give them an Idea on how to work with Sterility in Procedures and on how the procedures are performed under Fluoroscopy and in Interventional radiology
Learning Outcomes	• After successful accomplishment of the course, the Students will know about the procedures performed in Interventional Radiology and in Fluoroscopy. • The Procedures such as RGU, MCU, IVU, PTBD, ERCP, IPTC Etc

Sr. No.	Topics	No. of Hrs.
1	**Alimentary Tract**: Procedure, requirements, indications, contra indications and contrast media used. Contrast media for swallow, meal and enema. Double Contrast Study	5
2	**Urological Procedures**: Procedure, requirements, indications, contra indications and contrast media used. IVU, MCU, and RGU techniques	10
3	**Radiological procedures Pertaining to**: Salivary glands, lacrimal system, Bronchography, arthrography and hystero salpangiography - various requirements trolley setup, indications and contra indications, contract media used	5
4	**Interventional Radiological Procedures:** IPTC, PTBD, ERCP, fine needle aspiration cytology, percutaneous nephrostomy. Cardiac catherization - embolization, dilation etc. Angiography: Cerebral, cardiac, abdominal aortography, general, renal and selective renal. Splenoporto venography Peripheral, arterial and venous angiography, precautions, radiation protection, film changers, manual automatic biplane, film types - large, miniature, cine contrast media injection procedure and technique	15
5	**Diagnostic Ultrasound:** Historical developments, Its principle, applications and role in medicine, Various types of transducers: Their features and applications, Definition of terms.	5
6	**Myelography:** Technique, contrast media used injection of contrast media indications and contra indications.	5
Total		**45 hrs**

Reference:

1. Merrill's Atlas of Radiographic Positioning & Procedures, 11th Edition, 2007, Frank, long, Smith.
2. Clark's positioning in Radiology, 12th Edition, 2005, Clark.
3. Radiological Procedures, 1st Edition, 2004, Bhargava S K
4. Double Contrast GI, 2nd Edition, Laufer, Levine
5. Myelography, 2nd Edition, Skalpe, Sortland
6. Interventional Radiology, 2nd Edition, 2005, Kessel , Lain Robertson

BMRIT 123CP Directed Clinical Education – 3

Students will gain additional skills in clinical procedures, interaction with patients and professional personnel. Students apply knowledge from previous clinical learning experience under the supervision of a senior technologist. Students are tested on intermediate clinical radio diagnosis skills.
(Total- 450 hrs)

CORE ELECTIVE COURSES

Name of the Programme	**B.Sc. Medical Radiology and Imaging Technology**
Name of the Course	**Basics of Clinical Skills Learning**
Course Code	**CEC 005 L**

Teaching Objective	• To Understand the basic ideas on how to check for Vital Signs of the Patient • This course the Student will learn how to handle the patients and their positioning • They will also learn on the Basics of Nasal-Gastric Tube • The Students will learn on Administration of IV, IV and Medication • Also they will know about Cleanliness in the Asepsis
Learning Outcomes	• After successful accomplishment of the course, the students would be able to Measure Vital Signs, do basic physical Examination of the patients, NG tube basics, Administration of Medicines • The students will learn about Asepsis, and the Cleanliness related to asepsis and on mobility of the patients

Sr. No.	Topics	No. of Hrs.
1	**MEASURING VITAL SIGNS:** Temperature: Axillaries Temperature, Pulse: Sites of pulse, Measurement, Respiratory, Blood Pressure, Pain: Pain Scale	5
2	**PHYSICAL EXAMINATION:**Observation, Auscultation(Chest), Palpation, Percussion, History Taking	10
3	**FEEDING: ENTRAL FEEDING, NG TUBE:** Measurement, Procedure, Care, Removal of Nasal-Gastric Tube, Nasal-Gastric Tube Feeding, and Parentral Nutrition.	10
4	**ADMINISTRATIONS:**Oral, Intravenous, Intramuscular, Subcutaneous, Recapping of Syringe, Loading of Drugs, Calculation of Drugs, Venipuncture, IV Infusion, Cannula, Attachment of IV infusion Set, Fluid Collection, Heparin Lock, Maintenance of IV set, Performing Nebulizer Therapy, Inhaler, Oxygen Therapy (Nasal, prongs, nasal Catheter,Venturi Mask, face mask)	10
5	**ASEPSIS:**Hand wash Techniques,(Medical, Surgical) Universal Precaution, Protecting Equipments: Using Sterile Gloves, Opening a Sterile package and Establishing a Sterile Field, Sterile Dressing Changes, Surgical Attire ,Wound Dressing, Suture Removal, Cleaning and Application of Sterile Dressing, Wearing and Removal of personal protective Equipment	5
6	**MOBILITY AND SUPPORT:**Moving and Positioning, range of Motion exercises (Active & Passive) Assisting for Transfer, Application of Restraints	5
Total		**45 hrs**

Name of the Programme	**B.Sc. Medical Radiology and Imaging Technology**
Name of the Course	**Hospital Operation Management**
Course Code	**CEC 006 L**

Teaching Objective	• To promote scientific management of hospital and advancement of health care systems so as to make it rational, responsive and cost efficient • To promote the development of high quality of hospital care in the community and the country. • It has to provide a satisfactory environment to the patient and also to the doctors for clinical research.
Learning Outcomes	• Understand and apply resource management concepts (personnel, finance, and material resources) and the processes and strategies needed in specific hospital sectors • Communicate effectively and develop their leadership and teambuilding abilities • Apply modern change management and innovation management concepts to optimize structures • Analyze existing hospital service policies and enhance their alignment within the local and national context

Sr. No.	Topics	No. of Hrs.
1	**MEDICO-LEGAL CASES:** Introduction,Laws associated with Medico-Legal Cases, Three Core Contents in Medico-legal cases w.r.t Doctors, Patient & Profession,	5
2	**CONSIDERATIONS OF ETHICS:** Consent, Confidentiality, Mental Health, End of life and Organ Transportation, Research & Clinical Trials	10
3	**HOSPITAL INFORMATION SYSTEM(HIS):** Hospital Information System Management, software applications in registration, billing, investigations, reporting, medical records management, Security and ethical challenges	10
4	**EQUIPMENT OPERATIONS MANAGEMENT:** Hospital equipment repair and maintenance, types of maintenance, job orders, equipment maintenance log books, AMCS	10
5	**ROLE OF MEDICAL RECORDS IN HEALTH CARE MANAGEMENT:** Computers for Medical records, Developments of computerized medical record information processing system(EMR's), Computer stored (Vs) Manual hand written record, Advantages of EMR (Vs) Manual	10
Total		**45 hrs**

THIRD YEAR

B.Sc. Medical Radiology & Imaging Technology

SEMESTER-VI

Code No.	Core Subjects
Theory	
BMRIT 124L	Quality Assurance in Medical Imaging
BMRIT 125L	Modern Technologies in Imaging
BMRIT 126L	Radiation Physics and Radiation Protection
BMRIT 127CP	MIT Directed Clinical Education - 4
Practical	
BMRIT 124P	Quality Assurance in Medical Imaging
BMRIT 125P	Modern Technologies in Imaging

Name of the Programme	**B.Sc. Medical Radiology and Imaging Technology**
Name of the Course	**Quality Assurance in Medical Imaging**
Course Code	**BMRIT 124 L**

Teaching Objective	• Students can do the quality assurance tests of the equipment and accessories with the help of simple test tools. • They will know how to keep the films stored and chemicals and also know how to handle the chemicals. • They will know about the darkroom Layout.
Learning Outcomes	• After successful accomplishment of the course, the students would be able to do quality assurance of the machines and the Equipment. • The student must able to correlate the knowledge with the technical procedures.

Sr. No.	Topics	No. of Hrs.
1	**Planning of Radio-diagnosis Department:** Location of the department, Adjacent department and areas, Basics of the imaging rooms, Patient waiting areas, Basics infrastructures of the imaging rooms	10
2	**Quality Assurance in Radio diagnosis:** Aim of quality assurance in medical imaging, Q.A. Program	10
3	**Accessory equipment:** Collimator, Cassettes and Intensifying screens, Grid, Lead rubber aprons and gloves, Viewing box, Patient positioning aids, Patients measuring calipers	10
4	**X-ray equipment:** Choosing x-ray equipments, Acceptance of new x-ray equipments, Generator, X-ray tube, column, table, potter bucky and upright bucky, Portable and mobile x-ray units	10
5	**Manual film processing:** The darkroom, Film and chemical storage, Film processing	10
6	**Making simple test tools:** Water phantom, Aluminum step wedge, Film/screen contact test tool, Measuring calipers, Tomography test tools.	10
Total		**60 hrs**

BCCT 124 P Quality Assurance in Medical Imaging

Sr. No.	Topics	No. of Hrs.
1	Tests to check light leakage in the cassette.	
2	White light leakage test.	
3	Safelight efficiency test.	
4	Film/screen contact test.	
5	Sensitometry test using an aluminum step wedge.	
6	Collimator accuracy of scale test.	
7	Light beam/x-ray beam alignment test.	
8	Film/screen compatibility – color of light emission test.	**60 hrs**
9	Grid line damage and grid movement test.	
10	Test to detect cracking of lead aprons and gloves.	
11	Accuracy of timer and kVp test.	
12	Test alignment of x-ray beam to upright bucky.	
13	Cassette centered to the middle of the bucky test.	
14	Central ray centered to the middle of the bucky test	
Total		**60 hrs**

Reference:

1. Quality Assurance Workbook, 2004, Peter J. Lloyd
2. Assurance of Quality on Diagnostic X-ray Dept, J A Gannett et al
3. Positioning and Quality Control, Mammography Today for Radiographers, 1992, Rickard, Wilson, Ferris, Blackett.
4. Computed Tomography: Physical Principles, Clinical Applications, and Quality Control, 2009, Seeram, Euclid
5. Fuch's principles of radiographic Exposures, processing and quality Control, Carroll, Quinn B

Name of the Programme	**B.Sc. Medical Radiology and Imaging Technology**
Name of the Course	**Modern Technologies in Imaging**
Course Code	**BMRIT 125 L**

Teaching Objective	• To competently handle the specialized imaging equipments i.e. CT scan, MRI, Mammography and Angiographic equipments and their related accessories. • Demonstrate good understanding of the normal anatomy and common pathological conditions on the images obtained using these special equipments. • Should take all precautions in the protection of staff and patient. • Should have knowledge of the advantages and limitations of the each equipment.
Learning Outcomes	• After successful accomplishment of the course, the students would be able to describe the applied physics and correlate it with technical procedures. Students should understand Concepts of Physics to be applied for learning various Imaging Modalities. • The student must able to correlate the knowledge with the technical procedures

Sr. No.	Topics	No. of Hrs.
1	**Computed Tomography Scan:** Physical Principles of Computed tomography, Data Acquisition Concepts, Instrumentation, Image Post processing and visulation tools, Electron Beam Computed Tomography, Multi slice CT, Patient dose and Quality control, CT artifacts, Indications and Contra indications	15
2	**Advanced MRI:** Physical Principles of MRI, Equipment description, Image formation and SNR, Fast imaging, Pulse sequences, Scanning protocols, MR artifacts, Indications and Contra-indications	15
3	**Mammography:** Basic principles of Mammography, Equipment description, Imaging technology, Uses and advantages	5
4	**Ultra Sonography :** Basic principles of ultra sound, Basics of Doppler ultra sound, Doppler flow imaging, Types of transducers, Uses and advantages	10
5	**Interventional Radiology:** Basic principles of Interventional radiology, Interventional Procedures, Imaging materials, imaging technology, Uses and advantages	10
6	**Digital Radiography(DR):** Basic principles of DR, Imaging Materials, Imaging Technology, Uses and advantages	5
Total		**60 hrs**

BMRIT 125P : Modern Technologies in Imaging

Sr. No.	Topics	No. of Hrs.
1	Imaging techniques of CT scan.	
2	Imaging techniques of MRI	
3	Imaging techniques in Interventional radiology.	
4	Imaging techniques in Mammography.	60
5	Imaging techniques in CR.	
6	Imaging techniques in DR.	
Total		**60 hrs**

Reference:

1. X-ray Physics and Equipment, Ashuworth.
2. Radiographic Imaging, 4th Edition, 1987, D N Chesney, M O Chesney.
3. Computed Radiography for Radiographers, 1986, M J Brooker.
4. MRI in Practice, 3rd Edition, 2005, Westbook, Rath.
5. The MRI Manual, 2nd Edition, 1998, Robert b Lufkin.
6. Essentials of Nuclear Medical Imaging, 5th Edition, 2006, Mettler, Guibertean
7. Interventional Radiology, 2nd Edition, 2005, Kessel, Lain Robertson.
8. Clinical Sonography, A, Practical Guide, 1998, Roger C Sanders
9. Merrill's Atlas of Radiographic Positioning & Procedures, 11th Edition, 2007, Frank, long, Smith.

Name of the Programme	**B.Sc. Medical Radiology and Imaging Technology**
Name of the Course	**Radiation Physics and Radiation Protection**
Course Code	**BMRIT 126 L**

Teaching Objective	• On completion of this subject, students shall be able to Apply basic methods of radiation protection in diagnostic radiology. • Should take all precautions in the protection of staff and patient
Learning Outcomes	• This will make the students aware about the Safety required in the Radiology Dept. • This Subject will teach them about the Dose limits required for the Patients and the Technologist.

Sr. No.	Topics	No. of Hrs.
1	**Biological effects of Radiation:** Sources of exposure in environment, Somatic & Genetic effects, Effects on cellular levels, Effects on organs, Stochastic and non-stochastic effects	15
2	**Radiation** quantities and Units: Activity, Exposure, Kerma, Absorbed Dose, Equivalent Dose, Effective Dose	5
3	**Radiation Protection:** Maximum permissible levels for radiation workers and general public, ICRP recommendation, Principles of time, distance and shielding, Half value thickness, Personnel Monitoring, National/International agencies associated in radiation safety	15
4	**Radiation Hazard Evaluation And Control:** Philosophy of Radiation protection, effects of time, Distance & Shielding, Calculation of Work load, weekly calculated dose to radiation worker & General public, Good work practice in Diagnostic Radiology	10
Total		**45 hrs**

Reference:

1. Radiological Science for Technologist: Physics, Biology and Protection, 8th Edition, 2004, Bushong, Stewart C.
2. Safety code for medical diagnostic x-ray equipment and installations, 1986, Radiological Safety Division, AERB.
3. Radiological safety in Enclosed Radiography installations, 1986, Radiological Safety Division, AERB.
4. Protection of the Patient in Diagnostic Radiology, AERB, AERB.
5. Radiation protection of the Patient, Walter A Langmead.

BMRIT 127CP Directed Clinical Education – 4

Students will gain additional skills in clinical procedures, interaction with patients and professional personnel. Students apply knowledge from previous clinical learning experience under the supervision of a senior technologist. Students are tested on intermediate clinical radio diagnosis skills.
(Total-450 hrs.)

INTERNSHIP

Guidelines:

1. The internship shall commence after the student has completed and passed all subjects up to VI semesters.
2. The internship is compulsory.
3. The duration of the internship shall be one year.
4. The degree of Bachelor in Allied Health Sciences shall be awarded after the satisfactory completion of the internship.

Evaluation of Internees:

Formative Evaluation:

Day to day assessment of the internees during their internship postings should be done by the Head of the Department/Faculty assigned. The objective is that all the interns must acquire necessary minimum skills required for carrying out day to day professional work competently. This can be achieved by maintaining Records/Log Book by all internees. This will not only provide a demonstrable evidence of the processes of training but more importantly of the internee's own acquisition of competence as related to performance.

Summative Evaluation:

It shall be based on the observation of the Sr. Technical staff / Faculty of the department concerned and Record / Log book maintained by the interns. Based on these twoevaluations, the Head of the Department shall issue certificate of satisfactory completion of training, following which the university shall award the degree or declare him/her eligible for it.
To implement the project work uniformly for all the specialties in view of the curriculum and training to be acceptable internationally and the students to get opportunity for higher studies and employment.

Internship Programme:

- 05 days for orientation Programme
- 300 days in Radiology Dept. (90 days each for CT,MRI, X-rays and 30 days for Mammography
- 15 days in community Medicine Department / visit to other hospitals
- 30 days for other Modalities (Special investigation & sonography)
- 15 days related to radiation safety and other Legal aspects.

Checklist - I

Continuous Evaluation of Directed Clinical Education (Clinical Posting) by Faculty in charge

Name of the student: _____ Date:_____

Semester: _____ Name of the faculty/Observer:_____

Core Competencies	Grade
Students will begin to develop critical thinking abilities utilizing the allied health personnel roles of communicator and caregiver. Students will learn principles of professional allied health personnel practice and provide direct care to individuals within a medical surgical setting while recognizing the diverse uniqueness of individuals with health alterations.	Write a grade 1-4 in the boxes below
I. Clinical Teaching	
a. Demonstrate beginning competency in technical skills.	
II. Independent Work by Student guided by faculty	
a. Develop effective communication skills (verbally and through charting) with patients, team members, and family	
b. Identify relevant data for communication in pre and post conferences	
c. Identify intra and inter-professional team member roles and scopes of practice. Establish appropriate relationships with team members.	
d. Identify need for help when appropriate to situation. Delegates level specific skills to appropriate team member.	
III. Hands on practical work by students	
a. Navigate and document clear and concise responses to care in the electronic health record for patient, where appropriate for clinical setting	
b. Protect confidentiality of electronic health records data, information, and knowledge of technology in an ethical manner	
IV. Independent work by student	
a. Maintain a positive attitude and interact with inter-professional team members, faculty, and fellow students in a positive, professional manner. Accept constructive feedback and develop plan of action for improvement.	
b. Demonstrate expected behaviours and complete tasks in a timely manner. Arrive to clinical experiences at assigned times. Maintain professional behaviour and appearance.	
c. Accept individual responsibility and accountability for nursing interventions, outcomes, and other actions. Engage in self evaluation & assumes responsibility for learning.	

***Clinical evaluation tool guidelines for full descriptions of grades 1-4.**

4-exceeds expectations (range of marks –40-50 marks)

3-meets expectations (range of marks –30-40 marks)

2-below expectations (range of marks –25-30 marks)

1-does not meet expectations (range of marks –no marks)