Programme Handbook
M.Sc. in Medical Radiology & Imaging Technology
School of Health Sciences
Academic Year 2024-25

Programme Handbook M.Sc. MRIT

PRELIMINARY DEFINITIONS AND NOMENCLATURE

In this document, unless the context otherwise requires:

1. "**Programme**" means Degree Programme that is M.Sc. in Medical Radiology & Imaging Technology (M.Sc. MRIT)
2. "**Discipline**" means specialization in radiography, special radiological procedures, radiographic examinations and technical knowledge of CT, MRI, CR & DR, Conventional X-RAY, DSA, Mammography, DEXA, etc.
3. "**Course**" means a theory or practical subject that is normally studied in a semester, like Radio-imaging technology, radiation physics, etc.
4. **"Director, Academic Affairs"** means the authority of the University who is responsible for all academic activities of the Academic Programmes for implementation of relevant rules of this Regulations pertaining to the Academic Programmes.
5. **"Dean/Director"** means head of the school concerned.
6. **"PD"** means Programme Director of the respective programme of the school concerned.
7. **"Controller of Examinations (COE)"** means the authority of the University who is responsible for all activities of the University Examinations.
8. **"SU/ University"** means Sushant University (Erstwhile Ansal University)
9. **"MSE"**- Mid-Semester Evaluation, "**ESE"**- End Semester Examination**, "SGPA"**- Semester Grade Point Average, "**CGPA"**- Cumulative Grade Point Average, "**TDCC"-** Trans Disciplinary Certificate Course

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1. ADMISSION

1. Candidates applying for admission to M.Sc. MRIT Degree Program: must have completed a B.Sc. in Medical Technology (Radio Diagnosis and Imaging)/ B.Sc. in Radiological Technology / B.Sc. in Radiography or B.Sc. in Medical Technology (X-ray), with at least 60% marks in their B.Sc. degree.
2. Selection of the students by the Entrance examination conducted by the Institute, followed by personal interview or counselling by the Interview Board constituted by the institution according to the norms.

2. STRUCTURE OF PROGRAMME

2.1. Credits requirement

Minimum credit requirement is 106 credits for a student to be eligible to get M.Sc. in Science in Medical Radiology and Imaging Technology (M.Sc. MRIT).

2.2. Categorization of Courses

M.Sc. MRIT Programme will have a curriculum with syllabi consisting of theory and clinical courses that shall be categorized as follows:

2.3 Induction Programme

S. No.	Category	Suggested breakup of Credits (Total 106)
1.	**Core Courses**	69
2.	**Discipline Specific Electives (DSE)**	01
3.	**Generic Elective I (GE I)**	04
4.	**Generic Elective II (GE II)**	01
5.	**Dissertation/Project/Internship**	25
6.	**Skill Enhancement Course (SEC)**	02
7.	**Ability Enhancement Course (AEC)**	02
8.	**Service Learning/Community Service Based Course**	02
	TOTAL	106

2.3.1. An induction programme with at least two weeks duration will be conducted before the commencement of I semester class as per the school curriculum or preference. The following physical activities shall be completed during the induction programme-.

I. Physical fitness and Health

- Physical fitness Activities
- Sports/Games Related

II. Culture

- Learning an art form
- Heritage
- Intangible Cultural Heritage

III. Literature & Media

- Literature, Cinema and Media
- Group reading of classics

IV. Social Service

- Social Awareness
- Social Service

V. Self-Development

- Spiritual, Mindfulness & Meditation
- Religion and Inter-faith
- Human Values
- Behavioural and Interpersonal skills

- Lectures

VI. Nature

- Nature Club
- Environment Protection (non-credit course)

VII. Innovation

2.3.2. Other Courses (MOOC courses)

- AI & Modern Radiology
- Radiation Monitoring & safety measures

2.4. Bridge Courses

Lecture based Modules for Bridge Course – The bridge courses are offered before the commencement of Semester I. The main objective of the course is to bridge the gap between subjects studied at Pre-university level and subjects they would be studying in Graduation. Students from diverse educational background will be acquainted with fundamental concepts of the discipline of Medical Radiology and Imaging Technology.

The Capstone Bridge Course is a dynamic, three-week program designed to provide an enriching transition for 12th-grade students by introducing them to innovative and interdisciplinary subjects. It serves as a foundation for exploring advanced concepts that bridge high school learning with higher education aspirations. The curriculum emphasizes hands-on, integrative approaches across courses such as "From Cell to Systems," "Investigating the World of Pathogenic Organisms," and "Information Practices in Health Sciences." Through interactive lectures, students gain critical insights into human biology, microbiology, and data management in health sciences, fostering curiosity and preparedness for future academic and professional challenges.

From Cell to Systems: Decoding Human Structure and Function

This course explores the intricate architecture of the human body, beginning with cellular structures and progressing to organ systems. Students gain a comprehensive understanding of human anatomy and physiology, emphasizing the interconnections between cellular functions and systemic operation

Investigating the World of Pathogenic Organisms: Focusing on microbiology and infectious diseases, this course delves into the characteristics, mechanisms, and impacts of pathogenic organisms. Students study bacteria, viruses, fungi, and parasites, along with their role in causing diseases. Emphasis is placed on diagnostic techniques, antimicrobial resistance, and infection control strategies, equipping learners to tackle real-world challenges in clinical and research settings.

Information Practices in Health Sciences

This course introduces students to the critical role of information management in healthcare. It covers data collection, analysis, and interpretation methods used in health sciences. Topics include electronic health records, medical databases, and the ethical use of patient information. Students develop skills to manage and utilize health data effectively, supporting informed decision-making in clinical and administrative environments.

2.5. Number of courses per Semester

Each semester curriculum shall normally have a blend of lecture courses not exceeding 50 credits.

2.6. Credit Assignment

Each course is assigned certain number of credits based on the following:

Contact period per week	Credits
1 Lecture period	1
1 tutorial Periods	1
2 Practical Periods	1

2.7 Industrial Training / Internship

2.7.1. The students may undergo Industrial training for a period (8 Weeks) as specified in the Curriculum during summer / winter vacation. In this case the training has to be undergone continuously for the entire period.

2.7.2. The students may undergo Internship at reputed, multi-speciality hospitals and diagnostic centre (after due approval from the Dean/Director) for the period prescribed in the curriculum during summer / winter vacation. The report and certificate of the internship has to be submitted to the Internship and Recruitment Cell of the department and be presented as and when required.

2.8. Industrial Visit

Every student will be required to go for an Industrial Visit as per the requirement of the curriculum. The Deans/Directors shall ensure that necessary arrangements are made in this regard.

2.9. Massive Open Online Courses

Students may be permitted to credit one online course under Massive Open Online Course (which are provided with certificate) subject to a maximum of two credits. The approved list of online courses will be provided by the concerned department from portals like Swayam, NPTEL, edX, Udemy, Coursera before the commencement of every semester. The credit attained through MOOC course has to be transferred to the marksheet of their respective semester and will be a compulsory course to meet the programme requirements. In a scenario, where the complete assessment is not done by the MOOC platform the School may conduct its own exam for evaluation of the respective course. The details regarding online courses taken up by students should be sent to the Controller of Examinations one month before the commencement of End Semester Examination.

2.10. Medium of Instruction

The medium of instruction is English for all courses, examinations, seminar presentations and project / thesis / dissertation reports.

3. ATTENDANCE REQUIREMENTS FOR COMPLETION OF THE SEMESTER

3.1. A student who has fulfilled the following conditions shall be deemed to have satisfied the requirements for completion of a semester. Every student is expected to attend all classes of all the courses and secure 100% attendance. However, in order to give provision for certain unavoidable reasons such as Medical / participation in sports, the student is expected to attend at least 75% of the classes. Therefore, **he/she shall secure not less than 75%** (after rounding off to the nearest integer) of overall attendance.

3.2. However, a student who secures attendance between 65% and 74% in the current semester due to medical reasons (prolonged hospitalization / accident / specific illness) / participation in sports events may be permitted to appear for the current semester examinations subject to the condition that the student shall submit the medical certificate/ sports participation certificate attested by the Dean/Director. The same, after approval of the VC shall be forwarded to the Controller of Examinations for record purposes.

3.3. Except special circumstances as mentioned in clause 3.2, students who secure less than 75% attendance in all the courses of the semester and students who do not satisfy

the other requirements as specified by their respective programme shall not be permitted to write the University examination at the end of the semester. They are required to repeat the incomplete semester in the summer exams, as per the norms prescribed and duly notified by the Controller of Examination.

4. FACULTY MENTOR

To help the students in planning their courses of study and for general advice on the academic programme, the Dean/Director of the Department will attach a certain number of students to a teacher of the Department who shall function as Faculty mentor for those students throughout their period of study. The Faculty Mentor shall advise the students in registering and reappearance registering of courses, authorize the process, monitor their attendance and progress and counsel them periodically. If necessary, the Faculty Mentor may also discuss with or inform the parents about the progress / performance of the students concerned.

The responsibilities for the faculty mentor shall be:

- To act as the channel of communication between the Dean/Director and the students of the respective group.
- To collect and maintain various statistical details of students.
- To inform the students about the various facilities and activities available to enhance the student's curricular and co-curricular activities.
- To guide student enrolment and registration of the courses.
- To authorize the final registration of the courses at the beginning of each semester.
- To monitor the academic and general performance of the students including attendance and to counsel them accordingly.

5. PROGRAMME COMMITTEE

5.1. Every Programme shall have a Programme Committee consisting of teachers of the programme concerned, student representatives and chaired by the Dean/Director. It is like a 'Quality Circle' (more commonly used in industries) with the overall goal of improving the teaching-learning process. The functions of the Programme committee include-

- Solving problems experienced by students in the class room and in the

laboratories.

- Informing the student representatives, the academic schedule including the dates of assessments and the syllabus coverage for each assessment.
- Informing the student representatives, the details of regulations regarding weightage used for each assessment. In the case of courses like project work / seminar etc. the breakup of marks for each exercise / module of work, should be clearly discussed in the Programme committee meeting and informed to the students.
- Analysing the performance of the students of the respective Programme after each test and finding the ways and means of solving problems, if any.
- Identifying the weak students, if any, and requesting the teachers concerned to provide some additional help or guidance or coaching to such weak students.

5.2. The Programme committee shall be constituted within the first week of each semester by the Dean/Director.

5.3. At least 4 student representatives (usually 2 boys and 2 girls) shall be included in the Programme committee depending upon the strength of the programme.

5.4. The Chairperson of the programme committee may invite the Faculty mentor(s) if required to the programme committee meeting.

5.5. The Programme Director is required to prepare the minutes of every meeting, submit the same to Dean/Director within two days of the meeting and arrange to circulate it among the students and faculty members concerned.

5.6. The first meeting of the Programme committee shall be held within one week from the date of commencement of the semester, in order to inform the students about the nature and weightage of assessments within the framework of the regulations. Two or three subsequent meetings shall be held in a semester at suitable intervals. The Programme Committee shall put on the Notice Board the cumulative attendance particulars of each student at the end of every such meeting to enable the students to know their attendance details. During these meetings the student members representing the respective class, shall meaningfully interact and express the opinions and suggestions of the other students of the class in order to improve the effectiveness of the teaching-learning process.

Grievance Committee	Member	Designation

President	Dr. Elina Dewanji Sen	Head of Department, School of Health Sciences.
Secretary	Ms. Neha Singh	Assistant Professor, MRIT
	Ms. Laxmi Singh	Assistant Professor, MRIT
Members	Ms. Tanshika	MMRIT 1ST Semester
	Ms. Mansi	BMRIT 5TH Semester
	Ms. Nikita	BMRIT 3RD Semester
Examination Committee	Ms. Neha Singh, Mr. Ayush Wilson	Assistant Professor, MRIT & Optometry
Attendance Committee	Mr. Nakul Tyagi, Ms. Laxmi Singh	Assistant Professor, MRIT
Discipline Committee	Ms. Laxmi Singh, Ms. Neha Singh	Assistant Professor, MRIT
Extra-Curricular Activities Committee	Ms. Neha Singh, Ms. Laxmi Singh, Mr. Nakul Tyagi	Assistant Professor, MRIT

6. COURSE COMMITTEE FOR COMMON COURSES

Each common theory course offered to more than one discipline or group, shall have a "Course Committee" comprising all the teachers teaching the common course with one of them nominated as Course Coordinator. The nomination of the Course Coordinator shall be made by the Dean/ Director depending upon whether all the teachers teaching the common course belong to a single department or to several departments. The 'Course committee' shall meet in order to arrive at a common scheme of evaluation for the test and shall ensure a uniform evaluation of the tests. Wherever feasible, the course committee may also prepare a common question paper for the internal assessment test(s).

6.1. CURRIICULAM DEVELOPMENT COMMITTEE A Curriculum Development Committee (CDC) is a formal group tasked with designing, revising, and enhancing educational curricula to meet academic standards, align with institutional goals, and cater to the needs of students and industries. The committee operates within educational institutions, training organizations, or professional bodies to ensure high-quality and relevant learning experiences.

Member	Designation	Affiliation

Dr. Sanjeev Sharma	Chairperson	Dean, School of Health Sciences.
Prof. Jyoti Sinha	Vice-Chairperson	Associate Dean & Principal of Pharmacy School of Health Sciences.
Dr. Elina Dewanji Sen	Secretary	Head of Department, School of Health Sciences.
Ms. Laxmi Singh	Joint- Secretary	Assistant Professor, MRIT, Sushant University.
Mr. Anil Yadav	Director, Academic & Quality Assurance	COE, Sushant University.
Mr. Mohan Lal Bhagwat	External Academic Expert Member	Head of Center of Research and Skill, Jamia Hamdard University
Mr. Rakesh Kaul	Industry Expert Member	Chief Radiotherapy Technologist, Max Hospital, Saket.

7. EXAMINATION SYSTEM

7.1. The academic performance of students is adjudged by the aggregate of continuous mid Semester Evaluation (MSE) and the End Semester Examination (ESE).

7.2. Each course, both theory and practical (including project work & viva voce Examinations) shall be evaluated for a maximum of 100 marks.

- The weightage of End Semester Examination (ESE) to Mid Semester Evaluation (MSE) of all courses except TDL/Soft-Skills/ Seminar Papers/ Internship and MOOC courses is 60% to 40%.

- The weightage of End Semester Examination (ESE) to Mid Semester Evaluation (MSE) of TDL/TDC and Soft-Skills courses is 40% to 60%.

7.3. Industrial training and seminar shall be part of the course concerned.

7.4. The University examination theory and practical course will be of 2 hours duration shall ordinarily be conducted twice in December and May for Odd and Even semester respectively.

End Semester Examination question paper pattern is given below:

A question paper for theory examinations of a course unit of any programme will be of 2 hours' duration with maximum marks 60 (weightage 60%) and will have three parts; Part A, Part-B and Part-C. (The duration of examinations for the value addition courses will have a different format).

Part-A: 28 Marks (students are advised to devote approximately 50 minutes to 60 minutes out of total 2 hours on this part)

In this section, a student is required to answer 4 out of 5 given questions. Each question will be of 7 marks. These questions may include short numerical problems or theory questions to assess students' understanding of concepts and frameworks.

If needed in this part, a question might be designed to have maximum two sub- parts (a) and (b) with weightage of 3 and 4 or 4 and 3 marks respectively to enable testing on more concepts and frameworks.

Part-B: 20 Marks (students are advised to devote approximately 30 minutes to 40 minutes out of total 2 hours on this part)

In this part, a student is required to answer any 2 out of 3 given questions. Each question will have a weightage of 10 marks and may include long theory questions or numerical problems requiring students to apply the concepts to a given situation or in a given context and analyse a situation.

If a faculty feels that a question in this section needs to have sub-parts, there may be maximum two sub- parts provided that sub-part (a) involves understanding of a concept through a numerical or a theory question and sub- part (b) is application/ analysis of the concept used in sub-part (a).

Part-C: 12 Marks (students are advised to devote approximately 20 to 30 minutes out of total 2 hours on this part)

This part will be compulsory without any choice and will have a weightage of 12 marks. This may be a case study, a hypothetical problem or a situation seeking a possible solution(s), students' response to a situation based on general awareness of the broad discipline of study etc. The objective is not only to judge the skills of students to apply the concept to a particular situation or context but also to assess his/her analytical ability and how a student make realistic assumptions and can ascribe meaning to data (given in the question paper or to be assumed). The students will also be tested on integrative and evaluative skills by making them apply more than one concept together in a given

situation or the context.

7.5. The University examination for project work/dissertation shall consist of evaluation of the final report submitted by the student or students of the project group (of not exceeding X students) by an external examiner and an internal examiner, followed by a viva-voce examination conducted separately for each student by a committee consisting of the external examiner, the supervisor of the project group and an internal examiner.

7.6. For the University examination in both theory and practical courses including project work/Dissertation the internal and external examiners shall be appointed by the Dean/Director in consultation with the Controller of Examinations.

8. PROCEDURE FOR AWARDING MARKS FOR INTERNAL ASSESSMENT

8.1. Internal Assessment

For all theory and clinical courses, the distribution of marks for various **components for the Internal Assessment** is shown below in the table:

For a course of 100 marks containing only Theory Component

Mid Semester Theory Examination	Quiz(s), Presentation(s), Faculty Student Interaction	Assignment(s)	Continuous Assessment	Total
15	**15**	**5**	**5**	**40**

END SEMESTER EXAMINATION (60)
Theory (60)

8.1.2. For a course of 100 marks containing both theory and Lab Component:

MID SEMESTER EVALUATION (40) – Theory (25 Marks) + Lab (15 Marks)

Mid Semester Examination Theory	Quiz(s), Presentation(s), Lab practical performed & lab report	Assignment(s)	Continuous Assessment	Total
15	**15**	**5**	**5**	**40**

END SEMESTER EXAMINATION (60)	
Theory (35)	Lab (25)

8.1.3. For a course of 100 marks containing only Practical Component:

Internal (20)	Continues Assessment (10)	Lab work(10)	Presentation (30)	Viva (20)	Practical File (10)	Total (100)

8.2. TDCC

For Inter disciplinary/Trans disciplinary certificate courses the External Assessment Marks will be 40 and Internal Assessment will be 60.

8.3. Internship/Project Work

8.3.1. The courses included under this category are- hospital training and Internship, Summer training I & II, etc.

8.3.2. Here the Internal Assessment based on project prepared and submitted will be 40 marks and the External Assessment based on Viva-voce/presentation will 60.

8.3.3. If a student fails to submit the project report on or before the specified deadline, he/ she is deemed to have failed in the Project Work and shall re-register for the same in a subsequent semester.

8.4. Seminar Papers

Students are encouraged to conduct research, write, and present their findings in the seminar paper.

8.5. Attendance and Assessment Record

Every teacher is required to upload on ERP the 'attendance and assessment record' which consists of attendance marked in each lecture or practical or project work class, the test marks and the record of class work (topic covered), separately for each course. The teacher is also expected to safely keep excel of the attendance and the assessments. The University or any inspection team appointed by the University may verify the records of attendance and assessment of both current and previous semesters

9. EXAM REGULATIONS

9.1. Requirements for appearing for End Semester Examinations- A student shall normally be permitted to appear for the End Semester Examinations for all the courses registered in the current semester (vide clause 9.10) if he/she has satisfied the semester

completion requirements.

9.2.-The students-will be graded under absolute 10-point **Grading Scheme** as given below:

Grade	Range	Grade Point Attached
O	>=95	10
A+	>=85	9
A	>=75	8
B+	>=70	7
B	>=60	6
C	>=50	5
D	>=40	4
F	<40	0
AB	——	0

9.3. Passing Criterion

A student has to fulfil the following conditions to pass M.Sc.MRIT academic programme of the University:

- A student should earn minimum "D" grade in all courses separately. However, he/she can improve his/her grade ("D" grade onwards) by re-appearing.
- To pass a course, student must obtain 40% marks in the aggregate of Mid Semester Evaluation (MSE) & End Semester Examination (ESE). In order to pass a particular course, student must appear in the Final examination irrespective of the marks obtained in the Mid Semester Evaluation.
- For successful completion of a programme, the student should secure a minimum Cumulative Grade Point Average (CGPA) of 4.0 at the end of final year of the Programme.

9.4. Exam Duration

All End Semester Examinations (ESE) would be of two hours duration unless specified otherwise.

9.5. Re-Appearing

There is a provision for re-appearing in the examination (without attending the course-work again) for a course. Re-appearing in examination will be in following cases:

1. A student who fails to meet passing criteria in a course shall be eligible to re-appear in the examination of such course as and when scheduled, with a view to improve the performance.
2. A student who fails to appear in the examination shall be eligible to subsequently re-appear in the examination when scheduled for next batch of students.
3. The latest result obtained by the student in re-appear courses is considered as final and same will be considered for calculating his/her SGPA and CGPA.
4. There is no provision of re-appear in the Mid Semester Evaluation (MSE). **Students who have not passed a course need to take the re-appear of the End Semester Examination (ESE). The previous internal marks shall be carried forward.**
5. A student who has to re-appear in ESE in terms of provisions made above shall be examined as per the syllabus in the scheme of teaching applicable at the time of his/her joining the concerned programme. However, in cases where only some minor modifications have been made in the syllabus of the course(s) and the Dean/Director of the concerned Department certifies the same, the examination may be held in accordance with the revised syllabus.

9.6. Improvement of Score

- If a student has poor performance in number of courses in a particular term, he may at his option, take only one academic break for one year, and re-register for both the semesters of that academic year in the next academic year on payment of prescribed fee. Such a student may have the option of repeating any or all the courses in the semester(s) and retain the credits already earned by him in other course(s).
- A student shall be allowed to improve his SGPA and CGPA by re-appearing in the Examination(s) in the Courses of his choice when these examinations are held in normal schedule in which case his Mid Semester Evaluation (MSE) shall be carried forward. However, permission will not be granted to improve internal assessment. The best of the marks obtained in that subject(s) shall be taken into consideration for calculating the SGPA and CGPA and eligibility for award of a degree.

- A student, who has failed to meet the passing criteria (required CGPA), have the option to re-appear in the Final Examination (End Semester Examination) of those courses in which he/she desires to improve his/her performance in order to secure the minimum CGPA, when these examinations are scheduled for next batch of students. **Improvement is only possible in courses which have a written theory exam component in the ESE (VIVA, Jury and submission-based ESE cannot be taken for improvement).**
- Improvement in the score of courses completed by a student prior to his lateral entry in the University shall not be allowed.

9.7. Methods for Redressal of Grievances in Evaluation

Re-Checking/Re-Evaluation of Answer Books of ESE:

1. Student is entitled to ask for re-checking or re-evaluation of any of his/her paper(s) on the payment of prescribed fee within the stipulated time as notified by the Controller of Examinations.
2. If the re-evaluated/ re-checked marks are less than the earlier obtained marks, the same less marks will be treated as final.

9.8. Disciplinary Control of Students in Examinations

1. The student shall maintain proper discipline and orderly conduct during the examinations. They shall not make use of any unfair or dishonest means or indulge in disorderly conduct in the examinations.
2. No student will be allowed to appear in the Examination unless he/she is carrying his/her **ID Card and Admit Card during End Semester Examination**. All the students reappearing in End Term Examination will be allowed with the valid admit card.
3. If a student is found in possession of written/printed matter related to the subject of examination on anything (such as mobile phone, piece of paper or cloth, scribbling pad etc.), other than the answer book, any other response sheet specifically provided by the University to the students, it will be treated as act of unfair means and such cases will be forwarded to Unfair Means Committee.

9.9. Duration of the Programme

The minimum period required for completion of a programme shall be as specified in the Scheme of Teaching and Examination and Syllabi for concerned programme approved by the Academic Council on the recommendations of the Board of Studies.

The maximum number of years within which a student must pass the credit requirements for award of a degree is as follows:

For 2 years and above Programs = n+2 years

The maximum permissible period includes, academic break, if availed by the student.

9.10. Grade sheet

After results are declared, Grade Sheets will be issued to each student which will contain the following details:

- The list of courses registered during the semester and the grade scored.
- The Grade Point Average (GPA) for the semester.
  The Cumulative Grade Point Average (CGPA) of all courses enrolled from first semester onwards would be shown on the final semester grade sheet.

The Semester performance of a student is indicated as “Semester Grade Point Average (SGPA)”. The SGPA is weighted average of Grade Points of all letter grades awarded to a student for all the Courses in the semester. The formula for Computing SGPA is given below:

Grade points secured in the Semester SGPA= Associated Credits in the Semester

The overall performance of a student in all the previous Semester(s) including the current Semester is indicated as “Cumulative Grade Point Average (CGPA)". The Cumulative Grade Point Average (CGPA) is the weighted average of grade points of all letter grades awarded to a student for all the courses in the previous Semester(s) including the current Semester. The formula for computing CGPA is given below:

$$\text{SGPA} = \frac{\text{Grade points secured in the Semester}}{\text{Associated Credits in the Semester}}$$

CGPA to Percentage Conversion Formula is given below:

Percentage (%) = CGPA (X) 10

9.11. Eligibility for the Award of the Degree

A student shall be declared to be eligible for the award of the M.Sc.MRIT Degree provided t the student has

1. Successfully gained the required number of total credits as specified in the curriculum corresponding to the student's programme within the stipulated time.
2. Successfully passed all the Courses as per curriculum.
3. Successfully completed the Programme requirements, appeared for the End-Semester examinations and passed all the subjects prescribed.
4. The award of Degree must be approved by the Academic Council of SU.

1.13. Declaration of Result

The university shall strive to declare the results of every examination conducted by it within a period of thirty days from the last date of the examination for that particular programme/course and shall in any case declare the results latest within a period of forty-five days from such date

1.14. Convocation

Convocation of the university shall be held every academic year for conferring degrees, diplomas, certificates and shall be conducted as specified in the Act/Statues. The dates for the convocation (normally within six months) shall be notified well in advance to all the students.

10. PROVISION FOR AUTHORISED BREAK OF STUDY

10.1. Students who apply for Academic Break and the case is recommended by the Deans/Directors for justifiable reasons to be recorded, can be granted academic break of one year to the students, if approved by the Vice Chancellor, under the following circumstances:

a. The student has been continuously ill.
b. Career advancement
c. Justified personal reasons.

10.2. The student who is granted academic break shall not be required to pay the academic fee for that year. However, on re-joining, he/she will pay the fee applicable to the batch he/she joins.

11. DISCIPLINE

Every student is required to observe discipline and decorous behaviour both inside and outside the University and not to indulge in any activity which will tend to bring down the prestige of SU. The disciplinary committee of the University enquires into acts of gross indiscipline and notify the University about the disciplinary action taken against the student.

12. REVISION OF REGULATIONS, CURRICULUM AND SYLLABI

SU may from time-to-time revise, amend or change the Regulations, Curriculum, Syllabus and scheme of examinations as proposed by the BOS and approved by the Academic Council.

13. EXTRA/ CO-CURRICULAR ACTIVITIES OF THE SCHOOL

The school aims at holistic development of the students. The students represent our school in various co-curricular and extra-curricular activities not only at the university level but also outside the university by being a part of these committees.

14. PROGRAM STRUCTURE

Course Duration- 2 Years

Batch (2024-26)

Total Credits -106

Color Code	Nature of Courses	Actual Percentage	Proposed Percentage
	Core Courses	69%	60-70%
	Discipline Specific Electives (DSE)	10%	10-15 %

	Generic Elective I (GE I)	2 Courses (TDCC)	2 Courses in PG as Required
	Generic Elective II (GE II)	1 Courses	1 Courses in PG as required
	Dissertation/Project/Internship	25 Credits	30 Credits
	Skill Enhancement Course (SEC)	2 Courses	2 Courses
	Ability Enhancement Course (AEC)	1 Courses	2 courses
	Service Learning/Community Service Based Course	1 Courses	1 Course

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Core Courses
Generic Elective I (GE I)
Generic Elective II (GE II)
Dissertation or Internship
Skill Enhancement Course (SEC)
Ability Enhancement Course (AEC)

FIRST SEMESTER

Course Code	Course Titles	Lectures (L)	Tutorial {T}	Practical {hours}	Total Credits
23MMRIT-101	Physics Of Newer Imaging Modality	4	-	4	06
23MMRIT-102	Modern imaging Techniques PET/SPECT	6	-	4	08
MMRIT-103	Advanced Physics of Radiology & Imaging	4	-	4	06
23MMRIT-104	Research Methodology and Biostatistics	4	-	-	04
MMRIT-105	Community Service (workshop)	-	1	0	01
23MMRIT-135	Residency – I Clinical Posting	-	-	08	04
TOTAL					**29**

SECOND SEMESTER

Course Code	Course Title	Lectures (L)	Tutorial {T}	Practical {hours}	Total Credits
23MMRIT-201	Radiation Safety	5	-	2	06
23MMRIT-202	Modern imaging techniques PET CT & PET MRI	5	-	2	06
23MMRIT-203	Radiological Procedures	6	-	2	07
23MMRIT- 204	Recent Advances in Medical Imaging and Biostatics	5	-	2	06
23MMRIT- 205	Nuclear Medicine Imaging Techniques	3	-	2	04
	TDCC	1	-	2	02
TOTAL					**31**

THIRD SEMESTER

Course Code	Course Title	Lectures (L)	Tutorial {T}	Practical {hours}	Total Credits
MMRIT-301	Quality Assurance and Quality Control in Diagnostic Radiology and Imaging	3	-	2	04
MMRIT-302	Newer Imaging Modalities	3	-	2	04
MMRIT-303	Intervention Radiological Techniques and Care of Patient	6	-	2	07
MMRIT-304	Research Methodology and Biostatistics – II	5	-	-	05
MMRIT-305	Workshop/Seminars/Project	-	1	-	01
MMRIT306	Residency-III	-	-	12	06
MMRIT-307	MOOC	-	1	-	01
	TDCC	1	-	2	02
TOTAL					**30**

FOURTH SEMESTER

Course Code	Course Title	Lectures (L)	Tutorial {T}	Practical {hours}	Total Credits
23MMRIT-401	Project work	-	-	6	03
23MMRIT-402	Seminars/Group Discussions	-	-	6	03
MMRIT-435	Residency –IV Dissertation	-	-	20	10
TOTAL			**0**	**32**	**16**

Vision:

The mission of the School of Health Sciences is to Develop highly qualified clinical technologists in health care through excellence in education and patient care. As a Health Sciences research and education provider, develop strategic partnerships and collaboration initiatives, and innovative approaches to education through industry integration and research excellence.

Mission:

- We empower, engage, and educate health professionals, scientists and researchers who will lead their fields to best serve the health and well-being of people.
- Encourage community participation and create an atmosphere through the provision of services to the underprivileged.
- Continued creativity and innovation in education, patient care and research and create an environment of evidence-based learning.
- Teach ethics and professionalism and demonstrate a deep conviction to the integrity of the institution and all of its people.
- Develop and empower effective leaders that serve our institution, our patients, our communities, our profession and our world.
- To foster life-long learning among our students, faculty and staff.

Syllabus
With
Examination Scheme

COURSE DESCRIPTION- (Duration: Two Year - Full Time)

M.Sc. in Medical Radiology & Imaging Technology is a Postgraduate 2 years academic program. Medical radiology imaging technology plays a crucial role in diagnosing and monitoring of various medical conditions by taking internal images of the human body. Students will be able to perform procedures on various modalities like X-ray imaging, Mammography, DSA, DEXA, Computed Tomography (CT), Magnetic Resonance Imaging (MRI), Ultrasound, and Nuclear Medicine. These technologies enable the visualization of bones, soft tissues, and organs, aiding in the diagnosis and monitoring of a wide range of medical conditions. Student will be able to interpret radiological images accurately, identifying normal and abnormal findings across different imaging modalities.

Learning Objectives:

The M.Sc. in Medical Radiology & Imaging Technology is specifically aimed at those pursuing a professional career in Imaging Science technology. It is designed to provide specialized training in the scientific principles of modern imaging science and in the application of these principles in the field of radio diagnosis. It is designed as a higher degree course suitable for gradates having experience in the technology of imaging science. The objective of the programme is to train students in to qualified, patient focused, compassionate, critical thinkers Diagnostic Radiographer / Technologist for the community who are engaged in lifelong learning.

Up to successful completion of the M.Sc. course, students will have developed a broad knowledge of the principles, technology, instrumentation, recent developments and proper handling of the modern radiological equipment and proper execution of the various radiological procedures and be able to embark Up to a successful career in their chosen direction of Imaging Science research.

Specializations:

1. Modern imaging techniques
2. Advance radiation physics

3. Intellectual planning and management of radiology
4. Radiation protection-AERB
5. Radiological procedures
6. Interventional radiology patient care
7. Quality assurance and quality control

POSTGRADUATE ATTRIBUTES

The postgraduate attributes in Medical Radiology and Imaging Technology involve skills expected to be gained by a student through studies that support in sharpening contemporary knowledge base, acquiring new learning and skills, identifying with future studies, engaging well in a preferred career and performing a positive role as enlightened skilled professional in the society. The characteristic, profundity and magnitude of the learning experiences made available to the students support them to unfold the quality attributes in the following manner:

1.Disciplinary Knowledge:

Aptitude to manifest wide and extensive knowledge in the field of study and comprehension of one or more disciplines constitute part of postgraduate attributes including how other disciplines relate to the field of knowledge. An international perspective in the area of study also gives a wider learning of the subject. In the specialized course, the constant review and renewal of subject and courses assure coverage of recent developments. Quality education and training build a condition in which learning is exchanged, critically evaluated and used in contemporary situations with the aptitude to review, examine and integrate and utilize actual learning in the appropriate field.

2.Communication Skill:

Classroom discussion and formal presentations render a suitable opportunity to sharpen oral communication and written assessment skills. They create the ability to manifest ideas and thoughts in writing and orally to communicate confidently their viewpoints. By expressing adeptness to listen meticulously, they can read and write logically as well as give obscure information in explicit and succinct manner. With practice as a part of interdisciplinary team, students become able to choose and employ the proper form and methods of communication.

3.Critical Thinking:

The ability to apply critical reasoning to issues through independent thought and informed judgment are important postgraduate attributes integrating information from a wide range of sources. The postgraduates are able to apply analytical thought to body of knowledge and critically evaluate ideas, analysis, and examine on the basis of empirical patient history from reasoned perspectives. They become able to identify relevant assumptions or implications and formulate techniques in none conditions.

4.Research Related Skills:

Research papers and other research tasks are expected to develop a degree of creativity, originality and discovery that benefits a postgraduate programme of the highest quality and to which students are encouraged. An ability is developed to undertake supervised research, including the design and conduct of investigations in a systematic, critical manner.

5.Self-Directed Learning:

The demanding nature of postgraduate attributes requires effective time-management and an ability to work independently. The rigor of programmes ensure that all postgraduates have developed the ability to work with relative autonomy which provides a foundation for future leadership roles. Ability to work and learn independently and effectively leads to generating innovative ideas in the changing environment to investigate problems and to have creative solution. Self-learning and application of competence in exploring also help in solving non- familiar problems. This leads to application of one's learning to real life situation and critical sensibility to lived experiences. Well-developed problem-solving abilities also contribute to flexibility of approach.

6.Ethical and Social Understanding:

Profound respect for truth and intellectual integrity including the ethics of scholarship add to the ability to embrace values in conducting one's life and in formulating position about ethical problems from multiple perspectives appreciating environmental and sustainability issues. This postgraduate attribute fosters understanding of social and ethical responsibility and ability to apply ethical standards in order to attain unbiased and truthful actions in all

aspects of life. It also involves appreciation of the philosophical and social contexts of a discipline with knowledge of other cultures and appreciation of cultural diversity.

7.Quality of Team Work:

Team work, as postgraduate attributes, creates capacity to value and work effectively and respectfully with diverse team and to facilitate coordinated effort for a common cause. It involves training in mapping out tasks of a team, setting directions and formulating an inspiring vision.

Program Educational Objectives

1. **Patient-Centered Care**: Verifying informed consent and assuming responsibility for patient needs during imaging procedures while maintaining a high standard of ethical and compassionate care.
2. **Radiation Safety**: Applying ALARA principles to minimize radiation exposure to patients, self, and others while adhering to safety protocols and guidelines.
3. **Technical Proficiency**: Evaluating and ensuring the technical quality of diagnostic images, proper identification, and accurate documentation.
4. **Advanced Imaging Skills**: Performing diagnostic radiographic, fluoroscopic, and MRI procedures, assisting in complex radiological examinations, and troubleshooting technical challenges.
5. **Collaborative Practice**: Promoting effective inter- and intra-departmental teamwork to achieve departmental objectives and enhance patient outcomes.
6. **Emergency Response**: Identifying and managing emergency situations competently, ensuring patient and staff safety.
7. **Research and Innovation**: Engaging in the development and refinement of imaging techniques and contributing to evidence-based practices in medical imaging.
8. **Education and Leadership**: Teaching and mentoring students, new employees, and other healthcare providers while demonstrating leadership and supervisory skills.
9. **Quality Assurance**: Performing continuous quality assurance activities to maintain high standards in imaging practices and equipment performance.
10. **Professional Development**: Adapting to advancements in medical imaging technologies, pursuing ongoing education, and exhibiting professionalism in all aspects of clinical and academic responsibilities.

Program Outcomes (POs)

1.Disciplinary knowledge: provide an advanced qualification for students wanting to better understand the nature of Legal provisions in the face of global political, economic, social, legal, ethical and environmental challenges;

2.Effective communication: Graduates are able to communicate effectively to various stakeholders and practice their profession with high regard to societal needs, diversity, constraints in the professional workplace and ethical responsibilities.

3.Critical thinking: describe and critique the differing approaches, perspectives, and models of legal practices and research and how they impact the ways in which education is carried out in diverse settings;

4.Research related skills: design, conduct, analyze and present findings using diverse research tools and methods in order to create knowledge and awareness about legal research, identify diverse methodological tools and skills needed to conduct ethical research synthesize contextual understanding, reflective analysis, theoretical frameworks, and methodological training to inform the production of a thesis and field-based research projects;

5.Self-directed learning: Ability to work and learn independently and effectively leads to generating innovative ideas in the changing environment to investigate problems and to have creative solution;

6.Ethical and Social Understanding: provide opportunities for the development of practical skills necessary to work in organizations confronted by these challenges;

7.Building Up Teamwork: provide prospects for the development of practical skills necessary to work in team work by doing various activities in groups confronted by these challenges;

8.Employability: Demonstrate core values relating to profession or job requirements and meet new challenges maintaining the dignity of the profession.

9. Lifelong Learning: Demonstrate participation and learning process by updating knowledge and practice in order to meet the professional needs and priorities of the system.

Annexure A

For a course of 100 marks containing only Theory Component

Mid Semester Theory Examination	Quiz(s), Presentation(s), Faculty Student Interaction	Assignment(s)	Continuous Assessment	Total
15	**15**	**5**	**5**	**40**

END SEMESTER EXAMINATION (60)
Theory (60)

MID SEMESTER EVALUATION (40) – Theory (25 Marks) + Lab (15 Marks)

Mid Semester Examination Theory	Quiz(s), Presentation(s), Lab practical performed & lab report	Assignment(s)	Continuous Assessment	Total
15	**15**	**5**	**5**	**40**

END SEMESTER EXAMINATION (60)	
Theory (35)	Lab (25)

For a course of 100 marks containing only Practical Component:

Internal (20)	**Continues Assessment (10)**	**Lab work(10)**	**Presentation (30)**	**Viva (20)**	**Practical File (10)**	**Total (100)**

1. <u>Eligibility for admissions:</u>

1. Candidates applying for admission to M.Sc.MRIT Degree Program: must have completed a B.Sc. in Medical Technology (Radio Diagnosis and Imaging)/ B.Sc. in Radiological Technology / B.Sc. in Radiography or B.Sc. in Medical Technology (X-ray), with at least 60% marks in their B.Sc. degree.
2. Selection of the students by the Entrance examination conducted by the Institute, followed

by personal interview or counselling by the Interview Board constituted by the institution according to the norms.

2. **Duration of the course:**

Duration of the course: 4 semesters or 2 Years (590 hours of Theory & 750 hours of Practical Classes) and 850 hours of Resident Postings.

Total hours – 2180

3. **Medium of instruction:**

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

4. **Assessment:**

Assessments should be completed by the academic staff, based on the compilation of the student's theoretical &clinical performance throughout the training programme. To achieve this, all assessment forms and feedback should be included and evaluated

5. **Selection of eligible candidates:**

Selection to the Master in Radiology and Medical Imaging Technology course shall be on the performance in written exam or interview conducted by Sushant University. Medical fitness certificate needs to be submitted by the candidate on the day of Admission.

6. **Withdrawal -Temporary and Permanent:**

A. Temporary:

A candidate who has been admitted to the course may be permitted to withdraw temporarily for a period of six months or more up to one year on the grounds of prolonged illness, grave calamity in the family etc. provided:

He applies stating the reason of withdrawal with supporting documents and endorsement by parent/guardian.

The University is satisfied that without counting the period of withdrawal candidate is likely to complete his requirement of the degree within maximum time specified.

There are no outstanding dues or demands with the department, library, hostel and Institute / University.

The tuition fee for the subsequent year may be collected in advance based on the severity of the case before giving approval for any such temporary withdrawal.

Scholarship holders are bound by the appropriate rules applicable.

The decision of the University regarding withdrawal of a candidate is final and binding.

B. Permanent:

A candidate who withdraws admission before closing date of admission for the academic session is eligible for refund of the deposit only. The fees once paid will not be refunded on any account.

Once the admission for the year is closed and if a candidate wants to leave the Institute, he /she will be permitted to do so and take the Transfer Certificate from the Institute/University, if required only after remitting all the tuition fees for the remaining years.

Those candidates who have received any scholarship/stipend/other forms of assistance from the Institute/University shall repay all such amounts in addition to those mentioned in the clause above.

The decision of the Institute/University regarding withdrawal of a student is final and binding.

7.Conduct and Discipline:

Candidates shall conduct themselves within and outside premises of the Institution in a manner defecting professional institution.

As per the order of Honorable Supreme Court of India, ragging in any form is considered as a criminal offence and is banned. Any form of ragging will be severely dealt with.

The following acts of omission and /or commission shall constitute gross violation of the code of conduct and are liable to invoke disciplinary measures:

Ragging is strictly prohibited.

Lack of courtesy and decorum, indecent behavior anywhere within or outside the campus.

Willful damage or stealthy removal of any property/belongings of the institute/hostel or of fellow students/citizens. Possession, consumption or distribution of alcoholic drinks or any kind of hallucinogenic drugs. Mutilation or unauthorized possession of library books.Noisy or unruly behaviou disturbing studies of fellow students.
Hacking in computer systems (such as entering other person's domain without prior permission, manipulation and/or damage to the computer hardware and software or any other cybercrime etc.) Plagiarism of any nature.

Any other act of gross indiscipline as decided by the Board of Management from time to time. Commensurate with the gravity of offence, the punishment may be: reprimand, fine, expulsion from the hostel, debarment from an examination, disallowing the use of certain facilities of the Institute, rustication for a specific period or even outright expulsion from the institute, or even handing over the case to appropriate law enforcement authorities or the judiciary as required by the circumstances.

For any offence committed in hostel, department, class room, and elsewhere, the Chief Warden, the Head of the Department/Course Coordinator and the Director (Student Affairs)/ Authorities of the University respectively, shall have the authority to reprimand or impose fine.

All cases involving punishment other than reprimand or fine shall be reported to the Vice- Chancellor. Cases of adoption of unfair means and/or any malpractice in an examination shall be reported to the

Controller of Examinations for taking the appropriate action.

8.Graduation requirements:

Candidate shall be declared eligible for the award of the degree if he has:

- Fulfilled degree requirement.
- No dues to the University, Institute, Departments, Hostels, Library etc.
- No disciplinary action pending against him.

The award of the degree must be recommended by the Board of Management.

9.Convocation:

Degrees will be awarded in person to all eligible the students who have graduated during preceding academic year at the annual convocation. For eligible students who are unable to attend the convocation, degree certificate will be sent by post. Students are required to apply for the convocation along with prescribed fee within the specified date, after having satisfactorily completed all degree requirements.

10.Attendance:

A candidate has to secure minimum-

- 75% attendance in theoretical.
- 80%inSkills training (practical) for qualifying to appear for the final examination

Program outcome (PO):-

1. Demonstrate the knowledge and skills in basic radiology and imaging technology to facilitate their overall professional development.

2) Plan, implement and evaluate Programme to identify Radio Imaging Technology needs in corporation with patients.

3) To describe the ethical and legal bases for Radio Imaging Technology Services.

4) To prepare students to have knowledge of the radiological and imaging technology required for the diagnosis of different ailments.

5) To adapt to new Clinical Skills and Imaging Technology

6) The Radiology or X-ray & Imaging Technology Programme trains students to work as radiology technicians in radiology departments of hospitals, diagnostic centers and clinics.

7) To equip the students with the skills and expertise in carrying out all routine and sophisticated medical diagnostic procedures efficiently.

8) To impart a broad knowledge and understanding of the principles, technology, instrumentation, recent developments and proper handling of the modern radiological equipment and proper execution of the various radiological procedures to gain professional competence in the arena of medical imaging technology and be able to embark up to a successful career in their chosen direction of Imaging Science research.

9) The program aims to train human resources with requisite skills in the area of medical radiology & imaging professionals can be hired in all kinds of healthcare settings including hospitals, diagnostic and Medical Labs, Clinical and Medical Research organizations and Medical equipment and device companies.

10) The demand for qualified professionals is on the rise and the job profile may vary according to the modality and scope of practice such as Applications Specialist, Quality control Technologist, Sales and marketing of radiology industry, etc. Other Administrative posts in Medical Imaging department & hospital, Teaching & research faculty in medical colleges and Research Scientists in Medical imaging industry

Programme Specific Outcomes (PSO):-

PSO 1. The program enhances exercise effective interpersonal communication skills with patients, also apply effective interdisciplinary communication skills.

PSO 2. The program develops execute logical procedural variations for non-routine situations and to evaluate radiographic image quality.

PSO 3. The program exhibits the professional responsibilities of medical imaging technologists, engaging in self-development related to professional practice as well.

PSO 4. The program also demonstrates clinical procedural proficiency and utilize radiation safety practices.

Programme Educational Objectives (PEO):-

PEO 1. M.Sc. MRIT demonstrates the knowledge and skills in basic radiology and imaging technology to facilitate their overall professional development and communicate effectively in the health care setting.

PEO 2. Plan, implement and evaluate Programme to identify Radio Imaging Technology needs in corporation with patients along with utilization of critical thinking and problem-solving skills.

PEO 3. To describe the ethical and legal bases for Radio Imaging Technology Services in model professionalism.

PEO 4. Demonstrate clinical competence and prepare students to have knowledge of the radiological and imaging technology required for the diagnosis of different ailments.

UNIVERSITY MISSION WITH PROGRAMME EDUCATIONAL OBJECTIVES

M1	Transform lives and communities through education and research
M2	Achieve excellence through participatory governance and focus on quality research and innovation
M3	Attract talent through international partnerships and collaborations to achieve highest standards
M 4	Facilitate learning through student centric and empathetic approach
M5	Develop thought leadership with industry integration

PEO / M	**PEO 1**	**PEO 2**	**PEO 3**	**PEO 4**
M1	**H**	**H**	**H**	**H**
M2	**H**	**M**	**H**	**L**
M3	**H**	**L**	**L**	**M**

M4	**H**	**H**	**H**	**M**
M5	**H**	**M**	**L**	**H**

PROGRAMME EDUCATIONAL OBJECTIVES WITH PROGRAMME SPECIFIC OUTCOMES

PSO 1.	The program enhances exercise effective interpersonal communication skills with patients, also apply effective interdisciplinary communication skills.
PSO 2.	The program develops execute logical procedural variations for non-routine situations and to evaluate radiographic image quality.
PSO 3	The program exhibits the professional responsibilities of medical imaging technologists, Engaging in self-development related to professional practice as well.
PSO 4.	The program also demonstrates clinical procedural proficiency and utilize radiation safety practices
PO1.	Demonstrate the knowledge and skills in basic radiology and imaging technology to facilitate their overall professional development.
PO2	Plan, implement and evaluate Programme to identify Radio Imaging Technology needs in corporation with patients
PO3	To describe the ethical and legal bases for Radio Imaging Technology Services
PO4	To prepare students to have knowledge of the radiological and imaging technology required for the diagnosis of different ailments.
PO5	To adapt to new Clinical Skills and Imaging Technology
PO6	The Radiology or X-ray & Imaging Technology programme trains students to work as

	radiology technicians in radiology departments of hospitals, diagnostic centres and clinics.
PO7	To equip the students with the skills and expertise in carrying out all routine and sophisticated medical diagnostic procedures efficiently.
PO8	To impart a broad knowledge and understanding of the principles, technology, instrumentation, recent developments and proper handling of the modern radiological equipments and proper execution of the various radiological procedures to gain professional competence in the arena of medical imaging technology and be able to embark up to a successful career in their chosen direction of Imaging Science research
PO9	The program aims to train human resources with requisite skills in the area of medical radiology & imaging professionals can be hired in all kinds of healthcare settings including hospitals, diagnostic and Medical Labs, Clinical and Medical Research organizations and Medical equipment and device companies.
PO10	The demand for qualified professionals is on the rise and the job profile may vary according to the modality and scope of practice such as Applications Specialist, Quality control Technologist, Sales and marketing of radiology industry, etc. Other Administrative posts in Medical Imaging department & hospital, Teaching & research faculty in Medical colleges and Research Scientists in Medical imaging industry

PSO / PO	**PO 1**	**PO 2**	**PO 3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**
PSO 1	**M**	**M**	**L**	**H**	**M**	**L**	**H**	**H**	**H**	**H**
PSO 2	**H**	**H**	**H**	**M**	**M**	**L**	**L**	**H**	**H**	**H**
PSO 3	**H**	**M**	**L**	**M**	**H**	**H**	**L**	**M**	**M**	**H**
PSO 4	**H**	**H**	**H**	**M**	**H**	**L**	**H**	**H**	**H**	**H**
PSO 5	**H**	**H**	**M**	**L**	**H**	**M**	**H**	**H**	**M**	**M**

	School of Health Sciences **M.Sc.MRIT**		
Course Title: Physics of Newer Imaging Modality			
Semester: I	**Course code :MMRIT-101**	**Credits:06**	**Core**
No of sessions Lectures / Tutorial: 60		**No of practical hours:60**	
Course Pre-requisites:		**Number of sessions: 120**	

Course Introduction

This course explores the fundamental physics principles underlying newer imaging modalities in the field of medical diagnostics and research. Students will gain an understanding of the physical principles and technologies behind advanced imaging techniques such as MRI, PET, SPECT, and ultrasound. The course aims to equip students with the knowledge necessary to comprehend the operation, advantages, and limitations of these cutting-edge imaging modalities.

Course Objectives:

1. To provide students with a solid foundation in the physics principles governing newer imaging modalities.
2. To enable students to understand the operation of various advanced imaging technologies.
3. To analyze the advantages and limitations of each imaging modality in clinical and research settings.
4. To foster critical thinking skills for evaluating and selecting appropriate imaging techniques.

Course Learning Outcomes

By the end of the course, students should be able to:

CO1; Explain the fundamental physical principles underlying MRI, PET, SPECT, and ultrasound imaging technologies.

CO2: Describe the components and instrumentation used in each imaging modality.

CO3; Analyze the advantages and limitations of different imaging techniques in various clinical and research applications.

CO4; Evaluate and recommend appropriate imaging modalities for specific diagnostic or research needs.

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4. Course Pedagogy

This course employs a mix of interactive lectures, assignments, and numerical practice to strengthen students' conceptual understanding of applied physics. The emphasis is on real-world applications, improving problem-solving skills, and enhancing practical proficiency

5.**Course content.**

Module 1: Basic Computed Tomography (CT)

Basic principles of CT, Generations of CT, CT instrumentation, Image formation in CT, CT image reconstruction, Hounsfield unit, CT image quality, CT image display

Module 2: Advanced Computed Tomography - Helical CT scan

Slip ring technology and its advantages, Multi-detector array helical CT, Cone-beam geometry, Reconstruction of helical CT images, CT artifacts, CT angiography, CT fluoroscopy, High-Resolution CT (HRCT), Post-processing

techniques (MPR, MIP, Min IP, 3D rendering: SSD and VR), CT dose, Patient preparation, Imaging techniques and protocols for various body parts, CT contrast-enhanced protocols (Aortogram, selective angiogram head, neck, and peripheral), Image documentation and filing, Maintenance of equipment and accessories

Module 3: Advanced Technique & Instrumentation of MRI

Types of magnets used in MRI, RF transmitter and receiver in MRI, Gradient coils and shim coils, RF shielding in MRI, Computers in MRI

Module 4: Basic Principles of MRI And pulse sequence in MRI

Spin, Precession, Relaxation time, Pulse cycle, T1 weighted image, T2 weighted image, Proton density image, Spin echo pulse sequence, Turbo spin echo pulse sequence, Gradient echo sequence, Turbo gradient echo pulse sequence, Inversion recovery sequence, STIR sequence, SPIR sequence, FLAIR sequence, Echo planar imaging, Advanced pulse sequences

Module 5: MR Instrumentation, Image Formation, and Other Imaging Modalities

Image formation using the 2D Fourier transformation method, K-space representation, 3D Fourier imaging, Maximum Intensity Projection (MIP), MR contrast media, MR angiography (TOF & PCA), MR Spectroscopy, Functional MRI, Real-time ultrasound: Line density and frame rate, Real-time ultrasound transducers (mechanical and electronic arrays), Ultrasound artifacts, Ultrasound recording devices, Distance, area, and volume measurements, Techniques for imaging different anatomical areas with ultrasound, Ultrasound artifacts, biological effects, and safety, Automated Breast Volume Scanner (ABVS), Fusion Imaging (PET CT & PET MRI)

Course Assessment:

MID SEMESTER EVALUATION (40) – Theory (25 Marks) + Lab (15 Marks)

Mid Semester Examination Theory	Quiz(s), Presentation(s), Lab practical performed & lab report	Assignment(s)	Continuous Assessment	Total
15	**15**	**5**	**5**	**40**

END SEMESTER EXAMINATION (60)	
Theory (35)	Lab (25)

Course Assessment Scheme

Students would be assessed continuously throughout the semester in the form of continuous evaluation. Periodic tests and surprise tests will be conducted. Students will have to submit written assignments, make charts and posters, make models, and conduct quiz for the topics. Practical will be conducted with viva. Midterm and end term evaluation will be done theoretically and practically. Students will also be assessed on the basis of presentations of various topics.

MAPPING BETWEEN CO'S AND PO'S		
	COURSE OUTCOMES	MAPPED PROGRAMME OUTCOMES

CO1	Understood the basic concepts, fundamental principles, and the scientific theories related to various scientific phenomena and their relevancies in the day-to-day life.	PO1, PO2,PO3,PO7,PO10
CO2	Acquired the skills in handling scientific instruments, planning and performing in laboratory experiments.	PO1,PO2,PO3,PO7,P010,P006,
CO3	Realized how developments in any science subject helps in the development of other science subjects and vice-versa and how interdisciplinary approach helps in providing better solutions and new ideas for the sustainable developments.	PO1,P02,PO5, PO7

Relationship between the Course Outcomes (COs) and Program Outcomes (POs)

0-PO Keywords	*Knowledge & Expertise of Medical radio-*	*Leadership and mentorship*	*Problem solving*	*Ethics and accountability*	*Communication & presentation skills*	*Commitment to professional exc*	*Research*	*Lifelong learning*	*Employability, Entrepreneurship*	*Organizational Behavior*	*Ethical, Social and professional understanding*

	imaging technology					*excellence*					
COURSE OUTCOMES	*PO1*	*PO2*	*PO3*	*PO4*	*PO5*	*PO6*	*PO7*	*PO8*	*PO9*	*PO10*	***PO11***
CO1	***3***	***3***	***2***	***3***	***3***	***3***	***3***	***2***	***3***	***3***	***3***
CO2	***3***	***3***	***1***	***3***		***3***	***3***	***1***	***3***	***3***	***3***
CO3	***3***	***3***	***3***	***2***	***3***	***3***	***3***	***3***	***2***	***3***	***3***
CO4	***3***	***3***	***2***	***3***	***3***	***3***	***3***	***2***	***3***	***3***	***3***

1= LOW 2= MEDIUM 3= HIGH

Text Books:

- "Principles of Magnetic Resonance Imaging" by Dwight Nishimura
- "Physics in Nuclear Medicine" by Simon R. Cherry and James A. Sorenson
- "Ultrasound: The Requisites" by Barbara S. Hertberg and William D. Middleton

Sushant University soaring high	**School of Health Sciences** **M.Sc.MRIT**		
Course Title: Modern imaging Techniques PET/SPECT			
Semester: I	**Course code:MMRIT-102**	**Credits:08**	**Core**
No of sessions Lectures / Tutorial: 60		**No of practical hours:120**	
Course Pre-requisites:		**Number of sessions: 180**	

Course Introduction

Course Introduction

This course explores the principles, technologies, and applications of modern imaging techniques, focusing on Single photon emission computed tomography (SPECT) and Positron Emission Tomography (PET). Students will gain a comprehensive understanding of how these advanced imaging modalities work, their clinical significance, and their role in diagnosing and managing medical conditions.

Course Objectives:

- To provide students with in-depth knowledge of SPECT and PET principles.
- To develop proficiency in interpreting SPECT and PET images.
- To understand the clinical applications and relevance of these imaging techniques.
- To foster critical thinking skills for evaluating and recommending appropriate imaging modalities.

Course Learning Outcomes

By the end of the course, students should be able to:

CLO1: Explain the underlying principles of SPECT and PET.

CLO2: Interpret SPECT and PET images accurately.

CLO3: Evaluate the clinical significance and applications of SPECT and PET.

CLO4: Make informed decisions on when to use SPECT, PET, or other imaging modalities.

Course Pedagogy

This course will utilize a variety of teaching methods to enhance understanding and practical skills, including:

Interactive Lectures

Hands-on Image Analysis

Clinical Case Studies

Guest Lectures by Imaging Experts

Group Discussions and Seminars

COURSE CONTENT

Module1: **Nuclear Medicine Introduction & History**

History, Electromagnetic spectrum, Radioactivity & Interaction of Radiation, Applications and Apparatus for nuclear medicine

Module2: **Radionuclides & radioactivity**

Characteristics and half-life of Radionuclides.

Commonly used Radionuclides, Radioactivity-Discovery-Natural & Artificial Radioactivity, Isotopes and nuclides-binding forces between nuclear particles-alpha & beta particles, gamma radiation-mechanisms of radioactive decay-half life –Interaction of electrons, X-ray & x-rays with matter, Scattering and its types, production of Radioisotopes.

Module3: Gamma Camera

Camera head construction and principle of operation Collimators – parallel multi hole, high resolution, high sensitivity pin hole, diverging hole, slant hole. Collimators Scintillation crystal, size Light guide – Photo multipliers per amplifiers, Applications, Function

Module4: SPECT Imaging

Definition, Collimators, Scintillation crystal, Photo multipliers per amplifiers, Applications, Clinical uses, advantages & disadvantages, limitations.

Module5: PET Imaging

Definition, Scintillation crystal, Photo multipliers per amplifiers, Applications, Clinical uses, advantages & disadvantages, limitations.

Recent advances in SPECT, PET including hybrid system.

Course Assessment Scheme

Students would be assessed continuously throughout the semester in the form of continuous evaluation. Periodic tests and surprise tests will be conducted. Students will have to submit written assignments, make charts and posters, make models, and conduct quiz for the topics. Practical will be conducted with viva. Midterm and end term evaluation will be done theoretically and practically. Students will also be assessed on the basis of presentations of various topics.

For a course of 100 marks containing only Theory Component

MID SEMESTER EVALUATION (40) – Theory (25 Marks) + Lab (15 Marks)

Mid Semester Examination Theory	Quiz(s), Presentation(s), Lab practical performed & lab report	Assignment(s)	Continuous Assessment	Total
15	**15**	**5**	**5**	**40**

END SEMESTER EXAMINATION (60)	
Theory (35)	Lab (25)

MAPPING BETWEEN CO'S AND PO'S		
	COURSE OUTCOMES	MAPPED PROGRAMME OUTCOMES
CO1	Understood the basic concepts, fundamental principles, and the scientific theories related to various scientific phenomena and their relevancies in the day-to-day life.	PO1, PO2,PO3,PO7,PO10
CO2	Acquired the skills in handling scientific instruments, planning and performing in laboratory experiments.	PO1,PO2,PO3,PO7,P010,P006,
CO3	Realized how developments in any science subject helps in the development of other science subjects and vice-versa and how interdisciplinary approach helps in providing better solutions and new ideas for the sustainable developments.	PO1,P02,PO5, PO7

Relationship between the Course Outcomes (COs) and Program Outcomes (POs)

0-PO Keywords	*Knowledge & Expertise of Medical radio-imaging*	*Leadership and mentorship*	*Problem solving*	*Ethics and accountability*	*Communication & presentation skills*	*Commitment to professional excellence*	*Research*	*Lifelong learning*	*Employability, Entrepreneurship*	*Organizational Behavior*	*Ethical, Social and professional understanding*

	technology										
COURSE OUTCOMES	*PO1*	*PO 2*	*PO 3*	*PO4*	*PO5*	*PO 6*	*PO7*	*PO8*	*PO 9*	*PO1 0*	***PO11***
CO1	***3***	***3***	***2***	***3***	***3***	***3***	***3***	***2***	***3***	***3***	***3***
CO2	***3***	***3***	***1***	***3***		***3***	***3***	***1***	***3***	***3***	***3***
CO3	***3***	***3***	***3***	***2***	***3***	***3***	***3***	***3***	***2***	***3***	***3***
CO4	***3***	***3***	***2***	***3***	***3***	***3***	***3***	***2***	***3***	***3***	***3***

1= LOW 2= MEDIUM 3= HIGH

Text Books:
Physics & radiobiology of nuclear medicine by Gopal B Saha

Sushant University soaring high	**School of Health Sciences** **M.Sc.MRIT**		
Course Title: Advanced Physics of Radiology & Imaging			
Semester: I	**Course code: MMRIT-103**	**Credits:06**	**Core**
No of sessions Lectures / Tutorial: 60		**No of practical hours:60**	
Course Pre-requisites:		**Number of sessions: 120**	

Course Introduction

This course explores the fundamental physics principles behind Magnetic Resonance Imaging (MRI) and Ultrasonography. Students will gain a comprehensive understanding of the underlying physics, technologies, and applications of these advanced imaging modalities.

Course Objectives:

- To provide students with a strong foundation in the physics principles governing MRI.
- To develop proficiency in understanding and operating MRI equipment.
- To comprehend the physics of Ultrasonography and its practical applications.
- To foster critical thinking skills for evaluating image quality and applying safety protocols.

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Course Learning Outcomes

By the end of the course, students should be able to:

- Explain the fundamental physics principles of MRI and Ultrasonography.
- Operate MRI and Ultrasonography equipment effectively.
- Understand the technology and advantages of these imaging modalities.
- Evaluate image quality and apply safety protocols in MRI and Ultrasonography.

Course Pedagogy

The course will employ various teaching methods, including:

Interactive Lectures
Hands-On Equipment Operation
Image Quality Evaluation Exercise
Case Studies and Image Analysis
Guest Lectures by Imaging Experts
Group Discussions and Seminars

Course Contents

Module 1: X-ray Radiography and Fluoroscopy

Principles of X-ray Generation and Interaction
X-ray Equipment: Radiographic and Fluoroscopic
Image Formation in X-ray Radiography
Image Quality Evaluation and Radiation Safety

Module 2: Magnetic Resonance Imaging (MRI)

Advanced MRI Principles
MRI Instrumentation: Magnets, RF Transmitter, RF Receiver, Gradient Coils
Advanced Pulse Sequences and Functional MRI
Emerging MRI Technologies

Module 3: Computed Tomography (CT)

Principles of CT Imaging
Generations of CT Scanners
CT Instrumentation and Image Formation
CT Image Reconstruction and Quality Evaluation
Advanced CT Techniques and Applications

Module 4: Ultrasonography Advancements

Advanced Ultrasonography Principles
Novel Ultrasound Technologies and Transducers
Advanced Image Analysis and Quality Enhancement
3D and 4D Ultrasound Applications

Module 5: Emerging Imaging Technologies

Cutting-Edge Developments in Medical Imaging
Future Trends and Potential Applications
Ethical and Social Considerations in Advanced Imaging
Preparing for Research and Innovation in Medical Imaging

Course Assessment Scheme

Students would be assessed continuously throughout the semester in the form of continuous evaluation. Periodic tests and surprise tests will be conducted. Students will have to submit written assignments, make charts and posters, make models, and conduct quiz for the topics. Practical will be conducted with viva. Midterm and end term evaluation will be done theoretically and practically. Students will also be assessed on the basis of presentations of various topics.

Course Assessment:

For a course of 100 marks containing only Theory Component

MID SEMESTER EVALUATION (40) – Theory (25 Marks) + Lab (15 Marks)

Mid Semester Examination Theory	Quiz(s), Presentation(s), Lab practical performed & lab report	Assignment(s)	Continuous Assessment	Total
15	**15**	**5**	**5**	**40**

END SEMESTER EXAMINATION (60)	
Theory (35)	Lab (25)

MAPPING BETWEEN CO'S AND PO'S		
	COURSE OUTCOMES	MAPPED PROGRAMME OUTCOMES
CO1	Understood the basic concepts, fundamental principles, and the scientific theories related to various scientific phenomena and their relevancies in the day-to-day life.	PO1, PO2,PO3,PO7,PO10
CO2	Acquired the skills in handling scientific instruments, planning and performing in laboratory experiments.	PO1,PO2,PO3,PO7,P010,P006,
CO3	Realized how developments in any science subject helps in the development of other science subjects and vice-versa and how interdisciplinary approach helps in providing better solutions and new ideas for the sustainable developments.	PO1,P02,PO5, PO7

Relationship between the Course Outcomes (COs) and Program Outcomes (POs)

0-PO Keywords	*Knowledge & Expertise of Medical radio-*	*Leadership and mentorship*	*Problem solving*	*Ethics and accountability*	*Communication & presentation skills*	*Commitment to professional excelle*	*Research*	*Lifelong learning*	*Employability, Entrepreneurship*	*Organizational Behavior*	*Ethical, Social and professional understanding*

	imaging technology					*nce*					
COURSE OUTCOMES	*PO1*	*PO 2*	*PO 3*	*PO4*	*PO5*	*PO 6*	*PO7*	*PO8*	*PO 9*	*PO1 0*	***PO11***
CO1	***3***	***3***	***2***	***3***	***3***	***3***	***3***	***2***	***3***	***3***	***3***
CO2	***3***	***3***	***1***	***3***		***3***	***3***	***1***	***3***	***3***	***3***
CO3	***3***	***3***	***3***	***2***	***3***	***3***	***3***	***3***	***2***	***3***	***3***
CO4	***3***	***3***	***2***	***3***	***3***	***3***	***3***	***2***	***3***	***3***	***3***

1= LOW 2= MEDIUM 3= HIGH

Text Books:

Computed Tomography: Physical Principles, Clinical Applications, and Quality Control" by Euclid Seeram
"MRI in Practice" by Catherine Westbrook, Carolyn Kaut Roth, and John Talbot
Radiological Physics by K. Thalayan

Sushant University soaring high	**School of Health Sciences** **M.Sc.MRIT**		
Course Title: Research Methodology and Biostatics I			
Semester: I	**Course code :MMRIT-104**	**Credits: 04**	**Core**
No of sessions Lectures / Tutorial:20		**No of practical hours:**	
Course Pre-requisites:		**Number of sessions:**	

1. **Course Objectives:**
   This is an extension of part one of RM course and focuses more on statistics. At the end of the semester the student is expected to do statistical analysis independently
2. **Course Outcome**

   Upon successful completion of the course, the students should be able to:
   CO1: Understand the need of research in vision science and to understand the basic concept of research methods which includes basic errors in research, data collection methods and formulation of research question.
   CO2: Able to identify different research study designs used in research and application of different sampling methods and understanding of biological variability
   CO3: Able to apply and calculate fundamental statistical concepts of sensitivity and specificity and formulation of questionnaire
   CO4: Able to write a research proposal after clear understanding of existing literature and research gap.
3. **COURSE CONTENTS**

Module 1: Introduction to Research Methodology

Understanding the importance of research methodology in scientific inquiry.

Different research methods and their applications.

Formulating research questions and hypotheses.

Module 2: Data Collection and Measurement

Methods of data collection and their suitability in research.

Measurement scales: nominal, ordinal, interval, and ratio.

Designing data collection instruments and surveys.

Module 3: Descriptive Statistics

Basic statistical concepts.

Measures of central tendency: mean, median, and mode.

Measures of variability: range, quartiles, standard deviation, and variance.

Module 4: Data Presentation and Graphical Representation

Creating frequency distributions and histograms.
Constructing scatterplots and bar charts.
Interpretation of graphical representations.

5. Course References

1. **Text books:**

- B.K. Mahajan. Methods in Biostatistics, Jaypee Brothers
- P.S.S. Sundar Rao. An Introduction to Biostatistics: A manual for students in Health Sciences, J.Richard Prentice Hall, 1996.

2. **Reference Books :**

- Daniel, Wayne.W. Bio-Statistics: A foundation for Analysis in the Health Sciences, John Wiley and Sons Pub, 1991.

Course Assessment:

For a course of 100 marks containing only Theory Component

Mid Semester Theory Examination	Quiz(s), Presentation(s), Faculty Student Interaction	Assignment(s)	Continuous Assessment	Total
15	**15**	**5**	**5**	**40**

END SEMESTER EXAMINATION (60)
Theory (60)

MAPPING BETWEEN CO'S AND PO'S		
	COURSE OUTCOMES	**MAPPED PROGRAMME OUTCOMES**
CO1	Understand the need of research in vision science and to understand the basic concept of research methods which includes basic errors in research, data collection methods and formulation of research question.	**PO1,PO2,PO5,PO6,PO7,PO10,PO11,PO12**
CO2	Able to indentify different research study designs used in research and application of different sampling methods and understanding of biological variability	**PO1,PO2,PO3,PO4,PO8,PO12,PO7,PO11**

CO3	Able to apply and calculate fundamental statistical concepts of sensitivity and specificity and formulation of questionnaire	**PO1,PO2,PO3,PO4,PO7,PO9,PO10**
CO4	Able to write a research proposal after clear understanding of existing literature and research gap.	**PO5,PO7,PO8,PO9,PO10**

Relationship between the Course Outcomes (COs) and Program Outcomes (POs)

0-PO Keywords	*Knowledge & Expertise of Medical radio-imaging technology*	*Leadership and mentorship*	*Problem solving*	*Ethics and accountability*	*Communication & presentation skills*	*Commitment to professional excellence*	*Research*	*Lifelong learning*	*Employability, Entrepreneurship*	*Organizational Behavior*	*Ethical, Social and professional understanding*
COURSE OUTCOMES	*PO1*	*PO 2*	*PO3*	*PO4*	*PO5*	*PO6*	*PO7*	*PO8*	*PO 9*	*PO10*	***PO11***
CO1	***3***	***3***	***2***	***3***	***3***	***3***	***3***	***2***	***3***	***3***	***3***
CO2	***3***	***3***	***1***	***3***		***3***	***3***	***1***	***3***	***3***	***3***
CO3	***3***	***3***	***3***	***2***	***3***	***3***	***3***	***3***	***2***	***3***	***3***
CO4	***3***	***3***	***2***	***3***	***3***	***3***	***3***	***2***	***3***	***3***	***3***

1= LOW 2= MEDIUM 3= HIGH

Sushant University soaring high	**School of Health Sciences** **M.Sc.MRIT**		
Course Title: Radiation Safety			
Semester: II	**Course code:MMRIT201**	**Credits:06**	**Core**
No of sessions Lectures / Tutorial: 60		**No of practical hours: 60**	
Course Pre-requisites:		**Number of sessions: 120**	

Course Objectives: The purpose of this course is to provide an understanding of physical concepts and underlying various technological applications. This course also provides fundamental idea about circuit analysis, working principles of machines. In addition, the course is expected to develop scientific temperament and analytical skill in students, to enable them logically tackle complex engineering problems in their chosen area of application.

Course Outcomes

CO 1- Use X-ray equipment and maintenance of equipment.
Should know the Warm-up procedures of X-ray machine and cooling methods.
CO 2- To be able to know how to use X-Ray exposure switches.
CO 3- Demonstrate work flow Digital/IITV fluoroscopy equipment handling
Demonstrate Handling, care and maintenance of equipment & accessories

Course Pedagogy
The course will use the mixed technique of interactive lectures, regular assignments and practicing numerical. Teaching in this course is aimed to engage the students in strengthening their conceptual foundation and applying the knowledge gained to different day-to-day real-world applications. It will not only help students to understand the fundamentals of applied physics but also improve skills and techniques for tackling practical problems.
Course contents

Module 1: Introduction to Radiation Protection

Understanding the need for radiation protection.
Aims and objectives of radiation protection.
Concept of ALARA (As Low As Reasonably Achievable).
Maximum permissible dose.
Exposure limits for pregnant individuals and children.
Occupational exposure limits.
Dose limits for the public.

Module 2: Radiation Protection in Specific Modalities

Radiation safety practices in Radiography.
Radiation safety measures in Fluoroscopy.

Radiation protection considerations in Mammography.
Safety protocols for Mobile Radiography.
Radiation safety guidelines for CT scans.
Safety measures in Digital Subtraction Angiography (DSA).
Radiation protection in Interventional Radiology.
Types of radiation measuring instruments:
Survey meters
Area monitors.
Personnel dosimeters.
Film badges.
Thermo luminescent dosimeters.
Pocket dosimeters.

Module 3: Radiation Quantities and Units

Understanding radiation and radioactivity.
Sources of radiation, including natural and manmade sources.
Radiation quantities: Kerma, Exposure, absorbed dose, Equivalent Dose, Weighting Factors, Effective Dose.
Biological Effects of Radiation

Direct and indirect actions of radiation.

Concept of detriment.
Deterministic and stochastic effects of radiation.
Somatic and genetic effects.
Dose-response relationships.
Effects of antenatal exposure.
Chromosomal aberrations and their use in biological dosimetry.
Effects of ionizing radiation on major organ systems.
Somatic and hereditary effects.
Acute exposure vs. chronic exposure.
LD50 and factors affecting radiosensitivity.
Biological effects of non-ionizing radiation**.**

Module 4 : Radiation Detection and Measurements

Ionization of gases.
Fluorescence and Phosphorescence.
Effects on photographic emulsion.
Types of detectors: Ionization Chambers, Proportional Counters, G.M Counters, Scintillation Detectors, Liquid Semiconductor Detectors, Gamma Ray Spectrometers.
Measuring systems, including free air ionization chambers, thimble ion chambers, and condenser chambers.
Secondary standard dosimeters.
Film dosimeters.
Chemical dosimeters.

Thermo-luminescent Dosimeters (TLDs).
Pocket dosimeters.
Radiation survey meters and monitoring devices.
Advantages and disadvantages of different detectors for various radiation measurements**.**

Module 5: Dose and Dosimetry
Understanding CT Dose Index (CTDI) and related concepts.
Multiple Scan Average Dose (MSAD).
Dose Length Product (DLP).
Dose Profile.
Effective Dose.
Phantom Measurement Methods.
Dose considerations for different application protocols.
Techniques for dose optimization.
Dose area product in fluoroscopy and angiography systems.
Average glandular dose (AGD) in mammography.

Module 6: Radiation Protection, Hazard Evaluation, and Control
Principles of radiation protection.
Time-distance and shielding principles.
Radiation survey and monitoring.
Calculation of workload and weekly dose to radiation workers.
Good work practices in diagnostic radiology.
Factors like use factor, occupancy factors, and different shielding materials.
Protection considerations for primary radiation.
Workload and use factor calculations.
Protection from scatter radiation and leakage radiation.
Room design for X-Ray, Fluoroscopy, Mammography, Interventional Radiology, DSA, and CT.

Course Assessment:

For a course of 100 marks containing both theory and Lab Component:

MID SEMESTER EVALUATION (40) – Theory (25 Marks) + Lab (15 Marks)

Theory (25 Marks) + Lab (15 Marks)				
Mid Semester Examination Theory	Quiz(s), Presentation (s), Lab/ practical performed & Lab report	Assignment(s)	Continuous Assessment	**Total**
15	15	5	5	**40**

END SEMESTER EXAMINATION (60)	
Theory (35)	Lab (25)

MAPPING BETWEEN CO'S AND PO'S		
	COURSE OUTCOMES	**MAPPED PROGRAMME OUTCOMES**
CO1	Use X-ray equipment and maintenance of equipment. Should know the Warm-up procedures of X-ray machine and cooling methods.	**PO1,PO2,PO3,PO4,PO5,PO6,PO7**
CO2	To be able to know how to use X-Ray exposure switches.	**PO5,PO7,PO8,PO9,PO10,PO11**
CO3	Demonstrate work flow Digital/IITV fluoroscopy equipment handling Demonstrate Handling, care and maintenance of equipment & accessories	**PO5,PO7,PO8,PO9,PO10,PO11**

Relationship between the Course Outcomes (COs) and Program Outcomes (POs)

0-PO Keywords	*Knowledge & Expertise of Medical radio-imaging technology*	*Leadership and mentorship*	*Problem solving*	*Ethics and accountability*	*Communication & presentation skills*	*Commitment to professional excellence*	*Research*	*Lifelong learning*	*Employability, Entrepreneurship*	*Organizational Behavior*	*Ethical, Social and professional understanding*
COURSE OUTCOMES	*PO1*	*PO2*	*PO3*	*PO4*	*PO5*	*PO6*	*PO7*	*PO8*	*PO9*	*PO10*	***PO11***
CO1	***3***	***3***	***2***	***3***	***3***	***3***	***3***	***2***	***3***	***3***	***3***
CO2	***3***	***3***	***1***	***3***		***3***	***3***	***1***	***3***	***3***	***3***
CO3	***3***	***3***	***3***	***2***	***3***	***3***	***3***	***3***	***2***	***3***	***3***
CO4	***3***	***3***	***2***	***3***	***3***	***3***	***3***	***2***	***3***	***3***	***3***

1= LOW 2= MEDIUM 3= HIGH

Text Books:

1. S.K Bhargawa text book of Radiological Physics
2. Joseph Selman Fundamental of X Rays and Radium
3. Text book for Radiotherapy ,Radiation Physics by Walter and Miller’s

Sushant University soaring high	**School of Health Sciences** **M.Sc.MRIT**		
Course Title: Modern imaging techniques			
Semester: II	**Course code:MMRIT-202**	**Credits:06**	**Core**
No of sessions Lectures / Tutorial: 60		**No of practical hours: 60**	
Course Pre-requisites:		**Number of sessions: 120**	

Course Objectives

The purpose of this course is to provide an understanding of physical concepts and underlying various technological applications of mammography and computed radiography and DSA. Should able to scanning also in mammography, computed radiography and DSA.

Course Outcomes

CO 1-Perform the procedure of mammography scanning.
CO 2-Enumerate and able to know the principle computed radiography.
CO 3-Able to know and perform vascular imaging with PACS

Course Pedagogy

The course will use the mixed technique of interactive lectures, regular assignments and practicing numerical. Teaching in this course is aimed to engage the students in strengthening their conceptual foundation and applying the knowledge gained to different day-to-day real-world applications. It will not only help students to understand the fundamentals of physics of mammography and CT scan but also improve skills and techniques for tackling practical problems.

Course contents

Module 1: X-Ray Generation and Modern X-Ray Tubes
High-Frequency X-Ray Generators: Types and Applications
Modern X-Ray Tubes: Types and Technological Advancements
Module 2: Digital Radiology and Special Radiological Equipment
Computed Radiography: Principles, Physics, and Equipment
Digital Radiography (Direct and Indirect Methods), Digital Fluoroscopy, Digital Mammography
Cones, Compression Devices, and Stereotactic Biopsy Systems
Module 3: Image Receptors and Image Processing
Flat Panel Detectors
Image Processing Workstations and Imaging Cameras
Module 4: Advanced Imaging Techniques
Tomography: Principles, Equipment, and Multi-Section Movements
Tomosynthesis, Stitch Radiography, and Dual-Energy X-Ray Absorptiometry (DEXA)

Course Assessment:

For a course of 100 marks containing both theory and Lab Component:

MID SEMESTER EVALUATION (40) – Theory (25 Marks) + Lab (15 Marks)

Theory (25 Marks) + Lab (15 Marks)				
Mid Semester Examination Theory	Quiz(s), Presentation (s), Lab/ practical performed & Lab report	Assignment(s)	Continuous Assessment	**Total**
15	15	5	5	**40**

END SEMESTER EXAMINATION (60)	
Theory (35)	Lab (25)

MAPPING BETWEEN CO'S AND PO'S		
	COURSE OUTCOMES	**MAPPED PROGRAMME OUTCOMES**
CO1	Perform the procedure of mammography scanning.	**PO1,PO2,PO4,OO5PO6,PO7,P10**
CO2	Enumerate and able to know the principle computed radiography.	**PO2,PO3,PO4,PO5,PO6,PO7,PO10**
CO3	Able to know and perform vascular imaging with PACS	**PO2,PO3,PO4,PO5,PO6,PO7,P10**

Relationship between the Course Outcomes (COs) and Program Outcomes (POs)

0-PO Keywords	*Knowledge & Expertise of Medical radio-imaging technology*	*Leadership and mentorship*	*Problem solving*	*Ethics and accountability*	*Communication & presentation skills*	*Commitment to professional excellence*	*Research*	*Lifelong learning*	*Employability, Entrepreneurship*	*Organizational Behavior*	*Ethical, Social and professional understanding*
COURSE OUTCOMES	*PO1*	*PO 2*	*PO 3*	*PO4*	*PO5*	*PO 6*	*PO7*	*PO8*	*PO 9*	*PO1 0*	***PO11***
CO1	***3***	***3***	***2***	***3***	***3***	***3***	***3***	***2***	***3***	***3***	***3***
CO2	***3***	***3***	***1***	***3***		***3***	***3***	***1***	***3***	***3***	***3***
CO3	***3***	***3***	***3***	***2***	***3***	***3***	***3***	***3***	***2***	***3***	***3***
CO4	***3***	***3***	***2***	***3***	***3***	***3***	***3***	***2***	***3***	***3***	***3***

1= LOW 2= MEDIUM 3= HIGH

Text Books:

1. S.K Bhargawa text book of Radiological Physics
2. Joseph Selman Fundamental of X Rays and Radium
3. Text book for Radiotherapy ,Radiation Physics by Walter and Miller's

Sushant University soaring high	**School of Health Sciences** **M.Sc.MRIT**		
Course Title: Radiological Procedures			
Semester: II	**Course code: MMRIT203**	**Credits:07**	**Core**
No of sessions Lectures / Tutorial: 60		**No of practical hours:100**	
Course Pre-requisites:		**Number of sessions: 160**	

Course Objectives-
This course is designed to systematic investigations with using contrast media and image intensifier.

Course outcomes-
CO 1- Explain indication, contraindication and reactions of contrast media Demonstrate how to take in minimum numbers of exposures in each special investigation.
CO 2-Demonstratethe positioning and technique of the special studies**.**
CO 3-Explainthe technique of all GIT study according to investigation.
CO 4- Demonstrate surface anatomy. To be able to know the technique behind the radiography.

Course Contents:

Module 1: Introduction to Special Radiographic/Radiological Procedures

Overview of special radiographic and radiological procedures.
The selection of appropriate equipment and general considerations.
Responsibilities of radiographers in conducting these procedures.
Fluoroscopy and Contrast Media
Types of contrast media: positive and negative, ionic and non-ionic.
Understanding adverse reactions to contrast media and patient management.
The role of emergency drugs in the radiology department.
Aseptic technique for various procedures.

Module 2: Gastrointestinal Tract Procedures

Barium swallow for pharynx and esophagus examination.
Barium meal and follow-through procedures.
Hypotonic duodenography.
Small bowel enema.
Barium enema for colon and rectum examinations.
Double-contrast studies and colostomy procedures.
Special techniques for specific diseases.
Use of water-soluble contrast media.

Module 3: Salivary Gland and Biliary System Procedures

Routine techniques and procedures for sialography.
Plain film radiography for the biliary system.
Intravenous cholangiography.
Percutaneous cholangiography.
Endoscopic retrograde cholangiopancreatography (ERCP).
Operative cholangiography.
Post-operative cholangiography (T-tube cholangiography).

Module 4: Urinary System Procedures

Intravenous urography.
Retrograde pyelography.
Antegrade pyelography.
Cystography and micturating cystourethrography.
Urethrography (ascending) and renal puncture.

Module 5: Reproductive System Procedures

Techniques related to the male and female reproductive systems.
Hysterosalpingography.
Breast Imaging
Mammography
.

Module 6 : Respiratory System Procedures

Bronchography.
Sinography
Routine techniques and procedures for sinography.

Course Assessment

For a course of 100 marks containing both theory and Lab Component:

MID SEMESTER EVALUATION (40) – Theory (25 Marks) + Lab (15 Marks)

Theory (25 Marks) + Lab (15 Marks)				
Mid Semester Examination Theory	Quiz(s), Presentation (s), Lab/ practical performed & Lab report	Assignment(s)	Continuous Assessment	**Total**
15	15	5	5	**40**

END SEMESTER EXAMINATION (60)	
Theory (35)	Lab (25)

MAPPING BETWEEN CO'S AND PO'S		
	COURSE OUTCOMES	**MAPPED PROGRAMME OUTCOMES**
CO1	Explain indication, contraindication and reactions of contrast media Demonstrate how to take in minimum numbers of exposures in each special investigation.	**PO1,PO2,PO4,PO5,PO6,PO9,PO8,P10**
CO2	Demonstratethe positioning and technique of the special studies**.**	**PO1,PO4,PO5,PO6,PO7,PO8,PO9**
CO3	Explainthe technique of all GIT study according to investigation.	**PO1,PO2,PO3,PO4,PO7,PO9,PO10**
CO4	Demonstrate surface anatomy. To be able to know the technique behind the radiography.	**PO5,PO6 ,PO8 ,PO9**

Relationship between the Course Outcomes (COs) and Program Outcomes (POs)

0-PO Keywords	*Knowledge & Expertise of Medical radio-imaging technology*	*Leadership and mentorship*	*Problem solving*	*Ethics and accountability*	*Communication & presentation skills*	*Commitment to professional excellence*	*Research*	*Lifelong learning*	*Employability, Entrepreneurship*	*Organizational Behavior*	*Ethical, Social and professional understanding*
COURSE OUTCOMES	*PO1*	*PO 2*	*PO 3*	*PO4*	*PO5*	*PO 6*	*PO7*	*PO8*	*PO 9*	*PO10*	***PO11***
CO1	***3***	***3***	***2***	***3***	***3***	***3***	***3***	***2***	***3***	***3***	***3***
CO2	***3***	***3***	***1***	***3***		***3***	***3***	***1***	***3***	***3***	***3***
CO3	***3***	***3***	***3***	***2***	***3***	***3***	***3***	***3***	***2***	***3***	***3***
CO4	***3***	***3***	***2***	***3***	***3***	***3***	***3***	***2***	***3***	***3***	***3***

1= LOW 2= MEDIUM 3= HIGH

Sushant University soaring high	**School of Health Sciences** **M.Sc.MRIT**		
Course Title: The Recent Advances in Medical Imaging Techniques and Biostatics.			
Semester: II	**Course code:MMRIT204**	**Credits:06**	**Core**
No of sessions Lectures / Tutorial: 60		**No of practical hours: 60**	
Course Pre-requisites:		**Number of sessions: 120**	

Course Objectives

This course is designed to provide the students the basic knowledge in Radiography with patient care and code of ethics. At the end of the course, the student should be able to

Course Outcomes

CO1- Understood about Introduction to hospital staffing and medical records and documentation.
CO2 – Must know about Legal issues and Professional ethics.
CO3- How to handle and must know Departmental Safety and Infection control.
CO4- Understood Body mechanics and transferring of patient.

Course Pedagogy

The course will use the mixed technique of interactive lectures, regular assignments and practicing numerical. Teaching in this course is aimed to engage the students in strengthening their conceptual foundation and applying the knowledge gained to different day-to-day real world applications. It will not only help students to understand the fundamentals of applied physics but also improve skills and techniques for tackling practical problems.

Course Assessment

Course contents

MODULE 1

In addition to existing Radiological and Imaging Modalities -Newer Developments in Digital Imaging CT,MRI,US and any other modality.

Newer Radiological and Imaging Equipment: including Computed radiography: Digital Radiography, Digital Fluoroscopy, Digital Mammography and DSA - Introduction to Newer Technology innovations, software and its applications.

Computed Tomography Introduction to Newer Developments/ Newer Technology innovations, software and its applications.

MODULE 2

MRI Introduction to Newer Developments/Newer Technology innovations, software and its applications.

Advanced Ultrasonography Newer Developments/Newer, Technology innovations, software and its applications. Elastography, HIFU, ABVS etc.

Fusion Imaging -PET CT & PET MRI

Tele-radiology, HIS, RIS, PACS, Imaging processing and archiving.

Biostatistics & Basic Research Methodology

MODULE 3

statistics – importance of statistics in behaviours sciences- descriptive statistics and inferential statistics-usefulness of qualification in behavioural sciences – scales of measurements- nominal, ordinal, interval and ratio scales.

Data collection – classification of data-class intervals – continuous and discrete measurements-drawing frequency polygon-histogram-cumulative frequency curve-ogives-drawing inference from graph.

Measures of central tendency- need-types: mean, median, mode – working out these measures with illustrations. Measures of variability – need- types range, quartile deviation, average deviation, standard deviation, variance-interpretation.

MODULE 4

Normal distribution-general properties of normal distribution-theory of probability-illustration of normal distribution-area under the normal probability curve. Variants from the normal distribution-skewness-quantitative measurements of skewness-kurtosis- measurements of kurtosis-factors contributing for non-normal distribution

MODULE 5

Correlation-historical contribution-meaning of correlation-types: rank correlation, regression analysis.

Tests of significance- need for-significance of the mean-sampling error-significance of differences between means-interpretation of probability levels-small samples-large samples-inferential statistics-parametric and non-parametric methods-elements of multivariate analysis

Course Assessment

For a course of 100 marks containing both theory and Lab Component:

MID SEMESTER EVALUATION (40) – Theory (25 Marks) + Lab (15 Marks)

Theory (25 Marks) + Lab (15 Marks)				
Mid Semester Examination Theory	Quiz(s), Presentation (s), Lab/ practical performed & Lab report	Assignment(s)	Continuous Assessment	**Total**
15	15	5	5	**40**

END SEMESTER EXAMINATION (60)	
Theory (35)	Lab (25)

Text Books-

Text book of radiology for residents and technicians- S K Bhargava.

Text book of radiation physics.

MAPPING BETWEEN CO'S AND PO'S		
	COURSE OUTCOMES	**MAPPED PROGRAMME OUTCOMES**
CO1	Understood about Introduction to hospital staffing and Medical records and documentation.	**PO1,PO3,PO4,PO6,PO7,PO9,PO8**
CO2	Must know about Legal issues and Professional ethics.	**PO6,PO7,PO8,PO9,PO10**
CO3	How to handle and must know Departmental Safety and Infection control	**PO7,PO8,PO9,PO10,PO4,PO5**
CO4	Understood Body mechanics and transferring of patient	**PO1,P02,PO5,PO6 PO8,PO9**

Relationship between the Course Outcomes (COs) and Program Outcomes (POs)

0-PO Keywords	*Knowledge & Expertise of Medical radio-imaging technology*	*Leadership and mentorship*	*Problem solving*	*Ethics and accountability*	*Communication & presentation skills*	*Commitment to professional excellence*	*Research*	*Lifelong learning*	*Employability, Entrepreneurship*	*Organizational Behavior*	*Ethical, Social and professional understanding*
COURSE OUTCOMES	*PO1*	*PO2*	*PO3*	*PO4*	*PO5*	*PO6*	*PO7*	*PO8*	*PO9*	*PO10*	***PO11***
CO1	***3***	***3***	***2***	***3***	***3***	***3***	***3***	***2***	***3***	***3***	***3***
CO2	***3***	***3***	***1***	***3***		***3***	***3***	***1***	***3***	***3***	***3***
CO3	***3***	***3***	***3***	***2***	***3***	***3***	***3***	***3***	***2***	***3***	***3***
CO4	***3***	***3***	***2***	***3***	***3***	***3***	***3***	***2***	***3***	***3***	***3***

1= LOW 2= MEDIUM 3= HIGH

Sushant University soaring high	**School of Health Sciences** **M.Sc.MRIT**		
Course Title: Nuclear Medicine Imaging Procedure			
Semester: II	**Course code:MMRIT-205**	**Credits:04**	**Core**
No of sessions Lectures / Tutorial:40		**No of practical hours:60**	
Course Pre-requisites:		**Number of sessions: 100**	

Objectives:

1. To know basic principle and physics of nuclear medicine.
2. Preparation of patient for nuclear medicine examination.
3. Preparation and precautions while handling radiopharmaceuticals.
4. Recognizing the artefacts associated with nuclear medicine.
5. To learn the measures for improving image quality in nuclear medicine.

Course Outcomes

CO-1. Students will be able to prepare and position the patients for nuclear medicine examination.
CO-2 Knowledge of improving image quality in nuclear medicine.
CO-3 Scanning of patient with various nuclear medicine protocols for better representation of images.
CO-4 Post processing for nuclear medicine data
CO-5 Management of patient for any late reactions associated with radiotracers in nuclear medicine.

Module1:

Definition and Scope of Nuclear Medicine
Overview of Imaging Modalities in Nuclear Medicine (Planar Imaging, SPECT, PET)
Introduction to Radiopharmaceuticals: Preparation and Administration

MODULE-2

General Guidelines for Patient Preparation
Radiation Safety and Precautions
Handling and Disposal of Radioactive Materials
Introduction to Quality Control in Nuclear Medicine

MODULE-3

Bone Scans: Basics, Indications, and Techniques
Thyroid Scans: Procedure, Interpretation, and Role in Thyroid Disorders
Renal Scans: Functional and Structural Imaging
Lung Scans: Perfusion and Ventilation Imaging

MODULE-5

SPECT imaging PET imaging Radiation safety in nuclear medicine Radiation units' quantities MPD.

Radiation monitoring Survey meters Personnel dosimeters Wipe testing Contamination monitor Isotope calibrator Area monitor Inventory of isotopes

References :

1. Physics in Nuclear Medicine-**Sorenson**
2. Physics in Nuclear Medicine-**Powsne**

Course Assessment

For a course of 100 marks containing both theory and Lab Component:

MID SEMESTER EVALUATION (40) – Theory (25 Marks) + Lab (15 Marks)

Theory (25 Marks) + Lab (15 Marks)				
Mid Semester Examination Theory	Quiz(s), Presentation (s), Lab/ practical performed & Lab report	Assignment(s)	Continuous Assessment	**Total**
15	15	5	5	**40**

END SEMESTER EXAMINATION (60)	
Theory (35)	Lab (25)

MAPPING BETWEEN CO'S AND PO'S		
	COURSE OUTCOMES	**MAPPED PROGRAMME OUTCOMES**
CO1	Students will be able to prepare and position the patients for nuclear medicine examination.	**PO1,PO4,PO6,PO7,PO8,PO9,PO10**
CO2	Knowledge of improving image quality in nuclear medicine.	**PO4,PO6,PO7,PO8,PO9**
CO3	Scanning of patient with various nuclear medicine protocols for better representation of images.	**PO1,PO2,PO4,PO9,PO10**
CO4	Post processing for nuclear medicine data	**PO10,PO9,PO8**
CO5	Management of patient	**PO7,PO9,PO10**

	for any late reactions associated with radiotracers in nuclear medicine.	

Relationship between the Course Outcomes (COs) and Program Outcomes (POs)

0-PO Keywords	*Knowledge & Expertise of Medical radio-imaging technology*	*Leadership and mentorship*	*Problem solving*	*Ethics and accountability*	*Communication & presentation skills*	*Commitment to professional excellence*	*Research*	*Lifelong learning*	*Employability, Entrepreneurship*	*Organizational Behavior*	*Ethical, Social and professional understanding*
COURSE OUTCOMES	*PO1*	*PO 2*	*PO 3*	*PO4*	*PO5*	*PO 6*	*PO7*	*PO8*	*PO 9*	*PO10*	***PO11***
CO1	***3***	***3***	***2***	***3***	***3***	***3***	***3***	***2***	***3***	***3***	***3***
CO2	***3***	***3***	***1***	***3***		***3***	***3***	***1***	***3***	***3***	***3***
CO3	***3***	***3***	***3***	***2***	***3***	***3***	***3***	***3***	***2***	***3***	***3***
CO4	***3***	***3***	***2***	***3***	***3***	***3***	***3***	***2***	***3***	***3***	***3***

1= LOW 2= MEDIUM 3= HIGH

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Sushant University soaring high	**School of Health Sciences** **M.Sc.MRIT**		
Course Title: Quality Assurance and Quality, Control in Diagnostic, Radiology and Imaging			
Semester: III	**Course-code:MMRIT-301**	**Credits:04**	**Core**
No of sessions Lectures / Tutorial: 40		**No of practical hours: 80**	
Course Pre-requisites:		**Number of sessions: 120**	

Course Objectives

This course is designed to provide the students the basic knowledge In Radiography. At the end of the course, the student should be able to:
1-Radiation protection
2-Biological effects of radiation
3-Planning of radiation installation-protection primary & secondary radiation
4-Personnel monitoring systems

Course learning Outcomes

CLO 1-Enumerate the guidelines of all respective organization. Enumerate the risk and effects of the radiation.

CLO 2-Label & demonstrate how to use and care of all types of lead aprons
CLO 3-Demonstrate the handling and how to use TLD's and badges as per guidelines

Course contents-

Module 1: Fundamentals of Quality Control and Assurance

Introduction to the objectives of quality control in radiology and imaging.
Enhancing diagnostic value and reducing radiation exposure.
Importance of minimizing film wastage and maintaining equipment performance.

Module 2: Quality Assurance Procedures

Quality assurance activities throughout equipment lifecycle.
Responsibilities during equipment selection, installation, and operation.
Preventive maintenance practices for continued quality assurance**.**

Module 3: Testing and Calibration

Routine testing and calibration of radiological equipment.
Daily, weekly, monthly, quarterly, and annual checks.
Quality assurance concepts for various equipment types, including LASER printers and digital imaging.
Phantom measurements in CT, US, and MRI.

Module 4: Film and Image Quality

Evaluating and ensuring quality in film and image recording.
Understanding sensitometry, characteristic curves, and artifacts.
Calibration of monitors and use of SMPTE patterns.
Care, maintenance, and preventive measures for diagnostic equipment.

Quality control in modern radiological and imaging equipment, including digital radiography, CT scans, MRI scans, ultrasonography, and PACS systems**.**

- **Assessment Scheme:**

For a course of 100 marks containing both theory and Lab Component:

MID SEMESTER EVALUATION (40) – Theory (25 Marks) + Lab (15 Marks)

Theory (25 Marks) + Lab (15 Marks)				
Mid Semester Examination Theory	Quiz(s), Presentation (s), Lab/ practical performed & Lab report	Assignment(s)	Continuous Assessment	**Total**
15	15	5	5	**40**

END SEMESTER EXAMINATION (60)	
Theory (35)	Lab (25)

Text books

Clark's Radiography- Clark / Text book of radiology for residents and technicians- s k bhargava
Radiographic positioning- Garkal
Radiology- Special investigation – champma

MAPPING BETWEEN CO'S AND PO'S		
	COURSE OUTCOMES	**MAPPED PROGRAMME OUTCOMES**
CO1	Students will be able to prepare and position the patients for nuclear medicine examination.	**PO1,PO4,PO6,PO7,PO8,PO9,PO10**
CO2	Knowledge of improving image quality in nuclear medicine.	**PO4,PO6,PO7,PO8,PO9**
CO3	Scanning of patient with various nuclear medicine protocols for better representation of images.	**PO1,PO2,PO4,PO9,PO10**
CO4	Post processing for nuclear medicine data	**PO10,PO9,PO8**

CO5	Management of patient for any late reactions associated with radiotracers in nuclear medicine.	**PO7,PO9,PO10**

Relationship between the Course Outcomes (COs) and Program Outcomes (POs)

0-PO Keywords	*Knowledge & Expertise of Medical radio-imaging technology*	*Leadership and mentorship*	*Problem solving*	*Ethics and accountability*	*Communication & presentation skills*	*Commitment to professional excellence*	*Research*	*Lifelong learning*	*Employability, Entrepreneurship*	*Organizational Behavior*	*Ethical, Social and professional understanding*
COURSE OUTCOMES	*PO1*	*PO 2*	*PO 3*	*PO4*	*PO5*	*PO 6*	*PO7*	*PO8*	*PO 9*	*PO1 0*	***PO11***
CO1	***3***	***3***	***2***	***3***	***3***	***3***	***3***	***2***	***3***	***3***	***3***
CO2	***3***	***3***	***1***	***3***		***3***	***3***	***1***	***3***	***3***	***3***
CO3	***3***	***3***	***3***	***2***	***3***	***3***	***3***	***3***	***2***	***3***	***3***
CO4	***3***	***3***	***2***	***3***	***3***	***3***	***3***	***2***	***3***	***3***	***3***

1= LOW 2= MEDIUM 3= HIGH

Sushant University soaring high	**School of Health Sciences** **M.Sc.MRIT**		
Course Title: Newer Imaging Modalities			
Semester: III	**Course code:MMRIT-302**	**Credits:04**	**Core**
No of sessions Lectures / Tutorial: 40		**No of practical hours:** 60	
Course Pre-requisites:		**Number of sessions: 100**	

Course Objectives

This course is designed to provide the students the basic knowledge in Radiography with using newer modalities of radiology. At the end of the course, the student should be able to know about ultrasonography Computed Tomography, Generation of CT Scanner, Magnetic resonance imaging, fusion imaging PET, Contrast media using, handling and tele radiology.

Course learning Outcomes

CLO 1 Able to know Computed Tomography its principle, various generations and advancements

CLO 2 Able to know Magnetic Resonance Imaging- its principle, advancements and applications.

CLO 3. Explain and able to know Ultrasonography, Color Doppler- its principle, advancements and applications. Digital Radiography and Digital subtraction angiography equipment- principle, advancements and applications.

CLO 4 Able to know Fusion Imaging including PET-CT, PET- MRI. Digital Mammography, DEXA equipment- principle, advancements and applications.

CLO 5 Able to know tele radiology HIS,RIS and PACS, Image processing in digital radiography systems: Post processing techniques in console using CR, DR and flat panel fluoroscopy systems

Course Pedagogy

The course will use the mixed technique of interactive lectures, regular assignments and practicing numerical. Teaching in this course is aimed to engage the students in strengthening their conceptual foundation and applying the knowledge gained to different day-to-day real-world applications. It will not only help students to understand the fundamentals of physics of mammography and CT scan/ultrasound/ PACS but also improve skills and techniques for tackling practical problems.

Course contents-

MODULE 1

Basic Computed Tomography- Basic principles of CT, generations of CT, CT instrumentation, image formation in CT, CT image reconstruction, Hounsfield unit, CT image quality, CT image display

Advanced Computed Tomography - Helical CT scan: Slip ring technology, advantages, multi detector

array helical CT, cone – beam geometry, reconstruction of helical CT images, CT artifact, CT angiography, CT fluoroscopy, HRCT, post processing techniques: MPR, MIP, Min IP, 3D rendering: SSD and VR, CT Dose, patient preparation, Imaging techniques and protocols for various parts of body, CT contrast enhanced protocols – CT angiography – (Aortogram, selective angiogram head, neck and peripheral) image documentation and Filing, maintenance of equipment and accessories.

MODULE 2

Advanced technique & instrumentation of MRI

Basic Principle: Spin – precession – relaxation time – pulse cycle – T1 weighted image – T2 weighted image – proton density image.

Pulse sequence: Spin echo pulse sequence – turbo spin echo pulse sequence - Gradient echo sequence – Turbo gradient echo pulse sequence - Inversion recovery sequence – STIR sequence – SPIR sequence – FLAIR sequence – Echo planar imaging – Advanced pulse sequences.

MR Instrumentation: Types of magnets – RF transmitter – RF receiver – Gradient coils – shim coils – RF shielding – computers.

Image formation: 2D Fourier transformation method – K-space representation – 3D Fourier imaging – MIP.

MR contrast media – MR angiography – TOF & PCA – MR Spectroscopy – functional MRI

MODULE 3

Ultrasonography

Basic Acoustics, Ultrasound terminologies: acoustic pressure, power, intensity, impedance, speed, frequency, dB notation: relative acoustic pressure and relative acoustic intensity.

Interaction of US with matter: reflection, transmission, scattering, refraction and absorption, attenuation and attenuation coefficients, US machine controls, US focusing.

Production of ultrasound: Piezoelectricity, Medical ultrasound transducer: Principle, construction and working, characteristics of US beam.

Ultrasound display modes: A, B, M

Real-time ultrasound: Line density and frame rate, Real-time ultrasound transducers: mechanical and electronic arrays, ultrasound artifacts, ultrasound recording devices, and Distance, area & volume measurements.

Techniques for imaging different anatomic areas, ultrasound artifacts, biological effects and safety.

Doppler Ultrasound- Patient preparation for Doppler, Doppler artifacts, vascular sonography,

Elastography, HIFU, ABVS etc.

Assessment Scheme:

For a course of 100 marks containing both theory and Lab Component:

MID SEMESTER EVALUATION (40) – Theory (25 Marks) + Lab (15 Marks)

Theory (25 Marks) + Lab (15 Marks)				
Mid Semester Examination Theory	Quiz(s), Presentation (s), Lab/ practical performed & Lab report	Assignment(s)	Continuous Assessment	**Total**
15	15	5	5	**40**

END SEMESTER EXAMINATION (60)	
Theory (35)	Lab (25)

MAPPING BETWEEN CO'S AND PO'S		
	COURSE OUTCOMES	**MAPPED PROGRAMME OUTCOMES**
CO1	Students will be able to prepare and position the patients for nuclear medicine examination.	**PO1,PO4,PO6,PO7,PO8,PO9,PO10**
CO2	Knowledge of improving image quality in nuclear medicine.	**PO4,PO6,PO7,PO8,PO9**
CO3	Scanning of patient with various nuclear medicine protocols for better representation of images.	**PO1,PO2,PO4,PO9,PO10**
CO4	Post processing for nuclear medicine data	**PO10,PO9,PO8**
CO5	Management of patient for any late reactions associated with radiotracers in nuclear medicine.	**PO7,PO9,PO10**

Relationship between the Course Outcomes (COs) and Program Outcomes (POs)

0-PO Keywords	*Knowledge & Expertise of Medical radio-imaging technology*	*Leadership and mentorship*	*Problem solving*	*Ethics and accountability*	*Communication & presentation skills*	*Commitment to professional excellence*	*Research*	*Lifelong learning*	*Employability, Entrepreneurship*	*Organizational Behavior*	*Ethical, Social and professional understanding*
COURSE OUTCOMES	*PO1*	*PO 2*	*PO 3*	*PO4*	*PO5*	*PO 6*	*PO7*	*PO8*	*PO 9*	*PO10*	***PO11***
CO1	***3***	***3***	***2***	***3***	***3***	***3***	***3***	***2***	***3***	***3***	***3***
CO2	***3***	***3***	***1***	***3***		***3***	***3***	***1***	***3***	***3***	***3***
CO3	***3***	***3***	***3***	***2***	***3***	***3***	***3***	***3***	***2***	***3***	***3***
CO4	***3***	***3***	***2***	***3***	***3***	***3***	***3***	***2***	***3***	***3***	***3***

1= LOW 2= MEDIUM 3= HIGH

Text book

Clark's Radiography- Clark / Text book of radiology for residents and technicians- s k bhargava
Radiographic positioning- Garkal
Radiology- Special investigation – champman

Sushant University soaring high	**School of Health Sciences** **M.Sc.MRIT**		
Course Title: Intervention Radiological Techniques and Care of Patient			
Semester: III	**Course code:MMRIT-303**	**Credits:07**	**Core**
No of sessions Lectures / Tutorial: 40		**No of practical hours: 60**	
Course Pre-requisites:		**Number of sessions: 100**	

Course Objectives-
This course is designed to provide the students the basic knowledge in systematic investigations with using contrast media and image intensifier.

Course learning outcomes-
CLO 1- Explain indication, contraindication and reactions of contrast media Demonstrate how to take in minimum numbers of exposures in each special investigation.
CLO 2-Demonstratethe positioning and technique of the special studies**.**
CLO 3-Explainthe technique of all GIT study according to investigation.
CLO 4- Demonstrate surface anatomy. To be able to know the technique behind the radiography.
Course contents

Module 1: Angiography and DSA

History of Angiography
Angiography Techniques
Patient Care in Angiography
Percutaneous Catheterization
Catheterization Sites
Asepsis in Angiography
Equipment (Guide wires, catheters, pressure injectors, accessories)
Digital Subtraction Angiography (Single-plane and bi-plane)
Diagnostic Procedures (Angiography, angioplasty, biliary examination, renal evaluation, drainage procedure, aspiration cytology)

Module 2: Central Nervous System Imaging

Myelography
Ventriculography
Arthrography
Shoulder Arthrography
Knee Arthrography
Elbow Arthrography

Module 3: Angiography

Carotid Angiography
Thoracic and Arch Aortography
Vertebral Angiography
Femoral Arteriography
Selective Studies (Renal, SMA, Coeliac axis)
Angiocardiography

Module 4: Venography

Peripheral Venography
Cerebral Venography

Module 5: Cardiac Catheterization Procedures

PTCA (Percutaneous Transluminal Coronary Angioplasty)
BMV (Balloon Mitral Valvuloplasty)
CAG (Coronary Angiography)
Pacemaker Insertion
Microbiology
Introduction to Microbiology
Classification of Microorganisms
Bacterial Morphology
Use of Microscope
Growth and Nutrition
Sterilization and Disinfection

Module 6: Patient Care in Interventional Radiology

Introduction to Patient Care
General Patient Care
Surgical Asepsis
Nursing Procedures
Patient Care During Investigations
Infection Control
Patient Education
Medical Emergencies
Drug Administration

Course Assessment:

For a course of 100 marks containing both theory and Lab Component:

MID SEMESTER EVALUATION (40) – Theory (25 Marks) + Lab (15 Marks)

Theory (25 Marks) + Lab (15 Marks)				
Mid Semester Examination Theory	Quiz(s), Presentation (s), Lab/	Assignment(s)	Continuous Assessment	**Total**

	practical performed & Lab report			
15	15	5	5	**40**

END SEMESTER EXAMINATION (60)	
Theory (35)	Lab (25)

MAPPING BETWEEN CO'S AND PO'S		
	COURSE OUTCOMES	**MAPPED PROGRAMME OUTCOMES**
CO1	Students will be able to prepare and position the patients for nuclear medicine examination.	**PO1,PO4,PO6,PO7,PO8,PO9,PO10**
CO2	Knowledge of improving image quality in nuclear medicine.	**PO4,PO6,PO7,PO8,PO9**
CO3	Scanning of patient with various nuclear medicine protocols for better representation of images.	**PO1,PO2,PO4,PO9,PO10**
CO4	Post processing for nuclear medicine data	**PO10,PO9,PO8**
CO5	Management of patient for any late reactions associated with radiotracers in nuclear medicine.	**PO7,PO9,PO10**

Relationship between the Course Outcomes (COs) and Program Outcomes (POs)

0-PO Keywords	*Knowledge & Expertise of Med*	*Leadership and mentorshi*	*Problem solving*	*Ethics and accountability*	*Communication & presentation skills*	*Commitment to profession*	*Research*	*Lifelong learning*	*Employability, Entrep*	*Organizational Behavior*	*Ethical, Social and professional understandi*

	ical radio-imaging technology	*p*				*al excellence*			*ren eurship*		*ng*
COURSE OUTCOMES	*PO1*	*PO 2*	*PO 3*	*PO4*	*PO5*	*PO 6*	*PO7*	*PO8*	*PO 9*	*PO1 0*	***PO11***
CO1	***3***	***3***	***2***	***3***	***3***	***3***	***3***	***2***	***3***	***3***	***3***
CO2	***3***	***3***	***1***	***3***		***3***	***3***	***1***	***3***	***3***	***3***
CO3	***3***	***3***	***3***	***2***	***3***	***3***	***3***	***3***	***2***	***3***	***3***
CO4	***3***	***3***	***2***	***3***	***3***	***3***	***3***	***2***	***3***	***3***	***3***

1= LOW 2= MEDIUM 3= HIGH

Text Books-

Clark's Radiography- Clark / Text book of radiology for residents and technicians- s k bhargava
Radiographic positioning- Garkal

Sushant University soaring high	**School of Health Sciences** **M.Sc.MRIT**		
Course Title: Research Methodology and Biostatics -II			
Semester: III	**Course code:MMRIT-304**	**Credits: 05**	**Core**
No of sessions Lectures / Tutorial:30		**No of practical hours: 40**	
Course Pre-requisites:		**Number of sessions:70**	

Course Objectives:
This is an extension of part one of RM course and focuses more on statistics .At the end of the semester the student is expected to do statistical analysis independently

Course Outcome

Upon successful completion of the course, the students should be able to:
CO1: Understand the need of research in vision science and to understand the basic concept of research methods which includes basic errors in research, data collection methods and formulation of research question.
CO2: Able to identify different research study designs used in research and application of different sampling methods and understanding of biological variability
CO3: Able to apply and calculate fundamental statistical concepts of sensitivity and specificity and formulation of questionnaire
CO4: Able to write a research proposal after clear understanding of existing literature and research gap.

COURSE CONTENTS

Module 1: Inferential Statistics
Hypothesis testing and its significance in research.
Understanding p-values and significance levels.
Parametric vs. non-parametric tests.

Module 2: Correlation and Regression Analysis
Correlation and its applications in data analysis.
Simple and multiple regression analysis.
Interpretation of regression results.

Module 3: Sampling Techniques and Sample Size Determination
Different sampling methods and their selection criteria.
Calculating the required sample size for research studies.

Module 4: Experimental Design
Principles of experimental design.
Randomization and control groups.
Types of experimental designs.

Module 5: Biostatistics Applications

Application of statistical techniques in biostatistics.
Data analysis in the context of biomedical and healthcare research.
Practical exercises and case studies.

6. **Course Assessment**

For a course of 100 marks containing only Theory Component

Mid Semester Theory Examination	Quiz(s), Presentation(s), Faculty Student Interaction	Assignment(s)	Continuous Assessment	Total
15	**15**	**5**	**5**	**40**

END SEMESTER EXAMINATION (60)
Theory (60)

7. **Course References**

3. Text books:

- B.K. Mahajan. Methods in Biostatistics, Jaypee Brothers
- P.S.S. Sundar Rao. An Introduction to Biostatistics: A manual for students in Health Sciences, J.Richard Prentice Hall, 1996.

4. Reference Books :

- Daniel, Wayne.W. Bio-Statistics: A foundation for Analysis in the Health Sciences

MAPPING BETWEEN CO'S AND PO'S		
	COURSE OUTCOMES	**MAPPED PROGRAMME OUTCOMES**
CO1	Understand the need of research in vision science and to understand the basic concept of research methods which includes basic errors in research, data collection methods and formulation of research question.	**PO1,PO2,PO5,PO6,PO7,PO10,PO11,PO12**
CO2	Able to indentify different research study designs used in research and application of different sampling methods and understanding of biological variability	**PO1,PO2,PO3,PO4,PO8,PO12,PO7,PO11**

CO3	Able to apply and calculate fundamental statistical concepts of sensitivity and specificity and formulation of questionnaire	**PO1,PO2,PO3,PO4,PO7,PO9,PO10**
CO4	Able to write a research proposal after clear understanding of existing literature and research gap.	**PO5,PO7,PO8,PO9,PO10**

Relationship between the Course Outcomes (COs) and Program Outcomes (POs)

0-PO Keywords	*Knowledge & Expertise of Medical radio-imaging technology*	*Leadership and mentorship*	*Problem solving*	*Ethics and accountability*	*Communication & presentation skills*	*Commitment to professional excellence*	*Research*	*Lifelong learning*	*Employability, Entrepreneurship*	*Organizational Behavior*	*Ethical, Social and professional understanding*
COURSE OUTCOMES	*PO1*	*PO 2*	*PO 3*	*PO4*	*PO5*	*PO 6*	*PO7*	*PO8*	*PO 9*	*PO1 0*	***PO11***
CO1	***3***	***3***	***2***	***3***	***3***	***3***	***3***	***2***	***3***	***3***	***3***
CO2	***3***	***3***	***1***	***3***		***3***	***3***	***1***	***3***	***3***	***3***
CO3	***3***	***3***	***3***	***2***	***3***	***3***	***3***	***3***	***2***	***3***	***3***
CO4	***3***	***3***	***2***	***3***	***3***	***3***	***3***	***2***	***3***	***3***	***3***

1= LOW 2= MEDIUM 3= HIGH

Sushant University soaring high	**School of Health Sciences** **M.Sc.MRIT**		
Course Title: Workshops /Seminars and Project			
Semester: III	**Course code:MMRIT- 305**	**Credits:01**	**Core**
No of sessions Lectures / Tutorial: 10		**No of practical hours: 10**	
Course Pre-requisites:		**Number of sessions:**	

ASSESMENT SCHEME

For a course of 100 marks containing only practical Component:

Internal (20)	Continues Assessment (10)	Lab work (10)	Presentation (30)	Viva (20)	Practical File (10)	Total (100)

Sushant University soaring high	**School of Health Sciences** **M.Sc.MRIT**		
Course Title: Residency-III			
Semester: III	**Course code:MMRIT- 306**	**Credits:06**	**Core**
No of sessions Lectures / Tutorial: 10		**No of practical hours: 10**	
Course Pre-requisites:		**Number of sessions:**	

ASSESMENT SCHEME

For a course of 100 marks containing only practical Component:

Internal (20)	Continues Assessment (10)	Lab work (10)	Presentation (30)	Viva (20)	Practical File (10)	Total (100)

Sushant University soaring high	**School of Health Sciences** **M.Sc.MRIT**		
Course Title: MOOC			
Semester: III	**Course code: MMRIT- 307**	**Credits:01**	**Core**
No of sessions Lectures / Tutorial: 10		**No of practical hours: 10**	
Course Pre-requisites:		**Number of sessions:**	

ASSESMENT SCHEME

For a course of 100 marks containing only practical Component:

Internal (20)	Continues Assessment (10)	Lab work (10)	Presentation (30)	Viva (20)	Practical File (10)	Total (100)

	School of Health Sciences **M.Sc.MRIT**		
Course Title: Seminars/ Group Discussions			
Semester: IV	**Course code: 23MMRIT-401**	**Credits:03**	**Core**
No of sessions Lectures / Tutorial:20		**No of practical hours 60**	
Course Pre-requisites:		**Number of sessions: 80**	

ASSESMENT SCHEME

For a course of 100 marks containing only practical Component:

Internal (20)	**Continues Assessment (10)**	**Lab work (10)**	**Presentation (30)**	**Viva (20)**	**Practical File (10)**	**Total (100)**

Sushant University soaring high	**School of Health Sciences** **M.Sc.MRIT**		
Course Title: Seminars/Group Discussions			
Semester: IV	**Course code: 23MMRIT- 402**	**Credits:03**	**Core**
No of sessions Lectures / Tutorial: 10		**No of practical hours: 10**	
Course Pre-requisites:		**Number of sessions:**	

ASSESMENT SCHEME

For a course of 100 marks containing only practical Component:

Internal (20)	Continues Assessment (10)	Lab work (10)	Presentation (30)	Viva (20)	Practical File (10)	Total (100)

Sushant University soaring high	**School of Health Sciences** **M.Sc.MRIT**		
Course Title: Residency –IV Dissertation			
Semester: IV	**Course code: MMRIT435**	**Credits:10**	**Core**
No of sessions Lectures / Tutorial: 10		**No of practical hours: 10**	
Course Pre-requisites:		**Number of sessions:**	

ASSESMENT SCHEME

For a course of 100 marks containing only practical Component:

Internal (20)	Continues Assessment (10)	Lab work (10)	Presentation (30)	Viva (20)	Practical File (10)	Total (100)