MGM INSTITUTE OF HEALTH SCIENCES

(Deemed to be University u/s 3 of UGC Act, 1956)
Grade 'A' Accredited by NAAC
Sector-01, Kamothe, Navi Mumbai -410 209
Tel 022-27432471, 022-27432994, Fax 022 -27431094
E-mail: registrar@mgmuhs.com; Website :www.mgmuhs.com

CHOICE BASED CREDIT SYSTEM

(CBCS)

(with effect from 2025-26 Batches)

Curriculum for

M.Sc. Medical Physics

Approved as per AC-52/2025, Dated 28/11/2025

Amended History

1. Approved as per AC-52/2025, [Resolution No. 5.2, (Annexure-19)]; Dated 28/11/2025.

Resolution No. 5.2 of Academic Council (AC-52/2025):
Resolved that the post facto revision of the M.Sc. Medical Physics program syllabus, including the Program Outcomes (POs) and Course Outcomes (COs), in accordance with the AERB guidelines, is approved for implementation from the Academic Year 2025-26. Further resolved that the intake capacity of 10 students per year for the M.Sc. Medical Physics program is approved, with effect from the Academic Year 2025-26 onwards.
[ANNEXURE-19].

MGM SCHOOL OF BIOMEDICAL SCIENCES

(A constituent unit of MGM INSTITUTE OF HEALTH SCIENCES)
(Deemed University u/s 3 of UGC Act 1956)
Grade "A^{++}" Accredited by NAAC
Sector 1, Kamothe, Navi Mumbai-410209, Tel.No.:022-27437631,27437632, 27432890
Email. sbsnm@mgmuhs.com/Website: www.mgmsbsnm.edu.in

CHOICE BASED CREDIT SYSTEM (CBCS)

(Academic Year 2025 – 26)

Curriculum for

M.Sc. Allied Health Sciences

M.Sc. Medical Physics

Semester I to IV

Two years Program
and
one-year Internship

Ms. Shubhangi Tirpude
Radiation Safety Officer & Medical Physicist
Department of Medical Physics & Radiotherapy
MGM Medical College & Hospital,
Kamothe, Navi Mumbai-410209.

Director
MGM School of Biomedical Science
Kamothe, Navi Mumbai

M.G.M. SCHOOL OF BIO-MEDICAL SCIENCES KAMOTHE NAVI MUMBAI

DIRECTOR'S MESSAGE

Welcome Message from the Director

Dear Postgraduate Students,

Welcome to **MGM School of Biomedical Sciences (MGMSBS), MGMIHS**, a premier institution dedicated to advancing allied and health sciences education. As you embark on this transformative academic journey, you are joining a community that fosters excellence in research, clinical expertise, and innovation**.**

MGMIHS, accredited with **NAAC 'A^{++}' Grade (CGPA 3.55, 2022)** and recognized as a **Category I Institution by UGC**, offers an ecosystem that nurtures both academic and professional growth. With **NIRF (151-200 rank band) recognition, NABH-accredited hospitals, NABL-accredited diagnostic labs, and JCI accreditation for MGM New Bombay Hospital**, we uphold global benchmarks in education and healthcare.

At MGMSBS, our **15 postgraduate programs** are meticulously designed to align with the National Commission for Allied and Healthcare Professionals **(NCAHP)** standards**,** National Education Policy **(NEP)** 2020**,** and the National Credit Framework **(NCrF).** We have implemented the **Choice-Based Credit System (CBCS)** to provide academic flexibility while ensuring rigorous training in clinical and technical skills**.** Our state-of-the-art research laboratories, digital classrooms, and the Central Research Laboratory (CRL) foster an environment that encourages innovation and evidence-based learning**.**

Postgraduate education at MGMSBS goes beyond theoretical learning—our curriculum integrates **hands-on clinical training, interdisciplinary collaboration, and exposure to real-world healthcare challenges**. We emphasize **research-driven education**, encouraging students to actively participate in **scientific discoveries, publications, and international collaborations**.

Beyond academics, we believe in **holistic development**, with initiatives such as the **AARAMBH Science and Wellness Club**, which promotes **mental well-being, leadership, and professional networking**.

As you step into this **next phase of academic and professional growth**, we encourage you to explore new ideas, engage in impactful research, and contribute meaningfully to the **healthcare ecosystem**. We are confident that your journey at MGMSBS will shape you into **skilled, compassionate, and visionary professionals**, ready to lead in the ever-evolving healthcare landscape.

We look forward to witnessing your achievements and contributions!

Dr. Mansee Thakur
Director, MGM School of Biomedical Sciences
MGM Institute of Health Sciences, Navi Mumbai

ABOUT MGM SCHOOLOF BIOMEDICAL SCIENCES

Mission

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

Vision

By the year2026, MGM Institute of Health Sciences aims to be top-ranking Centre of Excellence in Medical Education and Research. Students graduating from the Institute will have the required skills to deliver quality health care to all sections of the society with compassion and benevolence, without prejudice or discrimination, at an affordable cost. As a research Centre, it shall focus on finding better, safer and affordable ways of diagnosing, treating and preventing diseases. In doing so, it will maintain the highest ethical standards.

About–School of Biomedical Sciences

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

School of Biomedical Sciences is dedicated to the providing the highest quality education in basic medical sciences by offering a dynamic study environment with well-equipped labs. The school encompasses 21 courses each with its own distinct, specialized body of knowledge and skill. This includes 7 UG coursesand14PGcourses. The college at its growing years started with mere 100 students has recorded exponential growth and is now a full-fledged educational and research institution with the student strengthreachingapproximately581at present.

Our consistent theme throughout is to encourage students to become engaged, be active learners and to promote medical research so that ultimately, they acquire knowledge, skills, and understanding so as to provide well qualified and trained professionals in Allied Health Sciences to improve the quality of life.
As there is increased need to deliver high quality, timely and easily accessible patientcare system the collaborative efforts among physicians, nurses and allied health providers become ever more essential for an effective patient care. Thus, the role of allied health professionals in ever-evolving medical system is very important in providing high-quality patient care.

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

MGMIHS Curriculum for M. Sc. Medical Physics

Two years Program and one-year Internship

Introduction

The Medical physicist is an expert in physics and instrumentation with a good knowledge of the relevant biology, and provides technical support for therapeutic and diagnostic medical procedures and treatments as a member of a team of healthcare professionals.

The roles and responsibilities for clinical medical physicists vary depending upon the sub-specialty in which they are employed. However, the tasks are mainly related to the safety and performance of related equipment and computer systems. Sub-specialties include Radiotherapy, Diagnostic Imaging, and Nuclear Medicine. Medical physicist's roles often also include radiation protection responsibilities.

Medical physicists are concerned with three areas of activity: Clinical Service, Research and Development, and Teaching. On average their time is distributed equally among these three areas.

Clinical Service

Many medical physicists are heavily involved with responsibilities in areas of diagnosis and treatment, often with specific patients. These activities take the form of consultations with physician colleagues. Medical Physics is an established clinical specialty with wide-ranging applications in Radiotherapy planning and treatment. It can be defined as embracing all applications of radioactive sources in the treatment of cancerous and non-cancerous diseases.

In radiation oncology departments, one important example is the planning of radiation treatments for cancer patients, using either external radiation beams or internal radioactive sources. An indispensable service is the accurate measurement of the radiation output from radiation sources employed in cancer therapy. In the specialty of nuclear medicine, physicists collaborate with physicians in procedures utilizing radionuclides for delineating internal organs and determining important physiological variables, such as metabolic rates and blood flow. Other important services are rendered through investigation of equipment performance, organization of quality control in imaging systems, design of radiation installations, and control of radiation hazards. The medical physicist is called upon to contribute clinical and scientific advice and resources to solve the numerous and diverse physical problems that arise continually in many specialized medical areas.

Research & Development

Medical physicists play a vital and often leading role on the medical research team. Their activities cover wide frontiers, including key areas as cancer. In cancer, they work primarily on issues involving radiation, such as the basic mechanisms of biological change after irradiation, the application of new high-energy machines to patient treatment, and the development of new techniques for precise measurement of radiation. Significant computer developments continue in the area of dose calculation for patient treatment and video display of this treatment information. Particle irradiation is an area of active research with promising biological advantages over traditional photon treatment.

Medical physicists are also concerned with research of general medical significance, including the applications of digital computers in medicine and applications of information theory to diagnostic problems; processing, storing, and retrieving medical images; measuring the amount of radioactivity in

the human body; and studying the anatomical and temporal distribution of radioactive substances in the body.
Medical physicists are also involved in the development of new instrumentation and technology for use in radiotherapy. These include the use of magnetic and electro-optical storage and manipulation of x-ray images, quantitative analysis of both static and dynamic images using digital computer techniques, radiation methods for the analysis of tissue characteristics and composition, and the exciting new areas of computerized tomography and magnetic resonance imaging for displaying detailed cross-sectional images of the anatomy.
Typical examples of the various research areas presently under active investigation may be found in scientific journals dedicated to this field. The journal, Medical Physics, is published by the AAPM. In addition, the AAPM holds two national scientific meetings a year, one in the summer and one in the winter. During the winter meeting, the AAPM conducts scientific sessions in joint sponsorship with the Radiological Society of North America. Special summer courses, workshops, and frequent regional meetings are also held by the AAPM.

Teaching

Often medical physicists have faculty appointments at universities and colleges, where they help train future medical physicists, resident physicians, medical students, and technologists who operate the various types of equipment used to perform diagnosis and treatment. They also conduct courses in medical physics and aspects of biophysics and radiobiology for a variety of graduate and undergraduate students. The Commission on Accreditation of Medical Physics Education Programs, Inc. (CAMPEP), jointly sponsored by the American College of Radiology (ACR), American Association of Physicists in Medicine (AAPM) and the American College of Medical Physics (ACMP), assures high educational standards in the field.

Medical physicists have a Masters or Ph.D. in medical physics, physics, radiation biology, or a related discipline, and training in clinical medical physics. Clinical training may be obtained through a residency traineeship or a postdoctoral program of one or two years in a hospital. Clinical medical physicists are employed in medical schools, hospitals or clinics, or are in private practice. These physicists divide their time between clinical service and consultation, research and development, and teaching. Some medical physicists work in industrial or research positions, and have no clinical responsibilities.

Several universities in the country offer academic programs in medical physics leading to a master's or doctor's degree. A thorough preparation in general physics is highly desirable before entry into these programs. The most common programs emphasize the physical properties and medical applications of radiation of all types. Important skills that should be acquired during academic training include knowledge of electronics and computer techniques. A list of training programs is available here.

Academic training alone does not make a medical physicist. Practical experience with medical problems is essential. This experience may be acquired through a residency traineeship and to have experience as Medical Physicist in a hospital. These programs are becoming an increasingly important mode of entry into the profession.

Medical Physics is an established clinical specialty with wide-ranging applications in Radiotherapy planning and treatment. It can be defined as embracing all applications of radioactive sources in the treatment of cancerous and non-cancerous diseases.

The student of Medical Physics also gains knowledge about different equipment used in Radiotherapy planning and treatment and their quality assurances. There is ample scope of research in area of medical physics. The students will also be imparted to training and teaching. Therefore, the Medical Physics syllabus has been prepared in such a way that it will make the student a good clinical physicist, researcher, and teacher after qualifying this course. As this is a specialized branch of medicine and is multidisciplinary in nature, it requires skilled/trained manpower.

Vision Mission and Goal

Vision: "To offer diverse Medical Physics program to establish and maintain the standards of the students of Medical Physics in the disciplines of Diagnostic Imaging, Radiation Oncology and Nuclear Medicine".

Mission: To promote professional growth by offering state-of-the-art postgraduate program in Medical Physics in India.

Title of the Course: M.Sc. Medical Physics

Aims and Objectives

The aims of this course are:

To induce lifelong learning skills, attitudes for social & personal development.

- To provide trained manpower.
- To provide leadership qualities.
- To create awareness of health hazards due to carcinogenic materials.
- To associate in development of new methods & techniques for the radiotherapy treatment of various cancer diseases and to have correct diagnosis of the diseases and subsequent proper implementation of radiotherapy to have cure of patient.
- To develop radiotherapy treatment managerial skills and trained Radiation Physicists.

This program is aimed at developing skilled scientific and technical manpower in Medical Physics. They should be able to demonstrate high standards of professional skills, competence/leadership qualities. The goal of the course is to cultivate an educational environment that provides the full spectrum of learning opportunities in clinical medical physics, radiation oncology and radiobiology.

The curriculum is flexible and designed to enable a student to optimize their learning experience throughout their three-year program.

It is an expectation that upon the completion of the program, a student will be an outstanding "Radiation Oncology Medical Physicist" capable of making an immediate impact in either an academic or community practice setting.

General Objectives:

In recent decades, radiation therapy has come to play an increasingly vital role in the treatment of cancer. High-quality patient care in radiation therapy depends upon teamwork. The radiation oncologist, the radiation therapist, the engineers, the medical physicist specializing in radiation therapy, the biomedical engineer of hospital, the dosimetrist and the nurse are all important members of the team.

The quality of patient care provided by the radiation oncologist is dependent upon, among other factors, precisely administered treatments. Without such precision, it is not possible to optimally balance maximum probability of cure or palliation and acceptable levels of complications. Quality assurance related to the whole treatment process is essential if such results are to be obtained.

Radiation Physicist, often called as Medical Physicist, plays very vital and important role in this team work interns of ensuring complete quality assurance of radiation generating equipments which include, among other aspects, Physics Dosimetry of radiation beams, performing the aid to arrive at accurate treatment planning and guiding radiation oncologists in precise treatment delivery, pre and post treatment quality checks on treatment plans.

There are tremendous increases in the technological advancement of the radiation therapy equipment, which is used for cancer care. Technological advancements ranging from: superficial & deep x-ray, tele-caesium, telecobalt, low energy linear accelerators, multi leaf collimators, high energy linear accelerators, Intensity Modulated Radiation Therapy (IMRT) and Image Guided Radiation Therapy (IGRT).
These advances, IGRT and IMRT, have revolutionized the treatment outcome of the cancer since these treatments precisely target the cancer cells and associated clinical target volume. These treatment modalities are delivered with stringent quality assurance procedures of the treatment machine and patient. Radiation Physicist play vital role in these high-quality treatments, amongst his other responsibilities.

In radiation oncology, physicists have the primary responsibility for the following, except where the responsibility is noted as shared:

Planning for resource allocation with radiation oncologists, administrators, and technologists, including:

- Equipment usage, selection and replacement,
- Staff requirements, assignments, and recruitment,
- Budget preparation,
- Program operation, and
- Continuing review of the program's policies and procedures.

Physical aspects of all radiation sources (radioactive materials and radiation producing machines) used in a radiation oncology program, including:

- Performance specification, acceptance testing and commissioning of new equipment
- Calibration of the sources and maintenance of all information necessary for their appropriate use
- Development and maintenance of a quality assurance program for all treatment modalities, localization procedures, and computational equipment and programs to assure that patients receive:
- Prescribed doses and dose distributions, within acceptable degrees of accuracy,
- Maintenance of all instrumentation required for calibration of sources, measurement of radiation, and calculation of doses, and
- First-order maintenance of treatment units (in conjunction with any in-house electronic technician).
- The radiation safety program (possibly shared with an institution's radiation safety officer, including:
- Development and administration of the radiation safety program, including compliance with all regulating and certifying agencies (e.g., AERB, the Nuclear Regulatory Commission, the Joint Commission on Accreditation of Health Care Organizations, the Occupational Safety and Health Administration, and appropriate state and local agencies),
- Administration of a personnel radiation monitoring program,

- Supervision of source preparation and handling during brachytherapy, and the continual maintenance of the brachytherapy source inventory,
- Participation on the institutional Radiation Safety Committee, and other committees (e.g., General Safety) as needed, and Calculation of shielding required for new or renovated treatment rooms, radioactive-source storage and handling facilities, and brachytherapy patient rooms.

The physical aspects of patients' treatments, including:

- Consultations with radiation oncologists on the physical and radiobiological aspects of patients' treatments, and the development of treatment plans.
- Acquisition and storage of data for treatment plans
- Calculation of dose distributions and machine settings for patient treatments,
- Design and fabrication of treatment aids and treatment-beam modifiers.
- Assurance of the accuracy of treatment unit parameters and settings used for a patient's treatment, including correct transfer of parameters between the simulator, treatment plan and the treatment unit, and periodic review of each patient's chart.
- *In-vivo* measurement to verify the dose delivered to a patient.
- Assisting the radiation oncologists in statistical analysis for evaluation of treatment efficacy, and participation in clinical trials,
- Development of techniques (hardware, software, or procedural) to improve the delivery of radiation treatments,
- Participation at patient-discussion conferences, and
- Continuing education of the radiation oncology staff.

Interaction with the medical physics community, including:

- Participation at radiation oncology physics or related medical meetings to receive and disseminate state-of-the-art information, and
- Participation in peer review.

Over the years, the number of radiation oncology centers has increased many folds and a great deal of demand for quality Radiation Physicist professionals in radiation oncology. Currently very few centers in the country are offering the Medical Physics program and number of qualified personnel is no way nearer to the need. Hence the need to have this course which would help the oncology community in acquiring the right staff.

Outcome of the program

- The student will be well versed with the concept of Physics (specifically radiation e.g., X-rays, Gamma rays etc.) which can be used for medical applications.
- The student will learn different advanced techniques (e.g., 3D CRT, IMRT, IGRT, Brachytherapy, etc.) involved in the treatment of cancer.
- Culture of Interdisciplinary research will be seeded through collaborations with various Cancer hospitals.

Job opportunities:

- The students have tremendous opportunities to work as clinical medical physicist in various leading hospitals all over India with attractive salary packages.
- The students have opportunities to work as an Assistant Professor where there are courses of M.Sc. Medical Physics.

- The students can work as Scientists in the Research institutes.
- The students can also work as dosimetrists in various companies providing radiation measuring devices.
- The students also have opportunities to pursue higher studies in India and abroad in related fields.

Duration of the Course

Duration: **2 years** of coursework and a **1-year mandatory internship** in an AERB-recognized hospital. Note as per AERB MSc. Medical Physics degree completion certificate should be issued to the successful candidate prior to start of Medical Physics internship.

Eligibility for admission

Candidates who have passed Bachelor's in Physics (B.Sc.) with ≥ 50% marks. Final selection includes an interview.

Please note that the candidates who studied B.Sc. through correspondence and open university stream are not eligible.

Medium of Instruction:

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

Programme of Study

The course shall be pursued on full time basis.

The training of this postgraduate degree shall be residency pattern with graded responsibilities in the management and treatment of cancer patients entrusted to his/her care. The course is mainly focused on practical aspects of **Medical Physics**. Hence majority of the course pattern is dedicated towards all the practical aspects. The participation of the students in all facets of educational process is essential. Every candidate should take part in seminars, group discussions, case demonstrations, journal review meetings and clinics. Training should include involvement in laboratory and experimental work, and research studies.

Every successful candidate has an opportunity to work also as Radiological Safety Officer (RSO) in addition to the responsibilities of a Medical Physicist. For this, every candidate needs to get **RSO certification** from the Bhabha Atomic Research Centre (BARC) and Atomic Energy Regulatory Board (AERB), Mumbai, after successful completion of M.Sc. (Medical Physics).

Syllabus for the students

The broad outlines of the course are annexed and have been prepared to keep in view the guidelines/ requirements of AERB and BARC, Mumbai. The syllabus is designed as per the revised Dip. R. P. syllabus of RPAD, BARC excluding industrial applications and safety should be as minimum syllabus for 2nd year of this course. In addition, the syllabus is elaborated on Nuclear Physics, Radiation Physics, Solid State Physics, Electronics and Instrumentation and Mathematical Physics. The emphasis is given on the computer programming and applications as well.

Teaching and Training: The staff of MGMIHS, Its Medical Colleges, Hospitals and Associated Cancer Hospital shall impart the teaching and training to the students jointly.

First year of the teaching/training will be mainly in the University. For practical's, the students will be at an operational AERB-approved advanced Cancer hospital, as decided by the University.

Second year of the teaching and clinical training shall be at an operational AERB-approved advanced Cancer hospital, as decided by the University.

Full-time Internship Training (Duration one year)

At an operational AERB-approved advanced Cancer hospital, as decided by the University (as per AERB):
Twelve months full-time mandatory Internship at an AERB-approved advanced cancer hospital

As per the revised Atomic Energy Regulatory Board (AERB) safety code [Code No: AERB/RF-SC/MED-1(Rev.1)], after completion of **two years M.Sc. degree in Medical Physics**, additionally the candidate has to undergo one-year full time internship program in a AERB recognized well-equipped radiation therapy department.

After successful completion of one-year full-time internship, candidate can register as a Radiation Professional at eLORA (AERB) and the candidate becomes eligible to appear for the Radiological safety Officer (RSO) qualifying examination conducted by the Bhabha Atomic Research Centre (BARC) and Atomic Energy Regulatory Board (AERB) at Mumbai. The candidates are requested to keep watch on the notifications issued by BARC about the schedule of RSO examination.

Attendance, Progress and Conduct: A candidate pursuing this degree course should be associated with the concerned department for the full period as a full-time student. No candidate is permitted to do any other course, running parallel, while studying this postgraduate course.

Each semester/year shall be taken as a unit to calculate attendance.

Every student shall attend symposia, seminars, conferences, journal review meetings, grand rounds, case presentations, clinics and lectures during each year as prescribed by the department and not absent himself/herself from work without valid reasons.
Every candidate is required to attend a minimum of 75% of the training during each academic year of the postgraduate course. Provided further, leave of any kind shall not be counted as part of academic term without prejudice to minimum of 75% attendance of training period each year.

Any student who fails to complete the course in the manner stated above shall not be permitted to appear for the University Examinations.

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

Program Outcome & Specific Outcome

Programme Outcome	1. **Fundamental Knowledge:** Apply advanced knowledge of physics, anatomy, physiology, and radiation physics to understand and solve problems in medical physics and healthcare. 2. **Radiation Physics and Dosimetry:** Demonstrate expertise in the principles and applications of radiation physics, dosimetry, and the safe use of ionizing and non-ionizing radiation in medical diagnosis and therapy. 3. **Clinical Application:** Apply medical physics principles in clinical settings, including radiology, radiation therapy, nuclear medicine, and radiation protection, ensuring accuracy and safety in patient care. 4. **Regulatory Compliance and Safety**: Understand and comply with national and international regulations (e.g., AERB, IAEA) regarding radiation safety, protection, and medical equipment quality assurance. 5. **Problem Solving and Analytical Skills:** Analyze clinical and technical problems critically and develop evidence-based solutions in medical physics practices and research. 6. **Technical Proficiency:** Operate and perform quality assurance on sophisticated medical imaging and radiation therapy equipment such as LINACs, CT scanners, MRI, PET-CT, and treatment planning systems 7. **Research and Development:** Engage in scientific research, data analysis, and development of new technologies in medical physics, contributing to innovations in medical diagnostics and therapy. 8. **Communication and Collaboration:** Communicate effectively with clinicians, technologists, and healthcare teams, and provide expert consultation on radiation safety and treatment planning 9. **Ethical and Professional Responsibility:** Demonstrate high ethical standards, responsibility, and commitment to lifelong learning in the field of medical physics.
Programme Specific Outcome	1. The primary goal of the Master of Science in Medical Physics program is to prepare accomplished professionals in Cancer care with a specific emphasis on clinical skills and technical knowledge along with professional research. 2. Students will acquire the research-based knowledge and procedural skills necessary to deliver a high standard of care to patients with cancer disease requiring radiation therapy. 3. This course involves all aspects of care for patients with cancer. 4. The overall goal of this training is to foster the student's development into an independent care provider and researcher in the field of cancer care. 5. The program intends for its post-graduates to contribute to a new generation of academic Medical Physics professionals equipped to address the challenging problems in radiation therapy.

SEMESTER I
Course Outcome

MMP 101 L	Applied Mathematics	Mapped POs	Teaching-Learning Methodologies	Assessment Tools
CO1	Understand vector analysis in various coordinate systems to apply in radiation physics and dosimetry.	P01, P02, P03, P04, P05, P06, P07, P08, P09	Lecture, Journal, Assignment, E-Learning and Poster / Videos	Internal Assessment and University Exam, Theory exam, MCQ, Seminar, Assignment
CO2	Apply eigenvalue problems and matrix methods in solving radiation transport equations.	P01,P02,P03, P04,P05,P06, P07,P08,P09	Lecture, Journal, Assignment, E-Learning and Poster / Videos	Internal Assessment and University Exam, Theory exam, MCQ, Seminar, Assignment
CO3	Use complex functions and contour integration in solving medical imaging and wave equations.	P01,P03,P05, P06,P07,P08, P09	Lecture, Journal, Assignment, E-Learning and Poster / Videos	Internal Assessment and University Exam, Theory exam, MCQ, Seminar, Assignment
CO4	Utilize orthonormal series and special functions in data modelling and Fourier applications in radiology.	P01,P02,P03, P05,P06,P07, P08,P09	Lecture, Journal, Assignment, E-Learning and Poster / Videos	Internal Assessment and University Exam, Theory exam, MCQ, Seminar, Assignment
CO5	Model boundary value problems in radiation diffusion and heat transfer simulations.	P01,P03,P05, P06,P07,P08, P09	Lecture, Journal, Assignment, E-Learning and Poster / Videos	Internal Assessment and University Exam, Theory exam, MCQ, Seminar, Assignment
CO6	Use Laplace and Fourier transforms for system analysis and signal processing in diagnostics.	P01,P03,P05, P06,P07,P08, P09	Lecture, Journal, Assignment, E-Learning and Poster / Videos	Internal Assessment and University Exam, Theory exam, MCQ, Seminar, Assignment
CO7	Apply symmetry and group theoretical methods in nuclear and atomic structure analysis.	P01,P03,P05, P07,P08,P09	Lecture, Journal, Assignment, E-Learning and Poster / Videos	Internal Assessment and University Exam, Theory exam, MCQ, Seminar, Assignment
CO8	Perform stochastic modelling and error analysis in radiation measurement and dosimetry.	P01,P02,P03, P04,P05,P06, P07,P08,P09	Lecture, Journal, Assignment, E-Learning and Poster / Videos	Internal Assessment and University Exam, Theory exam, MCQ, Seminar, Assignment

MMP 102 L	Solid State Physics	Mapped POs	Teaching-Learning Methodologies	Assessment Tools
CO1	Analyse electron behaviour in metals for electrical and thermal conductivity understanding in RT devices.	P01,P02,P03,P04,P05,P06,P07,P08,P09	Lecture, Journal, Assignment, E-Learning and Poster / Videos	Internal Assessment and University Exam, Theory exam, Practical Exam, MCQ, Viva-voce, Station Exercise, Seminar, Assignment
CO2	Interpret material structures used in detectors and shielding via diffraction techniques.	P01,P02,P03,P04,P05,P06,P07,P08,P09	Lecture, Journal, Assignment, E-Learning and Poster / Videos	Internal Assessment and University Exam, Theory exam, Practical Exam, MCQ, Viva-voce, Station Exercise, Seminar, Assignment
CO3	Calculate binding energy of solids to assess material suitability in equipment design.	P01,P03,P05,P06,P07,P08,P09	Lecture, Journal, Assignment, E-Learning and Poster / Videos	Internal Assessment and University Exam, Theory exam, Practical Exam, MCQ, Viva-voce, Station Exercise, Seminar, Assignment
CO4	Understand band gap and charge transport relevant for semiconductors in detectors.	P01,P03,P05,P06,P07,P08,P09	Lecture, Journal, Assignment, E-Learning and Poster / Videos	Internal Assessment and University Exam, Theory exam, Practical Exam, MCQ, Viva-voce, Station Exercise, Seminar, Assignment
CO5	Evaluate semiconductor properties for radiation sensors and dosimetry.	P01,P02,P03,P04,P05,P06,P07,P08,P09	Lecture, Journal, Assignment, E-Learning and Poster / Videos	Internal Assessment and University Exam, Theory exam, Practical Exam, MCQ, Viva-voce, Station Exercise, Seminar, Assignment
CO6	Examine heat transport in solid materials relevant for radiation protection.	P01,P02,P03,P04,P05,P06,P07,P08,P09	Lecture, Journal, Assignment, E-Learning and Poster / Videos	Internal Assessment and University Exam, Theory exam, Practical Exam, MCQ, Viva-voce, Station Exercise, Seminar, Assignment
CO7	Apply concepts like Landau levels and Hall effects in detector physics.	P01,P02,P03,P05,P06,P07,P08,P09	Lecture, Journal, Assignment, E-Learning and Poster / Videos	Internal Assessment and University Exam, Theory exam, Practical Exam, MCQ, Viva-voce, Station Exercise, Seminar, Assignment
CO8	Understand magnetic materials used in shielding and MRI	P01,P02,P03,P04,P05,P06,P07,P08,P09	Lecture, Journal, Assignment, E-Learning and Poster / Videos	Internal Assessment and University Exam, Theory exam, Practical Exam, MCQ, Viva-voce, Station Exercise, Seminar, Assignment
CO9	Analyse low-resistance materials in advanced medical imaging systems.	P01,P02,P03,P05,P06,P07,P08,P09	Lecture, Journal, Assignment, E-Learning and Poster / Videos	Internal Assessment and University Exam, Theory exam, Practical Exam, MCQ, Viva-voce, Station Exercise, Seminar, Assignment

MMP 103 L	Nuclear Physics	Mapped POs	Teaching-Learning Methodologies	Assessment Tools
CO1	Evaluate nuclide stability for therapeutic and diagnostic isotope selection.	P01,P02,P03, P04,P05,P06, P07,P08,P09	Lecture, Journal, Assignment, E-Learning and Poster / Videos	Internal Assessment and University Exam, Theory exam, MCQ, Seminar, Assignment
CO2	Apply nuclear force models in reactor physics and shielding design.	P01,P02,P03, P04,P05,P06, P07,P08,P09	Lecture, Journal, Assignment, E-Learning and Poster / Videos	Internal Assessment and University Exam, Theory exam, MCQ, Seminar, Assignment
CO3	Understand energy release and fission principles used in isotope production.	P01,P02,P03, P04,P05,P06, P07,P08,P09	Lecture, Journal, Assignment, E-Learning and Poster / Videos	Internal Assessment and University Exam, Theory exam, MCQ, Seminar, Assignment
CO4	Analyse nuclear energy levels and spin for radiation emission prediction.	P01,P02,P03, P04,P05,P06, P07,P08,P09	Lecture, Journal, Assignment, E-Learning and Poster / Videos	Internal Assessment and University Exam, Theory exam, MCQ, Seminar, Assignment
CO5	Apply scattering and reaction cross-section knowledge in therapy planning.	P01,P02,P03, P04,P05,P06, P07,P08,P09	Lecture, Journal, Assignment, E-Learning and Poster / Videos	Internal Assessment and University Exam, Theory exam, MCQ, Seminar, Assignment
CO6	Classify fundamental particles for applications in PET/SPECT physics.	P01,P02,P03, P04,P05,P06, P07,P08,P09	Lecture, Journal, Assignment, E-Learning and Poster / Videos	Internal Assessment and University Exam, Theory exam, MCQ, Seminar, Assignment
CO7	Understand beta decay and neutrino interactions in medical isotope use.	P01,P02,P03, P04,P05,P06, P07,P08,P09	Lecture, Journal, Assignment, E-Learning and Poster / Videos	Internal Assessment and University Exam, Theory exam, MCQ, Seminar, Assignment

MMP 104 L	Fundamentals of Computers and Programming Applications	Mapped POs	Teaching-Learning Methodologies	Assessment Tools
CO1	Design and analyse digital circuits used in imaging and therapy equipment.	P01,P03,P05, P06,P08,P09	Lecture, Journal, Assignment, E-Learning and Poster / Videos	Internal Assessment and University Exam, Theory exam, MCQ, Seminar, Assignment
CO2	Apply stochastic simulation in radiation interaction modelling and dosimetry.	P01,P02,P03, P04,P05,P06, P07,P08,P09	Lecture, Journal, Assignment, E-Learning and Poster / Videos	Internal Assessment and University Exam, Theory exam, MCQ, Seminar, Assignment
CO3	Use MS Office, MATLAB, and SPSS for documentation, data analysis, and plotting in research.	P01,P03,P05, P06,P08,P09	Lecture, Journal, Assignment, E-Learning and Poster / Videos	Internal Assessment and University Exam, Theory exam, MCQ, Seminar, Assignment
CO4	Solve medical physics-related numerical problems using C++ and MATLAB.	P01,P03,P05, P06,P07,P08, P09	Lecture, Journal, Assignment, E-Learning and Poster / Videos	Internal Assessment and University Exam, Theory exam, MCQ, Seminar, Assignment
CO5	Understand AI applications in image analysis, treatment planning, and workflow optimization.	P01,P02,P03, P04,P05,P06, P07,P08,P09	Lecture, Journal, Assignment, E-Learning and Poster / Videos	Internal Assessment and University Exam, Theory exam, MCQ, Seminar, Assignment

CC 001 L	Research Methodology and Biostatistics	Mapped POs	Teaching-Learning Methodologies	Assessment Tools
CO1	Students will be able to understand statistical models, research designs with the understanding of background theory of various commonly used statistical techniques as well as analysis, interpretation & reporting of results and use of statistical software.	P01,P05,P06, P07,P09	Lecture, Practical, Assignment, Journal	Internal Assessment and University Exam, Theory exam, Practical Exam, Seminar, Viva-Voce, Station exercise, MCQ,

MMP 105 P	Solid State Physics	Mapped POs	Teaching-Learning Methodologies	Assessment Tools
CO1	Understand the working principles and handling of basic solid-state physics instruments.	P01,P02,P03, P05,P06,P07, P09	Lecture, Practical, Journal, Assignment, E-Learning and Poster / Videos	Internal Assessment and University Exam, Theory exam, Practical Exam, MCQ, Viva-voce, Station Exercise, Seminar, Assignment
CO2	Acquire practical skills in measuring and analysing properties of solid materials.	P01,P02,P03, P05,P06,P07, P09	Lecture, Practical, Journal, Assignment, E-Learning and Poster / Videos	Internal Assessment and University Exam, Theory exam, Practical Exam, MCQ, Viva-voce, Station Exercise, Seminar, Assignment
CO3	Apply experimental techniques to support theoretical concepts relevant to radiological technology.	P01,P02,P03, P05,P06,P07, P09	Lecture, Practical, Journal, Assignment, E-Learning and Poster / Videos	Internal Assessment and University Exam, Theory exam, Practical Exam, MCQ, Viva-voce, Station Exercise, Seminar, Assignment

MMP 106 CP	Physics Directed Clinical Education I	Mapped POs	Teaching-Learning Methodologies	Assessment Tools
CO1	Operate TPS software for site-specific cancer planning.	P01,P02,P03, P04,P05,P06, P07,P08,P09	Practical, Clinical Posting, Demonstration, Case- study, Clinical Simulation	Practical Exam, Station Exercise, Viva-voce, logbook
CO2	Assist in simulation and contouring procedures.	P01,P02,P03, P04,P05,P06, P08,P09	Practical, Clinical Posting, Demonstration, Case- study, Clinical Simulation	Practical Exam, Station Exercise, Viva-voce, logbook
CO3	Participate in daily, monthly, and annual QA of LINAC and imaging systems.	P01,P02,P03, P04,P05,P06, P07,P08,P09	Practical, Clinical Posting, Demonstration, Case- study, Clinical Simulation	Practical Exam, Station Exercise, Viva-voce, logbook
CO4	Contribute to patient-specific and phantom dosimetry.	P01,P02,P03, P04,P05,P06, P07,P08	Practical, Clinical Posting, Demonstration, Case- study, Clinical Simulation	Practical Exam, Station Exercise, Viva-voce, logbook
CO5	Maintain treatment records, prescriptions, and procedural logs.	P01,P03,P04, P05,P06,P09	Practical, Clinical Posting, Demonstration, Case- study, Clinical Simulation	Practical Exam, Station Exercise, Viva-voce, logbook

CO6	Work with oncologists, technologists in treatment delivery.	P01,P02,P03, P04,P05,P06, ,P08,P09	Practical, Clinical Posting, Demonstration, Case- study, Clinical Simulation	Practical Exam, Station Exercise, Viva-voce, logbook
CO7	Understand and adhere to AERB standards and requirements	P01,P02,P03, P04,P05,P06, P08,P09	Practical, Clinical Posting, Demonstration, Case- study, Clinical Simulation	Practical Exam, Station Exercise, Viva-voce, logbook

CC 001 P	**Research Methodology and Biostatistics**	**Mapped POs**	**Teaching-Learning Methodologies**	**Assessment Tools**
CO1	Understand and apply basic research designs and statistical models in scientific studies.	P01,P03,P04, P05,P06,P07, P08,P09	Lecture, Practical, Journal, Assignment, E-Learning and Poster / Videos	Internal Assessment and University Exam, Theory exam, Practical Exam, MCQ, Viva-voce, Station Exercise, Seminar, Assignment
CO2	Analyse, interpret, and report research data using appropriate statistical techniques.	P01,P03,P04, P05,P06,P07, P08,P09	Lecture, Practical, Journal, Assignment, E-Learning and Poster / Videos	Internal Assessment and University Exam, Theory exam, Practical Exam, MCQ, Viva-voce, Station Exercise, Seminar, Assignment
CO3	Gain hands-on experience with statistical software for data analysis and presentation.	P01,P03,P04, P05,P06,P07, P08,P09	Lecture, Practical, Journal, Assignment, E-Learning and Poster / Videos	Internal Assessment and University Exam, Theory exam, Practical Exam, MCQ, Viva-voce, Station Exercise, Seminar, Assignment

SEMESTER II

MMP 107 L	Medical Imaging	Mapped POs	Teaching-Learning Methodologies	Assessment Tools
CO1	Evaluate image quality, dose, and equipment parameters in diagnostic imaging.	P01,P02,P03,P04,P05,P06,P07, P09	Lecture, Journal, Assignment, E-Learning and Poster / Videos	Internal Assessment and University Exam, Theory exam, MCQ, Seminar, Assignment
CO2	Understand CT physics and apply appropriate protocols in oncology imaging.	P01,P02,P03,P04,P05,P06,P07, P08,P09	Lecture, Journal, Assignment, E-Learning and Poster / Videos	Internal Assessment and University Exam, Theory exam, MCQ, Seminar, Assignment
CO3	Analyse MR physics, sequences, and safety for oncology applications.	P01,P02,P03,P04,P05,P06,P07, P09	Lecture, Journal, Assignment, E-Learning and Poster / Videos	Internal Assessment and University Exam, Theory exam, MCQ, Seminar, Assignment
CO4	Understand SPECT/PET imaging and tracer kinetics in cancer diagnosis.	P01,P02,P03,P04,P05,P06,P07, P09	Lecture, Journal, Assignment, E-Learning and Poster / Videos	Internal Assessment and University Exam, Theory exam, MCQ, Seminar, Assignment
CO5	Implement safety protocols in diagnostic departments.	P01,P02,P03,P04,P05,P06,P07, P08,P09	Lecture, Journal, Assignment, E-Learning and Poster / Videos	Internal Assessment and University Exam, Theory exam, MCQ, Seminar, Assignment

MMP 108 L	Nuclear Electronics and Instrumentation	Mapped POs	Teaching-Learning Methodologies	Assessment Tools
CO1	Understand the working principles of nuclear instrumentation systems and electronic components used in radiation detection.	P01,P02,P03, P05,P06,P07, P09	Lecture, Journal, Assignment, E-Learning and Poster / Videos	Internal Assessment and University Exam, Theory exam, Practical Exam, MCQ, Viva-voce, Station Exercise, Seminar, Assignment
CO2	Perform experiments using detectors, pulse processing units, and counting systems to analyze nuclear radiation.	P01,P02,P03, P05,P06,P07, P09	Lecture, Journal, Assignment, E-Learning and Poster / Videos	Internal Assessment and University Exam, Theory exam, Practical Exam, MCQ, Viva-voce, Station Exercise, Seminar, Assignment
CO3	Apply calibration and measurement techniques for	P01,P02,P03, P04,P05,P06,	Lecture, Journal, Assignment, E-	Internal Assessment and University Exam, Theory

	radiation detectors and evaluate data accuracy.	P07,P08,P09	Learning and Poster / Videos	exam, Practical Exam, MCQ, Viva-voce, Station Exercise, Seminar, Assignment
CO4	Demonstrate hands-on skills in handling nuclear electronics instruments like GM counters, scintillation counters, and multichannel analyzers.	P01,P02,P03, P05,P06,P07, P09	Lecture, Journal, Assignment, E-Learning and Poster / Videos	Internal Assessment and University Exam, Theory exam, Practical Exam, MCQ, Viva-voce, Station Exercise, Seminar, Assignment
CO5	Interpret experimental results, troubleshoot circuit setups, and maintain laboratory safety protocols.	P01,P02,P03, P04,P05,P06, P07,P09	Lecture, Journal, Assignment, E-Learning and Poster / Videos	Internal Assessment and University Exam, Theory exam, Practical Exam, MCQ, Viva-voce, Station Exercise, Seminar, Assignment

MMP 109 L	**Radiation Therapy I**	**Mapped POs**	**Teaching-Learning Methodologies**	**Assessment Tools**
CO1	Compare various modalities (Co-60, LINAC) and apply dosimetry protocols.	P01,P02,P03, P04,P05,P06, P07,P08,P09	Lecture, Journal, Assignment, E-Learning and Poster / Videos	Internal Assessment and University Exam, Theory exam, Practical Exam, MCQ, Viva-voce, Station Exercise, Seminar, Assignment
CO2	Use TAR, TMR, PDD in treatment plan verification.	P01,P02,P03, P04,P05,P06, P07,P08,P09	Lecture, Journal, Assignment, E-Learning and Poster / Videos	Internal Assessment and University Exam, Theory exam, Practical Exam, MCQ, Viva-voce, Station Exercise, Seminar, Assignment
CO3	Understand isodose planning and brachytherapy procedures	P01,P02,P03, P04,P05,P06, P07,P08,P09	Lecture, Journal, Assignment, E-Learning and Poster / Videos	Internal Assessment and University Exam, Theory exam, Practical Exam, MCQ, Viva-voce, Station Exercise, Seminar, Assignment
CO4	Operate TPS software for patient-specific plan generation.	P01,P02,P03, P04,P05,P06, P07,P08,P09	Lecture, Journal, Assignment, E-Learning and Poster / Videos	Internal Assessment and University Exam, Theory exam, Practical Exam, MCQ, Viva-voce, Station Exercise, Seminar, Assignment

MMP 110 L	Electrodynamics	Mapped POs	Teaching-Learning Methodologies	Assessment Tools
CO1	Analyze electrostatic fields in shielding and imaging systems.	P01,P02,P03,P04,P05,P06,P07,P09	Lecture, Journal, Assignment, E-Learning and Poster / Videos	Internal Assessment and University Exam, Theory exam, MCQ, Seminar, Assignment
CO2	Model field behaviour in patient interfaces and detectors.	P01,P02,P03,P04,P05,P06,P07,P08,P09	Lecture, Journal, Assignment, E-Learning and Poster / Videos	Internal Assessment and University Exam, Theory exam, MCQ, Seminar, Assignment
CO3	Apply solution methods for potential distribution analysis in detectors.	P01,P02,P03,P04,P05,P06,P07,P08,P09	Lecture, Journal, Assignment, E-Learning and Poster / Videos	Internal Assessment and University Exam, Theory exam, MCQ, Seminar, Assignment
CO4	Evaluate dielectric materials used in imaging and shielding.	P01,P02,P03,P04,P05,P06,P07,P08,P09	Lecture, Journal, Assignment, E-Learning and Poster / Videos	Internal Assessment and University Exam, Theory exam, MCQ, Seminar, Assignment
CO5	Interpret current-induced magnetic fields in therapy coils and LINACs.	P01,P02,P03,P04,P05,P06,P07,P08,P09	Lecture, Journal, Assignment, E-Learning and Poster / Videos	Internal Assessment and University Exam, Theory exam, MCQ, Seminar, Assignment
CO6	Predict charged particle paths for dose deposition analysis.	P01,P02,P03,P04,P05,P06,P07,P08,P09	Lecture, Journal, Assignment, E-Learning and Poster / Videos	Internal Assessment and University Exam, Theory exam, MCQ, Seminar, Assignment
CO7	Model wave propagation in tissues and imaging modalities.	P01,P02,P03,P04,P05,P06,P07,P08,P09	Lecture, Journal, Assignment, E-Learning and Poster / Videos	Internal Assessment and University Exam, Theory exam, MCQ, Seminar, Assignment
CO8	Analyze energy loss and emission patterns in accelerators.	P01,P02,P03,P04,P05,P06,P07,P08,P09	Lecture, Journal, Assignment, E-Learning and Poster / Videos	Internal Assessment and University Exam, Theory exam, MCQ, Seminar, Assignment

MMP 111 L	Clinical and Radiation Biology	Mapped POs	Teaching-Learning Methodologies	Assessment Tools
CO1	Understand cell structure, DNA repair mechanisms, and cell death post-irradiation	P01,P03, P07,P09	Lecture, Journal, Assignment, E-Learning and Poster / Videos	Internal Assessment and University Exam, Theory exam, MCQ, Seminar, Assignment
CO2	Identify organ systems, their function, and relevance in radiology.	P01,P02, P03,P07, ,P09	Lecture, Journal, Assignment, E-Learning and Poster / Videos	Internal Assessment and University Exam, Theory exam, MCQ, Seminar, Assignment
CO3	Analyze radiation-induced changes and models of survival curves.	P01,P02, P03,P07, ,P09	Lecture, Journal, Assignment, E-Learning and Poster / Videos	Internal Assessment and University Exam, Theory exam, MCQ, Seminar, Assignment
CO4	Differentiate between somatic and genetic effects of radiation.	P01,P02, P03,P07, ,P09	Lecture, Journal, Assignment, E-Learning and Poster / Videos	Internal Assessment and University Exam, Theory exam, MCQ, Seminar, Assignment
CO5	Understand the clinical aspects of treatment delivery and side effects.	P01,P02, P03,P07, ,P09	Lecture, Journal, Assignment, E-Learning and Poster / Videos	Internal Assessment and University Exam, Theory exam, MCQ, Seminar, Assignment
CO6	Apply models like NSD, TDF to optimize radiotherapy schedules.	P01,P02, P03,P07, ,P09	Lecture, Journal, Assignment, E-Learning and Poster / Videos	Internal Assessment and University Exam, Theory exam, MCQ, Seminar, Assignment

MMP 112 P	Nuclear Electronics and Instrumentation	Mapped POs	Teaching-Learning Methodologies	Assessment Tools
CO1	Identify and understand the functions of basic nuclear electronic components and modules.	P01,P02, P03,P05, P06,P07	Lecture, Practical Demonstration, Assignment, Seminar,	Internal Assessment and University Exam, Theory exam, Practical Exam, Seminar, Viva-Voce, Station exercise, MCQ, Assignment
CO2	Set up and operate radiation detection systems like GM counters and scintillation detectors.	P01,P02, P03,P05, P06,P07	Lecture, Practical Demonstration, Assignment, Seminar,	Internal Assessment and University Exam, Theory exam, Practical Exam, Seminar, Viva-Voce, Station exercise, MCQ, Assignment

CO3	Analyze pulse height spectra using Single and Multi-Channel Analyzers.	P01,P02, P03,P05, P06,P07	Lecture, Practical Demonstration, Assignment, Seminar,	Internal Assessment and University Exam, Theory exam, Practical Exam, Seminar, Viva-Voce, Station exercise, MCQ, Assignment
CO4	Calibrate detectors and interpret measurements with accuracy and precision.	P01,P02, P03,P05, P06,P07	Lecture, Practical Demonstration, Assignment, Seminar,	Internal Assessment and University Exam, Theory exam, Practical Exam, Seminar, Viva-Voce, Station exercise, MCQ, Assignment
CO5	Apply radiation safety measures and standard laboratory protocols during experiments.	P01,P02, P03,P05, P06,P07	Lecture, Practical Demonstration, Assignment, Seminar,	Internal Assessment and University Exam, Theory exam, Practical Exam, Seminar, Viva-Voce, Station exercise, MCQ, Assignment

MMP 113 P	**Radiation Therapy I**	**Mapped POs**	**Teaching-Learning Methodologies**	**Assessment Tools**
CO1	Understand and demonstrate the setup of teletherapy and brachytherapy treatment units.	P01,P02,P03, P04,P05,P06, P07,P08,P09	Lecture, Practical, Demonstration, Assignment, Journal	Internal Assessment and University Exam, Theory exam, Practical Exam, Seminar, Viva-Voce, Station exercise, MCQ, Assignment
CO2	Perform treatment planning simulations and field arrangements for different cancer sites.	P01,P02,P03, P04,P05,P06, P07,P08,P09	Lecture, Practical, Demonstration, Assignment, Journal	Internal Assessment and University Exam, Theory exam, Practical Exam, Seminar, Viva- Voce, Station exercise, MCQ, Assignment
CO3	Apply dosimetry principles in clinical practice using phantom measurements.	P01,P02,P03, P04,P05,P06, P07,P08,P09	Lecture, Practical, Demonstration, Assignment, Journal	Internal Assessment and University Exam, Theory exam, Practical Exam, Seminar, Viva- Voce, Station exercise, MCQ, Assignment
CO4	Operate treatment planning systems and evaluate dose distribution.	P01,P02,P03, P04,P05,P06, P07,P08,P09	Lecture, Practical, Demonstration, Assignment, Journal	Internal Assessment and University Exam, Theory exam, Practical Exam, Seminar, Viva- Voce, Station exercise, MCQ, Assignment
CO5	Follow radiation safety and quality assurance protocols during clinical procedures.	P01,P02,P03, P04,P05,P06, P07,P08,P09	Lecture, Practical, Demonstration, Assignment, Journal	Internal Assessment and University Exam, Theory exam, Practical Exam, Seminar, Viva- Voce, Station exercise, MCQ, Assignment

MMP 114 CP	Physics Directed Clinical Education II	Mapped POs	Teaching-Learning Methodologies	Assessment Tools
CO1	Students will gain additional clinical skills in this program to increase the role of Radiation Therapy in the practice of Oncology and disease prevention by providing a unique combination of educational experiences to students.	P01,P02,P03, P04,P05,P06, P07,P08,P09	Practical, Clinical Posting, Demonstration, Case-study, Clinical Simulation	Practical Exam, Station Exercise, Viva-voce, logbook
CO2	The students will be exposed to both clinical and academic aspects of Radiation Therapy.	P01,P02,P03, P04,P05,P06, P07,P08,P09	Practical, Clinical Posting, Demonstration, Case-study, Clinical Simulation	Practical Exam, Station Exercise, Viva-voce, logbook

SEC 001 L	Innovation and Entrepreneurship	Mapped POs	Teaching-Learning Methodologies	Assessment Tools
CO1	Students will grasp the concepts of innovation, its ecosystem, and the role of various stakeholders such as government policies, startups, and innovation hubs.	P01,P04, P05,P08, P09	Lecture, E-Learning, Guest Lecture, Industrial Visit, Industrial Expert Talk, Poster and Videos	Internal Assessment, University Exam, Theory exam, Seminar, MCQ
CO2	Cultivating an entrepreneurial mindset and leadership qualities necessary for driving innovation and leading ventures.	P01,P04, P05,P08, P09	Lecture, E-Learning, Guest Lecture, Industrial Visit, Industrial Expert Talk, Poster and Videos	Internal Assessment, University Exam, Theory exam, Seminar, MCQ
CO3	Understanding the intersection of technology and innovation and leveraging emerging technologies for entrepreneurial ventures.	P01,P04, P05,P08, P09	Lecture, E-Learning, Guest Lecture, Industrial Visit, Industrial Expert Talk, Poster and Videos	Internal Assessment, University Exam, Theory exam, Seminar, MCQ

SEC 002 L	One Health (NPTEL)	Mapped POs	Teaching-Learning Methodologies	Assessment Tools
CO1	A comprehensive understanding of One Health's role in global health challenges, emphasizing interconnectedness among human, animal, and	P01,P07, P08,P09	E-Learning, Assignment, Theory	Online MCQ Test

	environmental health			
CO2	Topics include research ethics, disease surveillance, and successes in controlling emerging infectious diseases.	P01,P07, P08,P09	E-Learning, Assignment, Theory	Online MCQ Test
CO3	Students explore disease emergence, transmission, antimicrobial resistance, and food safety, gaining insights into effective public health strategies	P01,P07, P08,P09	E-Learning, Assignment, Theory	Online MCQ Test

SEMESTER - III

MMP 115 L	Radiation Safety	Mapped POs	Teaching-Learning Methodologies	Assessment Tools
CO1	Identify potential hazards and categorize different types of radiation exposure.	P01,P02,P03,P04,P05,P06,P07,P08,P09	Lecture, Practical, Demonstration, Assignment, Journal	Internal Assessment and University Exam, Theory exam, MCQ, Seminar, Assignment
CO2	Apply ALARA principles and implement safety measures.	P01,P02,P03,P04,P05,P06,P07,P08,P09	Lecture, Practical, Demonstration, Assignment, Journal	Internal Assessment and University Exam, Theory exam, MCQ, Seminar, Assignment
CO3	Design shielding for diagnostic and therapeutic facilities.	P01,P02,P03,P04,P05,P06,P07,P08,P09	Lecture, Practical, Demonstration, Assignment, Journal	Internal Assessment and University Exam, Theory exam, MCQ, Seminar, Assignment
CO4	Operate personnel and area monitoring devices like TLDs, GM counters.	P01,P02,P03,P04,P05,P06,P07,P08,P09	Lecture, Practical, Demonstration, Assignment, Journal	Internal Assessment and University Exam, Theory exam, MCQ, Seminar, Assignment
CO5	Interpret AERB, ICRP, and BARC guidelines for radiation workers.	P01,P02,P03,P04,P05,P06,P07,P08,P09	Lecture, Practical, Demonstration, Assignment, Journal	Internal Assessment and University Exam, Theory exam, MCQ, Seminar, Assignment
CO6	Handle and dispose of radioactive waste safely in medical facilities.	P01,P02,P03,P04,P05,P06,P07,P08,P09	Lecture, Practical, Demonstration, Assignment, Journal	Internal Assessment and University Exam, Theory exam, MCQ, Seminar, Assignment

MMP 116 L	Radiation Physics & Radiation Generators	Mapped POs	Teaching-Learning Methodologies	Assessment Tools
CO1	Understand the fundamental principles of radioactivity, types of radiation, decay mechanisms, and their significance in nuclear physics.	P01,P02,P03,P04,P05,P06,P07,P08,P09	Lecture, Practical, Demonstration, Assignment, Journal	Internal Assessment and University Exam, Theory exam, MCQ, Seminar, Assignment
CO2	Analyze the working principles, types, and applications of various particle accelerators and their relevance in medical and industrial fields.	P01,P02,P03,P04,P05,P06,P07,P08,P09	Lecture, Practical, Demonstration, Assignment, Journal	Internal Assessment and University Exam, Theory exam, MCQ, Seminar, Assignment
CO3	Describe the design, function, and safety aspects of medical and industrial X-ray generators, including modern imaging systems.	P01,P02,P03,P04,P05,P06,P07,P08,P09	Lecture, Practical, Demonstration, Assignment, Journal	Internal Assessment and University Exam, Theory exam, MCQ, Seminar, Assignment

CO4	Explain the interactions of different types of radiation (electromagnetic, charged particles, and neutrons) with matter, including attenuation, ionization, and energy transfer processes.	P01,P02,P03,P04,P05,P06,P07,P08,P09	Lecture, Practical, Demonstration, Assignment, Journal	Internal Assessment and University Exam, Theory exam, MCQ, Seminar, Assignment
CO5	Apply the concepts of radiation physics to assess the behavior and penetration of radiation in various media, relevant to radiological and clinical applications.	P01,P02,P03,P04,P05,P06,P07,P08,P09	Lecture, Practical, Demonstration, Assignment, Journal	Internal Assessment and University Exam, Theory exam, MCQ, Seminar, Assignment

MMP 117 L	**Radiation Dosimetry and Standardization**	**Mapped POs**	**Teaching-Learning Methodologies**	**Assessment Tools**
CO1	Calculate dose quantities and conversions used in treatment planning.	P01,P02,P03,P04,P05,P06,P07,P08,P09	Lecture, Practical, Demonstration, Assignment, Journal	Internal Assessment and University Exam, Theory exam, MCQ, Seminar, Assignment
CO2	Identify and characterize clinical radiation sources.	P01,P02,P03,P04,P05,P06,P07,P08,P09	Lecture, Practical, Demonstration, Assignment, Journal	Internal Assessment and University Exam, Theory exam, MCQ, Seminar, Assignment
CO3	Apply Bragg-Gray theory and CPE for dose calibration.	P01,P02,P03,P04,P05,P06,P07,P08,P09	Lecture, Practical, Demonstration, Assignment, Journal	Internal Assessment and University Exam, Theory exam, MCQ, Seminar, Assignment
CO4	Operate and interpret measurements from ion chambers.	P01,P02,P03,P04,P05,P06,P07,P08,P09	Lecture, Practical, Demonstration, Assignment, Journal	Internal Assessment and University Exam, Theory exam, MCQ, Seminar, Assignment
CO5	Use passive dosimeters for patient and phantom measurements.	P01,P02,P03,P04,P05,P06,P07,P08,P09	Lecture, Practical, Demonstration, Assignment, Journal	Internal Assessment and University Exam, Theory exam, MCQ, Seminar, Assignment
CO6	Select appropriate dosimeters based on clinical requirements.	P01,P02,P03,P04,P05,P06,P07,P08,P09	Lecture, Practical, Demonstration, Assignment, Journal	Internal Assessment and University Exam, Theory exam, MCQ, Seminar, Assignment
CO7	Implement guidelines in QA processes.	P01,P02,P03,P04,P05,P06,P07,P08,P09	Lecture, Practical, Demonstration, Assignment, Journal	Internal Assessment and University Exam, Theory exam, MCQ, Seminar, Assignment

MMP 118 L	**Radiation Therapy II**	**Mapped POs**	**Teaching-Learning Methodologies**	**Assessment Tools**
CO1	Understand the principles, classification, and techniques of brachytherapy, including source characteristics and dose rate systems.	P01,P02,P03,P04,P05,P06,P07,P08,P09	Lecture, Practical, Demonstration, Assignment, Journal	Internal Assessment and University Exam, Theory exam, MCQ, Seminar, Assignment

CO2	Apply dosimetry concepts and protocols such as TG-43, ICRU, and TECDOC standards in brachytherapy planning and source calibration.	P01,P02,P03,P04,P05,P06,P07,P08,P09	Lecture, Practical, Demonstration, Assignment, Journal	Internal Assessment and University Exam, Theory exam, MCQ, Seminar, Assignment
CO3	Analyze the functioning, QA, and regulatory requirements of manual and remote afterloading systems and integrated brachytherapy units.	P01,P02,P03,P04,P05,P06,P07,P08,P09	Lecture, Practical, Demonstration, Assignment, Journal	Internal Assessment and University Exam, Theory exam, MCQ, Seminar, Assignment
CO4	Evaluate the role of computers in radiotherapy treatment planning, including algorithms, optimization, DICOM standards, and QA protocols	P01,P02,P03,P04,P05,P06,P07,P08,P09	Lecture, Practical, Demonstration, Assignment, Journal	Internal Assessment and University Exam, Theory exam, MCQ, Seminar, Assignment
CO5	Demonstrate knowledge of advanced brachytherapy techniques such as image-guided planning, electronic and intravascular brachytherapy with clinical applications.	P01,P02,P03,P04,P05,P06,P07,P08,P09	Lecture, Practical, Demonstration, Assignment, Journal	Internal Assessment and University Exam, Theory exam, MCQ, Seminar, Assignment

MMP 119	**Dissertation/Project**	**Mapped POs**	**Teaching-Learning Methodologies**	**Assessment Tools**
CO1	To introduce students to the fundamentals of research methodology and scientific writing.	P01,P03,P04, P05,P06,P07, P08,P09	Practical Examination, Station Exercises, Viva-Voce, Logbook Maintenance, Faculty Supervision and Mentoring ,Literature Review and Scientific Writing, Hands-on QA Training, Seminar Presentation, Peer and Expert Feedback Sessions	Practical Examination, Station Exercises, Viva-Voce, Logbook Evaluation, Continuous Internal Assessment, Dissertation/ Project Report Evaluation, Seminar/Presentation Assessment, External Examiner Evaluation, SAC evaluation / Ethical committee evaluation
CO2	To encourage independent project work in advanced topics of medical physics.	P01,P03,P04, P05,P06,P07, P08,P09	Practical Examination, Station Exercises, Viva-Voce, Logbook Maintenance, Faculty Supervision and Mentoring ,Literature Review and Scientific Writing, Hands-on QA Training, Seminar Presentation, Peer and Expert Feedback Sessions	Practical Examination, Station Exercises, Viva-Voce, Logbook Evaluation, Continuous Internal Assessment, Dissertation/ Project Report Evaluation, Seminar/ Presentation Assessment, External Examiner Evaluation, SAC evaluation / Ethical committee evaluation
CO3	To enhance analytical, problem-solving, and technical documentation skills.	P01,P03,P04, P05,P06,P07, P08,P09	Practical Examination, Station Exercises, Viva-Voce, Logbook Maintenance, Faculty Supervision and Mentoring	Practical Examination, Station Exercises, Viva-Voce, Logbook Evaluation, Continuous Internal Assessment, Dissertation/ Project Report Evaluation,

			,Literature Review and Scientific Writing, Hands-on QA Training, Seminar Presentation, Peer and Expert Feedback Sessions	Seminar/ Presentation Assessment, External Examiner Evaluation, SAC evaluation / Ethical committee evaluation
CO4	To promote collaboration with research institutes, hospitals, or industries.	P01,P03,P04, P05,P06,P07, P08,P09	Practical Examination, Station Exercises, Viva-Voce, Logbook Maintenance, Faculty Supervision and Mentoring ,Literature Review and Scientific Writing, Hands-on QA Training, Seminar Presentation, Peer and Expert Feedback Sessions	Practical Examination, Station Exercises, Viva-Voce, Logbook Evaluation, Continuous Internal Assessment, Dissertation/ Project Report Evaluation, Seminar/Presentation Assessment, External Examiner Evaluation, SAC evaluation / Ethical committee evaluation
CO5	To train students in presenting and defending their research through seminars and viva-voce.	P01,P03,P04, P05,P06,P07, P08,P09	Practical Examination, Station Exercises, Viva-Voce, Logbook Maintenance, Faculty Supervision and Mentoring ,Literature Review and Scientific Writing, Hands-on QA Training, Seminar Presentation, Peer and Expert Feedback Sessions	Practical Examination, Station Exercises, Viva-Voce, Logbook Evaluation, Continuous Internal Assessment, Dissertation/ Project Report Evaluation, Seminar/Presentation Assessment, External Examiner Evaluation, SAC evaluation / Ethical committee evaluation

MMP 120 P	**Radiation safety**	**Mapped POs**	**Teaching-Learning Methodologies**	**Assessment Tools**
CO1	Identify potential hazards and categorize different types of radiation exposure.	P01,PO2,P03 ,P04,P05,P06 ,P07,P08,P09	Lecture, Practical, Demonstration, Assignment, Journal	Internal Assessment and University Exam, Theory exam, Practical Exam, Seminar, Viva-Voce, Station exercise, MCQ, Assignment
CO2	Apply ALARA principles and implement safety measures.	P01,PO2,P03 ,P04,P05,P06 ,P07,P08,P09	Lecture, Practical, Demonstration, Assignment, Journal	Internal Assessment and University Exam, Theory exam, Practical Exam, Seminar, Viva-Voce, Station exercise, MCQ, Assignment
CO3	Design shielding for diagnostic and therapeutic facilities.	P01,PO2,P03 ,P04,P05,P06 ,P07,P08,P09	Lecture, Practical, Demonstration, Assignment, Journal	Internal Assessment and University Exam, Theory exam, Practical Exam, Seminar, Viva-Voce, Station exercise, MCQ, Assignment
CO4	Operate personnel and area monitoring devices like TLDs, GM counters.	P01,PO2,P03 ,P04,P05,P06 ,P07,P08,P09	Lecture, Practical, Demonstration, Assignment, Journal	Internal Assessment and University Exam, Theory exam, Practical Exam, Seminar, Viva-Voce, Station exercise, MCQ, Assignment

CO5	Interpret AERB, ICRP, and BARC guidelines for radiation workers.	P01,PO2,P03 ,P04,P05,P06 ,P07,P08,P09	Lecture, Practical, Demonstration, Assignment, Journal	Internal Assessment and University Exam, Theory exam, Practical Exam, Seminar, Viva-Voce, Station exercise, MCQ, Assignment
CO6	Handle and dispose of radioactive waste safely in medical facilities.	P01,PO2,P03 ,P04,P05,P06 ,P07,P08,P09	Lecture, Practical, Demonstration, Assignment, Journal	Internal Assessment and University Exam, Theory exam, Practical Exam, Seminar, Viva-Voce, Station exercise, MCQ, Assignment

MMP 121 P	**Radiation dosimetry and Standardization**	**Mapped POs**	**Teaching-Learning Methodologies**	**Assessment Tools**
CO1	Calculate dose quantities and conversions used in treatment planning.	P01,PO2,P03, P04,P05,P06, P07,P08,P09	Lecture, Practical, Demonstration, Assignment, Journal	Internal Assessment and University Exam, Theory exam, Practical Exam, Seminar, Viva-Voce, Station exercise, MCQ, Assignment
CO2	Identify and characterize clinical radiation sources.	P01,PO2,P03, P04,P05,P06, P07,P08,P09	Lecture, Practical, Demonstration, Assignment, Journal	Internal Assessment and University Exam, Theory exam, Practical Exam, Seminar, Viva-Voce, Station exercise, MCQ, Assignment
CO3	Apply Bragg-Gray theory and CPE for dose calibration.	P01,PO2,P03, P04,P05,P06, P07,P08,P09	Lecture, Practical, Demonstration, Assignment, Journal	Internal Assessment and University Exam, Theory exam, Practical Exam, Seminar, Viva-Voce, Station exercise, MCQ, Assignment
CO4	Operate and interpret measurements from ion chambers.	P01,PO2,P03, P04,P05,P06, P07,P08,P09	Lecture, Practical, Demonstration, Assignment, Journal	Internal Assessment and University Exam, Theory exam, Practical Exam, Seminar, Viva-Voce, Station exercise, MCQ, Assignment
CO5	Use passive dosimeters for patient and phantom measurements.	P01,PO2,P03, P04,P05,P06, P07,P08,P09	Lecture, Practical, Demonstration, Assignment, Journal	Internal Assessment and University Exam, Theory exam, Practical Exam, Seminar, Viva-Voce, Station exercise, MCQ, Assignment
CO6	Implement guidelines in QA processes.	P01,PO2,P03, P04,P05,P06, P07,P08,P09	Lecture, Practical, Demonstration, Assignment, Journal	Internal Assessment and University Exam, Theory exam, Practical Exam, Seminar, Viva-Voce, Station exercise, MCQ, Assignment

MMP 122 CP	**Physics Directed Clinical Education III**	**Mapped POs**	**Teaching-Learning Methodologies**	**Assessment Tools**
CO1	Students will gain additional clinical skills in this program to increase the role of Radiation Therapy in the practice of Oncology and disease prevention by providing a unique combination of educational experiences to	P01,P02,P03,P 04,P05,P06,P0 7,P08,P09	Practical, Clinical Posting, Demonstration, Case-study, Clinical Simulation	Practical Exam, Station Exercise, Viva-voce, logbook

	students.			
CO2	The students will be exposed to both clinical and academic aspects of Radiation Therapy. To provide hands-on experience in Quality Assurance of radiotherapy and diagnostic equipment.	P01,P02,P03,P04,P05,P06,P07,P08,P09	Practical, Clinical Posting, Demonstration, Case- study, Clinical Simulation	Practical Exam, Station Exercise, Viva-voce, logbook

SEMESTER IV

MMP 123 L	Quality Assurance	Mapped POs	Teaching-Learning Methodologies	Assessment Tools
CO1	Learn and acquire practical knowledge about various national and international dosimetry protocols and guidelines	P01,PO2,P03, P04,P05,P06,P 07,P08,P09	Lecture, Practical, Demonstration, Assignment, Journal	Internal Assessment and University Exam, Theory exam, MCQ, Seminar, Assignment
CO2	Use IAEA guidance for standardized QA audits.	P01,PO2,P03, P04,P05,P06,P 07,P08,P09	Lecture, Practical, Demonstration, Assignment, Journal	Internal Assessment and University Exam, Theory exam, MCQ, Seminar, Assignment
CO3	Perform QA of LINACs, beam symmetry, flatness, and output.	P01,PO2,P03, P04,P05,P06,P 07,P08,P09	Lecture, Practical, Demonstration, Assignment, Journal	Internal Assessment and University Exam, Theory exam, MCQ, Seminar, Assignment
CO4	Verify source strength, geometry, and TPS calculations.	P01,PO2,P03, P04,P05,P06,P 07,P08,P09	Lecture, Practical, Demonstration, Assignment, Journal	Internal Assessment and University Exam, Theory exam, MCQ, Seminar, Assignment
CO5	Evaluate CT, MRI, and simulator equipment for compliance.	P01,PO2,P03, P04,P05,P06,P 07,P08,P09	Lecture, Practical, Demonstration, Assignment, Journal	Internal Assessment and University Exam, Theory exam, MCQ, Seminar, Assignment
CO6	Validate algorithm accuracy and commissioning of TPS.	P01,PO2,P03, P04,P05,P06,P 07,P08,P09	Lecture, Practical, Demonstration, Assignment, Journal	Internal Assessment and University Exam, Theory exam, MCQ, Seminar, Assignment
CO7	Contribute to institutional and national dosimetry audits. Maintain AERB-compliant records and logs.	P01,PO2,P03, P04,P05,P06,P 07,P08,P09	Lecture, Practical, Demonstration, Assignment, Journal	Internal Assessment and University Exam, Theory exam, MCQ, Seminar, Assignment

GE 001 L	Pursuit of Inner self Excellence (POISE)	Mapped POs	Teaching-Learning Methodologies	Assessment Tools
CO1	Students will become self dependent, more decisive and develop intuitive ability for their study and career related matter.	P01,P05, P08,P09	Lecture, E-Learning, Guest Lecture, Industrial Visit, Industrial Expert Talk, Poster and Videos	Internal Assessment, University Exam, Theory exam, Seminar, MCQ
CO2	Students ability to present their ideas will be developed.	P01,P05, P08,P09	Lecture, E-Learning, Guest Lecture, Industrial Visit, Industrial Expert Talk, Poster	Internal Assessment, University Exam, Theory exam, Seminar, MCQ

			and Videos	
CO3	Enhanced communication skills, public speaking & improved Presentation ability.	P01,P05, P08,P09	Lecture, E-Learning, Guest Lecture, Industrial Visit, Industrial Expert Talk, Poster and Videos	Internal Assessment, University Exam, Theory exam, Seminar, MCQ
CO4	Students will be able to explore their inner potential and inner ability to become a successful researcher or technician & hence become more focused	P01,P05, P08,P09	Lecture, E-Learning, Guest Lecture, Industrial Visit, Industrial Expert Talk, Poster and Videos	Internal Assessment, University Exam, Theory exam, Seminar, MCQ
CO5	Students will observe significant reduction in stress level.	P01,P05, P08,P09	Lecture, E-Learning, Guest Lecture, Industrial Visit, Industrial Expert Talk, Poster and Videos	Internal Assessment, University Exam, Theory exam, Seminar, MCQ
CO6	With the development of personal attributes like Empathy, Compassion, Service, Love & brotherhood, students will serve the society and industry in better way with teamwork and thus grow professionally.	P01,P05, P08,P09	Lecture, E-Learning, Guest Lecture, Industrial Visit, Industrial Expert Talk, Poster and Videos	Internal Assessment, University Exam, Theory exam, Seminar, MCQ

GE 002 L	**Bioethics, Biosafety, IPR and Technology Transfer**	**Mapped POs**	**Teaching-Learning Methodologies**	**Assessment Tools**
CO1	Effectively manage the health and safety aspects of a biological laboratory.	P01,P05,P06,P08,P09	Lecture, E-Learning, Guest Lecture, Industrial Visit, Industrial Expert Talk, Poster and Videos	Internal Assessment, University Exam, Theory exam, Seminar, MCQ
CO2	Give reliable, professional and informed advice and information to colleagues and managers.	P01,P05,P06,P08,P09	Lecture, E-Learning, Guest Lecture, Industrial Visit, Industrial Expert Talk, Poster and Videos	Internal Assessment, University Exam, Theory exam, Seminar, MCQ
CO3	Help to ensure that their institution complies with relevant legislation, liaise effectively with enforcing authorities and beware of the penalties for failing to comply.	P01,P05,P06,P08,P09	Lecture, E-Learning, Guest Lecture, Industrial Visit, Industrial Expert Talk, Poster and Videos	Internal Assessment, University Exam, Theory exam, Seminar, MCQ
CO4	Build a context of understanding through communication.	P01,P05,P06,P08,P09	Lecture, E-Learning, Guest Lecture, Industrial Visit, Industrial Expert Talk, Poster and Videos	Internal Assessment, University Exam, Theory exam, Seminar, MCQ
CO5	Mediate between other conflicting parties.	P01,P05,P06,P08,P09	Lecture, E-Learning, Guest Lecture, Industrial Visit, Industrial Expert Talk, Poster and Videos	Internal Assessment, University Exam, Theory exam, Seminar, MCQ
CO6	Exhibit de – escalatory behaviours in situations of conflict.	P01,P05,P06,P08,P09	Lecture, E-Learning, Guest Lecture, Industrial Visit, Industrial Expert Talk, Poster and Videos	Internal Assessment, University Exam, Theory exam, Seminar, MCQ

CO7	Demonstrate acknowledgment and validation of the feelings, opinions, and contributions of others.	P01,P05,P06,P08,P09	Lecture, E-Learning, Guest Lecture, Industrial Visit, Industrial Expert Talk, Poster and Videos	Internal Assessment, University Exam, Theory exam, Seminar, MCQ

GE 003 L	**Disaster Management and Mitigation Resources**	**Mapped POs**	**Teaching-Learning Methodologies**	**Assessment Tools**
CO1	Knowledge and understanding of the disaster phenomenon, its different contextual aspects, impacts and public health consequences.	P01,P04,P05,P06,P08,P09	Lecture, E-Learning, Guest Lecture, Industrial Visit, Industrial Expert Talk, Poster and Videos	Internal Assessment, University Exam, Theory exam, Seminar, MCQ
CO2	Knowledge and understanding of the International Strategy for Disaster Reduction (UNISDR) and to increase skills and abilities for implementing the Disaster Risk Reduction (DRR) Strategy.	P01,P04,P05,P06,P08,P09	Lecture, E-Learning, Guest Lecture, Industrial Visit, Industrial Expert Talk, Poster and Videos	Internal Assessment, University Exam, Theory exam, Seminar, MCQ
CO3	Ensure skills and abilities to analyze potential effects of disasters and of the strategies and methods to deliver public health response to avert these effects.	P01,P04,P05,P06,P08,P09	Lecture, E-Learning, Guest Lecture, Industrial Visit, Industrial Expert Talk, Poster and Videos	Internal Assessment, University Exam, Theory exam, Seminar, MCQ

GE 004 L	**Human Rights**	**Mapped POs**	**Teaching-Learning Methodologies**	**Assessment Tools**
CO1	Identify, contextualize and use information about the human rights situationin a given country	P01,P05,P06,P08,P09	Lecture, E-Learning, Guest Lecture, Industrial Visit, Industrial Expert Talk, Poster and Videos	Internal Assessment, University Exam, Theory exam, Seminar, MCQ
CO2	Critically appraise source material, including cases from human rights committees and tribunals and reports and summary records from treaty bodies	P01,P05,P06,P08,P09	Lecture, E-Learning, Guest Lecture, Industrial Visit, Industrial Expert Talk, Poster and Videos	Internal Assessment, University Exam, Theory exam, Seminar, MCQ
CO3	Analyze a country’s situation or an international situation in terms of human rights and formulate human rights-based initiatives and policies	P01,P05,P06,P08,P09	Lecture, E-Learning, Guest Lecture, Industrial Visit, Industrial Expert Talk, Poster and Videos	Internal Assessment, University Exam, Theory exam, Seminar, MCQ
CO4	Promote human rights through legal as well as non-legal means.	P01,P05,P06,P08,P09	Lecture, E-Learning, Guest Lecture, Industrial Visit, Industrial Expert Talk, Poster and Videos	Internal Assessment, University Exam, Theory exam, Seminar, MCQ
CO5	Participate in legal, political and other debates involving human rights in acknowledgeable and constructive way	P01,P05,P06,P08,P09	Lecture, E-Learning, Guest Lecture, Industrial Visit, Industrial Expert Talk, Poster and Videos	Internal Assessment, University Exam, Theory exam, Seminar, MCQ

MMP 124 P	Quality Assurance	Mapped POs	Teaching-Learning Methodologies	Assessment Tools
CO1	Learn and acquire practical knowledge about various national and international dosimetry protocols and guidelines	P01,PO2,P03, P04,P05,P06,P 07,P08,P09	Lecture, Practical, Demonstration, Assignment, Journal	Internal Assessment and University Exam, Theory exam, Practical Exam, Seminar, Viva-Voce, Station exercise, MCQ, Assignment
CO2	Use IAEA guidance for standardized QA audits.	P01,PO2,P03, P04,P05,P06,P 07,P08,P09	Lecture, Practical, Demonstration, Assignment, Journal	Internal Assessment and University Exam, Theory exam, Practical Exam, Seminar, Viva-Voce, Station exercise, MCQ, Assignment
CO3	Perform QA of LINACs, beam symmetry, flatness, and output.	P01,PO2,P03, P04,P05,P06,P 07,P08,P09	Lecture, Practical, Demonstration, Assignment, Journal	Internal Assessment and University Exam, Theory exam, Practical Exam, Seminar, Viva-Voce, Station exercise, MCQ, Assignment
CO4	Verify source strength, geometry, and TPS calculations.	P01,PO2,P03, P04,P05,P06,P 07,P08,P09	Lecture, Practical, Demonstration, Assignment, Journal	Internal Assessment and University Exam, Theory exam, Practical Exam, Seminar, Viva-Voce, Station exercise, MCQ, Assignment
CO5	Evaluate CT, MRI, and simulator equipment for compliance.	P01,PO2,P03, P04,P05,P06,P 07,P08,P09	Lecture, Practical, Demonstration, Assignment, Journal	Internal Assessment and University Exam, Theory exam, Practical Exam, Seminar, Viva-Voce, Station exercise, MCQ, Assignment
CO6	Validate algorithm accuracy and commissioning of TPS.	P01,PO2,P03, P04,P05,P06,P 07,P08,P09	Lecture, Practical, Demonstration, Assignment, Journal	Internal Assessment and University Exam, Theory exam, Practical Exam, Seminar, Viva-Voce, Station exercise, MCQ, Assignment
CO7	Contribute to institutional and national dosimetry audits. Maintain AERB-compliant records and logs.	P01,PO2,P03, P04,P05,P06,P 07,P08,P09	Lecture, Practical, Demonstration, Assignment, Journal	Internal Assessment and University Exam, Theory exam, Practical Exam, Seminar, Viva-Voce, Station exercise, MCQ, Assignment

MMP 125 CP	Physics Directed Clinical Education IV	Mapped POs	Teaching-Learning Methodologies	Assessment Tools
CO1	Students will gain additional clinical skills in this program to increase the role of Radiation Therapy in the practice of Oncology and disease prevention by providing a unique combination of educational experiences to students.	P01,PO2,P03 ,P04,P05,P06 ,P07,P08,P09	Practical, Clinical Posting, Demonstration, Case-study, Clinical Simulation	Practical Exam, Station Exercise, Viva-voce, logbook
CO2	The students will be exposed to both clinical and academic aspects of Radiation Therapy.	P01,PO2,P03 ,P04,P05,P06 ,P07,P08,P09	Practical, Clinical Posting, Demonstration, Case-study, Clinical Simulation	Practical Exam, Station Exercise, Viva-voce, logbook

MMP 126	Dissertation/Project	Mapped POs	Teaching-Learning Methodologies	Assessment Tools
CO1	To introduce students to the fundamentals of research methodology and scientific writing.	P01,P04 ,P05,P0 6,P07,P 08,P09	Practical Examination, Station Exercises, Viva-Voce, Logbook Maintenance, Faculty Supervision and Mentoring, Literature Review and Scientific Writing, Hands-on QA Training, Seminar Presentation, Peer and Expert Feedback Sessions	Practical Examination, Station Exercises, Viva-Voce, Logbook Evaluation, Continuous Internal Assessment, Dissertation/Project Report Evaluation, seminar/ Presentation Assessment, External Examiner Evaluation, SAC evaluation / Ethical committee evaluation
CO2	To encourage independent project work in advanced topics of medical physics.	P01,P04 ,P05,P0 6,P07,P 08,P09	Practical Examination, Station Exercises, Viva-Voce, Logbook Maintenance, Faculty Supervision and Mentoring, Literature Review and Scientific Writing, Hands-on QA Training, Seminar Presentation, Peer and Expert Feedback Sessions	Practical Examination, Station Exercises, Viva-Voce, Logbook Evaluation, Continuous Internal Assessment, Dissertation/Project Report Evaluation, seminar/ Presentation Assessment, External Examiner Evaluation, SAC evaluation / Ethical committee evaluation
CO3	To enhance analytical, problem-solving, and technical documentation skills.	P01,P04 ,P05,P0 6,P07,P 08,P09	Practical Examination, Station Exercises, Viva-Voce, Logbook Maintenance, Faculty Supervision and Mentoring, Literature Review and Scientific Writing, Hands-on QA Training, Seminar Presentation, Peer and Expert Feedback Sessions	Practical Examination, Station Exercises, Viva-Voce, Logbook Evaluation, Continuous Internal Assessment, Dissertation/Project Report Evaluation, seminar/ Presentation Assessment, External Examiner Evaluation, SAC evaluation / Ethical committee evaluation
CO4	To promote collaboration with research institutes, hospitals, or industries.	P01,P04 ,P05,P0 6,P07,P 08,P09	Practical Examination, Station Exercises, Viva-Voce, Logbook Maintenance, Faculty Supervision and Mentoring, Literature Review and Scientific Writing, Hands-on QA Training, Seminar Presentation, Peer and Expert Feedback Sessions	Practical Examination, Station Exercises, Viva-Voce, Logbook Evaluation, Continuous Internal Assessment, Dissertation/Project Report Evaluation, seminar/ Presentation Assessment, External Examiner Evaluation, SAC evaluation / Ethical committee evaluation
CO5	To train students in presenting and defending their research through seminars and viva-voce.	P01,P04 ,P05,P0 6,P07,P 08,P09	Practical Examination, Station Exercises, Viva-Voce, Logbook Maintenance, Faculty Supervision and Mentoring, Literature Review and Scientific Writing, Hands-on QA Training, Seminar Presentation, Peer and Expert Feedback Sessions	Practical Examination, Station Exercises, Viva-Voce, Logbook Evaluation, Continuous Internal Assessment, Dissertation/Project Report Evaluation, seminar/ Presentation Assessment, External Examiner Evaluation, SAC evaluation / Ethical committee evaluation

OUTLINE OF COURSE CURRICULUM

M.Sc.Medical Physics

Semester I

Code No.	Core Course	Credits/Week					Hrs/Semester					Marks		
		Lecture (L)	Tutorial (T)	Practical (P)	Clinical Posing/ Rotation (CP)	Total Credits (C)	Lecture (L)	Tutorial (T)	Practical (P)	Clinical Posing/ Rotation (CP)	Total (hrs.)	Internal Assement (IA)	Semester End Exam (SEE)	Total
Discipiline Specific Core Theory														
MMP 101 L	Applied Mathematics	2	-	-	-	**2**	30	-	-	-	**30**	20	80	**100**
MMP 102 L	Solid State Physics	3	-	-	-	**3**	45	-	-	-	**45**	20	80	**100**
MMP 103 L	Nuclear Physics	3	-	-	-	**3**	45	-	-	-	**45**	20	80	**100**
MMP 104 L	Fundamentals of computers and programing applications	2	-	-	-	**2**	30	-	-	-	**30**	20	80	**100**
CC 001 L	Research Methodology and Biostatistics	3	-	-	-	**3**	45	-	-	-	**45**	-	50	**50**
Discipiline Specific Core Practical														
MMP 105 P	Solid State Physics	-	-	2	-	**1**	-	-	30	-	**30**	10	40	**50**
MMP 106 CP	Physics Directed Clinical Education I	-	-	-	15	**5**	-	-	-	225	**225**	-	50	**50**
CC 001 P	Research Methodology and Biostatistics	-	-	4	-	**2**	-	-	60	-	**60**	-	50	**50**
Total		**13**	**0**	**6**	**15**	**21**	**195**	**0**	**90**	**225**	**510**	**90**	**510**	**600**

OUTLINE OF COURSE CURRICULUM

M.Sc.Medical Physics

Semester II

Code No.	Core Course	Credits/Week					Hrs/Semester					Marks		
		Lecture (L)	Tutorial (T)	Practical (P)	Clinical Posing/ Rotation (CP)	Total Credits (C)	Lecture (L)	Tutorial (T)	Practical (P)	Clinical Posing/ Rotation (CP)	Total (hrs.)	Internal Assement (IA)	Semester End Exam (SEE)	Total
Discipiline Specific CoreTheory														
MMP 107 L	Medical Imaging	2	-	-	-	**2**	30	-	-	-	**30**	20	80	**100**
MMP 108 L	Nuclear Electronics and Instrumentation	2	-	-	-	**2**	30	-	-	-	**30**	20	80	**100**
MMP 109 L	Radiation Therapy I	3	-	-	-	**3**	45	-	-	-	**45**	20	80	**100**
MMP 110 L	Eletrodynamics	2	-	-	-	**2**	30	-	-	-	**30**	20	80	**100**
MMP 111 L	Clinical and Radiation Biology	2	-	-	-	**2**	30	-	-	-	**30**	20	80	**100**
Discipiline Specific Core Practical														
MMP 112 P	Nuclear Electronics and Instrumentation	-	-	2	-	**1**	-	-	30	-	**30**	10	40	**50**
MMP 113 P	Radiation Therapy I	-	-	2	-	**1**	-	-	30	-	**30**	10	40	**50**
MMP 114 CP	Physics Directed Clinical Education II	-	-	-	12	**4**	-	-	-	180	**180**	-	50	**50**
Skill Enhancement Course														
SEC 001 L	Innovation and Entrepreneurship	3	-	-	-	**3**	45	-	-	-	**45**	-	100	**100**
SEC 002 L	One Health (NPTEL)													
Total		**14**	**0**	**8**	**12**	**22**	**210**	**0**	**120**	**180**	**510**	**140**	**710**	**850**

OUTLINE OF COURSE CURRICULUM

M.Sc.Medical Physics

Semester III

Code No.	Core Course	Credits/Week					Hrs/Semester					Marks		
		Lecture (L)	Tutorial (T)	Practical (P)/ Dissertation	Clinical Posing/ Rotation (CP)	Total Credits (C)	Lecture (L)	Tutorial (T)	Practical (P)/ Dissertation	Clinical Posing/ Rotation (CP)	Total (hrs.)	Internal Assesment (IA)	Semester End Exam (SEE)	Total
Discipiline Specific Core Theory														
MMP 115 L	Radiation Safety	3	-	-	-	**3**	45	-	-	-	**45**	20	80	**100**
MMP 116 L	Radiation Physics & Radiation Generators	2	-	-	-	**2**	30	-	-	-	**30**	20	80	**100**
MMP 117 L	Radiation Dosimetry and Standardization	3	-	-	-	**3**	45	-	-	-	**45**	20	80	**100**
MMP 118 L	Radiation Therapy II	2	-	-	-	**2**	30	-	-	-	**30**	20	80	**100**
MMP 119	Dissertation / Project*	-	-	10	-	**5**	-	-	150	-	**150**	50	-	**50**
Discipiline Specific Core Practical														
MMP 120 P	Radiation Safety	-	-	2	-	**1**	-	-	30	-	**30**	10	40	**50**
MMP 121 P	Radiation Dosimetry and Standardization	-	-	4	-	**2**	-	-	60	-	**60**	10	40	**50**
MMP 122 CP	Physics Directed Clinical Education III	-	-	-	9	**3**	-	-	-	135	**135**	-	50	**50**
Total		**10**	**0**	**16**	**9**	**21**	**150**	**0**	**240**	**135**	**525**	**150**	**450**	**600**

OUTLINE OF COURSE CURRICULUM

M.Sc.Medical Physics

Semester IV

Code No.	Core Course	Credits/Week					Hrs/Semester					Marks		
		Lecture (L)	Tutorial (T)	Practical (P)/Dissertation	Clinical Posing/ Rotation (CP)	Total Credits (C)	Lecture (L)	Tutorial (T)	Practical (P)/Dissertation	Clinical Posing/ Rotation (CP)	Total (hrs.)	Internal Assesment (IA)	Semester End Exam (SEE)	Total
Discipiline Specific Core Theory														
MMP 123 L	Quality Assurance	2	-	-	-	**2**	30	-	-	-	**30**	20	80	**100**
General Elective (Any one)														
GE 001 L	Pursuit of Inner Self Excellence(POISE)	4	-	-	-	4	60	-	-	-	**60**	-	100	**100**
GE 002 L	Bioethics, Biosafety, IPR and Technology Transfer													
GE 003 L	Disaster Management and Mitigation Resources													
GE 004 L	Human Rights													
Discipiline Specific Core Practical														
MMP 124 P	Quality Assurance	-	-	2	-	**1**	-	-	30	-	**30**	10	40	**50**
MMP 125 CP	Physics Directed Clinical Education IV	-	-	-	6	**2**	-	-	-	90	**90**	-	50	**50**
MMP 126	Disserration/ Project	-	-	22	-	**11**	-	-	330	-	**330**	-	200	**200**
Total		**6**	**0**	**24**	**6**	**20**	**90**	**0**	**360**	**90**	**540**	**30**	**470**	**500**

FIRST YEAR

M.Sc. Medical Physics

SEMESTER-I

Code No	Core Subject
Discipline-Specific Core Theory	
MMP 101 L	Applied Mathematics
MMP 102 L	Solid State Physics
MMP 103 L	Nuclear Physics
MMP 104 L	Fundamentals of Computers and Programming Applications
CC 001 L	Research Methodology and Biostatistics
Discipline-Specific Core Practical	
MMP 105 P	Solid State Physics
MMP 106 CP	Physics Directed Clinical Education I
CC 001 P	Research Methodology and Biostatistics

Name of the Program	**M. Sc. Medical Physics**
Semester	**Semester I**
Name of the subject	**Applied Mathematics**
Subject Code	**MMP 101 L**

Teaching Objectives	•To introduce basic concepts of **Applied Mathematics** in the course. •To teach the management of basic Maths and applications in healthcare and university.
Learning Objectives	•Able to apply the concepts in the practice of radiotherapy and medical physics

Course Outcome	•Understand vector analysis in various coordinate systems to apply in radiation physics and dosimetry. •Apply eigenvalue problems and matrix methods in solving radiation transport equations. •Use complex functions and contour integration in solving medical imaging and wave equations.\ •Utilize orthonormal series and special functions in data modelling and Fourier applications in radiology. •Model boundary value problems in radiation diffusion and heat transfer simulations. •Use Laplace and Fourier transforms for system analysis and signal processing in diagnostics. •Apply symmetry and group theoretical methods in nuclear and atomic structure analysis. •Perform stochastic modelling and error analysis in radiation measurement and dosimetry.

Sr. No.	**Topics**	**No. of hrs.**
1	Vectors and Tensors (index notation, vector analysis in curvilinear coordinates. Cartesian tensors and four vectors, General tensors).	4
2	Linear Algebra with emphasis on applications to physical problems (linear transformations +Matrix representations, Eigen values + Eigen Vectors, Inner product spaces).	5
3	Complex analysis with applications (Cauchy-Riemann equations, Complex integration, Cauchy theorems, Contour integration, Branch points and branch cuts, Applications to integrals, series etc.)	4
4	Hilbert Space methods, special functions (Hilbert space, Orthonormal series expansions in Hilbert space especially Fourier series, Special functions.	4
5	Ordinary and partial differential equations (Analysis of second order OFE's Sturm-Liouville system, Boundary value problems for Laplace Diffusion (Heat) and wave equations).	4
6	Integral transforms, its applications and generalized functions (Laplace and Fourier transform, Dirac delta and other generalized functions, Green's functions of ODE and PDE).	3
7	Group theory (introduction using various groups occurring in physics, its algebra, Representation of groups, Characters).	3
8	Probability and Statistics (probability distributions, Stochastic processes like Brownian motion, Error analysis for experiments, Statistical inference).	3
Total		**30 hrs**

Reference books:

1. Elsevier, 2005 Arfken, George B. (George Brown), 1922, Mathematical methods for physicists. Boston
2. Charlie Harper, Introduction to mathematical physics, Englewood Cliffs, N.J: Prentice-Hall, ©1976.
3. Tai L Chow, Mathematical methods for physicists: a concise introduction, New York: Cambridge University Press, 2000.

Name of the Program	**M. Sc. Medical Physics**
Semester	**Semester I**
Name of the subject	**Solid State Physics**
Subject Code	**MMP 102 L**

Teaching Objectives	• To introduce basic concepts of Solid-State Physics in Radiotherapy Oncology and Medical Physics • To teach the management of radiotherapy program in healthcare and university with the Solid-State Physics.
Learning Objectives	• Able to apply the concepts in the Solid-State Physics in the practice of radiotherapy and medical physics/

Course Outcome	• Analyze electron behaviour in metals for electrical and thermal conductivity understanding in RT devices. • Interpret material structures used in detectors and shielding via diffraction techniques. • Calculate binding energy of solids to assess material suitability in equipment design. • Understand band gap and charge transport relevant for semiconductors in detectors • Evaluate semiconductor properties for radiation sensors and dosimetry. • Examine heat transport in solid materials relevant for radiation protection. • Apply concepts like Landau levels and Hall effects in detector physics. • Understand magnetic materials used in shielding and MRI • Analyze low-resistance materials in advanced medical imaging systems.

Sr. No.	**Topics**	**No. of Hrs.**
1	General introduction, Drude and Sommerfeld model	5
2	Crystal structure; x-ray diffraction	5
3	Cohesive energy	5
4	Blochs theorem, Band theory nearly free electrons, tight binding approximation, semiclassical dynamics of electrons in a band, motion of electrons in super-lattices, motion of atoms in an optical potential	5
5	Semiconductors	5
6	Thermal properties of insulators, phonons	5
7	Landau levels - de Hass van Alphen effect and Integer quantum hall effect (5 lectures)	5
8	Magnetism	5
9	Superconductivity	5
Total		**45 hrs**

MMP 105 P: Solid State Physics

Course Outcome	• Understand the working principles and handling of basic solid-state physics instruments. • Acquire practical skills in measuring and analysing properties of solid materials. • Apply experimental techniques to support theoretical concepts relevant to radiological technology.

Sr. No.	Topics	No. of Hrs.
1	Study of Crystal Structure	**30**
2	Miller Indices of Crystal Planes	
3	Characteristics of P-N junction Diode	
4	Characteristics of Zener Diode	
5	Characteristics of LED	
6	Characteristics of Photodiode	
Total		**30 hrs**

Reference Books:

1. Kittel, Charles, Introduction to solid state physics, New York, Wiley [1966]
2. Ashcroft, Neil W., Solid state physics., New York, Holt, Rinehart and Winston [©1976]
3. H M Rosenberg, The solid state, Oxford; New York: Oxford University Press, 1988
4. Burns, Gerald, Solid state physics. San Diego, California; London, England: Academic Press, ©1990

Name of the Program	**M. Sc. Medical Physics**
Semester	**Semester I**
Name of the subject	**Nuclear Physics**
Subject Code	**MMP 103 L**

Teaching Objectives	• To introduce basic concepts and utility of Nuclear Physics in Radiotherapy Oncology and Medical Physics • To teach the management of radiotherapy program in healthcare and university with the Nuclear Physics experience
Learning Objectives	• Able to apply the concepts in the Nuclear Physics in the practice of radiotherapy and medical physics and handle the required instruments.

Course Outcome	• Evaluate nuclide stability for therapeutic and diagnostic isotope selection. • Apply nuclear force models in reactor physics and shielding design. • Understand energy release and fission principles used in isotope production. • Analyze nuclear energy levels and spin for radiation emission prediction. • Apply scattering and reaction cross-section knowledge in therapy planning. • Classify fundamental particles for applications in PET/SPECT physics. • Understand beta decay and neutrino interactions in medical isotope use.

Sr. No.	Topics	No. of hrs.
1	Nuclear systematics and stability (masses, sizes, spins, magnetic moments, quadrupole moments, energetics) and stability against particle emission, beta decay	10
2	Nucleon-Nucleon interaction, space-time symmetries, conservation laws, isospin symmetry, low energy (effective range, shape independence, meson exchange picture (qualitative).	10
3	Liquid drop model, compound nucleus and fission, nuclear vibrations and rotations	5
4	Shell model, introduction to Hartree-Fock, spins and magnetic moments	5
5	Direct nuclear reactions	5
6	Mesons and baryons, resonances, SU(3) classification, isospin and strangeness, quark model, colour	5
7	Weak interactions (nuclear and particle decays, neutrinos etc)	5
Total		**45 hrs**

Reference Books:

1. R R Roy; B P Nigam, Nuclear physics theory and experiment, New York, Wiley [1967]
2. M A Preston; Rajat K Bhaduri, Structure of the nucleus, Boca Raton, FL : CRC Press, 2018.
3. David Griffiths, Introduction to Elementary Particles,Wiley-VCH; 2 edition (2008)
4. Donald H. Perkins, Introduction to High Energy Physics, Cambridge University Press; 4edition (2000)

Name of the Program	**M. Sc. Medical Physics**
Semester	**Semester I**
Name of the subject	**Fundamentals of Computers and Programming Applications**
Subject Code	**MMP 104 L**

Teaching Objectives	• To introduce basic concepts and programming applications of Computers and language in Radiotherapy Oncology and Medical Physics • To teach the management of radiotherapy program in healthcare and university with the Fundamentals of Computers and Programming Applications experience for expediting the process through automation.
Learning Objectives	• Able to apply the concepts in the Fundamentals of Computers and Programming Applications in the practice of radiotherapy and medical physics and handle the required instruments through automation.

Course Outcome	•Design and analyze digital circuits used in imaging and therapy equipment. •Apply stochastic simulation in radiation interaction modeling and dosimetry. •Use MS Office, MATLAB, and SPSS for documentation, data analysis, and plotting in research. •Solve medical physics-related numerical problems using C++ and MATLAB. •Understand AI applications in image analysis, treatment planning, and workflow optimization.

Sr. No.	Topics	No of hrs.
1	**Basics of digital electronics:** Number systems, Logic gates, Digital circuits**:** Boolean algebra, de Morgans theorem, Karnaugh maps. Data processing circuits: Multiplexers, Demultiplexers, Arithmetic building blocks, Encoders, Decoders.	6
2	**Monte Carlo methods:** Random variables, random variables – discrete & continuous, probability density function – discrete & continuous, cumulative distribution function, accuracy and precision, law of large number, central limit theorem. Random numbers and their generation, tests for randomness, inversion random sampling technique including worked examples, integration of simple multidimensional integrals including worked examples. Simulations using Monte Carlo methods: Geometrical simulations, absorption of gamma rays in matter. Brief account of electron-gamma shower (EGS), MCNP and GEANT simulation codes.	7
3	**Computational Tools & Techniques:** Working knowledge of Microsoft Excel, Word, Corel Draw, Origin, Latex and Power point. Computational packages: MATLAB, and SPSS in data analysis and graphics. MATLAB: Introduction to MATLAB environment, Constants, Variables and Expression, Matrices, Polynomials, I/O statements, MATLAB graphics, Data handling with Structures, Arrays with large dataset, Matrix operations in 3D and 4D datasets, Programming, Image processing toolbox – Coding, scanning and recognition, optimization toolbox, wavelet toolbox	6
4	**Revisit of Numerical Methods for C++ Programming and MATLAB:** Accuracy and errors on calculations - round-off error, evaluation of formulae. Iteration for solving x = g(x), Initial Approximation and Convergence Criteria. Interpolations: Finite differences-Forward–Backward-Central differences - Newton-Gregory forward, backward interpolation Formulae for equal intervals-Missing terms-Lagrange's interpolation formula for unequal intervals-Inverse interpolations Curve fitting - Principle of least squares. Simultaneous linear equations: Gauss elimination method - Jordan's modification. - Inverse of a matrix by	6

	Gauss - Jordan Method - Roots of nonlinear equations: Newton- Raphson method - Iterative rule - Termination criteria. Taylor series, approximating the derivation, numerical differentiation formulas. Introduction to numerical quadrature, Trapezoidal rule, Simpson's 2/3 rule, Simpson's Three-Eighth rule. Picard's method, Taylor's method, Euler's method, the modified Euler's method, Runge-Kutta method.	
5	**Artificial Intelligence in Medical physics** Definitions of terms related to artificial intelligence, Radiation medicine processes based on artificial intelligence and related risks, roles and responsibilities of clinically qualified medical physicists in AI-based clinical applications, practical application of AI in Medical Physics and their clinical significance	5
Total		**30 hrs**

Reference Books:

1. Sabine Landau and Brian S. Everitt, A Handbook of Statistical Analyses using SPSS
2. E. Balaguruswami, Object Oriented Programming by C++
3. S.S. Sastry, Introductory Methods of Numerical Analysis
4. Tao Pang, An Introduction to Computational Physics
5. MATLAB and its applications in Engineering, RK Bansal, AK Goel and M.K. Sharma, Pearson (R2007b).
6. G. Arfken and H.J. Weber, Mathematical Methods for Physicists: (Academic Press, San Diego), 2012
7. IAEA Training Course Series 83, Artificial Intelligence in Medical physics, 2023

Course code- MMP 106 CP: Physics Directed Clinical Education – I

Course Outcome	• Students will gain additional clinical skills in this program to increase the role of Radiation Therapy in the practice of Oncology and disease prevention by providing a unique combination of educational experiences to students. • The students will be exposed to both clinical and academic aspects of Radiation Therapy. To provide hands-on experience in Quality Assurance of radiotherapy and diagnostic equipment.

Students will gain additional clinical skills in this program to increase the role of Radiation Therapy in the practice of Oncology and disease prevention by providing a unique combination of educational experiences to students. The students will be exposed to both clinical and academic aspects of Radiation Therapy in the clinic. **(225 hrs.)**

Name of the Programme	**M.Sc. Medical Physics**
Semester	**Semester I**
Name of the Course	**Research Methodology & Biostatistics (Core Course)**
Course Code	**CC 001 L**

Teaching Objective	• The course is intended to give an overview of research and statistical models commonly used in medical and bio-medical sciences. The goal is to impart an intuitive, understanding and working knowledge of research designs and statistical analysis. The strategy would be to simplify, analyze the treatment of statistical inference and to focus primarily on how to specify and interpret the outcome of research.
Learning Outcomes	• Student will be able to understand develop statistical models, research designs with the understating of background theory of various commonly used statistical techniques as well as analysis, interpretation & reporting of results and use of statistical software.

Course Outcome	•Students will be able to understand statistical models, research designs with the understanding of background theory of various commonly used statistical techniques as well as analysis, interpretation & reporting of results and use of statistical software.

Sr. No.	**Topic**	**No. of Hrs.**
A	**Research Methodology:**	**23**
1	**Scientific Methods of Research**: Definition of Research, Assumptions, Operations and Aims of Scientific Research. Research Process, Significance and Criteria of Good Research, Research Methods versus Methodology	4
2	**Research Designs**: Observational Studies: Descriptive, explanatory, and exploratory, Experimental Studies: Pre-test design, post-test design, Follow-up or longitudinal design, Cohort Studies, Case – Control Studies, Cross-sectional studies, Intervention studies.	5
3	**Sampling Designs**: Census and Sample Survey, Need and importance for Sampling, Implications of a Sample Design, Different Types of Sample Designs (Probability sampling and non-probability sampling), Systematic sampling, Stratified sampling, Cluster sampling, Multi-stage sampling, Sampling with probability proportional to size, Sequential sampling.	5
4	**Measurement in research**: Measurement Scales, Sources of Error in Measurement,	3
5	**Methods of Data Collection**: Types of data, Collection of Primary Data, Observation Method, Interview Method	4
6	Research Ethics and plagiarism	2
B	**Biostatistics**	**22**
7	**Data Presentation**: Types of numerical data: Nominal, Ordinal, Ranked, Discrete and continuous. Tables: Frequency distributions, Relative frequency, Graph: Bar charts, Histograms, Frequency polygons, scatter plots, line graphs	3
8	**Measures of Central Tendency and Dispersion**: Mean, Median, Mode, Range, Inter quartile range, variance and Standard Deviation, Coefficient of variation, grouped mean and grouped standard deviation (including merits and demerits).	3
9	**Testing of Hypotheses**: Definition, Basic Concepts, Procedure for Hypothesis Testing, power of test, Normal distribution, Parametric Tests including Z-test, t-test, and ANOVA	4
10	**Chi-square Test**: Chi-square as a Non-parametric Test,Applications.	2
11	**Measures of Relationship**: Correlation and Simple Regression Analysis	3
12	**Non-parametric test**: Sign test, Wilcoxon signed-Rank Test, Wilcoxon Rank Sum Test: Mann-Whitney U test, KruskalWalli's test, Friedman's test, and Spearman Rank correlation test.	3
13	**Vital Health Statistics**: rate, crude rate, age specific rate, Measurement of fertility, Rate,	4

	Measures of mortality.	
Total		**45 hrs**

CC 001 P–Research Methodology & Biostatistics

Course Outcome	•Understand and apply basic research designs and statistical models in scientific studies. •Analyze, interpret, and report research data using appropriate statistical techniques. •Gain hands-on experience with statistical software for data analysis and presentation.

Sr. No.	**Topics**	**No. of Hrs.**
A	**Research Methodology**	
1	Research Article Presentation (Seminar)	5
B	**Biostatistics**	
2	Data Presentation	4
3	Measures of Central Tendency and Dispersion	6
4	Testing of Hypotheses	16
5	Chi-square Test	4
6	Measures of Relationship	6
7	Analysis of Variance	5
8	Non-parametric or Distribution-free Tests	8
9	Computer Application Using Statistical Software including SPSS	6
Total		**60 hrs**

Reference Books:

1. Daniel WW. Biostatistics: A foundation for analysis in the health sciences. 10th ed. Wiley; 2013.
2. Gupta SC, Kapoor VK. Fundamentals of mathematical statistics. Sultan Chand & Sons; 2020 Sep.
3. Kothari CR, Garg G. Research methodology: Methods and techniques.2019.
4. Mahajan BK. Methods in biostatistics for medical students and research workers. 7th ed. Jaypee Brothers Medical Publishers; 2010.
5. Murthy MN. Sampling theory and methods. Statistical Publishing Society; 1967.
6. Singh YK. Fundamental of research methodology and statistics. New Age International; 2006.

FIRST YEAR

M.Sc. Medical Physics

SEMESTER-II

Code No	Core Subject
Discipline-Specific Core Theory	
MMP 107 L	Medical Imaging
MMP 108 L	Nuclear Electronics and Instrumentation
MMP 109 L	Radiation Therapy I
MMP 110 L	Electrodynamics
MMP 111 L	Clinical and Radiation Biology
Discipline Specific Core Practical	
MMP 112 P	Nuclear Electronics and Instrumentation
MMP 113 P	Radiation Therapy I
MMP 114 CP	Physics Directed Clinical Education II
Skill Enhancement Course	
SEC 001 L	Innovation and Entrepreneurship
SEC 002 L	One Health (NPTEL)

Name of the Program	**M. Sc. Medical Physics**
Semester	**Semester II**
Name of the subject	**Medical Imaging**
Subject Code	**MMP 107 L**

Teaching Objectives	• To introduce basic concepts and utility of Medical Imaging in Radiotherapy Oncology and Medical Physics • To teach the management of radiotherapy program in healthcare and university with the Medical Imaging.
Learning Objectives	• Able to apply the concepts in the Medical Imaging in the practice of radiotherapy and medical physics/

Course Outcome	• Evaluate image quality, dose, and equipment parameters in diagnostic imaging. • Understand CT physics and apply appropriate protocols in oncology imaging. • Analyze MR physics, sequences, and safety for oncology applications. • Understand SPECT/PET imaging and tracer kinetics in cancer diagnosis. • Implement safety protocols in diagnostic departments.

Sr. No.	Topics	No. of hrs.
1	**Principles of X-ray Diagnosis & Conventional Imaging:** Physical principle of diagnostic radiology: Interactions of X-rays with human body, differential transmission of x-ray beam, spatial image formation, visualization of spatial image, limitations of projection imaging technique Viz. superimposition of overlying structures and scatter, application of contrast media and projections at different angles to overcome superimposition of overlying structures Radiography techniques: Prime factors (kVp, mAs and SID/SFD), influence of prime factors on image quality, selection criteria of prime factors for different types of imaging, different type of projection and slices selected for imaging, objectives of radio-diagnosis, patient dose Vs image quality Filters: inherent and added filters, purpose of added filters, beryllium filter, filters used for shaping X-ray spectrum (K-edge filters: holmium, gadolinium, molybdenum). Scatter reduction: Factors influencing scatter radiation, objectives of scatter reduction, contrast reduction factor, scatter reduction methods; beam restrictors (diaphragms, cones/cylinders & collimators), grids (grid function, different types of stationary grids, grid performance evaluation parameters, moving grids, artifacts caused by grids, grid selection criteria), air gap technique Intensifying screens: Function of intensifying screens, screen function evaluation parameters, emission spectra and screen film matching, conventional screens Vs rare earth screens Radiographic Film: Components of radiographic film, physical principle of image formation on film, double and single emulsion film, sensitometeric parameters of film (density, speed, latitude etc.), QA of film developer Image quality: Image quality parameters; sources of un-sharpness, reduction of un-sharpness, factors influencing radiographic contrast, resolution, factors influencing resolution, evaluation of resolution (point spread function (PSF), line spread function (LSF), edge spread function (ESF), modulation transfer function (MTF), focal spot size evaluation QA of conventional diagnostic X-ray equipment: Purpose of QA, QA protocols, QA a test method for performance evaluation of x-ray diagnostic equipment	**10**
2	**Digital X-Ray Imaging and Computed Tomography:** Xero-radiography, mammography, Interventional radiology, digital radiography (CR and DR systems), digital subtraction techniques, Conventional tomography (principle only), orthopan tomography (OPG), Computed Tomography (CT), QA of CT equipment	**4**
3	**Nuclear Medicine & Internal** **Dosimetry:** Introduction to Nuclear Medicine, Unsealed Sources, Production of Radionuclide used in Nuclear Medicine; Reactor based Radionuclides, Accelerator based Radionuclides, Photonuclear	**10**

	activation, Equations for Radionuclide Production, Radionuclide Generators and their operation principles. Various usages of Radiopharmaceuticals. In-vivo Non-imaging procedures; Thyroid Uptake Measurements, Renogram, Life Span of RBC, Blood Volume studies, Life Span of RBC etc. General concept of Radionuclide Imaging and Historical developments. Radionuclide Imaging: Other techniques and Instruments; The Rectilinear Scanner and its operational principle, Basic Principles and Design of the Anger Camera / Scintillation Camera; System components, Detector System and Electronics, Different types of Collimators, Design and Performance Characteristics of the Converging, Diverging and Pin hole Collimator, Image Display and Recording Systems, Digital Image Processing Systems, Scanning Camera, Limitation of the Detector System and Electronics. Different Imaging Techniques: Basic Principles, 2D Imaging Techniques, 3D Imaging Techniques - Basic Principles and Problem, Focal Plane Tomography, Emission Computed Tomography, Single Photon Emission Computed Tomography, Positron Emission Tomography. Various Image Reconstruction Techniques during Image formation such as Back Projection and Fourier based Techniques, Iterative Reconstruction method and their drawbacks. Attenuation Correction, Scatter Correction, Resolution Correction, Other requirements or Sources of Error. Image Quality Parameters: Spatial Resolution, Factor affecting Spatial Resolution, Methods of Evaluation of Spatial Resolution, Contrast, Noise. NEMA Protocols followed for Quality Assurance / Quality Control of Imaging Instruments. In-vitro Technique: RIA/IRMA techniques and its principles. Physics of PET and Cyclotron: Principles of PET, PET Instrumentations, Annihilation Coincidence Detection, PET Detector ad Scanner Design, Data Acquisition for PET, Data corrections and Quantitative Aspect of PET, Working of Medical Cyclotron, Radioisotopes Produced and their characteristics. Treatment of Thyrotoxicosis, Thyroid cancer with I-131, use of P-32 and Y-90 for palliative treatment, Radiation Synovectomy and the isotopes used. Concept of Delay Tank and various Waste Disposal Methods used in Nuclear Medicine. Planning and Shielding Calculations during the installation of SPECT, PET/CT and Medical Cyclotron in the Nuclear Medicine Department. **Internal Dosimetry** Internal Radiation Dosimetry: Different Compartmental Model; Single Compartmental Model, Two Compartmental Model with Back Transference, Two Compartmental Model without Back Transference. Classical Methods of Dose Evaluation; Beta particle Dosimetry; Equilibrium Dose Rate Equation, Beta Dose Calculation Specific Gamma Ray Constant, Gamma Ray Dosimetry, Geometrical Factor Calculation, Dosimetry of Low Energy Electromagnetic Radiation. MIRD Technique for Dose calculations; Basic procedure and some practical problems, Cumulative Activity, Equilibrium Dose Constant, Absorbed Fraction, Specific Absorbed Fraction, Dose Reciprocity Theorem, Mean Dose per unit Cumulative Activity and Problems related to the Dose Calculations. Limitation of MIRD Technique.	
4	**Magnetic Resonance Imaging (MRI):** Magnetic Resonance image - proton density, relaxation time T1 & T2 images - Image characteristics - MRI system components - Magnets, Magnetic fields, Gradients, Magnetic field shielding, Radio Frequency systems, computer functions - Imaging process – Image artifacts – MRI safety.	**3**
5	**Ultrasound Imaging:** Interaction of sound waves with body tissues, production of ultrasound - transducers – acoustic coupling - image formation - modes of image display - colour Doppler.	**3**
	Total	**30 hrs**

Reference Books:

1. Diagnostic Radiology Physics: A handbook for Teachers and Students (IAEA)
2. Farr's Physics of Medical Imaging by Penelope Allisy- Roberts & Jerry Williams
3. Physics of Nuclear Medicine by Simon R. Cherry, James A. Sorenson and Michael E. Phelps
4. Medical Imaging Physics by W.R. Hendee
5. Christensen',s Physics of Diagnostic Radiology by Thomas S Curry, IV Edition, Lippincott Williams & Wilkins, 1990.
6. The Essential Physics for Medical Imaging – 2nd Edition –Jerrold T Bushberg, Lippincott Williams & Wilkins 2002.
7. Medical Physics: Imaging, Jean A. Pope, Heinemann Publishers, 20124
8. MRI – Perry Sprawls – Medical Physics Publishing, Madison, Wisconsin-2000
9. Advances in Diagnositc Medical Physics – Himalaya Publishing House-2006.
10. Diagnositc Ultrasound applied to OBG – Sabbahaga – Maryland -1980.
11. Essentials of Nuclear Medicine Imaging. F A Mettler, MJ Guibertau, Saunders,2005.
12. Molecular Imaging FRET Microscopy and Spectroscopy Edited by AmmasiPeriasamy and Richard N Day, Oxford Press 2005

Name of the Program	**M. Sc. Medical Physics**
Semester	**Semester II**
Name of the subject	**Nuclear Electronics and Instrumentation**
Subject Code	**MMP 108 L**

Teaching Objectives	• To introduce basic concepts and application of Nuclear Electronics and Instrumentation in the field. • To teach the management of radiotherapy program in healthcare and university with the Nuclear Electronics and Instrumentation experience
Learning Objectives	• Able to apply the concepts in the practice of radiotherapy and medical physics and handle the required instruments

Course Outcome	• Understand the working principles of nuclear instrumentation systems and electronic components used in radiation detection. • Perform experiments using detectors, pulse processing units, and counting systems to analyze nuclear radiation. • Apply calibration and measurement techniques for radiation detectors and evaluate data accuracy. • Demonstrate hands-on skills in handling nuclear electronics instruments like GM counters, scintillation counters, and multichannel analyzers. • Interpret experimental results, troubleshoot circuit setups, and maintain laboratory safety protocols.

Sr. No.	Topics	No. of hrs.
1	Foundations, passive elements	5
2	sources – dependent sources, survey of network theorems and network analysis, transient response of R-L circuit, R-C circuits, sinusoidal steady state response, diodes and diodecircuits, power supply	5
3	rectifiers, full wave rectifier without center tapped transformer, bipolar junction transistors, constant current source, constant voltage source, field effect transistors, basic differential amplifier circuits, feedback and operational amplifiers	5
4	digital electronics, gates, universality of certain gates, Boolean expressions, other ways of realizing logic functions, multiplexers, flip-flops and latches, counters, sequential circuits	5
5	master slave flip-flop (S-R), edge triggered flip-flops, transducers, signal averaging, lock-in amplifier, D/A & A/D converter, multi channelanalyzer (8 lectures)	5
6	Introduction to microcomputers and microprocessors (5 lectures)	5
Total		**30 hrs**

MMP 112 P: Nuclear Electronics and Instrumentation

Course Outcome	• Identify and understand the functions of basic nuclear electronic components and modules. • Set up and operate radiation detection systems like GM counters and scintillation detectors. • Analyze pulse height spectra using Single and Multi-Channel Analyzers. • Calibrate detectors and interpret measurements with accuracy and precision. • Apply radiation safety measures and standard laboratory protocols during experiments.

Sr. No.	Topics	No of hrs.
1	Familiarization with general laboratory equipment and identification of electronics components	**30**
2	(a) Diode characteristics (Si/Ge & Zener), (b) Half wave rectifier circuit	
3	(a) Full wave bridge rectifier circuit, (b) Zener regulated power supply	
4	Passive RC filters and phase shifting network	
5	LCR series resonance circuit	
6	Transistor characteristics	
7	Single stage RC coupled amplifier	
8	Study of basic configuration of OPAMP (IC-741), simple mathematical operations and its use as comparator and Schmitt trigger	
9	Differentiator, Integrator and active filter circuits using OPAMP (IC-741); Phase shift oscillator using OPAMP (IC-741). Study of various logic families (DRL, DTL and TTL)	
10	Study of Boolean logic operations using ICs	
11	Design and study of full adder and subtractor circuits; Design and study of various flip flop circuits (RS, D, JK, T); Design and study of various counter circuits (up, down, ring, mod-n); Design and study of a stable multi vibrators using IC 555.	
Total		**30 hrs**

Reference Books:

1. Paul Horowitz, Winfield Hill, The art of electronics, New York, NY, USA : Cambridge University Press, 2015.
2. Allan R. Hambley, Electronics, Prentice Hall, 2000
3. Thomas L. Floyd, Electronics Fundamentals, Prentice-Hall, Inc.
4. Earl Gates, Introduction to Electronics, Cengage Learning, 2011
5. Ramakant A. Gayakwad, Op-Amps and Linear Integrated Circuits, Goodwill Retail Services,Inc.
6. J MILLMAN; A GRABEL, Microelectronics, New York, N.Y. : McGraw Hill, 1988
7. Raymond A. DeCarlo, Pen-Min Lin, Linear Circuit Analysis: Time Domain, Phasor, and Laplace Transform Approaches, Oxford University Press, 2001
8. HAYT, W H., Engineering Circuit Analysis, Tata McGraw-Hill, ©2010

Name of the Program	**M. Sc. Medical Physics**
Semester	**Semester II**
Name of the subject	**Radiation Therapy I**
Subject Code	**MMP 109 L**

Teaching Objectives	• To introduce basic concepts and utility of Radiation Therapy To teach the management of radiotherapy program in healthcare and university with Radiation Therapy experience
Learning Objectives	• Able to apply the concepts in Radiation Therapy in the practice of radiotherapy and medical physics and handle the required instruments.

Course Outcome	• Compare various modalities (Co-60, LINAC) and apply dosimetry protocols. • Use TAR, TMR, PDD in treatment plan verification. • Understand isodose planning and brachytherapy procedures • Operate TPS software for patient-specific plan generation.

Sr. No.	Topics	No of Hrs.
1	**Beam Therapy:** Description of low kV therapy x-ray units - spectral distribution of kV x-rays and effect of filtration - thoraeus filter - output calibration procedure. Construction and working of telecobalt units - source design - beam collimation and penumbra - trimmers and breast cones. Design and working of medical electron linear accelerators - beam collimation - asymmetric collimator - multileaf collimator - dose monitoring - electron contamination. Output calibration of 60Co gamma rays, high energy x-rays and electron beams using IAEA TRS 398, AAPM TG 51 and other dosimetry protocols. Relative merits and demerits of kV x-rays, gamma rays, MV x-rays and electron beams. Radiotherapy simulator and its applications. CT and virtual simulations. Central axis dosimetry parameters - Tissue air ratio (TAR) Back scatter/ Peak scatter factor (BSF/PSF) - Percentage depth doses (PDD) - Tissue phantom ratio (TPR) - Tissue maximum ratio (TMR) - Collimator, phantom and total scatter factors. Relation between TAR and PDD and its applications - Relation between TMR and PDD and its applications. SAR, SMR, Off axis ratio and Field factor. Build-up region and surface dose. Tissue equivalent phantoms. Radiation filed analyzer (RFA). Description and measurement of isodose curves/charts. Dosimetry data resources. Beam modifying and shaping devices - wedge filters - universal, motorized and dynamic wedges- shielding blocks and compensators. Treatment planning in teletherapy - target volume definition and dose prescription criteria- ICRU 50 and 62 - SSD and SAD set ups - two and three dimensional localization techniques - contouring - simulation of treatment techniques - field arrangements - single, parallel opposed and multiple fields - corrections for tissue inhomogeneity, contour shapes and beam obliquity - integral dose. Arc/ rotation therapy and Clarkson technique for irregular fields - mantle and inverted Y fields. Conventional and conformal radiotherapy. Treatment time and Monitor unit calculations. Clinical electron beams - energy specification - electron energy selection for patient treatment - depth dose characteristics (Ds, Dx, R100, R90, R50, Rpetc.) - beam flatness and symmetry - penumbra - isodose plots - monitor unit calculations - output factor formalisms - effect of air gap on beam dosimetry - effective SSD. Particulate beam therapy - Relative merits of proton, electron, neutron, x-ray and gamma ray beams - Neutron capture therapy - Heavy ion therapy. Quality assurance in radiation therapy - precision and accuracy in clinical dosimetry - quality assurance protocols for telecobalt, medical linear accelerator and radiotherapy simulators - IEC requirements - acceptance, commissioning and. quality control of telecobalt, medical linear accelerator and radiotherapy simulators. Portal and in-vivo dosimetry. Electronic portal imaging devices.	20

2	**Computers in treatment planning:** Scope of computers in radiation treatment planning - Review of algorithms used for treatment planning computations - Pencil beam, double pencil beam, Clarkson method, convolution superposition, lung interface algorithm, fast Fourier transform, Inverse planning algorithm, Monte Carlo based algorithms. Treatment planning calculations for photon beam, electron beam, and brachytherapy - Factors to be incorporated in computational algorithms. Plan optimization - direct aperture optimization - beamlet optimization - simulated annealing - dose volume histograms - Indices used for plan comparisons - Hardware and software requirements - beam & source library generation. Networking, DICOM and PACS. Acceptance, commissioning and quality assurance of radiotherapy treatment planning systems using IAEA TRS 430 and other protocols.	10
3	**Special and advanced techniques of radiotherapy:** Special techniques in radiation therapy - Total body irradiation (TBI) - large field dosimetry - total skin electron therapy (TSET) - electron arc treatment and dosimetry - intraoperative radiotherapy. Stereotactic radio surgery/radiotherapy (SRS/SRT) - cone and m MLC based X-Knife - Gamma Knife - immobilization devices for SRS/SRT - dosimetry and planning procedures - Evaluation of SRS/SRT treatment plans - QA protocols and procedures for X- and Gamma Knife units - Patient specific QA. Physical, planning, clinical aspects and quality assurance of stereotactic body radiotherapy (SBRT) and Cyber Knife based therapy. Intensity modulated radiation therapy (IMRT) - principles - MLC based IMRT - step and shoot and sliding window techniques - Compensator based IMRT - planning process - inverse treatment planning - immobilization for IMRT - dose verification phantoms, dosimeters, protocols and procedures - machine and patient specific QA. Concept of Intensity Modulated Arc Therapy (IMAT e.g. Rapid Arc), Image Guided Radiotherapy (IGRT), and Volumetrically Modulated Arc Therapy (VMAT) - Imaging modality, kV cone beam CT (kVCT), MV cone beam CT (MVCT), image registration, plan adaptation, QA protocol and procedures - special phantom, 4DCT. Tomotherapy - principle - commissioning - imaging - planning and dosimetry - delivery - plan adaptation - QA protocol and procedures	15
Total		**45 hrs**

MMP 113 P: Radiation Therapy I

Course Outcome	• Understand and demonstrate the setup of teletherapy and brachytherapy treatment units. • Perform treatment planning simulations and field arrangements for different cancer sites. • Apply dosimetry principles in clinical practice using phantom measurements. • Operate treatment planning systems and evaluate dose distribution. • Follow radiation safety and quality assurance protocols during clinical procedures.

Sr. No.	Experiment	No of Hrs.
1	Familiarisation with treatment planning procedure using a computerised radiotherapy treatment planning system for various clinical disease management sites.	**30**
2	CNS	
3	Head and Neck	
4	Breast & Chest Wall	
5	Lung	
6	Liver	
7	Abdomen	
8	Cervix	
9	Prostate	
10	Sarcoma	
11	Dose planning in cancer of uterine cervix	
Total		**30 hrs**

Reference Books:

1. F M Khan-Physics of Radiation Therapy, 3rd Edition,Liippincott Williams & Wilkins,USA, 2003.
2. W. R. Hendee, Medical Radiation Physics, Year Book Medical Publishers Inc., London, 2003.
3. R. F. Mould, Radiotherapy Treatment Planning, Medical Physics Hand Book Series No. 7, Adam Hilger Ltd., Bristol, 1981.
4. Khan, Faiz M. Treatment Planning in Radiation Oncology, 2nd Edition Lippincott Williams & Wilkins, 2007
5. Edward C. Halperin, Carlos A. Pérez, Luther W.. Brady, Perez and Brady's principles and practice of radiation oncology, Lippincott Williams & Wilkins, 2008
6. Gunilla C. Bentel, Charles E. Nelson, K. Thomas Noell, Treatment planning anddose calculation in radiation oncology, McGraw-Hill, 1989
7. Radiation oncology physics : A Handbook for teachers and students. IAEA publications 2005.
8. Samantha Morris, Radiotherapy physics and equipment, Churchill Livingstone, 2001
9. David Greene, P.C Williams, Linear Accelerators for Radiation Therapy, Second Edition, CRC Press, 1997

Name of the Program	**M. Sc. Medical Physics**

Semester	**Semester II**
Name of the subject	**Electrodynamics**
Subject Code	**MMP 110 L**

Teaching Objectives	• To introduce basic concepts of Electrodynamics in Radiotherapy Oncology and Medical Physics • To teach the management of radiotherapy program in healthcare and university with the Radiation Dosimetry and Standardization.
Learning Objectives	• Able to apply the concepts in the Electrodynamics in the practice of radiotherapy and medical physics/

Course Outcome	• Analyze electrostatic fields in shielding and imaging systems. • Model field behavior in patient interfaces and detectors. • Apply solution methods for potential distribution analysis in detectors • Evaluate dielectric materials used in imaging and shielding. • Interpret current-induced magnetic fields in therapy coils and LINACs. • Predict charged particle paths for dose deposition analysis. • Model wave propagation in tissues and imaging modalities. • Analyze energy loss and emission patterns in accelerators.

Sr. No.	Topics	No. of hrs.
1	Electrostatics in vacuum, force, field, potentials and energy.	4
2	Electrostatic boundary conditions and conductors.	4
3	Solution of Laplace's equation in one, two and three dimensions, uniqueness theorem, methods of images, separation of variables, multipole expansion.	4
4	Dielectrics	4
5	Current distributions, magnetic fields and magnetostatic boundary conditions	4
6	Motion of charges in E & B fields, energy and momentum of electromagnetic fields	4
7	Maxwell's equations, EM waves and their propagation in free space and in media	3
8	Potential formulation, Coulomb and Lorentz gauge, radiation from an accelerated charge, dipole radiation	3
Total		**30 hrs**

Reference Books:

1. David J Griffiths, Introduction to electrodynamics, Upper Saddle River, N.J. : Prentice Hall, ©1999.
2. John R Reitz; Frederick J Milford, Foundations of electromagnetic theory, Addison-Wesley Publishing Company, [1960]
3. John David Jackson, Classical electrodynamics, Wiley, [1962]
4. Dr. Munir H. Nayfeh, Dr. Morton K. Brussel, Electricity and Magnetism, Dover Publications; Illustrated edition (2015)

Name of the Program	**M. Sc. Medical Physics**
Semester	**Semester II**
Name of the subject	**Clinical and Radiation Biology**
Subject Code	**MMP 111 L**

Teaching Objectives	•To introduce basic concepts of Clinical and Radiation Biology in Radiotherapy Oncology and Medical Physics •To teach the management of radiotherapy program in healthcare and university with the Clinical and Radiation Biology.
Learning Objectives	•Able to apply the concepts in the Clinical and Radiation Biology in the practice of radiotherapy and medical physics/

Course Outcome	• Understand cell structure, DNA repair mechanisms, and cell death post-irradiation • Identify organ systems, their function, and relevance in radiology. • Analyze radiation-induced changes and models of survival curves. • Differentiate between somatic and genetic effects of radiation. • Understand the clinical aspects of treatment delivery and side effects. • Apply models like NSD, TDF to optimize radiotherapy schedules.

Sr. No.	Topics	No of hrs.
1	**Cell Biology:** Cell physiology and biochemistry - Structure of the cell - Types of cells and tissue, their structures and functions - Organic constituents of cells - Carbohydrates, fats, proteins and nucleic acids - Enzymes and their functions - Functions of mitochondria, ribosomes, golgi bodies and lysosomes - Cell metabolism - DNA as concepts of gene and gene action - Mitotic and meiotic cell division - Semi conservative DNA synthesis, Genetic variation Crossing over, mutation, chromosome segregation - Heredity and its mechanisms.	3
2	**Anatomy, Physiology and Pathology:** Anatomy and physiology as applied to radio diagnosis and radiotherapy - Structure & function of organs and systems & their common diseases: Skin, Lymphatic system, Bone and muscle, Nervous, Endocrine, Cardiovascular, Respiratory, Digestive (Gastro-Intestinal), Urinary, Reproductive, Eye and ear. Anatomy of human body, nomenclature & Surface anatomy, Radiographic Anatomy (including cross sectional anatomy - identify the different organs/ structures on plain x-rays, CT scans and other available imaging modalities. Normal anatomy & deviation for abnormalities. Tumour pathology and carcinogenesis, common pathological features of cancers and interpretation of clinico-pathological data	4
3	**Interaction of Radiation with Cells:** Action of radiation on living cells - Radiolytic products of water and their interaction with biomolecule - Nucleic acids, proteins, enzymes, fats - Influence of oxygen, temperature - Cellular effects of radiation - Mitotic delay, chromosome aberrations, mutations and recombinations - Giant cell formation, cell death -Recovery from radiation damage - Potentially lethal damage and sublethal damage recovery - Pathways for repair of radiation damage. Law of Bergonie and Tribondeau. Survival curve parameters - Model for radiation action - Target theory - Multihit, Multitarget - Repair mis-repair hypothesis - Dual action hypothesis - Modification of radiation damage - LET, RBE, dose rate, dose fractionation - Oxygen and other chemical sensitizers - Anoxic, hypoxic, base analogs, folic acid, and energy metabolism inhibitors - Hyperthermic sensitization - Radio-protective agents.	4
4	**Biological Effects of Radiation:** Somatic effects of radiation - Physical factors influencing somatic effects - Dependence on dose, dose rate, type and energy of radiation, temperature, anoxia, - Acute radiation	4

	sickness - LD 50 dose - Effect of radiation on skin and blood forming organs, digestive tract - Sterility and cataract formation - Effects of chronic exposure to radiation - Induction of leukaemia - Radiation Carcinogenesis - Risk of carcinogenesis - Animal and human data - Shortening of life span - In-utero exposure - Genetic effects of radiation - Factors affecting frequency of radiation induced mutations - Dose-effect relationship - first generation effects - Effects due to mutation of recessive characteristics - Genetic burden - Prevalence of hereditary diseases and defects - Spontaneous mutation rate - Concept of doubling dose and genetic risk estimate	
5	**Clinical Aspects of Medical Imaging & Radiation Oncology:** Radiation Therapy, Surgery, Chemotherapy, Hormone Therapy, Immunotherapy & Radionuclide therapy, Benign and malignant disease, Methods of spread of malignant disease, Staging and grading systems, Treatment intent - Curative & Palliative, Cancer prevention and public education and Early detection & Screening. Site specific signs, symptoms, diagnosis and management: Head and Neck, Breast, Gynaecological, Gastro-Intestinal tract, Genito-Urinary, Lung & Thorax, Lymphomas &Leukemias& Other cancers including AIDS related cancers. Patient management on treatment - side effects related to radiation and dose - Acute & Late - Monitoring and common management of side effects - Information and communication. Professional aspects and role of medical physicists: General patient care - Principles of professional practice - Medical terminology - Research & Professional writing - Patient privacy - Ethical & cultural issues. Legal aspects - Confidentiality, Informed consent, Health and Safety.	5
6	**Biological Basis of Radiotherapy:** Physical and biological factors affecting cell survival, tumour re-growth and normal tissue response -Non-conventional fractionation scheme and their effect of re-oxygenation, repair, redistribution in the cell cycle - High LET radiation therapy.	4
7	**Time Dose Fractionation:** Time dose fractionation - Basis for dose fractionation in beam therapy - Concepts for Nominal Standard Dose (NSD), Roentgen equivalent therapy (RET) - Time dose fractionation (TDF) factors and cumulative radiation effects (CRE) - Gap correction, Linear and Linear Quadratic models.	3
8	**Clinical Radiation Oncology:** Care of the patient, Site specific disease management (Head & Neck, CNS, Breast, GI, GU, Lung, Lymphoma, Leukemia, extremities etc) - Symptoms at presentation, Diagnosis, Staging, Treatment	3
Total		**30hrs**

Reference Books:

1. C.H. Best and N.B. Taylor, A Test in Applied Physiology, Williams and Wilkins Company, Baltimore, 1986
2. C.K. Warrick, Anatomy and Physiology for Radiographers, Oxford University Press, 1988.
3. J.R. Brobek, Physiological Basis of Medical Practice, Williams and Wilkins, London, 1995
4. Meschan. Normal Radiation Anatomy, Philadelphia-London Saunders, 1951
5. Hollinshead W.H. Text Book of Anatomy (2nd edition) Harper and Row, New York, NY, USA, 1967
6. Susan B Klein Fundamentals of Radiation Biology, 2023.
7. IAEA, Radiation Biology: A Handbook for Teachers and Students, 2010.
8. Radiobiology for Radiologist by E. J. Hall & Amato J. Ginccia
9. Basic Clinical Radiobiology by Michael C. Joiner, Albert van der Kogel

Course code- MMP 114 CP: Physics Directed Clinical Education – II

Course Outcome	• Students will gain additional clinical skills in this program to increase the role of Radiation Therapy in the practice of Oncology and disease prevention by providing a unique combination of educational experiences to students. • The students will be exposed to both clinical and academic aspects of Radiation Therapy. To provide hands-on experience in Quality Assurance of radiotherapy and diagnostic equipment.

Students will gain additional clinical skills in this program to increase the role of Radiation Therapy in the practice of Oncology and disease prevention by providing a unique combination of educational experiences to students. The students will be exposed to both clinical and academic aspects of Radiation Therapy. **(180 hrs.)**

SKILL ENHANCEMENT COURSES

Name of the Program	**M.Sc. Medical Physics**
Semester	**Semester II**
Name of the Course	**Innovation and Entrepreneurship**
Course Code	**SEC 001 L**

Course Outcome	• Students will grasp the concepts of innovation, its ecosystem, and the role of various stakeholders such as government policies, startups, and innovation hubs. • Cultivating an entrepreneurial mindset and leadership qualities necessary for driving innovation and leading ventures. • Understanding the intersection of technology and innovation and leveraging emerging technologies for entrepreneurial ventures.

Sr. No.	Topics	No. of Hrs.
1	Innovation and Innovation Eco-System, The Policy Framework, Startup L and scape and Innovation Hubs, - Digital India and Make in India, - Linking Innovation with Intellectual Property Rights, Raising Finance for Startups in India, Innovation in Indian Context, Writing a business plan	15
2	Creativity and Research, Converting Researches to Innovation: Innovation Types and Models, Product Development, IPR and its Commercialization, Support System to Develop Culture of Research and Innovation, Commercialization of research and innovation, Fund raising – Research and Innovation, Envisioning Innovation and Scenario Building	15
3	Introduction to Innovation in Entrepreneurship, Idea Generation and Validation, Design Thinking in Entrepreneurship, Business Model Innovation, Technology and Innovation, Funding Innovation, Entrepreneurial Mindset, Leadership & Intellectual Property, Scaling and Growth Strategies, sustainability & Social Innovation	15
Total		**45hrs**

Name of the Program	**M.Sc. Medical Physics**
Semester	**Semester II**
Name of the Course	**One Health (NPTEL)**
Course Code	**SEC 002 L**

Course Outcomes	• A comprehensive understanding of One Health's role in global health challenges, emphasizing interconnectedness among human, animal, and environmental health. • Topics include research ethics, disease surveillance, and successes in controlling emerging infectious diseases. • Students explore disease emergence, transmission, antimicrobial resistance, and food safety, gaining insights into effective public health strategies

Sr. No.	Topics	No. of Hrs.
1	**Introduction to One Health:** • Introduction to the One Health One Medicine Concept and National & International health/public health agencies • Global Health vs One Health, Basics of Research Ethics • Integrated human and animal disease surveillance systems • Recent success of One Health in control of emerging infectious diseases and the application of One Health in the control of endemic zoonoses in resource-poor communities	5
2	**Emerging Infectious Diseases and Antimicrobial Resistance:** • Emerging infectious diseases, • Process of disease emergence and assessment of the risk factors • Mechanisms of pathogen cross over across species boundaries and emerging infectious disease transmission, and its relevance in the 21st century • Importance of disease detection, Identification and monitoring in public health and the gaps in current health systems approaches and importance of Genome Sequencing • Introduction to disease vectors and basics of Medical Entomology • The factors influencing an emerging disease (whether is controlled or becomes endemic/epidemic as illustrated by different emerging diseases -STDs, HIV/AIDS, avian influenza, SARS, Ebola) • Antimicrobial resistance a global threat and Importance of antibiotic stewardship program, Introduction of Food Safety and Food Borne Diseases	10
3	**One Health Application in Management of Zoonotic Diseases:** • What are zoonotic diseases & its role in our changing world • Understanding of bacterial, viral and parasitic zoonotic diseases; critical evaluation of its control measures, awareness of local, national and global factors and Influences, Biogeography of zoonosis • The integration of human, animal and ecosystem health in the control and prevention of these diseases • Community engagement for zoonotic disease control in humans and animals through One Health	10
4	**Applied Epidemiology & Public Health in One Health Research:** • Basics of Epidemiological Studies • Rapid Response system, Disaster Management and Outbreak Investigation Plans • Basic statistical methods and their application and the measurement of disease frequency • Principles of survey design and the concepts of sampling • Mixed method research	5

5	**One Health and Health Policy:** • Introduction to health policy • Political and institutional challenges in implementing One Health and the importance of a unified policy to address the shared health threats of humans and animals	5
6	**Media & Community engagement for One Health:** • Risk Communication and Pandemic Preparedness • How ICMR and other Public Health Institutes tackled and managed pandemic situation in the country • Role of community in disease control & ways for community engagement • Uses of different types of media for communication and impact of the media on public attitudes to disease	10
Total		**45**

Note: Attaint the NPTEL Course with title and course code as "**One Health (Course Code: noc25-ge25) (NPTEL)"**

SECOND YEAR

M.Sc. Medical Physics

SEMESTER-III

Code No	Core Subject
Discipline Specific Core Theory	
MMP 115 L	Radiation Safety
MMP 116 L	Radiation Physics and Radiation Generators
MMP 117 L	Radiation Dosimetry and Standardization
MMP 118 L	Radiation Therapy II
MMP 119	Dissertation / Project
Discipline Specific Core Practical	
MMP 120 P	Radiation Safety
MMP 121 P	Radiation Dosimetry and Standardization
MMP 122 CP	Physics Directed Clinical Education III

Name of the Program	**M. Sc. Medical Physics**
Semester	**Semester III**
Name of the subject	**Radiation Safety**
Subject Code	**MMP 115 L**

Teaching Objectives	• To introduce basic concepts of Radiation Safety • To teach the management of radiotherapy program in healthcare and university with the Basics of Radiation Safety experience
Learning Objectives	• Able to apply the concepts and safety culture in practice

Course Outcome	• Identify potential hazards and categorize different types of radiation exposure. • Apply ALARA principles and implement safety measures. • Design shielding for diagnostic and therapeutic facilities. • Operate personnel and area monitoring devices like TLDs, GM counters. • Interpret AERB, ICRP, and BARC guidelines for radiation workers. • Handle and dispose of radioactive waste safely in medical facilities.

Sr. No.	Topics	No. of hrs.
1	**Radiation Protection Standards:** Radiation dose to individuals from natural radioactivity in the environment and man-made sources. Basic concepts of radiation protection standards - Historical background - International Commission on Radiological Protection and its recommendations – The system of Radiological Protection – Justification of Practice, Optimisation of Protection and individual dose limits – Radiation and tissue weighting factors, equivalent dose, effective dose, committed equivalent dose, committed effective dose – Concepts of collective dose- Potential exposures, dose and dose constraints – System of protection for intervention - Categories of exposures – Occupational, Public and Medical Exposures - Permissible levels for neutron flux - Factors governing internal exposure - Radionuclide concentrations in air and water - ALI, DAC and contamination levels	7
2	**Principles of Monitoring and Protection:** Evaluation of external radiation hazards - Effects of distance, time and shielding - Shielding calculations - Personnel and area monitoring - Internal radiation hazards – Radio toxicity of different radionuclides and the classification of laboratories – Control of contamination – Bioassay and air monitoring – chemical protection – Radiation accidents – disaster monitoring	6
3	**Safety in the Medical Uses of Radiation:** Planning of medical radiation installations – General considerations – Design of diagnostic, deep therapy, telegamma and accelerator installations, brachytherapy facilities and medical radioisotope laboratories. Evaluation of radiation hazards in medical diagnostic and therapeutic installations - Radiation monitoring procedures - Protective measures to reduce radiation exposure to staff and patients - Radiation hazards in brachytherapy departments and teletherapy departments and radioisotope laboratories - Particle accelerators Protective equipment - Handling of patients - Waste disposal facilities - Radiation safety during source transfer operations Special safety features in accelerators, reactors.	7
4	**Radioactive Waste Disposal:** Radioactive wastes – sources of radioactive wastes - Classification of waste - Treatment techniques for solid, liquid and gaseous effluents – Permissible limits for disposal of waste - Sampling techniques for air, water and solids – Geological, hydrological and meteorological parameters – Ecological considerations. Disposal of radioactive wastes - General methods of disposal - Management of radioactive waste in medical, industrial, agricultural and research establishments.	6
5	**Transport of Radioisotopes:** Transportation of radioactive substances - Historical background - General packing requirements - Transport documents - Labeling and marking of packages - Regulations applicable for different modes of transport - Transport by post - Transport emergencies - Special requirements for transport of large radioactive sources and fissile materials - Exemptions from regulations – Shipment approval – Shipment under exclusive use – Transport under special arrangement – Consignor's and carrier's responsibilities	7

6	**Legislation:** Physical protection of sources - Safety and security of sources during storage, use, transport and disposal – Security provisions: administrative and technical – Security threat and graded approach in security provision National legislation – Regulatory framework – Atomic Energy Act – Atomic Energy (Radiation Protection) Rules – Applicable Safety Codes, Standards, Guides and Manuals – Regulatory Control – Licensing, Inspection and Enforcement – Responsibilities of Employers, Licensees, Radiological Safety Officers and Radiation Workers – National inventories of radiation sources – Import, Export procedures	6
7	**Radiation Emergencies and their Medical Management:** Radiation accidents and emergencies in the use of radiation sources and equipment in industry and medicine - Radiographic cameras and teletherapy units - Loading and unloading of sources - Loss of radiation sources and their tracing - Typical accident cases. Radiation injuries, their treatment and medical management - Case histories. Prophylaxis and decorporating agents	6
	Total	**45hrs**

MMP 120 P: Radiation Safety

Course Outcome	• Identify potential hazards and categorize different types of radiation exposure. • Apply ALARA principles and implement safety measures. • Design shielding for diagnostic and therapeutic facilities. • Operate personnel and area monitoring devices like TLDs, GM counters. • Interpret AERB, ICRP, and BARC guidelines for radiation workers. • Handle and dispose of radioactive waste safely in medical facilities..

Sr. No.	Topics	No. of hrs.
1	Radiation protection survey of CT Simulator installation	**30**
2	Radiation protection survey of medical accelerator installation (C series)	
3	Radiation protection survey of brachytherapy installation	
4	Leakage level measurement of teletherapy equipment	
5	Radiation protection survey of diagnostic radiology installations	
6	Leakage level measurement of a diagnostic x-ray machine	
Total		**30 hrs**

Reference Books:

1. R. F. Mold, Radiation Protection in Hospitals, Adam Hilger Ltd., Bristol, 1985.
2. Martin, A and S. A. Harbisor, An introduction to Radiation Protection, John Wiley & sons Inc., New York, 1981.
3. ICRP Publications, 1990.
4. Khan, Faiz M. Treatment Planning in Radiation Oncology, 2nd Edition Lippincott Williams & Wilkins, 2007
5. Glenn F.Knoll. Radiation Detection and Measurement, 3rd edition John Wiley &Sons,Inc,2000 Subramania Jayaraman, Lawrence H.Lanzl., Clinical Radiotherapy physics, CRC Press,Inc,1996
6. E.B.Podgorsak, Radiation Oncology Physics IAEA Publication
7. K.N.Govindarajan Advanced Medical Radiation dosimetry, Prentice-Hall of India Pvt.Ltd,2004
8. Introduction to Health Physics by Herman Cember and Thomas E. Johnson
9. Atoms, Radiation and Radiation Protection by James E. Turner Radiation Protection and Dosimetry - An Introduction to Health Physics by Michael Stabin
10. Shielding Techniques for Radiation Oncology Facilities by Patton H. McGinley
11. Structural Shielding Design and Evaluation for Megavoltage X- and Gamma- Rays Radiotherapy Facilities NCRP Report No. 151

Name of the Program	**M. Sc. Medical Physics**
Semester	**Semester III**
Name of the subject	**Radiation Physics & Radiation Generators**
Subject Code	**MMP 116 L**

Teaching Objectives	• To introduce basic concepts of Radiation Physics and Generators • To teach the management of radiotherapy program in healthcare
Learning Objectives	• Able to apply the concepts in the Radiation Physics and Generators in the practice of radiotherapy and medical physics/

Course Outcome	• Understand the fundamental principles of radioactivity, types of radiation, decay mechanisms, and their significance in nuclear physics. • Analyze the working principles, types, and applications of various particle accelerators and their relevance in medical and industrial fields. • Describe the design, function, and safety aspects of medical and industrial X-ray generators, including modern imaging systems. • Explain the interactions of different types of radiation (electromagnetic, charged particles, and neutrons) with matter, including attenuation, ionization, and energy transfer processes. • Apply the concepts of radiation physics to assess the behavior and penetration of radiation in various media, relevant to radiological and clinical applications.

Sr. No.	Topics	No. of hrs.
1	**Nuclear Physics** Radioactivity - General properties of alpha, beta and gamma rays - Laws of radioactivity - Laws of successive transformations - Natural radioactive series - Radioactive equilibrium - Alpha ray spectra- Beta ray spectra - Theory of beta decay - Gamma emission - Electron capture - Internal conversion- Nuclear isomerism - Artificial radioactivity - Nuclear cross sections - Elementary ideas of fissionand reactors - Fusion.	5
2	**Particle Accelerators** Particle accelerators for industrial, medical and research applications - The Resonant transformer -Cascade generator - Van De Graff Generator - Pelletron - Cyclotron – Betatron - Synchro-Cyclotron-Linear Accelerator - Klystron and magnetron - Travelling and Standing Wave Acceleration -Microtron - Electron Synchrotron-Proton synchrotron. Details of accelerator facilities in India.	5
3	**X-ray Generators** Discovery - Production - Properties of X-rays - Characteristics and continuous spectra - Design of hotcathode X-ray tube - Basic requirements of medical diagnostic, therapeutic and industrial radiographic tubes - Rotating anode tubes - Hooded anode tubes - Industrial X-ray tubes - X-ray tubes for crystallography - Rating of tubes - Safety devices in X-ray tubes - Rayproof and shockproof tubes- Insulation and cooling of X-ray tubes - Mobile and dental units - Faults in X-ray tubes – Limitationson loading. Electric Accessories for X-ray tubes - Filament and high voltage transformers – Highvoltage circuits - Half-wave and full-wave rectifiers - Condenser discharge apparatus - Three phaseapparatus - Voltage doubling circuits - Current and voltage stabilisers - Automatic exposure control- Automatic Brightness Control- Measuring instruments - Measurement of kV and mA - timers - Control Panels - Complete X-ray circuit - Image intensifiers and closed circuit TV systems – Modern Trends.	10
4	Interaction of Radiation with Matter (oriented towards Radiology) Interaction of electromagnetic radiation with matter Exponential attenuation - Thomson scattering -Photoelectric and Compton process and energy absorption - Pair production - Attenuation and massenergy absorption coefficients - Relative importance of various processes. Interaction of chargedparticles with matter - Classical theory of inelastic collisions with atomic electrons - Energy loss perion pair by primary and secondary ionization - Dependence of collision energy	10

	losses on the physicaland chemical state of the absorber - Cerenkov radiation - Electron absorption process – ScatteringExcitation and Ionization - Radiative collision - Bremmstrahlung - Range energy relation -Continuous slowing down approximation (CSDA) - straight ahead approximation and detour factors- transmission and depth dependence methods for determination of particle penetration – empiricalrelations between range and energy - Back scattering.Passage of heavy charged particles throughmatter - Energy loss by collision - Range energy relation - Bragg curve - Specific ionization – StoppingPower - Bethe Bloch Formula. Interaction of neutrons with matter - scattering - capture – Neutroninduced nuclear reactions.	
Total		**30hrs**

Reference Books:

1. Radiation oncology physics: A Handbook for teachers and students. IAEA publications 2005.
2. F.M.Khan, The Physics of Radiation Therapy, Third Edition, Lippincott Williams and Wilkins,U.S.A.,2003
3. H. E. Jones, J. R. Cunningham, The Physics of Radiology, Charles C. Thomas, New York, 2002.
4. W. J. Meredith and J. B. Massey, Fundamental Physics of Radiology, John Wright and Sons, U. K., 2000.
5. W. R. Handee, Medical Radiation Physics, Year Book Medical Publishers Inc., London, 2003.
6. Donald T. Graham, Paul J. Cloke, Principles of Radiological Physics, Churchill Livingstone, 2003

Name of the Program	**M. Sc. Medical Physics**
Semester	**Semester II**
Name of the subject	**Radiation Dosimetry and Standardization**
Subject Code	**MMP 117 L**

Teaching Objectives	• To introduce basic concepts of Radiation Dosimetry and Standardization in Radiotherapy Oncology and Medical Physics • To teach the management of radiotherapy program in healthcare and university with the Radiation Dosimetry and Standardization.
Learning Objectives	• Able to apply the concepts in the Radiation Dosimetry and Standardization in the practice of radiotherapy and medical physics/

Course Outcome	• Calculate dose quantities and conversions used in treatment planning. • Identify and characterize clinical radiation sources. • Apply Bragg-Gray theory and CPE for dose calibration. • Operate and interpret measurements from ion chambers • Use passive dosimeters for patient and phantom measurements. • Select appropriate dosimeters based on clinical requirements. • Implement guidelines in QA processes.

Sr. No.	Topics	No. of hrs.
1	**Radiation Quantities and Units:** Radiation quantities and units – Radiometry – Particle flux and fluence – Energy flux and fluence – Cross Section – Linear and mass attenuation coefficients - Mass energy transfer and mass energy absorption coefficients - Stopping power - LET - Radiation chemical yield - W value - Dosimetry - Energy imparted - Absorbed dose - Kerma - Exposure - Air kerma rate constant - Charged particle equilibrium (CPE) – Relationship between Kerma, absorbed dose and exposure under CPE - Dose equivalent - Ambient and directional dose equivalents [(H*(d) and H'(d)] - Individual dose equivalent penetrating Hp(d) - Individual dose equivalent superficial Hs(d)	10
2	**Radiation Sources:** Radiation sources - Natural and artificial radioactive sources - Large scale production of isotopes - Reactor produced isotopes - Cyclotron produced isotopes - Fission products - industrial uses – Telecobalt and Brachy Caesium sources – Gold seeds - Tantalum wire - 125I Sources - Beta ray applicators - Thermal and fast neutron sources - Preparation of tracers and labeled compounds - Preparation of radio colloids.	5
3	**Dosimetry & Standardization of X- and Gamma Ray Beams:** Standards - Primary and Secondary Standards, Traceability, Uncertainty in measurement. Charged Particle Equilibrium (CPE), Free Air Ion Chamber (FAIC), Design of parallel plate FAIC, Measurement of Air Kerma/ Exposure. Limitations of FAIC. Bragg-Gray theory, Mathematical expression describing Bragg-Gray principle and its derivation. Burl in and Spencer Attix Cavity theories. Transient Charged Particle Equilibrium (TCPE), Concept of Dgas, Cavity ion chambers, Derivation of an expression for sensitivity of a cavity ion chamber. General definition of calibration factor - NX, NK, ND, air, ND,W. IAEA TRS277: Various steps to arrive at the expression for DW starting from NX. TRS398: ND, W, Q : ND, W : KQ,Q0 :KQ , Derivation of an expression for KQ,Q0. Calorimetric standards – Inter comparison of standards. Measurement of DW for External beams from 60Co teletherapy machines: Reference conditions for measurement, Type of ion chambers, Phantom, Waterproof sleeve, Derivation of an expression for Machine Timing error, Procedure for evaluation of Temperature and pressure correction: Thermometers and pressure gauges. Measurement of temperature and pressure. Saturation correction: derivation of expression for charge collection efficiency of an ion chamber based on Mie theory. Parallel plate, cylindrical and spherical ion chambers, Ksat ,Two voltage method for continuous and pulsed beams, Polarity correction. Measurement of DW for high-energy photon beams from Linear accelerators: Beam quality, beam quality index, beam quality correction coefficient, Cross calibration. Measurement of DW for high energy Electron beams from linear accelerators: Beam quality, beam quality index, beam	15

	quality correction coefficient, Cross calibration using intermediate beam quality. Quality Audit Programmes in Reference and Non-Reference conditions. Standardization of brachytherapy sources - Apparent activity - Reference Air Kerma Rate - Air Kerma Strength - Standards for HDR 192Ir and 60Co sources - Standardization of 125I and beta sources - IAEA TECDOC 1274 - room scatter correction. Calibration of protection level instruments and monitors	
4	**Neutron Standards & Dosimetry:** Neutron classification, neutron sources, Neutron standards - primary standards, secondary standards, Neutron yield and fluence rate measurements, Manganese sulphate bath system, precision long counter, Activation method. Neutron spectrometry, threshold detectors, scintillation detectors & and multispheres, Neutron dosimetry, Neutron survey meters, calibration, neutron field around medical accelerators.	5
5	**Standardization of Radionuclides:** Methods of measurement of radioactivity - Defined solid angle and 4-pi counting - Beta gamma coincidence counting - Standardization of beta emitters and electron capture nuclides with proportional, GM and scintillation counters - Standardization of gamma emitters with scintillation spectrometers - Ionization chamber methods – Extrapolation chamber - Routine sample measurements - Liquid counter – Windowless counting of liquid samples - Scintillation counting methods for alpha, beta and gamma emitter - Reentrant ionization chamber methods - Methods using (n, alpha) and (n, p) reactions - Determination of yield of neutron sources - Space integration methods - Solid state detectors.	5
6	**Radiation Chemistry and Chemical Dosimetry:** Definitions of free radicals and G-value-Kinetics of radiation chemical transformations - LET and dose-rate effects - Radiation Chemistry of water and aqueous solutions, peroxy radicals, pH effects - Radiation Chemistry of gases and reactions of dosimetry interest - Radiation polymerization, effects of radiation on polymers and their applications in dosimetry - Formation of free radicals in solids and their applications in dosimetry - Description of irradiators from dosimetric view point - Dosimetry principles - Definitions of optical density, molar absorption coefficient, Beer- Lambert's law, spectrophotometry - Dose calculations - Laboratory techniques - Reagents and procedures - Requirements for an ideal chemical dosimeter - Fricke dosimeter - FBX dosimeter - Free radical dosimeter - Ceric sulphate dosimeter - Other high and low level dosimeters - Applications of chemical dosimeters in Radiotherapy and industrial irradiators.	5
Total		**45 hrs**

MMP 121 P: Radiation Dosimetry and Standardization

Course Outcome	• Calculate dose quantities and conversions used in treatment planning. • Identify and characterize clinical radiation sources. • Apply Bragg-Gray theory and CPE for dose calibration. • Operate and interpret measurements from ion chambers • Use passive dosimeters for patient and phantom measurements. • Implement guidelines in QA processes.

Sr. No.	Topics	No. of Hrs.
1	Statistics of radioactive counting.	**60**
2	Study of voltage and current characteristics of therapy level dosimeter.	
3	Calibration of therapy level dosimeter using cross-calibration method.	
4	Evaluation of characteristics of a radiographic image.	
5	Dose output measurement of photon (^{60}Co gamma rays and high energy x-rays) beams used in radiotherapy treatment.	
6	Dose output measurement of electron beams used in radiotherapy treatment.	
7	Determination of percentage depth dose of photon and electron beams.	
8	AKS/ RAKR measurement of HDR brachytherapy sources using well type and cylindrical ionisation chambers.	
9	Determination of radiation field, flatness, symmetry and penumbra of external photon beam	

10	Dose verification in MRT	
Total		**60 hrs**

Reference Books:

1. R. F. Mould, Radiotherapy Treatment Planning, Medical Physics Hand Book Series No.7, Adam Hilger Ltd., Bristol, 1981
2. Christensen's Physics of Diagnostic Radiology by Thomas S. Curry, James E. Dowdey, Robert C. Murry
3. Radiation Oncology Physics: A Handbook for Teachers And Students by E. B. Podgorsak (IAEA)
4. Diagnostic Radiology Physics: A handbook for Teachers and Students (IAEA)
5. Radiation oncology physics: A Handbook for teachers and students. IAEA publications 2005.
6. F.M. Khan, The Physics of Radiation Therapy, Third Edition, Lippincott Williams and Wilkins,U.S.A.,2003.
7. H. E. Jones, J. R. Cunningham, The Physics of Radiology, Charles C. Thomas, New York, 2002
8. W. J. Meredith and J. B. Massey, Fundamental Physics of Radiology, John Wright and Sons,U. K., 2000.
9. W. R. Handee, Medical Radiation Physics, Year Book Medical Publishers Inc., London, 2003.
10. Donald T. Graham, Paul J. Cloke, Principles of Radiological Physics, Churchill Livingstone, 2003

Name of the Program	**M. Sc. Medical Physics**
Semester	**Semester II**
Name of the subject	**Radiation Therapy II**
Subject Code	**MMP 118 L**

Teaching Objectives	• To introduce basic concepts of **Radiation Therapy** • To teach the management of radiotherapy program in healthcare and university with **Radiation Therapy**.
Learning Objectives	• Able to apply the concepts in the **Radiation Therapy** in the practice of radiotherapy and medical physics/

Course Outcome	• Understand the principles, classification, and techniques of brachytherapy, including source characteristics and dose rate systems. • Apply dosimetry concepts and protocols such as TG-43, ICRU, and TECDOC standards in brachytherapy planning and source calibration. • Analyze the functioning, QA, and regulatory requirements of manual and remote afterloading systems and integrated brachytherapy units. • Evaluate the role of computers in radiotherapy treatment planning, including algorithms, optimization, DICOM standards, and QA protocols • Demonstrate knowledge of advanced brachytherapy techniques such as image-guided planning, electronic and intravascular brachytherapy with clinical applications.

Sr. No.	Topics	No. of hrs.
1	**Brachytherapy Overview, Techniques & Dosimetry** Definition and classification of brachytherapy techniques - surface mould, intracavitary, interstitial and intraluminal techniques. Requirement for brachytherapy sources - Description of radium and radium substitutes - ^{137}Cs, ^{60}Co, ^{192}Ir, ^{125}I and other commonly used brachytherapy sources. Dose rate considerations and classification of brachytherapy techniques - Low dose rate (LDR), high dose rate (HDR) and pulsed dose rate (PDR). Paterson Parker and Manchester Dosage systems. ICRU 38 and 58 protocols. Specification and calibration of brachytherapy sources – RAKR/AKS and Absorbed Dose to Water calibration - IAEA TECDOC 1274 and ICRU 72 recommendations – Point and line source dosimetry formalisms - Sievert Integral - AAPM TG-43/43U1 and other dosimetry formalisms. After loading techniques - Advantages and disadvantages of manual and remote after loading techniques. AAPM and IEC requirements for remote after loading brachytherapy equipment. Acceptance, commissioning and quality assurance of remote after loading brachytherapy equipment. ISO requirements and QA of brachytherapy sources. Integrated brachytherapy unit.	15
2	**Computers in Treatment Planning** Scope of computers in radiation treatment planning - Review of algorithms used for treatment planning computations, Treatment planning calculations, Factors to be incorporated in computational algorithms. Plan optimization, Indices used for plan comparisons - Hardware and software requirements - beam & source library generation. Networking, DICOM and PACS. Acceptance, commissioning and quality assurance of radiotherapy treatment planning systems using IAEA TRS 430 and other protocols.	5
3	**Special and Advanced Techniques of Brachytherapy** Brachytherapy treatment planning (2D and 3D)- x-Ray/CT/MR based brachytherapy planning - GEC ESTRO recommendations - forward and inverse planning – DICOM image import / export from OT - Record & verification. Brachytherapy treatment for Prostate cancer. Ocular brachytherapy using photon and beta sources. Intravascular brachytherapy - classification - sources - dosimetry procedures - AAPM TG 60 protocol. Electronic brachytherapy (Axxent, Mammosite, etc.).	10
	Total	**30 hrs**

Reference Books:

1. R. F. Mould, Radiotherapy Treatment Planning, Medical Physics Hand Book Series No.7, Adam Hilger Ltd., Bristol, 1981
2. Christensen's Physics of Diagnostic Radiology by Thomas S. Curry, James E. Dowdey, Robert C. Murry
3. Radiation Oncology Physics: A Handbook for Teachers And Students by E. B. Podgorsak (IAEA)
4. Diagnostic Radiology Physics: A handbook for Teachers and Students (IAEA)
5. Radiation oncology physics: A Handbook for teachers and students. IAEA publications 2005.
6. F.M. Khan, The Physics of Radiation Therapy, Third Edition, Lippincott Williams and Wilkins,U.S.A.,2003.
7. H. E. Jones, J. R. Cunningham, The Physics of Radiology, Charles C. Thomas, New York, 2002
8. W. J. Meredith and J. B. Massey, Fundamental Physics of Radiology, John Wright and Sons,U. K., 2000.
9. W. R. Handee, Medical Radiation Physics, Year Book Medical Publishers Inc., London, 2003.
10. Donald T. Graham, Paul J. Cloke, Principles of Radiological Physics, Churchill Livingstone, 2003

Name of the Program	**M. Sc. Medical Physics**
Semester	**Semester III**
Name of the subject	**Dissertation / Project**
Subject Code	**MMP 119**

Teaching Objectives	• To introduce basic concepts of practical applications in healthcare and university and to train the students with hands-on.
Learning Objectives	• Able to clinically operate the equipment under supervision.

Course Outcome	• To introduce students to the fundamentals of research methodology and scientific writing. • To encourage independent project work in advanced topics of medical physics. • To enhance analytical, problem-solving, and technical documentation skills. • To promote collaboration with research institutes, hospitals, or industries. • To train students in presenting and defending their research through seminars and viva-voce.

The Dissertation/Project work will begin from 3rdSemester and will continue through the 4thSemester. (Total - 150 hrs)

Course code- MMP 122 CP: Physics Directed Clinical Education – III

Course Outcome	• Students will gain additional clinical skills in this program to increase the role of Radiation Therapy in the practice of Oncology and disease prevention by providing a unique combination of educational experiences to students. • The students will be exposed to both clinical and academic aspects of Radiation Therapy. To provide hands-on experience in Quality Assurance of radiotherapy and diagnostic equipment.

Students will gain additional clinical skills in this program to increase the role of Radiation Therapy in the practice of Oncology and disease prevention by providing a unique combination of educational experiences to students. The students will be exposed to both clinical and academic aspects of Radiation Therapy. **(135 hrs.)**

SECOND YEAR

M.Sc. Medical Physics

SEMESTER- IV

Code No	Core Subject
Discipline Specific Core Theory	
MMP 123 L	Quality Assurance
General Elective (Any one)	
GE 001 L	Pursuit of Inner Self Excellence (POISE)
GE 002 L	Bioethics, Biosafety, IPR, and Technology Transfer
GE 003 L	Disaster Management and Mitigation Resources
GE 004 L	Human Rights
Discipline Specific Core Practical	
MMP 124 P	Quality Assurance
MMP 125 CP	Physics Directed Clinical Education IV
MMP 126	Dissertation / Project

The dissertation / Project Course commences in third semester and will continue in Semester IV

(Elective): Anyone subject is to be chosen from the following (Subjects offered may change from time to time depending on the availability of expertise)

Elective courses may or may not have practical and/or fieldwork.
▲Multidisciplinary/ Interdisciplinary

Semester	Semester IV
Name of the subject	Quality Assurance
Subject Code	MMP 123 L

Teaching Objectives	• To introduce basic concepts of Quality Assurance in healthcare and university and to train the students with hands on.
Learning Objectives	• Able to perform the Quality Assurance of the RT equipment under supervision.

Course Outcome	• Learn and acquire practical knowledge about various national and international dosimetry protocols and guidelines • Use IAEA guidance for standardized QA audits. • Perform QA of LINACs, beam symmetry, flatness, and output. • Verify source strength, geometry, and TPS calculations. • Evaluate CT, MRI, and simulator equipment for compliance. • Validate algorithm accuracy and commissioning of TPS. • Contribute to institutional and national dosimetry audits. Maintain AERB-compliant records and logs.

Sr. No.	Topics	No. of Hrs.
1	Introduction to National and International guidelines and QA protocols	3
2	Salient features and awareness of AAPM Task Group Reports	3
3	IAEA Safety codes TecDocs and IAEA Docs	3
4	QA of External radiotherapy systems	5
5	QA of Brachytherapy systems	3
6	QA of Imaging modalities	3
7	QA of TPS for external radiotherapy	3
8	QA of TPS for Brachytherapy	3
9	Dosimetry Quality Audits and Quality Control (National and International)	2
10	QA formats to be submitted to AERB and its compliances, Documentation	2
Total		**30 hrs**

MMP 124 P: Quality Assurance

Course Outcome	• Learn and acquire practical knowledge about various national and international dosimetry protocols and guidelines • Use IAEA guidance for standardized QA audits. • Perform QA of LINACs, beam symmetry, flatness, and output. • Verify source strength, geometry, and TPS calculations. • Evaluate CT, MRI, and simulator equipment for compliance. • Validate algorithm accuracy and commissioning of TPS. • Contribute to institutional and national dosimetry audits. Maintain AERB-compliant records and logs.

Sr. No.	Topics	No. of Hrs.
1	Production and attenuation of bremsstrahlung.	
2	Range of beta particles by Feather analysis.	
3	Backscattering of beta particles and its applications.	
4	Statistics of radioactive counting.	
5	Calibration check of survey instruments and pocket dosimeters.	
6	Calibration check of a G.M. monitor.	

7	Calibration of TL phosphor & TLD reader and its use in dose distribution measurements.	**30**
8	Determination of plateau and resolving time of a G.M. counter and its application in estimating the shelf-ratio and activity of a beta source.	
9	Quality assurance of a diagnostic x-ray machine.	
10	Evaluation of characteristics of a radiographic image.	
11	Integrity check and calibration of low activity brachytherapy sources.	
12	In-phantom dosimetry of a brachytherapy source.	
13	In-vivo dosimetry	
14	Verification of mechanical and radiation isocentre of a teletherapy machine	
15	Absorption and backscattering of gamma rays – Determination of HVT	
Total		**30 hrs**

Reference Docs

- IAEA TRS398 & TRS 483, IAEA Tecdocs
- AAPM TG 43, TG 186, ICRU 50, 62 & Other Task Group report
- AERB Safety Codes for RT, DR and NM
- IEC Documents
- IPEM
- ESTRO Guidelines

General Elective

Name of the Program	**M. Sc. Medical Physics**
Semester	**Semester IV**
Name of the subject	**Pursuit of Inner Self Excellence (POISE)**
Subject Code	**GE 001 L**

Teaching Objectives	• To identify the self-excellence from the student and encourage him/her for betterment.
Learning Objectives	• Able to perform in a better way in the society

Course outcomes	• Students will become self-dependent, more decisive and develop intuitive ability for their study and career related matter. • Students ability to present their ideas will be developed. • Enhanced communication skills, public speaking & improved Presentation ability. • Students will be able to explore their inner potential and inner ability to become a successful researcher or technician & hence become more focused. • Students will observe significant reduction in stress level. • With the development of personal attributes like Empathy, Compassion, Service, Love & brotherhood, students will serve the society and industry in better way with teamwork and thus grow professionally.

Sr. No.	Topics	No of hrs.
1	**Spiritual Values for human excellence:** The value of human integration; Compassion, universal love and brotherhood (Universal Prayer); Heart based living; Silence and its values, Peace and non-violence in thought, word and deed; Ancient treasure of values -Shatsampatti, Patanjali's Ashtanga Yoga, Vedic education-The role of the Acharya, values drawn from various cultures and religious practices- Ubuntu, Buddism, etc.: Why spirituality? Concept–significance: Thought culture	15
2	**Ways and Means:** Correlation between the values and the subjects; Different teaching techniques to impart value education; Introduction to Brighter Minds initiative; Principles of Communication; Inspiration from the lives of Masters for spiritual values- Role of the living Master	15
3	**Integrating spiritual values and life:** Relevance of VBSE (Value Based Spiritual Education) in contemporary life; Significant spiritual values; Spiritual destiny; Principles of Self-management; Designing destiny	15
4	**Experiencing through the heart for self-transformation (Heartfulness Meditation):** WhoamI?; Introduction to Relaxation; Why, what and how HFN Meditation?; Journal writing for Self-Observation; Why, what and how HFN Rejuvenation(Cleaning)?; Why, what and how HFN connect to Self (Prayer)?; Pursuit of inner self excellence; Collective Consciousness – concept of *egregore effect;*	15
Total		**60hrs**

Reference Books:

1. www.pdfdrive.net
2. www.khanacademy.org
3. www.acadeicearths.org
4. www.edx.org
5. www.open2study.com
6. www.academicjournals.org

Name of the Program	**M. Sc. Medical Physics**
Semester	**Semester IV**
Name of the subject	**Bioethics, Biosafety, IPR, and Technology Transfer**
Subject Code	**GE 002 L**

Teaching Objectives	•To make aware the student about bioethics, biosafety and other aspects related to technology transfer and encourage him/her for betterment.
Learning Objectives	•Able to understand the ethics for healthcare.

Course outcomes	**Students will learn to:** • Effectively manage the health and safety aspects of a biological laboratory. • Give reliable, professional and informed advice and information to colleagues and managers. • Help to ensure that their institution complies with relevant legislation, liaise effectively with enforcing authorities and beware of the penalties for failing to comply. • Build a context of understanding through communication. • Mediate between other conflicting parties. • Exhibit de – escalatory behaviours in situations of conflict. • Demonstrate acknowledgment and validation of the feelings, opinions, and contributions of others.

Sr. No.	Topics	No. of Hrs.
1	**Ethics**: Benefits of Allied Health Sciences, ELSI of Bioscience, recombinant therapeutic products for human healthcare, genetic modifications and food consumption, release of genetically engineered organisms, applications of human genetic rDNA research, humanembryonic stem cell research.	15
2	**Patenting:** Patent and Trademark, Bio science products and processes, Intellectual property rights, Plant breeders rights, trade marks, industrial designs, copyright biotechnology indeveloping countries. Biosafety and its implementation, Quality control in Biotechnology.	15
3	**Introduction to quality assurance, accreditation & SOP writing:** Concept of ISO standards and certification, National regulatory body for accreditation, Quality parameters, GMP& GLP, Standard operating procedures, Application of QA in field of genetics, Data management of clonical and testing laboratory.	15
4	**Funding Agencies** (Financing alternatives, VC funding, funding for Bioscience in India, Exit strategy, licensing strategies, valuation), support mechanisms for entrepreneurship (Bioentrepreneurship efforts in India, difficulties in India experienced, organizations supportinggro with, areas of scope, funding agencies in India, policy initiatives), Role of knowledge centers and R&D (knowledge centers like universities and research institutions, role of technology andup gradation)	15
Total		**60hrs**

Reference Books:

1. www.pdfdrive.net
2. www.khanacademy.org
3. www.acadeicearths.org
4. www.edx.org
5. www.open2study.com
6. www.academicjournals.org

Name of the Program	**M. Sc. Medical Physics**
Semester	**Semester IV**
Name of the subject	**Disaster Management and Mitigation Resources**
Subject Code	**GE 003 L**

Teaching Objectives	• To make aware the student for Disaster management and mitigation resources for betterment.
Learning Objectives	• Able to tackle the situation in difficult situations for healthcare.

Course outcomes	At the successful completion of course, the student will gain: • Knowledge and understanding of the disaster phenomenon, its different contextual aspects, impacts and public health consequences. • Knowledge and understanding of the International Strategy for Disaster Reduction (UNISDR) and to increase skills and abilities for implementing the Disaster Risk Reduction (DRR) Strategy. • Ensure skills and abilities to analyze potential effects of disasters and of the strategies and methods to deliver public health response to avert these effects.

Sr. No.	**Topics**	**No. of Hrs.**
1	**Introduction:** Definition of Disaster, hazard, global and Indian scenario, general perspective, importance of study in human life, Direct and indirect effects of disasters, long term effects of disasters. Introduction to global warming and climate change.	8
2	**Natural Disaster and Manmade disasters:** Natural Disaster: Meaning and nature of natural disaster, Flood, Flash flood, drought, cloud burst, Earthquake, Landslides, Avalanches, Volcanic eruptions, Mudflow, Cyclone, Storm, Storm Surge, climate change, global warming, sea level rise, ozone depletion Manmade Disasters: Chemical, Industrial, Nuclear and Fire Hazards. Role of growing population and subsequent industrialization, urbanization and changing life style of human beings in frequent occurrences of manmade disasters.	15
3	**Disaster Management, Policy and Administration:** Disaster management: meaning, concept, importance, objective of disaster management policy, disaster risks in India, Paradigm shift in disaster management. Policy and administration: Importance and principles of disaster management policies, command and co-ordination of in disaster management, rescue operations-how to start with and how to proceed in due course of time, study of flow charts howing the entire process.	12
4	**Financing Relief Measures:** Ways to raise finance for relief expenditure, role of government agencies and NGO's in this process, Legal aspects related to financeraising as well as overall management of disasters. Various NGO's and the works they have carried out in the past on the occurrence of various disasters, Ways to approach these teams. International relief aid agencies and their role in extreme events.	13
5	**Preventive and Mitigation Measures:** Pre-disaster, during disaster and post disaster measures in some events in general structural mapping: Risk mapping, assessment and analysis, sea walls and embankments, Bio shield, shelters, early warning and communication Non-Structural Mitigation: Community based disaster preparedness, risk transfer and risk financing, capacity development and training, awareness and education, contingency plans. Do's and don'ts in case of disasters and effective implementation of relief aids.	12
Total		**60hrs**

Reference Books:

1. Shailendra K. Singh: Safety & Risk Management, Mittal Publishers
2. J. H. Diwan:Safety, Security & Risk Management, APH
3. Stephen Ayers &Garmvik: Text Book of Critical Care, Holbook and Shoemaker
4. www.pdfdrive.net
5. www.khanacademy.org
6. www.acadeicearths.org
7. www.edx.org
8. www.open2study.com
9. www.academicjournals.org

Name of the Program	**M. Sc. Medical Physics**
Semester	**Semester IV**
Name of the subject	**Human Rights**
Subject Code	**GE 004 L**

Teaching Objectives	• To make aware the student about Human Rights for betterment.
Learning Objectives	• Able to understand the Human Rights and tackle the situation in the healthcare.

Course outcomes	Student will be able to virtue: • Identify, contextualize and use information about the human rights situationin a given country • Critically appraise source material, including cases from human rights committees and tribunals and reports and summary records from treaty bodies • Analyze a country's situation or an international situation in terms of human rights and formulate human rights-based initiatives and policies • Promote human rights through legal as well as non-legal means. • Participate in legal, political and other debates involving human rights in acknowledgeable and constructive way

Sr. No.	**Topics**	**Noof Hrs.**
1	**Background:** Introduction, Meaning, Nature and Scope, Development of Human Rights, Theories of Rights, Types of Rights	8
2	**Human rights at various level:** Human Rights at Global Level UNO, Human Rights – UDHR 1948– UN Conventions on Human Rights: International Covenant on civil and Political Rights 1966, International Convent on Economic, Social and Cultural Right, Racial Discrimination -1966 International, Instruments: U.N. Commission for Human Rights, European Convention on Human Rights.	15
3	**Human rights in India**: Development of Human Rights in India, Human Rights and the Constitution of India, Protection of Human Rights Act 1993- National Human Rights Commission, State Human Rights Commission, Composition Powers and Functions, National Commission for Minorities, SC/ST and Woman	12
4	**Human Rights Violations:** Human Rights Violations against Women, Human Rights Violations against Children, 35 Human Rights Violations against Minorities SC/ST and Trans-genders, Preventive Measures	13
5	**Political issues**: Political Economic and Health Issues, Poverty, Unemployment, Corruption and Human Rights, Terrorism and Human Rights, Environment and Human Rights, Health and Human Rights	12
Total		**60 hrs**

Reference Books:

1. Jagannath Mohanty Teaching of Humans Rights New Trends and Innovations Deep & Deep Publications Pvt. Ltd. New Delhi 2009
2. Ram Ahuja: Violence Against Women Rawat Publications Jewahar Nager Jaipur. 1998.
3. Sivagami Parmasivam Human Rights Salem 2008
4. Hingorani R. C. : Human Rights in India: Oxford and IBA New Delhi.

Course code- MMP 125 CP: Physics Directed Clinical Education – IV

Course outcomes	• Students will gain additional clinical skills in this program to increase the role of Radiation Therapy in the practice of Oncology and disease prevention by providing a unique combination of educational experiences to students. • The students will be exposed to both clinical and academic aspects of Radiation Therapy.

Students will gain additional clinical skills in this program to increase the role of Radiation Therapy in the practice of Oncology and disease prevention by providing a unique combination of educational experiences to students. The students will be exposed to both clinical and academic aspects of Radiation Therapy. **(90 hrs.)**

Name of the Program	**M. Sc. Medical Physics**
Semester	**Semester**
Name of the subject	**Dissertation / Project**
Subject Code	**MMP 126**

Teaching Objectives	• To introduce basic concepts of project and hands-on with Quality Assurance in healthcare and university and to train the students.
Learning Objectives	• Able to perform the short project with defined objectives with Quality Assurance of the RT equipment under supervision.

Course outcomes	• To introduce students to the fundamentals of research methodology and scientific writing. • To encourage independent project work in advanced topics of medical physics. • To enhance analytical, problem-solving, and technical documentation skills. • To promote collaboration with research institutes, hospitals, or industries. • To train students in presenting and defending their research through seminars and viva-voce.

The Dissertation work will begin from the 3rd semester and will continue through the 4th semester. (330 hrs)

1. Dissertation/Project work should be carried out as an individual Dissertation and actual bench work.

2. The students will carry independent project work under the supervision of the staff of Department on an advanced topic assigned to him/her. In house projects are encouraged. Students may be allowed to carry out the project work in other Departmental laboratories/ Research institutes / Industries as per the availability of Infrastructure.

3. Co guides from the other institutions maybe allowed.

4. The Dissertation/ Project work will begin from 3rd Semester, and will continue through the 4th Semester.

5. The Dissertation/ Project report (also work book shall be presented at the time of presentation and viva voce) will be submitted at the end of the 4th Semester and evaluated.

6. Five copies of the project report shall be submitted to the Director, SBS.

7. For the conduct of the End Semester Examination and evaluation of Dissertation/ Project work the University will appoint External Examiners.

8. Since the dissertation is by research, Dissertation/ Project work carries a total of 250 marks and evaluation will be carried out by both internal and external evaluators.

9. The student has to defend his/her Dissertation/Project Work in a seminar which will be evaluated by an internal and externalexperts appointed by the University.

10. The assignment of marks for Project/ Dissertation is as follows:

Part I -
Topic Selection, Review of Literature, Novelty of works-50 marks

Part II

a.Continuous Internal Assessment, Novelty, Overall Lab Work Culture- 100Marks
b. Dissertation/ Project work book: 50 Marks
c. Viva- Voce: 50 Marks
d. However, a student in 4th semester will have to opt for general elective course from other related disciplines in addition to his Dissertation/ Project work in the parent department.

Internship

As per AERB regulations, the one-year internship is mandatory and applicable only to candidates who have successfully completed the two-year M.Sc. Medical Physics coursework. A degree completion certificate must be issued to the candidate prior to the commencement of the internship. The internship must be undertaken in a hospital recognized by the Atomic Energy Regulatory Board (AERB) and is to be conducted as a full-time, in-house training. It spans a duration of 12 months, excluding national holidays, Sundays & sanctioned sick leaves. The internship follows a six-day work week with eight working hours per day, ensuring comprehensive clinical exposure and hands-on experience as per regulatory standards.

Upon successful completion of the internship, the candidate must submit the internship completion certificate to Department of Medical Physics, MGM School of Biomedical Sciences, MGMIHS, Navi Mumbai, the parent institute from where the degree was awarded which the student will further submit to AERB for registration and compliance purposes.

LOG BOOK

Table 1: Academic activities attended

Name:

Admission Year:

College:

Date	Type of activity, specific seminar, journal club, presentation, UG teaching	Particulars

Table 2: Academic activities attended

Name:

Admission Year:

College:

Date	Type of activity, specific seminar, journal club, presentation, UG teaching	Topic

Scheme of University Examination Theory for PG Program:

General structure / patterns for setting up question papers for Theory / Practical courses, their evaluation weightages for PG programs of MGMSBS are given in the following tables

Marks scheme for the University exam:

Final theory marks will be 100 marks (80 marks University Theory exam + 20 Marks Internal assessment).

Question		**Marks distribution**	**Marks allotted per section**	**Marks**
Sec: A	MCQ	10 x 1 M = 10	10	10
Sec: B	SAQ	3/4x 5 M = 15	15	35
Sec: B	LAQ	2/3 x 10 M=10	20	
Sec: C	SAQ	3/4x 5 M = 15	15	35
Sec: C	LAQ	2/3x 10 M = 10	20	
Total				**80 Marks**

Marks Scheme for the University Examination (50 Marks)

Final theory marks will be 50 marks University Theory exam pattern Research Methodology & Biostatistics (Core course)

Question	**Question No.**	**Question Type**	**Marks Distribution**	**Marks**
Sec: A	1.	LAQ (2 out of 3)	2 X 10 Marks = 20	20
Sec: B	2.	SAQ (6 out of 8)	6 X 05 Marks = 30	30
Total				**50 Marks**

Marks Scheme for the University Examination (100 Marks)

Final theory marks will be 100 marks University Theory exam pattern Elective Course

Question	**Question No.**	**Question Type**	**Marks Distribution**	**Marks**
Sec: A	1.	LAQ (10 out of 12)	10 X 10 Marks = 100	100
Total				**100 Marks**

Practical exam pattern: Total 40 marks with following breakup:

Exercise	**Description**	**Marks**
Q No 1	Practical exercise - 1	1 x15=15 M
Q No 2	Station exercise	2x5M=10 M
Q No 3	VIVA	10 M
Q No 4	Journal	5M
Total		**40 Marks**

Practical exam pattern Research Methodology & Biostatistics (Core course)

Total 50-mark distribution:

Exercise	Description	Marks
Q No 1	**Practical/Problem-Solving:** These questions can assess statistical analysis, research design, hypothesis testing, or interpretation of data etc.	2 × 10 marks each) = **20 marks**
Q No 2	Identification of study designs, Critical appraisal of research papers, Application of biostatistical tools, Sampling techniques etc.	(4 × 5 marks each) = **20 marks**
Q No 3	**Viva Voce (Oral Examination)** Assessing conceptual clarity, application of research methodology, and statistical reasoning.	**10 marks**
Total		**50 Marks**

Practical to be conducted at respective departments and marks submitted jointly by the parent department to the university.

Breakup of theory IA calculation for 20 marks

Description	Marks
Internal exam (at department)	15 marks
Seminar	5 marks
Total	**20 Marks**

Breakup of practical IA calculation:

Description	Marks
Internal exam (at department)	10 marks
Viva	5 marks
Journal	5 marks
Total	**20 Marks**

Note –20 marks to be converted to 10 marks weightage for submission to the university.

Model Checklist for Evaluation of the Clinical Directed Posting (PG)
Name of the student: _____Date:_____
Program: _____
Semester: _____ Name of the Internal faculty/Observer: _____
Name of the External Faculty/Observer: _____

Core Competencies	Marks allotted	Marks obtained
Students will begin to develop critical thinking abilities utilizing the allied health personnel roles of communicator and caregiver. Students will learn principles of professional allied health personnel practice and provide direct care to individuals within a medical surgical setting while recognizing the diverse uniqueness of individuals with health alterations.		
Clinical Teaching		
a. Demonstrate beginning competency in technical skills.	10	
Independent Work by Student guided by faculty		
a. Develop effective communication skills (verbally and through charting) with patients, team members, and family	2.5	
b. Identify intra and inter-professional team member roles and scopes of practice. Establish appropriate relationships with team members.	2.5	
Hands on practical work by students		
a. Protect confidentiality of electronic/manual health records data, information, and knowledge of technology in an ethical manner	05	
Independent work by student		
a. Demonstrate expected behaviours and complete tasks in a timely manner. Arrive to clinical experiences at assigned times. Maintain professional behavior and appearance.	05	
Log book	10	
Viva	10	
Attendance	05	
Total	**50 Marks**	

Sign of Internal Examiner: _____
Sign of External Examiner: _____

SEM 3 – Dissertation (PG) (Internal Assessment)

Dissertation/Project Proposal: overall performance of the student	**Marks allotted**	**Marks Obtained**
Open mindedness/ Receptivity to feedback Integrates feedback	5 Marks	
Meets deadlines / Regularity in meeting / Consistency in communication	10 Marks	
Continuous Internal evaluation (CIE)		
Interest shown in selecting topic	5 marks	
Appropriate review	10 marks	
Discussion with guide and other faculty	10 marks	
Quality of protocol	5marks	
Preparation of proforma / log book / daily reports	5marks	
TOTAL	**Out of 50**	

Evaluation parameter (Semester IV)

Evaluation parameter (Semester IV)	Continuous Internal Evaluation (CIE)	Semester End Evaluation (SEE)	
	Guide	Internal examiner	External examiner
Thesis preparation, Novelty, Overall Lab Work Culture	25	-	-
Dissertation/Project work book	25	25	25
Evaluation of thesis including Viva Voce	-	50	50
Total	50	75	75
Overall Total = 200			

MGM SCHOOL OF BIOMEDICAL SCIENCES, NAVI MUMBAI
(A constituent unit of MGM INSTITUTE OF HEALTH SCIENCES)
(Deemed University u/s 3 of UGC Act 1956)
Grade "A++" Accredited by NAAC
Sector 1, KamotheNavi Mumbai-410209, Tel.No.022-27437631, 27432890
Email. sbsnm@mgmuhs.com / Website: www.mgmsbsnm.edu.in

DEPARTMENT OF MEDICAL PHYSICS

CLINICAL POSTING LOG BOOK

Name of Student		
Roll No.		
PRN		
Batch		
Period	From	To
Name and Address of Department		

Date of Completion:

Coordinator	**HOD**	**Director**

CERTIFICATE OF COMPLETION

PRN_____ **Batch _____**

This is to certify that the work entered in this logbook is the work of Mr./Mrs. …….

Student of M.Sc. Medical Physics , MGM School of Biomedical Sciences, MGMIHS, Kamothe who has satisfactorily completed his / her clinical posting in the year…….. from …….…….

Course Coordinator **Head of the Department** **Director**

HOD & RSO
Apollo Hospitals,
Belapur ,
Navi Mumbai

Date: / /20

POSTING ATTENDANCE RECORD

Month	Total days	Total days Present	Total days Absent	Signature

Coordinator

HOD

Daily Log

(Summarize the procedure/activity observed, assisted, or performed, and also mention the remarks/learning outcomes)

Date	Department	Details	Sign

Academic Activities

Sr. no.	Date	Title	Topic	Details	Sign

Academic Activities

Cumulative list of abstracts presented at scientific meetings

Sr. no	Abstract

Note:
Abstracts to be enclosed

Academic Activities

1. Cumulative list of peer reviewed published papers in national / international journals

Sr. no	Details

Note:
Published manuscript to be provided

PROGRAM OUTCOME	
Course Code	M.Sc. MEDICAL PHYSICS
PO1	**Fundamental Knowledge :** Apply advanced knowledge of physics, anatomy, physiology, and radiation physics to understand and solve problems in medical physics and healthcare.
PO2	**Radiation Physics and Dosimetry :** Demonstrate expertise in the principles and applications of radiation physics, dosimetry, and the safe use of ionizing and non-ionizing radiation in medical diagnosis and therapy.
PO3	**Clinical Application :** Apply medical physics principles in clinical settings, including radiology, radiation therapy, nuclear medicine, and radiation protection, ensuring accuracy and safety in patient care.
PO4	**Regulatory Compliance and Safety:** Understand and comply with national and international regulations (e.g., AERB, IAEA) regarding radiation safety, protection, and medical equipment quality assurance.
PO5	**Problem Solving and Analytical Skills** : Analyze clinical and technical problems critically and develop evidence-based solutions in medical physics practices and research.
PO6	**Technical Proficiency** : Operate and perform quality assurance on sophisticated medical imaging and radiation therapy equipment such as LINACs, CT scanners, MRI, PET-CT, and treatment planning systems.
PO7	**Research and Development :** Engage in scientific research, data analysis, and development of new technologies in medical physics, contributing to innovations in medical diagnostics and therapy.
PO8	**Communication and Collaboration :** Communicate effectively with clinicians, technologists, and healthcare teams, and provide expert consultation on radiation safety and treatment planning.
PO9	**Ethical and Professional Responsibility :** Demonstrate high ethical standards, responsibility, and commitment to lifelong learning in the field of medical physics.
COURSE OUTCOMES (COs)	
Course Code	M.Sc. MEDICAL PHYSICS
SEMESTER I	
MMP 101 L	**Applied Mathematics**
CO1	Understand vector analysis in various coordinate systems to apply in radiation physics and dosimetry.
CO2	Apply eigenvalue problems and matrix methods in solving radiation transport equations.
CO3	Use complex functions and contour integration in solving medical imaging and wave equations.
CO4	Utilize orthonormal series and special functions in data modeling and Fourier applications in radiology.
CO5	Model boundary value problems in radiation diffusion and heat transfer simulations.
CO6	Use Laplace and Fourier transforms for system analysis and signal processing in diagnostics.
CO7	Apply symmetry and group theoretical methods in nuclear and atomic structure analysis.
C08	Perform stochastic modeling and error analysis in radiation measurement and dosimetry.
MMP 102 L	**Solid State Physics**
CO1	Analyze electron behavior in metals for electrical and thermal conductivity understanding in RT devices.
CO2	Interpret material structures used in detectors and shielding via diffraction techniques.
CO3	Calculate binding energy of solids to assess material suitability in equipment design.
CO4	Understand band gap and charge transport relevant for semiconductors in detectors.
CO5	Evaluate semiconductor properties for radiation sensors and dosimetry.
CO6	Examine heat transport in solid materials relevant for radiation protection.
CO7	Apply concepts like Landau levels and Hall effects in detector physics.
CO8	Understand magnetic materials used in shielding and MRI

CO9	Analyze low-resistance materials in advanced medical imaging systems.
MMP 103 L	**Nuclear Physics**
CO1	Evaluate nuclide stability for therapeutic and diagnostic isotope selection.
CO2	Apply nuclear force models in reactor physics and shielding design.
CO3	Understand energy release and fission principles used in isotope production.
CO4	Analyze nuclear energy levels and spin for radiation emission prediction.
CO5	Apply scattering and reaction cross-section knowledge in therapy planning.
CO6	Classify fundamental particles for applications in PET/SPECT physics.
C07	Understand beta decay and neutrino interactions in medical isotope use.
MMP 104 L	**Fundamentals of computers and programming applications**
CO1	Design and analyze digital circuits used in imaging and therapy equipment.
CO2	Apply stochastic simulation in radiation interaction modeling and dosimetry.
CO3	Use MS Office, MATLAB, and SPSS for documentation, data analysis, and plotting in research.
CO4	Solve medical physics-related numerical problems using C++ and MATLAB.
CO5	Understand AI applications in image analysis, treatment planning, and workflow optimization.
CC 001 L	**Research Methodology and Biostatistics**
CO1	Students will be able to understand statistical models, research designs with the understanding of background theory of various commonly used statistical techniques as well as analysis, interpretation & reporting of results and use of statistical software
MMP 105 P	**Solid State Physics**
CO1	Understand the working principles and handling of basic solid-state physics instruments.
CO2	Acquire practical skills in measuring and analyzing properties of solid materials.
CO3	Apply experimental techniques to support theoretical concepts relevant to radiological technology.
MMP 106 CP	**Physics Directed Clinical Education I**
CO1	Operate TPS software for site-specific cancer planning.
CO2	Assist in simulation and contouring procedures.
CO3	Participate in daily, monthly, and annual QA of LINAC and imaging systems.
CO4	Contribute to patient-specific and phantom dosimetry.
CO5	Maintain treatment records, prescriptions, and procedural logs.
CO6	Work with oncologists, technologists in treatment delivery.
CO7	Understand and adhere to AERB standards and requirements
CC 001 P	**Research Methodology and Biostatistics**
CO1	Understand and apply basic research designs and statistical models in scientific studies.
CO2	Analyze, interpret, and report research data using appropriate statistical techniques.
CO3	Gain hands-on experience with statistical software for data analysis and presentation.
SEMESTER II	

MMP 107 L	Medical Imaging
CO1	Evaluate image quality, dose, and equipment parameters in diagnostic imaging.
CO2	Understand CT physics and apply appropriate protocols in oncology imaging.
CO3	Analyze MR physics, sequences, and safety for oncology applications.
CO4	Understand SPECT/PET imaging and tracer kinetics in cancer diagnosis.
CO5	Implement safety protocols in diagnostic departments.
MMP 108 L	**Nuclear Electronics and Instrumentation**
CO1	Understand the working principles of nuclear instrumentation systems and electronic components used in radiation detection.
CO2	Perform experiments using detectors, pulse processing units, and counting systems to analyze nuclear radiation.
CO3	Apply calibration and measurement techniques for radiation detectors and evaluate data accuracy.
CO4	Demonstrate hands-on skills in handling nuclear electronics instruments like GM counters, scintillation counters, and multichannel analyzers.
CO5	Interpret experimental results, troubleshoot circuit setups, and maintain laboratory safety protocols.
MMP 109 L	**Radiation Therapy I**
CO1	Compare various modalities (Co-60, LINAC) and apply dosimetry protocols.
CO2	Use TAR, TMR, PDD in treatment plan verification.
CO3	Understand isodose planning and brachytherapy procedures
CO4	Operate TPS software for patient-specific plan generation.
MMP 110 L	**Electrodynamics**
CO1	Analyze electrostatic fields in shielding and imaging systems.
CO2	Model field behavior in patient interfaces and detectors.
CO3	Apply solution methods for potential distribution analysis in detectors.
CO4	Evaluate dielectric materials used in imaging and shielding
CO5	Interpret current-induced magnetic fields in therapy coils and LINACs.
CO6	Predict charged particle paths for dose deposition analysis.
CO7	Model wave propagation in tissues and imaging modalities.
CO8	Analyze energy loss and emission patterns in accelerators.
MMP 111 L	**Clinical and Radiation Biology**
CO1	Understand cell structure, DNA repair mechanisms, and cell death post-irradiation
CO2	Identify organ systems, their function, and relevance in radiology.
CO3	Analyze radiation-induced changes and models of survival curves.
CO4	Differentiate between somatic and genetic effects of radiation.
CO5	Understand the clinical aspects of treatment delivery and side effects.
CO6	Apply models like NSD, TDF to optimize radiotherapy schedules.
MMP 112 P	**Nuclear Electronics and Instrumentation**
CO1	Identify and understand the functions of basic nuclear electronic components and modules.

CO2	Set up and operate radiation detection systems like GM counters and scintillation detectors.
CO3	Analyze pulse height spectra using Single and Multi-Channel Analyzers.
CO4	Calibrate detectors and interpret measurements with accuracy and precision.
CO5	Apply radiation safety measures and standard laboratory protocols during experiments.
MMP 113 P	**Radiation Therapy I**
CO1	Understand and demonstrate the setup of teletherapy and brachytherapy treatment units.
CO2	Perform treatment planning simulations and field arrangements for different cancer sites.
CO3	Apply dosimetry principles in clinical practice using phantom measurements.
CO4	Operate treatment planning systems and evaluate dose distribution.
CO5	Follow radiation safety and quality assurance protocols during clinical procedures.

MMP 114 CP	**Physics Directed Clinical Education II**
CO1	Students will gain additional clinical skills in this program to increase the role of Radiation Therapy in the practice of Oncology and disease prevention by providing a unique combination of educational experiences to students.
CO2	The students will be exposed to both clinical and academic aspects of Radiation Therapy.
SEC 001 L	**Innovation and Entrepreneurship**
CO1	Students will grasp the concepts of innovation, its ecosystem, and the role of various stakeholders such as government policies, startups, and innovation hubs.
CO2	Cultivating an entrepreneurial mindset and leadership qualities necessary for driving innovation and leading ventures.
CO3	Understanding the intersection of technology and innovation and leveraging emerging technologies for entrepreneurial ventures.
SEC 002 L	**One Health (NPTEL)**
CO1	A comprehensive understanding of One Health's role in global health challenges, emphasizing interconnectedness among human, animal, and environmental health
CO2	Topics include research ethics, disease surveillance, and successes in controlling emerging infectious diseases.
CO3	Students explore disease emergence, transmission, antimicrobial resistance, and food safety, gaining insights into effective public health strategies
SEMESTER III	
MMP 115 L	**Radiation Safety**
CO1	Identify potential hazards and categorize different types of radiation exposure.
CO2	Apply ALARA principles and implement safety measures.
CO3	Design shielding for diagnostic and therapeutic facilities.
CO4	Operate personnel and area monitoring devices like TLDs, GM counters.
CO5	Interpret AERB, ICRP, and BARC guidelines for radiation workers.
CO6	Handle and dispose of radioactive waste safely in medical facilities.
MMP 116 L	**Radiation Physics & Radiation Generators**
CO1	Understand the fundamental principles of radioactivity, types of radiation, decay mechanisms, and their significance in nuclear physics.
CO2	Analyze the working principles, types, and applications of various particle accelerators and their relevance in medical and industrial fields.
CO3	Describe the design, function, and safety aspects of medical and industrial X-ray generators, including modern imaging systems.
CO4	Explain the interactions of different types of radiation (electromagnetic, charged particles, and neutrons) with matter, including attenuation, ionization, and energy transfer processes.
CO5	Apply the concepts of radiation physics to assess the behavior and penetration of radiation in various media, relevant to radiological and clinical applications.
MMP 117 L	**Radiation Dosimetry and Standardization**
CO1	Calculate dose quantities and conversions used in treatment planning.
CO2	Identify and characterize clinical radiation sources.
CO3	Apply Bragg-Gray theory and CPE for dose calibration.
CO4	Operate and interpret measurements from ion chambers.
CO5	Use passive dosimeters for patient and phantom measurements.
CO6	Select appropriate dosimeters based on clinical requirements.
CO7	Implement guidelines in QA processes.

MMP 118 L	**Radiation Therapy II**
CO1	Understand the principles, classification, and techniques of brachytherapy, including source characteristics and dose rate systems.
CO2	Apply dosimetry concepts and protocols such as TG-43, ICRU, and TECDOC standards in brachytherapy planning and source calibration.
CO3	Analyze the functioning, QA, and regulatory requirements of manual and remote afterloading systems and integrated brachytherapy units.
CO4	Evaluate the role of computers in radiotherapy treatment planning, including algorithms, optimization, DICOM standards, and QA protocols
CO5	Demonstrate knowledge of advanced brachytherapy techniques such as image-guided planning, electronic and intravascular brachytherapy with clinical applications.
MMP 119	**Dissertation/Project**
CO1	To introduce students to the fundamentals of research methodology and scientific writing.
CO2	To encourage independent project work in advanced topics of medical physics.
CO3	To enhance analytical, problem-solving, and technical documentation skills.
CO4	To promote collaboration with research institutes, hospitals, or industries.
CO5	To train students in presenting and defending their research through seminars and viva-voce.
MMP 120 P	**Radiation safety**
CO1	Identify potential hazards and categorize different types of radiation exposure.
CO2	Apply ALARA principles and implement safety measures.
CO3	Design shielding for diagnostic and therapeutic facilities.
CO4	Operate personnel and area monitoring devices like TLDs, GM counters.
CO5	Interpret AERB, ICRP, and BARC guidelines for radiation workers.
CO6	Handle and dispose of radioactive waste safely in medical facilities.
MMP 121 P	**Radiation dosimetry and standardization**
CO1	Calculate dose quantities and conversions used in treatment planning.
CO2	Identify and characterize clinical radiation sources.
CO3	Apply Bragg-Gray theory and CPE for dose calibration.
CO4	Operate and interpret measurements from ion chambers.
CO5	Use passive dosimeters for patient and phantom measurements.
CO6	Implement guidelines in QA processes.
MMP 122 CP	**Physics Directed Clinical Education III**
CO1	Students will gain additional clinical skills in this program to increase the role of Radiation Therapy in the practice of Oncology and disease prevention by providing a unique combination of educational experiences to students.
CO2	The students will be exposed to both clinical and academic aspects of Radiation Therapy. To provide hands-on experience in Quality Assurance of radiotherapy and diagnostic equipment.
SEMESTER IV	
MMP 123 L	**Quality Assurance**
CO1	Learn and acquire practical knowledge about various national and international dosimetry protocols and guidelines
CO2	Use IAEA guidance for standardized QA audits.
CO3	Perform QA of LINACs, beam symmetry, flatness, and output.

CO4	Verify source strength, geometry, and TPS calculations.
CO5	Evaluate CT, MRI, and simulator equipment for compliance.
CO6	Validate algorithm accuracy and commissioning of TPS.
CO7	Contribute to institutional and national dosimetry audits.Maintain AERB-compliant records and logs.
GE 001 L	**Pursuit of Inner self Excellence (POISE)**
CO1	Students will become self dependent, more decisive and develop intuitive ability for their study and career related matter.
CO2	Students ability to present their ideas will be developed.
CO3	Enhanced communication skills, public speaking & improved Presentation ability.
CO4	Students will be able to explore their inner potential and inner ability to become a successful researcher or technician & hence become more focused
CO5	Students will observe significant reduction in stress level.
CO6	With the development of personal attributes like Empathy, Compassion, Service, Love & brotherhood, students will serve the society and industry in better way with teamwork and thus grow professionally.
GE 002 L	**Bioethics, Biosafety, IPR and Technology Transfer**
CO1	Effectively manage the health and safety aspects of a biological laboratory.
CO2	Give reliable, professional and informed advice and information to colleagues and managers.
CO3	Help to ensure that their institution complies with relevant legislation, liaise effectively with enforcing authorities and beware of the penalties for failing to comply.
CO4	Build a context of understanding through communication.
CO5	Mediate between other conflicting parties.
CO6	Exhibit de – escalatory behaviours in situations of conflict.
CO7	Demonstrate acknowledgment and validation of the feelings, opinions, and contributions of others.
GE 003 L	**Disaster Management and Mitigation Resources**
CO1	Knowledge and understanding of the disaster phenomenon, its different contextual aspects, impacts and public health consequences.
CO2	Knowledge and understanding of the International Strategy for Disaster Reduction (UNISDR) and to increase skills and abilities for implementing the Disaster Risk Reduction (DRR) Strategy.
CO3	Ensure skills and abilities to analyze potential effects of disasters and of the strategies and methods to deliver public health response to avert these effects.
GE 004 L	**Human Rights**
CO1	identify, contextualize and use information about the human rights situationin a given country
CO2	critically appraise source material, including cases from human rights committees and tribunals and reports and summary records from treaty bodies
CO3	analyze a country's situation or an international situation in terms of human rights and formulate human rights-based initiatives and policies
CO4	Promote human rights through legal as well as non-legal means.
CO5	Participate in legal, political and other debates involving human rights inacknowledgeable and constructive way
MMP 124 P	**Quality Assurance**
CO1	Learn and acquire practical knowledge about various national and international dosimetry protocols and guidelines
CO2	Use IAEA guidance for standardized QA audits.
CO3	Perform QA of LINACs, beam symmetry, flatness, and output.
CO4	Verify source strength, geometry, and TPS calculations.
CO5	Evaluate CT, MRI, and simulator equipment for compliance.
CO6	Validate algorithm accuracy and commissioning of TPS.

CO7	Contribute to institutional and national dosimetry audits.Maintain AERB-compliant records and logs.
MMP 125 CP	**Physics Directed Clinical Education IV**
CO1	Students will gain additional clinical skills in this program to increase the role of Radiation Therapy in the practice of Oncology and disease prevention by providing a unique combination of educational experiences to students.
CO2	The students will be exposed to both clinical and academic aspects of Radiation Therapy.
MMP 126	**Dissertation/Project**
CO1	To introduce students to the fundamentals of research methodology and scientific writing.
CO2	To encourage independent project work in advanced topics of medical physics.
CO3	To enhance analytical, problem-solving, and technical documentation skills.
CO4	To promote collaboration with research institutes, hospitals, or industries.
CO5	To train students in presenting and defending their research through seminars and viva-voce.

MGM SCHOOL OF BIOMEDICAL SCIENCES, NAVI MUMBAI
(A constituent unit of MGM INSTITUTE OF HEALTH SCIENCES)

(Deemed University u/s 3 of UGC Act 1956)
Grade "A++" Accredited by NAAC
Sector 1, Kamothe Navi Mumbai-410209, Tel.No.:022-27437631,27432890
Email. sbsnm@mgmuhs.com / Website : www.mgmsbsnm.edu.in

CO PO Mapping
Programe - M.Sc. Medical Physics
Semester I and II

PO1.	**Fundamental Knowledge**Apply advanced knowledge of physics, anatomy, physiology, and radiation physics to understand and solve problems in medical physics and healthcare.
PO2.	**Radiation Physics and Dosimetry**Demonstrate expertise in the principles and applications of radiation physics, dosimetry, and the safe use of ionizing and non-ionizing radiation in medical diagnosis and therapy.
PO3.	**Clinical Application**Apply medical physics principles in clinical settings, including radiology, radiation therapy, nuclear medicine, and radiation protection, ensuring accuracy and safety in patient care.
PO4.	**Regulatory Compliance and Safety**Understand and comply with national and international regulations (e.g., AERB, IAEA) regarding radiation safety, protection, and medical equipment quality assurance.
PO5.	**Problem Solving and Analytical Skills**Analyze clinical and technical problems critically and develop evidence-based solutions in medical physics practices and research.
PO6.	**Technical Proficiency**Operate and perform quality assurance on sophisticated medical imaging and radiation therapy equipment such as LINACs, CT scanners, MRI, PET-CT, and treatment planning systems.
PO7.	**Research and Development**Engage in scientific research, data analysis, and development of new technologies in medical physics, contributing to innovations in medical diagnostics and therapy.
PO8.	**Communication and Collaboration**Communicate effectively with clinicians, technologists, and healthcare teams, and provide expert consultation on radiation safety and treatment planning.
P09.	**Ethical and Professional Responsibility**Demonstrate high ethical standards, responsibility, and commitment to lifelong learning in the field of medical physics.

PO Mapping same with correlation level 3,2,1 The notation of 1 - low, 2 - moderate , 3 - high

Semester	Course / Course Code	Course Outcome	Course Outcome	Fundamental Knowledge	Radiation Physics and Dosimetry	Clinical Application	Regulatory Compliance and Safety	Problem Solving and Analytical Skills	Technical Proficiency	Research and Development	Communication and Collaboration	Ethical and Professional Responsibility	Average
				PO1	P02	PO3	PO4	PO5	PO6	PO7	PO8	PO9	
	Applied Mathematics MMP 101 L	CO1	Understand vector analysis in various coordinate systems to apply in radiation physics and dosimetry.	3	1	2	1	3	2	2	1	1	1'8
		CO2	Apply eigenvalue problems and matrix methods in solving radiation transport equations.	3	2	2	3	3	1	2	1	1	2'0
		CO3	Use complex functions and contour integration in solving medical imaging and wave equations.	3	0	2	0	3	3	2	1	1	1'7
		CO4	Utilize orthonormal series and special functions in data modeling and Fourier applications in radiology.	3	1	2	0	3	2	2	1	1	1'7
		CO5	Model boundary value problems in radiation diffusion and heat transfer simulations.	3	0	2	0	3	1	2	1	1	1'4
		CO6	Use Laplace and Fourier transforms for system analysis and signal processing in diagnostics.	3	0	2	0	3	2	2	1	1	1'6
		CO7	Apply symmetry and group theoretical methods in nuclear and atomic structure analysis.	3	0	2	0	3	0	2	1	1	1'3
		CO8	Perform stochastic modeling and error analysis in radiation measurement and dosimetry.	3	1	2	3	3	3	2	1	1	2'1
		Average		3'0	0'6	2'0	0'9	3'0	1'8	2'0	1'0	1'0	1'7
		CO1	Analyze electron behavior in metals for electrical and thermal conductivity understanding in RT devices.	3	1	3	1	3	3	3	1	1	2'1

	Solid State Physics MMP 102 L	CO2	Interpret material structures used in detectors and shielding via diffraction techniques.	3	1	3	1	1	3	3	1	2	2'0
		CO3	Calculate binding energy of solids to assess material suitability in equipment design.	3	0	3	1	3	3	2	1	1	1'9
		CO4	Understand band gap and charge transport relevant for semiconductors in detectors.	3	0	3	1	3	3	2	1	1	1'9
		CO5	Evaluate semiconductor properties for radiation sensors and dosimetry.	3	3	3	3	3	3	3	1	1	2'6
		CO6	Examine heat transport in solid materials relevant for radiation protection.	3	1	3	3	3	3	2	1	1	2'2
		CO7	Apply concepts like Landau levels and Hall effects in detector physics.	3	3	3	0	3	3	2	1	1	2'1
		CO8	Understand magnetic materials used in shielding and MRI	3	1	3	3	3	3	2	1	1	2'2
		CO9	Analyze low-resistance materials in advanced medical imaging systems.	3	2	3	0	3	3	3	1	1	2'1
		Average		3	0'666666667	3	1	2'333333333	3	2'666666667	1	1'333333333	2'0
	Nuclear Physics MMP 103 L	CO1	Evaluate nuclide stability for therapeutic and diagnostic isotope selection.	3	3	3	3	3	3	3	1	2	2'7
		CO2	Apply nuclear force models in reactor physics and shielding design.	3	3	3	3	3	3	2	1	1	2'4
		CO3	Understand energy release and fission principles used in isotope production.	3	3	3	3	3	3	3	1	2	2'7
		CO4	Analyze nuclear energy levels and spin for radiation emission prediction.	3	3	3	3	3	3	2	1	2	2'6
		CO5	Apply scattering and reaction cross-section knowledge in therapy planning.	3	3	3	3	3	3	3	1	2	2'7
		CO6	Classify fundamental particles for applications in PET/SPECT physics.	3	3	3	3	3	3	2	1	3	2'7
Semester 1		CO7	Understand beta decay and neutrino interactions in medical isotope use.	3	3	3	3	3	3	3	1	2	2'7
		Average		3	3	3	3	3	3	2'571428571	1	2	2'6
	Fundamentals of computers and programming applications MMP 104 L	CO1	Design and analyze digital circuits used in imaging and therapy equipment.	3	0	3	0	3	3	0	1	1	1'6
		CO2	Apply stochastic simulation in radiation interaction modeling and dosimetry.	3	2	3	2	3	3	3	1	1	2'3
		CO3	Use MS Office, MATLAB, and SPSS for documentation, data analysis, and plotting in research.	3	0	2	0	3	3	0	3	2	1'8
		CO4	Solve medical physics-related numerical problems using C++ and MATLAB.	3	0	3	0	3	3	2	1	1	1'8
		CO5	Understand AI applications in image analysis, treatment planning, and workflow optimization.	3	2	3	2	3	3	2	1	2	2'3
		Average		3'0	0'8	2'8	0'8	3'0	3'0	1'4	1'4	1'4	2'0
	Research Methodology and Biostatistics CC 001 L	CO1	Student will be able to understand develop statistical models, research designs with the understating of background theory of various commonly used statistical techniques as well as analysis, interpretation & reporting of results and use of statistical software.	3	0	0	0	3	3	3	0	3	1'7
		Average		3	3	3	2	3	3	1	2	1	2'2
	Solid State Physics MMP 105 P	CO1	Understand the working principles and handling of basic solid-state physics instruments.	3	1	2	0	2	3	2	0	1	1'6
		CO2	Acquire practical skills in measuring and analyzing properties of solid materials.	3	1	2	0	2	3	2	0	1	1'6
		CO3	Apply experimental techniques to support theoretical concepts relevant to radiological technology.	3	1	2	0	2	3	2	0	1	1'6
		Average		3	1	2	0	2	3	2	0	1	1'6

Physics Directed Clinical Education I MMP 106 CP	CO1	Operate TPS software for site-specific cancer planning	3	3	3	1	3	2	2	1	1	2'1
	CO2	Assist in simulation and contouring procedures.	3	2	3	3	3	3	0	3	1	2'3
	CO3	Participate in daily, monthly, and annual QA of LINAC and imaging systems.	3	3	3	2	3	2	2	3	3	2'7
	CO4	Contribute to patient-specific and phantom dosimetry.	3	3	3	3	3	3	3	3	3	3'0
	CO5	Maintain treatment records, prescriptions, and procedural logs.	3	0	3	3	3	2	0	0	3	1'9
	CO6	Work with oncologists, technologists in treatment delivery.	1	1	3	3	3	3	0	3	3	2'2
	CO7	Understand and adhere to AERB standards and requirements	3	3	3	3	3	3	0	3	3	2'7
	Average		3'0	2'5	3'0	2'0	3'0	2'5	1'0	2'0	1'0	2'2
Research Methodology and Biostatistics CC 001 P	CO1	Understand and apply basic research designs and statistical models in scientific studies.	3	0	2	1	3	2	3	1	3	2'0
	CO2	Analyze, interpret, and report research data using appropriate statistical techniques.	3	0	2	1	3	2	3	1	3	2'0
	CO3	Gain hands-on experience with statistical software for data analysis and presentation.	3	0	2	1	3	2	3	1	3	2'0
	Average		3	0	2	1	3	2	3	1	3	2'0
Medical Imaging MMP 107 L	CO1	Evaluate image quality, dose, and equipment parameters in diagnostic imaging.	3	3	3	2	1	3	3	0	2	2'2
	CO2	Understand CT physics and apply appropriate protocols in oncology imaging.	3	3	3	2	3	3	3	1	2	2'6
	CO3	Analyze MR physics, sequences, and safety for oncology applications.	3	3	3	2	3	3	3	0	2	2'4
	CO4	Understand SPECT/PET imaging and tracer kinetics in cancer diagnosis.	3	3	3	2	3	3	3	0	2	2'4
	CO5	Implement safety protocols in diagnostic departments.	3	3	3	2	3	3	3	3	3	2'9
	Average		3'0	3'0	3'0	2'0	2'3	3'0	3'0	0'3	2'0	2'4
Nuclear Electronics and Instrumentation MMP 108 L	CO1	Understand the working principles of nuclear instrumentation systems and electronic components used in radiation detection.	3	3	3	0	2	3	3	0	2	2'1
	CO2	Perform experiments using detectors, pulse processing units, and counting systems to analyze nuclear radiation.	3	3	3	0	2	3	3	0	2	2'1
	CO3	Apply calibration and measurement techniques for radiation detectors and evaluate data accuracy.	3	3	3	2	3	3	3	2	2	2'7
	CO4	Demonstrate hands-on skills in handling nuclear electronics instruments like GM counters, scintillation counters, and multichannel analyzers.	3	3	3	0	2	3	3	0	2	2'1
	CO5	Interpret experimental results, troubleshoot circuit setups, and maintain laboratory safety protocols.	3	3	3	3	3	3	3	0	2	2'6
	Average		3'0	3'0	3'0	1'0	2'4	3'0	3'0	0'4	2'0	2'3
Radiation Therapy I MMP 109 L	CO1	Compare various modalities (Co-60, LINAC) and apply dosimetry protocols.	3	3	2	2	3	3	2	2	3	2'6
	CO2	Use TAR, TMR, PDD in treatment plan verification.	3	3	3	2	3	3	2	2	3	2'7
	CO3	Understand isodose planning and brachytherapy procedures	3	3	3	2	3	3	2	2	3	2'7
	CO4	Operate TPS software for patient-specific plan generation.	3	3	3	2	3	3	2	2	3	2'7
	Average		3	3	2'666666667	2	3	3	2	2	3	2'6

Semester 2	Electrodynamics MMP 110 L	CO1	Analyze electrostatic fields in shielding and imaging systems.	3	3	1	2	3	3	2	0	1	2'0
		CO2	Model field behavior in patient interfaces and detectors.	3	1	1	1	3	3	3	1	1	1'9
		CO3	Apply solution methods for potential distribution analysis in detectors.	3	1	1	1	3	3	3	1	1	1'9
		CO4	Evaluate dielectric materials used in imaging and shielding.	3	1	1	1	3	3	3	1	1	1'9
		CO5	Interpret current-induced magnetic fields in therapy coils and LINACs.	3	1	1	1	3	3	3	1	1	1'9
		CO6	Predict charged particle paths for dose deposition analysis.	3	1	1	1	3	3	3	1	1	1'9
		CO7	Model wave propagation in tissues and imaging modalities.	3	1	1	1	3	3	3	1	1	1'9
		CO8	Analyze energy loss and emission patterns in accelerators.	3	1	1	1	3	3	3	1	1	1'9
		Average		3'0	2'0	1'0	1'5	3'0	3'0	2'5	0'5	1'0	1'9
	Clinical and Radiation Biology MMP 111 L	CO1	Understand cell structure, DNA repair mechanisms, and cell death post-irradiation	3	0	3	0	0	0	3	0	3	1'3
		CO2	Identify organ systems, their function, and relevance in radiology.	3	1	3	0	0	0	3	0	3	1'4
		CO3	Analyze radiation-induced changes and models of survival curves.	3	1	3	0	0	0	3	0	3	1'4
		CO4	Differentiate between somatic and genetic effects of radiation.	3	1	3	0	0	0	3	0	3	1'4
		CO5	Understand the clinical aspects of treatment delivery and side effects.	3	1	3	0	0	0	3	0	3	1'4
		CO6	Apply models like NSD, TDF to optimize radiotherapy schedules.	3	1	3	0	0	0	3	0	3	1'4
		Average		3'0	0'8	3'0	0'0	0'0	0'0	3'0	0'0	3'0	1'4
	Nuclear Electronics and Instrumentation MMP 112 P	CO1	Identify and understand the functions of basic nuclear electronic components and modules.	3	2	2	0	3	2	2	0	0	1'6
		CO2	Set up and operate radiation detection systems like GM counters and scintillation detectors.	3	2	2	0	3	3	2	0	0	1'7
		CO3	Analyze pulse height spectra using Single and Multi-Channel Analyzers.	3	2	2	0	3	3	2	0	0	1'7
		CO4	Calibrate detectors and interpret measurements with accuracy and precision.	3	2	2	0	3	3	2	0	0	1'7
		CO5	Apply radiation safety measures and standard laboratory protocols during experiments.	3	2	2	0	3	3	2	0	0	1'7
		Average		3'0	2'0	2'0	0'0	3'0	2'7	2'0	0'0	0'0	1'6
	Radiation Therapy I MMP 113 P	CO1	Understand and demonstrate the setup of teletherapy and brachytherapy treatment units.	3	3	3	3	3	2	3	2	2	2'7
		CO2	Perform treatment planning simulations and field arrangements for different cancer sites.	3	3	3	3	3	2	3	2	2	2'7
		CO3	Apply dosimetry principles in clinical practice using phantom measurements.	3	3	3	3	3	2	3	2	2	2'7
		CO4	Operate treatment planning systems and evaluate dose distribution.	3	3	3	3	3	2	3	2	2	2'7
		CO5	Follow radiation safety and quality assurance protocols during clinical procedures.	3	3	3	3	3	2	3	2	2	2'7
		Average		3'0	3'0	3'0	3'0	3'0	2'0	3'0	2'0	2'0	2'7
	Physics Directed Clinical Education II MMP 114 CP	CO1	Students will gain additional clinical skills in this program to increase the role of Radiation Therapy in the practice of Oncology and disease prevention by providing a unique combination of educational experiences to students.	3	3	3	3	2	3	3	2	3	2'8
		CO2	The students will be exposed to both clinical and academic aspects of Radiation Therapy.	3	3	3	3	2	3	3	2	3	2'8

	Average		3'0	2'0	2'7	1'1	1'9	1'7	2'7	0'8	1'9	2'0
Innovation and Entrepreneurship SEC 001 L	CO1	Students will grasp the concepts of innovation, its ecosystem, and the role of various stakeholders such as government policies, startups, and innovation hubs.	2	0	0	3	2	0	0	3	3	1'4
	CO2	Cultivating an entrepreneurial mindset and leadership qualities necessary for driving innovation and leading ventures.	2	0	0	3	2	0	0	3	3	1'4
	CO3	Understanding the intersection of technology and innovation and leveraging emerging technologies for entrepreneurial ventures.	2	0	0	3	2	0	0	3	3	1'4
	Average		2'0	0'0	0'0	3'0	2'0	0'0	0'0	3'0	3'0	1'4
One Health (NPTEL) SEC 002 L	CO1	A comprehensive understanding of One Health's role in global health challenges, emphasizing interconnectedness among human, animal, and environmental health	1	0	0	0	0	0	3	3	3	1'1
	CO2	Topics include research ethics, disease surveillance, and successes in controlling emerging infectious diseases.	1	0	0	0	0	0	3	3	3	1'1
	CO3	Students explore disease emergence, transmission, antimicrobial resistance, and food safety, gaining insights into effective public health strategies	1	0	0	0	0	0	3	3	3	1'1
	Average		1'0	0'0	0'0	0'0	0'0	0'0	3'0	3'0	3'0	1'1
Radiation Safety MMP 115 L	CO1	Identify potential hazards and categorize different types of radiation exposure.	3	3	3	3	2	3	3	3	3	2'9
	CO2	Apply ALARA principles and implement safety measures.	3	3	3	3	2	3	3	3	3	2'9
	CO3	Design shielding for diagnostic and therapeutic facilities.	3	3	3	3	2	3	3	3	3	2'9
	CO4	Operate personnel and area monitoring devices like TLDs, GM counters.	3	3	3	3	2	3	3	3	3	2'9
	CO5	Interpret AERB, ICRP, and BARC guidelines for radiation workers.	3	3	3	3	2	3	3	3	3	2'9
	CO6	Handle and dispose of radioactive waste safely in medical facilities.	3	3	3	3	2	3	3	3	3	2'9
	Average		3'0	3'0	3'0	3'0	2'0	3'0	3'0	3'0	3'0	2'9
Radiation Physics & Radiation Generators MMP 116 L	CO1	Understand the fundamental principles of radioactivity, types of radiation, decay mechanisms, and their significance in nuclear physics.	3	3	3	3	3	3	3	3	3	3'0
	CO2	Analyze the working principles, types, and applications of various particle accelerators and their relevance in medical and industrial fields.	3	3	3	3	3	3	3	3	3	3'0
	CO3	Describe the design, function, and safety aspects of medical and industrial X-ray generators, including modern imaging systems.	3	3	3	3	3	3	3	3	3	3'0
	CO4	Explain the interactions of different types of radiation (electromagnetic, charged particles, and neutrons) with matter, including attenuation, ionization, and energy transfer processes.	3	3	3	3	3	3	3	3	3	3'0
	CO5	Apply the concepts of radiation physics to assess the behavior and penetration of radiation in various media, relevant to radiological and clinical applications	3	3	3	3	3	3	3	3	3	3'0
	Average		3'0	3'0	3'0	3'0	3'0	3'0	3'0	3'0	3'0	3'0

Semester 3	MMP 117 L Radiation Dosimetry and Standardization	CO1	Calculate dose quantities and conversions used in treatment planning.	3	3	3	3	3	3	3	3	3	3'0
		CO2	Identify and characterize clinical radiation sources.	3	3	3	3	3	3	3	3	3	3'0
		CO3	Apply Bragg-Gray theory and CPE for dose calibration.	3	3	3	3	3	3	3	3	3	3'0
		CO4	Operate and interpret measurements from ion chambers.	3	3	3	3	3	3	3	3	3	3'0
		CO5	Use passive dosimeters for patient and phantom measurements.	3	3	3	3	3	3	3	3	3	3'0
		C06	Select appropriate dosimeters based on clinical requirements.	3	3	3	3	3	3	3	3	3	3'0
		C07	Implement guidelines in QA processes.	3	3	3	3	3	3	3	3	3	3'0
		Average		3	3	3	3	3	3	3	3	3	3'0
	MMP 118 L Radiation Therapy II	CO1	Understand the principles, classification, and techniques of brachytherapy, including source characteristics and dose rate systems.	3	3	3	3	3	3	3	3	3	3'0
		CO2	Apply dosimetry concepts and protocols such as TG-43, ICRU, and TECDOC standards in brachytherapy planning and source calibration.	3	3	3	3	3	3	3	3	3	3'0
		CO3	Analyze the functioning, QA, and regulatory requirements of manual and remote afterloading systems and integrated brachytherapy units.	3	3	3	3	3	3	3	3	3	3'0
		CO4	Evaluate the role of computers in radiotherapy treatment planning, including algorithms, optimization, DICOM standards, and QA protocols	3	3	3	3	3	3	3	3	3	3'0
		CO5	Demonstrate knowledge of advanced brachytherapy techniques such as image-guided planning, electronic and intravascular brachytherapy with clinical applications.	3	3	3	3	3	3	3	3	3	3'0
		Average		3'0	3'0	3'0	3'0	3'0	3'0	3'0	3'0	3'0	3'0
	MMP 122 CP Physics Directed Clinical Education III	CO1	Students will gain additional clinical skills in this program to increase the role of Radiation Therapy in the practice of Oncology and disease prevention by providing a unique combination of educational experiences to students.	3	3	3	3	2	3	3	2	3	2'8
		CO2	The students will be exposed to both clinical and academic aspects of Radiation Therapy.	3	3	3	3	2	3	3	2	3	2'8
		Average		3'0	3'0	3'0	3'0	2'0	3'0	3'0	2'0	3'0	2'8
	MMP 119 Dissertation/Project	CO1	To introduce students to the fundamentals of research methodology and scientific writing.	3	0	3	3	3	3	3	2	3	2'6
		CO2	To provide hands-on experience in Quality Assurance of radiotherapy and diagnostic equipment.	3	0	3	3	3	3	3	2	3	2'6
		CO3	To encourage independent project work in advanced topics of medical physics.	3	0	3	3	3	3	3	2	3	2'6
		CO4	To enhance analytical, problem-solving, and technical documentation skills.	3	0	3	3	3	3	3	2	3	2'6
		CO5	To promote collaboration with research institutes, hospitals, or industries.	3	0	3	3	3	3	3	2	3	2'6
		CO6	To train students in presenting and defending their research through seminars and viva-voce.	3	0	3	3	3	3	3	2	3	2'6
		Average		3'0	1'8	3'0	3'0	2'4	3'0	3'0	2'0	3'0	2'7
		CO1	Identify potential hazards and categorize different types of radiation exposure.	3	3	3	3	2	3	3	3	3	2'9

	MMP 120 P Radiation safety	CO2	Apply ALARA principles and implement safety measures.	3	3	3	3	2	3	3	3	3	2'9
		CO3	Design shielding for diagnostic and therapeutic facilities.	3	3	3	3	2	3	3	3	3	2'9
		CO4	Operate personnel and area monitoring devices like TLDs, GM counters.	3	3	3	3	2	3	3	3	3	2'9
		CO5	Interpret AERB, ICRP, and BARC guidelines for radiation workers.	3	3	3	3	2	3	3	3	3	2'9
		CO6	Handle and dispose of radioactive waste safely in medical facilities.	3	3	3	3	2	3	3	3	3	2'9
		Average		3'0	3'0	3'0	3'0	2'0	3'0	3'0	3'0	3'0	2'9
	MMP 121 P Radiation dosimetry and standardization	CO1	Calculate dose quantities and conversions used in treatment planning.	3	3	3	3	2	3	3	3	3	2'9
		CO2	Identify and characterize clinical radiation sources.	3	3	3	3	2	3	3	3	3	2'9
		CO3	Apply Bragg-Gray theory and CPE for dose calibration.	3	3	3	3	2	3	3	3	3	2'9
		CO4	Operate and interpret measurements from ion chambers.	3	3	3	3	2	3	3	3	3	2'9
		CO5	Use passive dosimeters for patient and phantom measurements.	3	3	3	3	2	3	3	3	3	2'9
		CO6	Select appropriate dosimeters based on clinical requirements.	3	3	3	3	2	3	3	3	3	2'9
		CO7	Implement guidelines in QA processes.	3	3	3	3	2	3	3	3	3	2'9
		Average		3'0	3'0	3'0	3'0	2'0	3'0	3'0	3'0	3'0	2'9
	MMP 123 L Quality Assurance	CO1	Learn and acquire practical knowledge about various national and international dosimetry protocols and guidelines	3	3	3	3	2	3	3	3	3	2'9
		CO2	Use IAEA guidance for standardized QA audits.	3	3	3	3	2	3	3	3	3	2'9
		CO3	Perform QA of LINACs, beam symmetry, flatness, and output.	3	3	3	3	2	3	3	3	3	2'9
		CO4	Verify source strength, geometry, and TPS calculations.	3	3	3	3	2	3	3	3	3	2'9
		CO5	Evaluate CT, MRI, and simulator equipment for compliance.	3	3	3	3	2	3	3	3	3	2'9
		CO6	Validate algorithm accuracy and commissioning of TPS.	3	3	3	3	2	3	3	3	3	2'9
		CO7	Contribute to institutional and national dosimetry audits.Maintain AERB-compliant records and logs.	3	3	3	3	2	3	3	3	3	2'9
		Average		3'0	3'0	3'0	3'0	2'0	3'0	3'0	3'0	3'0	2'9
	MMP 125 CP Physics Directed Clinical Education IV	CO1	Students will gain additional clinical skills in this program to increase the role of Radiation Therapy in the practice of Oncology and disease prevention by providing a unique combination of educational experiences to students.	3	3	3	3	2	3	3	2	3	2'8
		CO2	The students will be exposed to both clinical and academic aspects of Radiation Therapy. To provide hands-on experience in Quality Assurance of radiotherapy and diagnostic equipment.	3	3	3	3	2	3	3	2	3	2'8
		Average		3'0	3'0	3'0	3'0	2'0	3'0	3'0	2'0	3'0	2'8

	MMP 126 Dissertation/Project	CO1	To introduce students to the fundamentals of research methodology and scientific writing.	3	0	0	3	2	2	3	3	3	2'1
		CO2	To provide hands-on experience in Quality Assurance of radiotherapy and diagnostic equipment.	3	0	0	3	2	2	3	3	3	2'1
		CO3	To encourage independent project work in advanced topics of medical physics.	3	0	0	3	2	2	3	3	3	2'1
		CO4	To enhance analytical, problem-solving, and technical documentation skills.	3	0	0	3	2	2	3	3	3	2'1
		CO5	To promote collaboration with research institutes, hospitals, or industries.	3	0	0	3	2	2	3	3	3	2'1
		CO6	To train students in presenting and defending their research through seminars and viva-voce.	3	0	0	3	2	2	3	3	3	2'1
		Average		3	0	0	3	2	2	3	3	3	2'1
	GE 001 L Pursuit of Inner self Excellence (POISE)	CO1	Students will become self dependent, more decisive and develop intuitive ability for their study and career related matter.	2	0	0	0	2	0	0	3	3	1'1
		CO2	Students ability to present their ideas will be developed.	2	0	0	0	2	0	0	3	3	1'1
		CO3	Enhanced communication skills, public speaking & improved Presentation ability.	2	0	0	0	2	0	0	3	3	1'1
		CO4	Students will be able to explore their inner potential and inner ability to become a successful researcher or technician & hence become more focused	2	0	0	0	2	0	0	3	3	1'1
		CO5	Students will observe significant reduction in stress level.	2	0	0	0	2	0	0	3	3	1'1
		CO6	With the development of personal attributes like Empathy, Compassion, Service, Love & brotherhood, students will serve the society and industry in better way with teamwork and thus grow professionally.	2	0	0	0	2	0	0	3	3	1'1
Semester 4		Average		2'0	0'0	0'0	0'0	2'0	0'0	0'0	3'0	3'0	1'1
	GE 002 L Bioethics, Biosafety, IPR and Technology Transfer	CO1	Effectively manage the health and safety aspects of a biological laboratory.	2	0	0	0	2	3	0	3	3	1'4
		CO2	Give reliable, professional and informed advice and information to colleagues and managers.	2	0	0	0	2	3	0	3	3	1'4
		CO3	Help to ensure that their institution complies with relevant legislation, liaise effectively with enforcing authorities and beware of the penalties for failing to comply.	2	0	0	0	2	3	0	3	3	1'4
		CO4	Build a context of understanding through communication.	2	0	0	0	2	3	0	3	3	1'4
		CO5	Mediate between other conflicting parties.	2	0	0	0	2	3	0	3	3	1'4
		CO6	Exhibit de – escalatory behaviours in situations of conflict.	2	0	0	0	2	3	0	3	3	1'4
		CO7	Demonstrate acknowledgment and validation of the feelings, opinions, and contributions of others.	2	0	0	0	2	3	0	3	3	1'4
		Average		2'0	0'0	0'0	0'0	2'0	3'0	0'0	3'0	3'0	1'4
		CO1	Knowledge and understanding of the disaster phenomenon, its different contextual aspects, impacts and public health consequences.	2	0	0	0	2	3	0	3	3	1'4

GE 003 L Disaster Management and Mitigation Resources	CO2	Knowledge and understanding of the International Strategy for Disaster Reduction (UNISDR) and to increase skills and abilities for implementing the Disaster Risk Reduction (DRR) Strategy.	2	0	0	0	2	3	0	3	3	1'4
	CO3	Ensure skills and abilities to analyze potential effects of disasters and of the strategies and methods to deliver public health response to avert these effects.	2	0	0	0	2	3	0	3	3	
	Average		2'0	0'0	0'0	0'0	2'0	3'0	0'0	3'0	3'0	1'4
GE 004 L Human Rights	CO1	identify, contextualize and use information about the human rights situationin a given country	2	0	0	0	2	3	0	3	3	1'4
	CO2	critically appraise source material, including cases from human rights committees and tribunals and reports and summary records from treaty bodies	2	0	0	0	2	3	0	3	3	1'4
	CO3	analyze a country's situation or an international situation in terms of human rights and formulate human rights-based initiatives and policies	2	0	0	0	2	3	0	3	3	1'4
	CO4	Promote human rights through legal as well as non-legal means.	2	0	0	0	2	3	0	3	3	
	CO5	Participate in legal, political and other debates involving human rights inacknowledgeable and constructive way	2	0	0	0	2	3	0	3	3	
	Average		2'0	0'0	0'0	0'0	2'0	3'0	0'0	3'0	3'0	1'4
MMP 124 P Quality Assurance	CO1	Learn and acquire practical knowledge about various national and international dosimetry protocols and guidelines	3	3	3	3	3	3	3	3	3	3'0
	CO2	Use IAEA guidance for standardized QA audits.	3	3	3	3	3	3	3	3	3	3'0
	CO3	Perform QA of LINACs, beam symmetry, flatness, and output.	3	3	3	3	3	3	3	3	3	3'0
	CO4	Verify source strength, geometry, and TPS calculations.	3	3	3	3	3	3	3	3	3	3'0
	CO5	Evaluate CT, MRI, and simulator equipment for compliance.	3	3	3	3	3	3	3	3	3	3'0
	CO6	Validate algorithm accuracy and commissioning of TPS.	3	3	3	3	3	3	3	3	3	3'0
	CO7	Contribute to institutional and national dosimetry audits.Maintain AERB-compliant records and logs.	3	3	3	3	3	3	3	3	3	3'0
	Average		3'0	3'0	3'0	3'0	3'0	3'0	3'0	3'0	3'0	3'0

Director
MGM School of Biomedical Sciences
Kamothe, Navi Mumbai

MGM INSTITUTE OF HEALTH SCIENCES

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

Grade 'A' Accredited by NAAC

Sector-01, Kamothe, Navi Mumbai - 410209

Tel 022-27432471, 022-27432994, Fax 022-27431094

E-mail- registrar@mgmuhs.com Website : www.mgmuhs.com