

Semester Wise Lay out of Course of M.Sc Radiation and Medical Oncology

Semester No	Course Number	Course Title	Credits
First Semester	MS- 510	Introduction to Nuclear Technology	NC +IR
	Ms-521	Principles of Radiotherapy and Cancer Chemotherapy	3
	MS- 522	Mathematical Modeling of Biological Systems and Epidemiology	3
	MS-523	Radiation Detection, Protection and Instrumentation	3
	MS-524	Tumor and Radiation Biology	3
	MS-525	Diagnostics of Cancer	3
	CMS-501	Communication Skills	
Second semester	MS-527	Radiation & Medical Oncology Laboratory	3
	MS-611	Treatment Planning in radiation Oncology	3
	MS-612	Pathophysiology of Tumors	3
	MS-613	Management and Treatment of Individual Cancers	3
	MS-614	Advanced Therapeutics in Oncology	3
Third Semester	MS-697	Thesis Project	10
Fourth Semester	MS-691	Intensive Clinical Training in radiation and Medical Oncology I	10
Fifth Semester	Ms-692	Intensive Clinical Training in radiation and Medical Oncology II	10

Detailed Course Contents

MS- 510 Introduction to Nuclear Technology

Compulsory	Institutional Requirement
Credits	Nil
Prerequisite	Nil
Course Format	One hour of lecture per week

Developments in physics leading to the discovery of nuclear fission; Development of nuclear technology; Review of nuclear reactors and fuel cycle facilities; Present status of nuclear power in Pakistan and in the world; Current problems and future prospects of nuclear power.

MS-521: Principles of Radiotherapy and Cancer Chemotherapy

Compulsory	C
Credits	3
Prerequisite	Nil
Course Format	Three hours of lectures per week

Use of ionizing radiation in radiotherapy, Linear accelerator physics, Physics of brachytherapy, Teletherapy, Electron beam physics, Heavy particle physics, Total body irradiation, Modern radiation therapy comprising of three dimensional conformal therapy, IMRT, Stereo tactic radio surgery. Cooperation between physicist and physician, Team work approach, Classification of chemotherapeutic agents, Mode of action of cytotoxic drugs, Pharmacokinetics and pharmacodynamics of chemotherapeutic agents, Drug design and development, Principle of clinical use of chemotherapeutic agents, Toxicity of chemotherapy, Analgesia in cancer patients, Steroids and anti-emetics, Drug interaction in cancer treatment, hormone therapy, Biological and novel therapies, concept of vaccination in cancers, Principles of high dose therapy, rationale, protection strategies, Unusual toxicities-veno-occlusive, Radiopharmaceuticals, Basic principles and use in cancer therapy, Biological therapies, Interferons, Colony stimulating factors, Growth factors , Target therapy.

MS-522: Mathematical Modelling Of Biological Systems And Epidemiology

Compulsory	C
Credits	3
Prerequisite	Nil
Course Format	Three hours of lectures per week

Differentiation and integration, First order and second order differential equations, Harmonic analysis and Fourier series & transform, Significance of statistics in medicine, Standard deviation, Poisson and Gaussian distribution, Applications of statistical analysis, Chi-square test,

Concepts of probability, Tests of significance, Statistical criteria for the selection and adjustment of counters, Survival analysis, Clinical trials and ethics, Principles of sample size calculation, Role and basic principles of meta-analysis, Odds ratios and relative risks, Mortality rates and standardized mortality rates, Cancer registration and follow-up, Trends in cancer incidence and mortality for major cancers .

MS-523: Radiation Detection, Protection and Instrumentation

Compulsory	C
Credits	3
Prerequisite	Nil
Course Format	Three hours of lectures per week

Basic concepts of radioactivity, Principles of radiation detectors and their common properties, Various types of detectors, Radiation spectroscopy, Nuclear electronics, Various types of dosimeters, Basic concept of dosimetry, Dose calibrator, Collimation of radiation; Radiation protection standards, Basic principles for control of external and internal exposures and absorbed dose estimation, Protection against radiation from brachytherapy sources, Nuclear regulatory commission regulations, Health Physics instrumentation and personal dosimetry, Early medical treatment of radiation injuries, Radioactive waste management in hospitals, Quality control and quality assurance of radiotherapy instrumentation, Co 60; Linear accelerator, Simulators, CT simulators

MS-524: Tumour and Radiation Biology

Compulsory	C
Credits	3
Prerequisite	Nil
Course Format	Three hours of lectures per week

Introduction, General principles of tumour biology, General principles of radiobiology, Techniques in molecular biology, Principles and use of techniques, Electrophoresis, Blotting, PCR, Sequencing, Transfection, Micro array techniques, Transgenic models, Effect of radiation at cellular level, Cell survival curves, Factors modifying the effect of radiation at the cellular levels, 4 R's of radiobiology used in radiotherapy, Genetics of normal and malignant cells, molecular biology of radiation damage and repair, Normal and aberrant mechanisms of cell growth control, Normal tissue radiobiology, Normal tissue damage and tolerance, Population radiation biology, Interaction between radiation and other agents, Chemotherapy, Hyperthermia, Causation of human cancers, The expression and consequences of oncogenes, Oncogenes triggers, The cellular mechanism of cancer including mechanisms for apoptosis and cellular immortality, Cell,

tissue and tumour kinetics, Time, dose and fractionation in Radiotherapy, Predictive assay, Alternative radiation modalities, Hyperthermia, Gene therapy.

MS-525: Diagnostics of Cancer

Compulsory	C
Credits	3
Prerequisite	Nil
Course Format	Three hours of lectures per week

Imaging modalities/procedures and technology, Radiological anatomy, Conventional X-Ray, Contrast media, Principles of ultrasound, A, B & M Mode, Basics of CT, CT imaging of different tumours, PET/CT in oncology, MRI in Oncology, Nuclear medicine procedures and radiopharmaceuticals used in the diagnosis and follow-up of different tumours, Mammography technique, Mammographic signs of breast cancer and mammographic features of benign and malignant disease, Specialized techniques of cancer diagnosis.

MS-527: Radiation & Medical Oncology Laboratory

Compulsory	C
Credits	3
Prerequisite	Nil
Course Format	Nine hours of laboratory work per week

Out of the experiments listed below, a minimum of 10 experiments are to be performed.

Radiation Detection and Measurement:

1. Characteristics of a G.M. tube, dead time measurement, and beta attenuation.
2. Verification of counting statistics.
3. Characteristics of scintillation detectors and determination of pulse height spectra of gamma sources.
4. Characteristics of Ge (Li), HPGe or Si (Li) detector and its use in gamma ray spectroscopy.
5. Measurement of half-lives of a single and a mixture of radio nuclides.
6. Determination of attenuation coefficient and build-up factor of gamma rays for different shielding materials.
7. Measurement of Co-60 source strength using gamma-gamma or beta-gamma coincidence method.

Health Physics

1. Calibration and use of survey meters.

2. Calibration of TLD system and measurement of unknown dose.
3. Contamination survey and decontamination procedures.
4. Verification of inverse square law and source strength measurement.

Clinical Laboratory

1. Treatment Planning.
2. Simulation
3. Quality control tests for radiotherapy instruments.
4. Routine operational tests for radiotherapy instruments.
5. Mould room practical work.

MS-611: Treatment Planning In Radiation Oncology

Compulsory	C
Credits	3
Prerequisite	Nil
Course Format	Three hours of lectures per week

Treatment planning, Iso dose distribution, Patient data, Corrections and setup, Field shaping, Skin dose and field separation, Electron beam therapy, Teletherapy, Treatment planning and its implementation, Treatment planning by computer, Brachytherapy, Treatment planning for implant therapy, Tumour and normal tissue dose computation by manual & computerized techniques, Use of wedge filters, bolus & tissue compensator; General principles of data processing, Design and use of simulators, Combination of Radiation fields, Isocentric technique, ICRU volumes, Verification port films.

MS-612 Pathophysiology of Tumours

Compulsory	C
Credits	3
Prerequisite	Nil
Course Format	Three hours of lectures per week

Anatomical sites and types of tumours, etiology, incidence and morphology of common tumours, The natural history of the disease including likely presentation, Characteristic growth and Metastatic pattern, Staging classifications, TNM, FIGO, Use of tumour markers in diagnosis and treatment of tumours, Use of specialised pathology techniques, e. g. Immunocytochemistry, Interpretation of clinicopathological data in the tumour site, specialised multidisciplinary approach to patient management, Classification and spread, staging protocols, Paraneoplastic syndromes.

MS-613: Management and Treatment of Individual Cancers

Compulsory	C
Credits	3
Prerequisite	Nil
Course Format	Three hours of lectures per week

Cancers of the head and neck, Cancer of the lung, Neoplasm of mediastinum, Cancers of gastrointestinal tract, Cancer of the genitourinary system, Cancer of the testis, Gynaecologic cancers, Cancers of the breast, Cancer of the endocrine system, Sarcomas of the soft tissues and bone, Benign and malignant mesothelioma, Cancer of the skin, Malignant melanoma, Neoplasms of the central nervous system, Cancers of childhood, Lymphomas, Leukaemias, Cancers of unknown primary site, Aids related malignancies.

MS-614 Advanced Therapeutics in Oncology

Compulsory	C
Credits	3
Prerequisite	Nil
Course Format	Three hours of lectures per week

Oncological emergencies, Acute and late complications of cancer and their management, Radiotherapy for benign diseases, Organ and system failures, Risk of second cancer, Supportive care for cancer patients, Physical measures (bed sores, splintage, massage etc), Cancer pain palliation, Cancer pain neurophysiology and biochemistry, Assessment of pain, Therapeutic strategies, Nutritional support, Cancer cachexia, Consequences and management, Psychological issues, Psychiatric and psychological disorders in cancer patients, Specialized care for terminally ill patient, Approaches to meet needs of dying patient, Genetic counselling, Components of genetic counselling session, Risk counselling; Infection in cancer patient; Immunological stress in cancer patients, Impaired host defences and common pathogens in cancer patients, Prevention of infection in cancer patient, Infection treatment strategies, Evaluation of febrile patient in cancer ward and management, Special condition to reduce toxicity of chemotherapy, Treatment of Metastatic cancer, Newer approaches in cancer treatment, Gene Therapy, Concepts and implication, Inhibition of genetic expression, Immunotoxins and anti angiogenic modes for cancer management, Chemotherapy protectors, Combination therapy, Molecular radiotherapy.

MS-691: Intensive Clinical Training in Radiation & Medical Oncology 1

Compulsory	C
Credits	10

Prerequisite	Nil
Course Format	Minimum of 30 hours of clinical work per week (18 weeks)

For clinical training, each student is attached to a specialist at a medical centre, which term includes all PAEC Medical Centres with radiation cancer treatment facility, oncology centres of the Armed Forces, Shaukat Khanum Memorial Cancer Hospital etc. The expert there will be responsible for providing guidance and supervision in clinical procedures. During this phase major aspects of general radiation treatment, planning and therapeutics are covered. It is of sufficient breadth to ensure that student is thoroughly acquainted with the techniques and methods of major diagnostic and therapeutic applications.

MS-692: Intensive Clinical Training in Radiation & Medical Oncology 2

Compulsory	C
Credits	10
Prerequisite	Nil
Course Format	Minimum of 30 hours of clinical work per week (Duration 18 weeks)

During this semester students will again be attached to different Medical Centres of PAEC as well as with other radiation and oncology centres. The training program is designed to give fellows ample opportunity to attain competence in correlating the patients' problems with optimum selection of the therapy regime. Fellows have to take histories, do physical examination, advise suitable investigations, formulate differential diagnosis and reach final diagnosis and devise management plan in consultation with supervisor. They have to do simulation and brachytherapy along with handling Co-60 & LINAC. Log book containing 50 cases including both of chemotherapy administration and radiotherapy (not just of chemotherapy administration). Basic procedures including nasogastric intubations, catheterization, and aspiration of fluids have to be carried out and recorded in the log book.

MS-697: Thesis Project

Compulsory	C
Credits	10
Prerequisite	Nil
Course Format	Minimum of 30 hours of research work per week (Duration 14 weeks)

Students will be attached with a Medical Centre, which term includes all PAEC Medical Centres with radiation cancer treatment facility, oncology centres of the Armed Forces, Shaukat Khanum Memorial Cancer Hospital etc., in Pakistan for work on their respective research/thesis project. In

collaboration with a project supervisor, each Fellow arranges a clinical project for the MS thesis. The purpose of the project is to acquaint the student with the techniques of research in radiation and medical oncology. This project does not necessarily have to be a completely original study but should exhibit a thorough knowledge of the subject and should be an exhaustive review of the literature on that particular topic. The area covered by the project should include nuclear physics, instrumentation, statistics, dosimetry, etc. The aim of the project is to train the students in planning and conducting research projects and writing scientific papers. At the end, each student has to submit a research project report.

CMS- 501 Communication Skills

Compulsory	C
Credits	1
Prerequisite	Nil
Course Format	1 hour of lecture per week

Writing Module: Preparation of a project proposal or technical report, Writing letters, Mission statements, Office memos etc. Speaking Module: Presentation of the project proposal or technical report. Listening Module: Simulations of interviews, lectures and question-answer sessions. Reading Module: Reading of a suitable fiction novel (approximately 30-50 pages a week) with the use of vocabulary support, completion of assigned tasks and discussions