

**M.D. RADIATION ONCOLOGY****[Syllabus Approved by Board of Studies, Medical & Health Sciences]**

<b>Programme Code</b>	:	HLTH09A04
<b>Programme Details</b>	:	MD RADIATION ONCOLOGY
<b>Programme Learning Outcomes (PLOs / PSOs)</b>	:	ANNEXED IN THE BELOW FORMAT
<b>Eligibility Criteria</b>	:	AS PER NMC NORMS
<b>Duration of the Course</b>	:	3 YEARS
<b>Programme Structure (Credit-Based)</b>	:	NA
<b>Detailed Course Syllabus</b>	:	ANNEXED IN THE BELOW FORMAT
<b>Teaching–Learning Methodologies</b>	:	3 YEARS RESIDENCY PROGRAM
<b>Examination &amp; Evaluation System</b>	:	ANNUAL APPRAISALS FOLLOWED BY FINAL YEAR EXAMINATION AS PER NMC NORMS
<b>Internship / Project / Dissertation Guidelines</b>	:	1 YEAR MANDATORY BOND
<b>Program In Charge</b>	:	HEAD, DEPT OF RADIATION ONCOLOGY

# M.D. (RADIATION ONCOLOGY)

*Programme Code:* HLTH09A02

*Programme Outcome:*

- To train the candidate in skills in various aspects of oncology – service, training & research.
- This will also enable the individual to practice oncology discipline as applicable to his/ her training.
- To be able to participate in the holistic management, including diagnosis, planning treatment, be a part of the multidisciplinary team delivering treatment and follow-up of a patient with cancer.
- He/ she should be able to train other oncology personnel, engage in effective, meaningful research
- The candidate should complete the training programme as per prespecified norms.
- All the necessary training and mandatory theory are specified in the syllabus of the MD Radiation Oncology Course.
- The student is expected to participate in the regular appraisal examinations and academic programmes conducted in the Institute.
- The purpose would be to acquire an understanding of the subject of radiation oncology in specific and clinical oncology in general
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- The candidate's progress through the 3 years will also be assessed with feedback from all stake holders, including the candidate

# PROGRAMME CURRICULUM

## ▪ OBJECTIVES

### ▪ General

The aim of the training is to enable the trainee capable of practicing independently as a competent doctor. The trainee should be compassionate and ethical in their practice of oncology and would also contribute to the future developments in oncology.

### ▪ Specific

- The trainees should acquire a sound working knowledge of the use of ionizing radiation, cytotoxic agents, hormones, biological response modifiers, etc. in the management of cancer.
- The trainees practice "Evidence Based Medicine" whenever possible, and be familiar with Clinical Trial Methodology.
- The trainees should become competent in providing and organizing a comprehensive supportive and palliative care in patients with very advanced disease and in terminally ill patients.
- The trainees should develop the ability of reasoning / logical thinking and decision making in grey areas and in difficult cases.
- The trainees should become competent to provide guidance and leadership in the 'Cancer Prevention Efforts'.
- The training should generate awareness and interest in basic and applied cancer biology and whenever possible, experience in the field.
- The trainees should develop leadership qualities and learn basic management and administration skills.

## ■ Three Year Structured Training

- Induction program for all trainees.
- Theory and practical sessions separately for first, second and third year trainees
- Dissertation
- Departmental academic activities including seminars, journal clubs, ward rounds, planning meetings etc. as per weekly schedule
  - Joint clinics such as Lymphoma/Gynae/Paediatric/Breast/CNS/Palliative Clinics
  - Clinical data analysis-As instructed by the teacher
  - Rotation posting in other departments/disciplines such as Medical Oncology/ Radio-Diagnosis/Radiation Medicine Centre etc. and presentation of the experience in these postings.
  - Scientific paper presentation at conferences.

For practical the student will maintain individual diary/logbook, which will be reviewed and endorsed by the teacher, under whom the candidate is registered. The individual teacher will be responsible for checking the progress of the candidate.

Trainees should discuss with their teacher regarding topic for presentation at clinical meetings, clinical data analysis and paper for presentation at conferences. Topics for presentations will be from the allotted list displayed on the notice board. The presentation should be on transparencies/slide with neat labeled diagram whenever necessary. The subject should be prepared well in advance and discussed with the individual teacher, minimum of a week before presentation. The literature search from journals and books or Internet is mandatory for second and third year students. Whenever the data from Tata Memorial Hospital is available, should be included in the presentation.

There will be internal assessment / examination (Practical and theory) in the month of January each year and after three years of training and submission of dissertation, the trainees would be eligible for the examination conducted by the university of Mumbai.

## ▪ **ORIENTATION FOR NEW TRAINEES**

(Within first two weeks of joining)

### ▪ **Objective**

The orientation will make familiarize the trainee with the Departments of Radiation Oncology and Medical Physics. The trainee will be acquainted with the various places and the activities in the Department. This will preferably be done on Saturday. The trainee will be taken to following minimum places:

- General OPD & Joint Clinics
- Minor Operating Theatre
- Teletherapy Machines : Accelerators and telecobalt areas
- Simulators
  - HDR brachytherapy area
  - Mould room
  - Medical Physics TPS area
  - Private OPDs
  - Radiation Oncology in-patient Ward
  - General & Private wards
  - IEC office
  - Digital Library

## ▪ **INDUCTION PROGRAMME**

Two Sessions (amorp) each in the first six to eight weeks

### ▪ **Objective**

The induction programme is intended to give the new trainees a general idea about Tata

Memorial Centre [TMC], the nature of work done in various departments and the location of various departments within the five interconnected buildings of TMH and ACTREC. The emphasis will be on the departments of Radiation Oncology, Medical Physics, and frequently used diagnostic and rehabilitative services. The Senior Registrar will introduce and guide the new students to various facilities listed below.

- Teletherapy Machines (To know about the machines available in the hospital; Energy, accessories, types of treatment possible, operation of machines)
- Brachytherapy Machines, Operation Theatre (types of brachytherapy procedure done) Learn about radiation protection measures, know the procedures such as CVS, VSA and intracavitary
- Computer Treatment Planning, Physics (Simple plans, iso dose charts)
- Mould Room & Simulator (Making POP, acrylic and thermoplastic moulds, Alloy blocks, Styrofoam cutter, Tissue compensators, Bolus and surface moulds)
- Radiotherapy In-patients: (Visit towards, patient management with IV fluids, care of patients admitted to wards, management of radiation reactions general aspects)
- I.V. Team & Daycare: Various investigations, IV access & chemotherapy administration.
- Other rehabilitative services such as Palliative care, Occupational and physiotherapy, Medical Social Workers, and voluntary organizations such as CPAA and 'V' Care.
- Preventive Oncology department
- Clinical Research Secretariat [CRS].
- Radio-diagnosis department
- Histopathology, microbiology, biochemistry and bloodbank.
- Main operation theatre and ICU.

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## TEACHING CURRICULAM

### FIRST YEAR

Candidates are expected to have wide knowledge of malignant diseases and the management of patients with cancer.

#### ▪ **CLINICAL ONCOLOGY [Theory] – I**

- Introduction to Oncology
- Principles of clinical and pathological staging of cancers
- Basics of Radiation Therapy
- Basics of Cancer Chemotherapy, Hormone & Biological therapy
- Basics of cancer surgery
- Decision making process in Oncology
- Combined modality of Radiotherapy and Surgery
- Combined modality of Radiotherapy and Chemotherapy
- Basics of Radiation Treatment Planning: Clinical aspects.
- Radiotherapy Techniques: Patient positioning, Immobilization techniques, Target determination, field arrangements, Tissue compensation, Shielding, Megavoltage techniques, electrons, Dose calculation, Radiotherapy prescription, quality assurance, radiation safety
- Care of patient and assessment of treatment: Reviews, treatment checks, symptom control, follow-up
- Drug Therapy: Drug delivery, support techniques, management of acute complications
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#### ▪ **CLINICAL ONCOLOGY [Practical]–I**

(Patient Evaluation, Care and procedures ):

- Communication with cancer patients and their relatives.
- Clinical examination methods like gynecological, laryngeal, breast, neurological and lymph node examination.
- Obtaining informed consent for routine treatment.
- Management of treatment complications like mucositis, dermatitis, proctitis, diarrhea, nausea, vomiting, xerostomia, lymphoedema, candidacies etc.

- Management/Care of patients with fluid electrolyte imbalance, malnutrition, neutropaenic sepsis, raised intracranial pressure, seizures, paraplegia, bed sores, tracheostomy, Nasogastric tube or gastrostomy, bleeding PV or SVC compression.
- Cervical biopsy, PAP smear, FNAC, Pleural and peritoneal paracentesis, bone marrow and lumbar puncture.
- Insertion and maintenance of IV lines (butterfly and Venflon types) for blood collection and giving fluids or cytotoxic agents.
- Patient positioning and immobilization using Thermoplastic, Acrylic and POP Masks
- Surface marking
- Simple Simulation techniques of such as single for Bone Metastasis, two or four Field for cervix, AP/PA for Lung, three Field for Esophagus and Bilateral Fields for Head & Neck.
- CVS and Intrauterine applications.
- Giving simple chemotherapy drugs like 5-FU, Bleomycin, Cyclophosphamide, low dose methotrexate (CMF), Procarbazine, CCNU, Cisplatin, Adriamycin etc.
- Interpreting Simple Radiographs like chest x-rays, barium swallows, osseous metastases, bone scan etc.
- Getting familiar and follow the established principles of bio-safety e.g. MRSA, Hepatitis B and C, HIV etc.

## ▪ **PHYSICS [Theory] – I**

- Electromagnetic radiation & spectrum
- Atomic structure, electron shells and energy levels, energy quantization
- Relation between wavelength, frequency and energy
- Radioactivity, description of x- and  $\gamma$ -beams (quality, energy, intensity, size tc.)
- Radioactive sources used in radiotherapy
- Production of x-Rays: The basic x-Ray tube, characteristics of x-Rays
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- Interaction of x-Rays with matter (Elastic scattering, Common effects, Pair production, Photonuclear interaction, Auger effect, scattering radiation, secondary electrons, range verses energy, Linear Energy transfer etc.)
- Interaction of sub-atomic particles with matter (Ionization & excitation due to charges particles, collision loss, particle range, Bragg peak, Bremsstrahlung, elastic & inelastic neutrons, proton ionization profile, p ions & heavy ions)

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- Radiation Dosimetry (radiation units, exposure and KERMA, Absorbed dose, radiation dose measurement, Methods of measurement)
- Teletherapy machines: Telecobalt & Linac (Superficial & ortho voltage machines, microwave production, waveguide construction, electron production, x-ray production and beam control. Construction of linear accelerator & telecobalt machine, output, Energy range, build up, skin sparing, isodose curves, fixed & iso centric approaches, wedges, output factors, beam geometry)
- Radiotherapy Simulators (Conventional and CT simulators structure and use)
- Machine calibration, acceptance test and Quality assurance
- Mouldroom Techniques(Beam modifying devices, tissue compensators)
- Basics of dose calculation (Simple methods, shielding, Clarkson integration, field matching, attenuation coefficient and half value layers)
- Basics of treatment planning and Dosimetric physical aspects (data required, immobilization techniques, patient & organ movements, tumor localization methods, transportation of patient data, data from MRI, USG and PET, single & multifield planning, Coplanar & non-coplanar planning, isodose dose distribution)
- ICRU guidelines: Teletherapy & Brachytherapy
- Principles of radiation protection (Radiation risk, stochastic and non-stochastic process, Quality factor, statutory framework, background radiation , radiation limits, classification of staff and designated areas, controlled areas and screening, guidance notes, protection mechanism (time, distance & shielding), primary secondary barriers, treatment room design, personnel Monitoring, film/TLD badges, dosimeters, Dose reporting mechanism)

## ■ PHYSICS [Practical] – I

- Parts and functions of various Teletherapy and Brachytherapy machines
- Radioisotope handling, Radiation Protection
- Calculation of output from  $^{60}\text{Co}$  machine
- Treatment time calculation for simple fields(open, regular)
- Quality control and machine calibration
- Iso dose curves and manual treatment plans using isodose curves
- Visit to BARC/BRIT/ nuclear installations

**■ MEDICAL STATISTICS & EPIDEMIOLOGY [Theory] – I**

- Sampling: Concept of a population and a sample and the need for statistics, random sampling, standard error, Confidence intervals.
- Properties of “Normal or Gaussian Distribution” curve
- Types of data: Paired and Unpaired; Categorical and continuous, Numerical data[discrete& continuous], Bar charts & histograms
- Comparing mean and median:  $\chi^2$ , Student ‘t’ test etc.
- Measurements & tests of association between variables: Correlation & regression scatter plots, sensitivity, and specificity, positive & negative predictive values.

**■ MEDICAL STATISTICS & EPIDEMIOLOGY [Practical] – I**

- Chi-square test on simple dataset (degree of freedom 1).

**■ CANCER BIOLOGY [Theory] – I**

- Cellular structure and function
  - Cell membrane and Cytoplasm
  - Nucleus, normal gene transcription, DNA repair mechanism, polymorphism, micro-satellites, Methylation, hypomethylation & methylation reversal
  - Haemopoiesis: Marrow structure, haemopoietic microenvironment, cell lineage & hierarchies  
Cell growth control: Normal cell growth & control, Autocrine, paracrine & endocrine control, signal transduction, cyclin kinases, gene promoters, signal pathways
  - Cell Cycle Control and cancer, basic kinetics
  - Growth disorders: Hyperplasia, dysplasia, *carcinoma-in-situ* and neoplasia  
Causation of Cancer: Environmental factors, carcinogenesis[viral, radiation] Normal tissue damage [early & late],
  - Mechanism of spread, local invasion, metastasis
  - Multistage carcinogenesis and metastatic cascade
  - Tumor vasculature & angiogenesis
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▪ **RADIO BIOLOGY [Theory] – I**

- Cellular system(hierarchical/flexible), Parallel and Linear systems
- Cell, tissue and tumour kinetics, Cell survival curve & basis of fractionation
- Radiation damage at cellular level (membrane, cytoplasmic, nuclear): normal tissue tolerance, effects on different tissues, schemes of reporting normal tissue damage
- LET, OER and RBE
- Factors affecting Radio-sensitivity, Radio-sensitizers & Radio-protectors
- Radiation biology models: monolayer, spheroids, animal[normal & transgenic],re-growth curves, clonogenic assay, MTT
- Acute and late effects of Whole body irradiation
- Radiation Carcinogenesis

▪ **RADIO BIOLOGY [Practical] –I**

- Using Flow- Cytometry to estimate Ploidy &S-Phase

**INTERNAL ASSESSMENT/EXAMINATION**

▪ **First Year**

Theory: Physics, basic radiobiology and statistics, MCQ.

Practical: Machine operations, various parts of the machines, set-up of the patient, treatment time calculation, calibration, gap calculation, instruments, evaluation of isodose charts, computer plans and related medical physics.

Clinical: Staging of common cancers, examination procedures, simple planning - clinical and simulation, recognition and management of radiation induced reactions.

Evaluation: Logbook, presentations during the year, appraisal scores.

## SECOND YEAR

### ■ CLINICAL ONCOLOGY [Theory] – II

Pathology, Staging, Prognostic factors, Management, Surgery, Radiotherapy, Drug therapy (Cytotoxic chemotherapy, Hormone & Biological) and outcome of the anatomical tumor sites.

- Head & Neck Tumors: Lip, Oral cavity & Oro-pharynx I, Nasopharynx & PNS, Hypopharynx and Larynx, salivary glands, ear, orbit, Lacrimal gland, Thyroid, Glomas Jugul are & Carotid body tumors
- Female Genital Tract: Uterine cervix, Endometrium, vagina, ovary, vulva, Fallopian tubes
- Breast cancers
- Genito-Urinary: Kidney, prostate, bladder, Ureter, Testis, Urethra and penile cancers
- Tumors of Chest & Pleura: Lung, Mediastinal tumours, Thymus, Pleura and Trachea
- Gastro-Intestinal Tract Tumors: Oesophageal, gastric, Small Bowel, Colon & rectum, Anal Canal & perianal region, Pancreas, Liver & Biliary tract
- Endocrine: Thyroid, Parathyroid, Pituitary, Adrenal
- CNS Tumours: Brain, Spinal cord, Craniopharyngioma, Chordoma, acoustic neuroma, meninges
- Bones & Soft-Tissue: Sarcomas, Bone tumors
- Lympho proliferative disorders: Hodgkin's & Non-Hodgkin's lymphomas, Plasma cell malignancies, Acute & Chronic leukemias,
- Skin: Basal cell, squamous cell carcinomas, Malignant melanoma, Cutaneous lymphomas, Mycosis Fungoides, Kaposi sarcomas
- Oncological emergencies

### ■ CLINICAL ONCOLOGY [Practical] – II

- Knowledge about treatment options and decision making for various cancers
- Discussing Randomized Trials with patients and obtaining their consent
- Management of patients with Renal failure, G.I. obstruction, SVCO, TOF, Cord Compression, severe vaginal bleeding, neutropaenic sepsis, hypercalcaemia, necrosis, pathological fractures etc.
- Management of patients in severe pain and of dying patients, palliative care.
- Hospice care: visit to 'Shanti Avedana Ashram', use of Morphine
- Use of divergent blocks (Mantle, Inverted Y, Rectum, Brain etc), Electron cutouts.

- Simulation Techniques e.g. Conservative Breast, Mantle, Inverted-Y, Dog leg, Pancreas, Nasopharynx, PNS, Vocal Cord, Brain, Planning CT Scans
- Magna-field Irradiation: Hemi Body irradiation, Total Body Irradiation, Whole Abdomen
- Computer Treatment Planning: Parallel opposed, Antero-lateral, 3 or 4-field beam arrangement with equal and unequal weight. Intracavitary and simple interstitial brachytherapy plans of breast, template, buccal mucosa
- Organizing and maintaining central lines (Hickman's), Parental Nutrition, Cytotoxic
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- drugs such as Doxorubicin, Vincristine, Mitoxantrone, Cisplatin etc.
- Assisting Interstitial Implants/ ILRT/ EBRT procedures. Performing simple procedures like intracavitary, CVS etc.
- Retrieving information from Medline, Internet etc.

## ■ PHYSICS [Theory] – II

- Radiation Dosimetry & Calibration methods (Ionization chambers, Geiger counter, diodes, Chemical methods, films, Thermo-luminescence [TLD], Scintillation counters, calorimetry)
  - Electron beam therapy (energy range, percent depth dose, factor affecting depth dose, build-up, effect of surface obliquity & inhomogeneity, internal shielding)
  - Principles of CT planning (data acquisition, Image manipulation, defining volumes, plan verification, DVH, element of inverse planning & Intensity Modulated Radiation Therapy)
  - Treatment Planning (Arc & rotation, non-coplanar planning, conformal, in homogenous media, volume definition, dose prescription, defining beam geometry, collimators, penumbra, beam quality,
  - Wedge & applicators, Multi-leaf collimators)
  - Evolution of brachytherapy dosage systems
  - Modern brachytherapy dosage calculation
  - Radioactive Sources (Isotopes, radioactive decay, parent & daughter decay series, half-life, characteristics of radiation, types of sources & their construction, requirement for clinical use, dose distribution around sources, sealed & unshielded sources and their storage, safety devices)
  - Physics principles in clinical use (Distribution rules & dose calculations, Gynecological brachytherapy systems, principle and types of after-loading)
  - Remote after -loading LDR, HDR and PDR machines
  - Computer Treatment planning systems
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- Use of unsealed sources (Isotopes, shelf-life, physical & biological life, radiopharmaceuticals, use in imaging & therapy, clinical applications and dose calculations)
- Principles of CT, MR, PET and USG imaging

## ■ **PHYSICS [Practical] – II**

- Manual localization of brachytherapy sources from orthogonal x-Rays and estimation of the Basal Dose Rate and Reference Dose Rate as per 'Paris' rules.
- Complex field shapes and modified beams. Computer treatment planning teletherapy (AP/PA; 3 or 4 fields, anterior/lateral; weighting)
- Computer treatment planning brachytherapy (CVS, Intracavitary, Breast, Buccal Mucosa, Template)
- Simple Conformal plans; Conformal blocks, CT Planning.
- Radio-Isotope waste disposal; Functions of RSO.
- HDR & LDR Surface mould treatment execution.

## ■ **MEDICAL STATISTICS & EPIDEMIOLOGY [Theory] – II**

- Principles of statistical inferences: Hypothesis testing, Sample size, Type I & II errors, interpretation of p-values, statistical & clinical significance.
- Survival analysis in cancer: Types of time-to-event data, Kaplan-Meier & Actuarial Survival Curves,
- Comparing groups: Log rank test, use of Cox's proportional hazards regression model, Hazard ratio and their interpretation
- Clinical trial methodology: Phase I-IV trials, Randomization & stratification methods, problem with on- randomized studies & historical controls, Blinding/masking, Design of clinical trials, Contents of trial protocols, ethics & informed consent, Sample size calculation, Interim analysis
- Measures of response: Tumor regression, Morbidity, Local/regional recurrence, Distant Metastasis, Death, Quality of Life. Intent-to-treat analysis
- Epidemiology: Retrospective (case control studies) & Prospective (Cohort studies), Odds ratio & relative risks, Mortality rates, cancer registration & follow-up, Trends in

cancer incidence.

■ **MEDICAL STATISTICS & EPIDEMIOLOGY [Practical] – II**

- Actuarial Survival Curves for a given data set
- Estimating Sample size for given type I and II error

■ **CANCER BIOLOGY [Theory] – II**

- Genetic Predisposition to Cancer
- Proto Oncogenes and Tumour suppressor genes, Protein-protein interaction
- Principles of molecular biology techniques (PCR, FCM, Electrophoresis, cloning etc.)
- Tissue culture techniques and Clonogenic assays
- Cancer Genetics: Genes associated with cancer, Inherited syndromes associated with cancer [ataxia telangiectasia, xeroderma pigmentosa, Nijmegen break syndrome, Li-Fraumeni, Lynch, Cockayne's familial polyposis coli, inherited breast cancer syndromes], Linkage analysis, genetic counseling.
- Human Genome Project

■ **CANCER BIOLOGY [Practical] – II**

- Basic Tissue Culture Techniques
- Nucleic acid analysis including electrophoresis, hybridization, blotting, PCR, sequencing, transfection

■ **RADIO BIOLOGY [Theory] – II**

- Molecular Biology of Radiation Damage & Repair: molecular process in radiation damage repair, time course of repair, chemotherapy drug resistance, damage [lethal, sublethal, potentially lethal]
- Acute & Late responding tissue and dose response relationship
- Time Dose Fractionation and the evolution of Bioeffect models
- Hyper fractionation, accelerated fractionation and hypofractionation, influence of gaps and time on radiation response
- Methods of identifying hypoxia
- Iso effect curves,  $\alpha/\beta$  ratio and relevance to acute & late responding tissues
- Linear Quadratic Model

- Predictive assays of Radiation response
- Radiation effect on embryo & Foetus

## ■ **RADIO BIOLOGY [Practical] – II**

- Calculation of Biologically Effective Doses for tumour control, acute and late effects using the LQ model.
- Clonogenic assays and Survival Fraction (SF2)
- Using Radio-sensitizers or Radio-Protectors(e.g.Amifostine,2-Deoxy-Glucose,Curcumin).

## ■ **CHEMOTHERAPY & CLINICAL PHARMACOLOGY [Theory] – II**

- Mechanism of action of Cytotoxic drugs: Mechanism of action, Phase & cell cycle specific drugs, Mechanism of cell death, Mechanism of cell death, Drug resistance modifiers, drug interaction.
- Pharmacokinetics and Pharmacodynamics: General Principles, Route & timing of administration, Plasma concentration, AUC, Drug activation, metabolism & clearance, Protein & tissue binding, Drug concentration at target site.
- Principal of Clinical use: Dose response curves, Dose intensity, Single agent & combination chemotherapy, Adjuvant & neo-adjuvant therapy, high dose chemotherapy, continuous infusion, intrathecal treatment.
- Toxicity of Chemotherapy: Mechanism of toxicity, Dose limiting & common toxicities, Dose related & idiosyncratic toxicities, Early, intermediate & late toxicity, factors modifying toxicities, safe handling of Cytotoxic drugs.
- Clinical pharmacology of analgesics, steroids & anti-emetics: Morphine & derivatives, drug interactions.
- Endocrine Therapy: Mechanism of action, resistance, common side effects and combination with other therapies.
- High dose therapy: Clinical methods (clinical trials), Protection & rescue of stem cells, unusual toxicities [veno-occlusive disease].

## **INTERNAL ASSESSMENT/EXAMINATION**

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## ▪ SECOND YEAR

**Theory:** Physics, radiobiology, statistics and clinical science, MCQ.

**Practical:** Computerized treatment plan assessment and discussion. Divergent blocks, calculation of ERD/BED etc., complex time calculations.

**Clinical:** Case presentation-long and short cases, assessment of examination and diagnostic skills, doctor-patient relationship, decision making ability.

**Evaluation:** Logbook, presentations during the year, appraisal scores.

## ▪ THIRD YEAR

### ▪ CLINICAL ONCOLOGY [Theory]–III

- Paediatric solid tumours
  - Cranial & Extracranial Stereotactic Irradiation
  - Radio therapy of Non-Malignant diseases
  - Advances in Interstitial and Intracavitary Brachytherapy, Endovascular Irradiation
  - Hyperthermia
  - Photodynamic therapy
  - AIDS related malignancies
  - Problem solving in grey areas & difficult cases
  - Supportive & Palliative Care: Pain relief, Symptom control in advanced cancer (nausea, vomiting, anorexia, dysphagia, depression and anxiety), Care of the dying patients & the Hospice care, The 'Truth' about cancer: When to tell, How much to tell & to whom?
  - Quality of Life: QoL assessment tools for clinical trials & routine practice, outcome measures
  - Medical ethics : A clinician's perspective, ethics in biomedical research, Professional values, Legal considerations
  - National Cancer Control Programme
  - Screening for common cancers : Pragmatic approaches for our country
  
  - Rehabilitation of cancer patients
  - Investigational Techniques in clinics and laboratory, Technology assessment and outcome measures, Economics in Radiation Oncology
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- Setting up Radiotherapy departments in India. Equipment and facilities needed?
- Oncologists as managers of Health care system
- Communication and publications

## ■ **CLINICAL ONCOLOGY [Practical] – III**

- Complex Simulation and treatment techniques e.g. asymmetric beam, TSET, Craniospinal Irradiation, Paediatric tumours, TBI.
- Treatment Planning (mixed beam, matching fields, electrons, head and neck implants)
- Intracavitary, ILRT and simple implants
- Preparing Surface Moulds
- Assisting EBRT, Head/Neck Implant, Templates
- Cytotoxic drugs (Taxanes, BCNU, Highdose Methotrexat, Interferon, G-CSF, Leuprolide etc.)

## ■ **PHYSICS [Theory] – III**

- Use of PET and SPECT
- Special techniques principles & practice (Total Body Irradiation, Total Skin Electron Therapy, IMRT/IGRT, Stereotactic radiation)
- Dosimetric aspects of Magnafield therapy.
- Complex field arrangements & mixed beams, electron arcs, Matching fields, asymmetric fields.
- Recent developments and future trend in RT planning and treatment delivery
- Quality Assurance in Radiotherapy (Quality Assurance & quality control, Monitoring accuracy, Verification parameters, megavoltage imaging, tolerance limits, Legal requirements)

## ■ **PHYSICS [Practical] – III**

- 3-Dimensional conformal planning
- Electronic portal imaging
- Networking
- Quality assurance tests in radiotherapy

▪ **MEDICAL STATISTICS & EPIDEMIOLOGY [Theory] – III**

- Role and function of cancer registries
- Multivariate analysis
- Meta Analysis
- Writing research articles for journals

▪ **MEDICAL STATISTICS & EPIDEMIOLOGY [Practical] – III**

- Designing and writing protocols for Phase I, II and III studies

▪ **CANCER BIOLOGY [Theory] – III**

- Molecular basis of radiation sensitivity
- Molecular basis of cytotoxic drug action and drug resistance
- Immunological aspects of cancer and cancer vaccines : Antigen recognition, Dendritic cells, immunological surveillance, tumor immunology,
- Antisense and Gene therapy
- Basic principles of Hyperthermia

▪ **CANCER BIOLOGY [Practical] – III**

- Understanding micro-array technique
- Transgenic models

▪ **RADIO BIOLOGY [Theory] – III**

- Dose rate effect in Brachytherapy
- How to compensate for missed treatment days?

▪ **CHEMOTHERAPY & CLINICAL PHARMACOLOGY [Theory] – III**

- Drug Design and development : Novel therapeutic targets, New drug discovery & development,
- Preclinical assessment of candidate compounds and phase I-IV studies.
- Biological & Novel therapies : Biological therapies mechanism & combination, Mode of action of interferons, interleukins, growth factors, gene therapy & immunotherapy, Novel targets, cell signal control, Oncogene products, Cancer vaccines

▪ **ARTIFICIAL INTELLIGENCE as applicable to Oncology and Radiation Oncology**

**INTERNAL ASSESSMENT/EXAMINATION**

▪ **Third Year**

**Theory:** Comprehensive knowledge of clinical oncology, optimal combination of surgery, radiotherapy, chemotherapy and hormones. Value of support services such as pathology, cytology, occupational therapy and preventive oncology. Medical statistics and design of clinical trial.

**Practical:** Update of previous years, use of MLC, IMRT CT planning, complex time calculations, pathology slides, pathology specimens, chemotherapeutic drugs, procedures, e.g. ILRT, ICA.

**Clinical:** Case presentation-Long and short cases, assessment of examination and diagnostic skills, doctor-patient relationship, decision making ability.

**Evaluation:** Logbook, Thesis/dissertation, paper presentations during the year, appraisal scores, publications.

**Final Examination after completing three years of training**

WEEKLY CLINICAL SCHEDULE

	08.30-09.15am	05.30-06.30pm
<b>Monday</b>	Seminar	University lecture series(1 <sup>st</sup> year)
<b>Tuesday</b>	Ward Rounds	
<b>Wednesday</b>	Group discussion	University lecture series(2 <sup>nd</sup> year)

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<b>Thursday</b>	Physics lecture Hospital Meeting	
<b>Friday</b>	Planning meeting/ Journal Club	University lectures series (3 <sup>rd</sup> year)
<b>Saturday</b>	Practical (9:30am–11am)	