Syllabus for
MD (Radiotherapy) Programme

Atal Medical & Research University

A state University established by the Govt of H.P

Atal Medical & Research University, H.P.

(A State Govt. University)

(SLBS Govt. Medical College & Hospital Campus, Ner Chowk, Mandi, H.P.)

Minutes of meeting of PG Board of Studies (Radiotherapy) held on 6th May, 2023 in Conference Hall, AMRU at 11:00 AM

A meeting of PG Board of Studies (Radiotherapy) was held on 6th May, 2023 at 11:00 AM at Conference Hall, AMRU under the Chairmanship of Dr. Manish Gupta, Professor & HOD Radiotherapy, IGMC, Shimla.

Following members attended the meeting:

1. Dr. Manish Gupta, Professor & HOD Radiotherapy, IGMC, Shimla -cum-Chairperson.
2. Dr. Sushmita Ghoshal, Professor & HOD, Radiotheraphy, PGI Chandigarh (External expert) nominated by the Hon'ble Vice Chancellor (though video conference).
3. Dr. Ratti Ram Negi, Professor & HOD Radiotherapy, SLBSGMC &H, Mandi -cum-Member.
4. Dr. Sidharth Vats, Associate Professor, Dept. of Radiotheraphy, IGMC, Shimla-cum-Member.
5. Dr. Mukesh Sharma, Assistant Professor, Dept. of Radiotheraphy, Dr. YSPGMC, Nahan-cum-Member (through video conference).

The meeting started with the Chairperson welcoming the members.

The following decisions were taken:

1. To change the name of Postgraduate degree to M.D. Radiation Oncology from M.D Radiotherapy as per guidelines of NMC.
2. Syllabus for degree of Radiation Oncology as per NMC guidelines was discussed among the members Dr. Sushmita Ghoshal, Dr. Ratti Ram Negi, Dr. Sidharth Vats, Dr. Mukesh Sharma, and required changes were done with consensus.
3. The syllabus for degree of Radiation Oncology already being used by other universities (HPU, PU, PGI, AIIMS) was also discussed and relevant points were added as per the consensus.
4. Format of question papers was discussed and sample papers were made as per the consensus of the members and sample papers attached.
5. Members were of consensus that periodic assessment is essential and log book will be monitored and checked by the faculty on regular basis. Sample of log book submitted.

The meeting ended with a vote of thanks to the chair.

Dr. Manish Gupta,
Professor & HOD Radiotherapy,
IGMC, Shimla

Dr. Sushmita Ghoshal
Professor & HOD, Radiotherapy
PGI Chandigarh.

Dr. Ratti Ram Negi,
Professor & HOD Radiotherapy,
SLBSGMC &H, Mandi.

Dr. Sidharth Vats,
Assistant Professor,
Dept. of Radiotherapy
IGMC, Shimla

Dr. Mukesh Sharma,
Dept. of Radiotherapy
Dr. YSPGMC, Nahan.

Post-graduate Radiation Oncology Course Curriculum

Preamble:

The purpose of PG education is to create specialists who would provide high quality health care and advance the cause of science through research & training.

Oncology is a highly specialized and technical discipline in clinical medicine comprising treatment with ionizing radiations and cytotoxic agents as major arms in non-surgical management and treatment of cancer. With a view to update, by inclusion of newer topics, and to provide a uniform syllabus and course contents in Indian universities and teaching medical institutions, the proposed guidelines provide course outlines based on recent developments in clinical medicine and other disciplines related to oncology.

The goal of providing training under this specialty is to enable the post graduate students to acquire complete knowledge in diagnosis and comprehensive management of cancer patients with radiotherapy. This clinical specialty is exclusively focused only on oncology at the post-graduate level. Hence, the doctors trained under this field, after completing their course, should be fully capable of handling cancer patients with non-surgical modalities of diagnosis and treatment. Besides, as per WHO, they should also be capable of guiding and coordinating cancer prevention), control, screening, early detection, rehabilitation, palliative and terminal care programs for these patients in the country as per the evolving needs and to meet the objectives of the National Cancer Control Programme of India. The post graduate students would also be expected to have acquired knowledge of various research methodologies, a broad based training in all aspects of cancer science and treatment and be able to plan/coordinate research studies in the departmental, and be apart of inter-departmental or multi-centric, national/international research programmes.
The PG students would have clinical management of these patients during radiation therapy and will also advise and supervise their palliative, supportive and terminal care, whenever needed, in coordination with other supportive staff. By the end of the three year course, the post graduate student is expected to have acquired a wide knowledge of malignant disease processes and efficient management of patients with cancer. The main emphasis during training shall be on radiotherapy (and combined practice with anti-cancer chemotherapy), but a good knowledge of general medicine, surgery, head & neck region, gynecology and pathology as pertaining to Radiation Oncology.

Dr. MANISH GUPTA
PROFESSOR & HEAD
DEPTT. OF RADIOTHERAPY &
ONCOLOGY IGMC, SHIMLA

TABLE OF CONTENT

GOAL

The main goal of the radiation oncology residency program is to produce radiation oncologists with the necessary knowledge, skill and attitude to prevent, diagnose and manage various cancers. As a result of training in Radiation Oncology, the resident should become competent in the use of the various radiation equipment, techniques, treatment planning, radiation dose prescription, treatment verification, treatment delivery; chemotherapy administration and management of related complications. In order to be considered a competent Radiation Oncologist, a resident must possess humanistic qualities, attitude and behaviour necessary for the development of appropriate patient-doctor relationship.

SUBJECT SPECIFIC COMPETENCIES

1. Demonstrate the ability to diagnose and treat all cases of malignancies using updated guidelines in Medical and Radiation Oncology with special ability to maintain inter disciplinary coordination.
2. Demonstrate the ability to address all emotional issues in patients and family members in relation to diagnosis, therapy, terminal care and mortality related to malignancies
3. Organize proper promotive and preventive care strategies in the community aimed at reducing the burden of care in malignancies
4. Lead and participate in planning and execution of team work related to establishment and maintenance of infrastructure related to radiation therapy, conforming to the updated guidelines
5. Plan and conduct research related to the topic
6. Demonstrate the ability to organize teaching/ training sessions for students and health workers in topics related to cancer prevention and care.

SUBJECT SPECIFIC LEARNING OBJECTIVES

The objectives of the MD programme in Radiation Oncology are to impart knowledge, practical skills and clinical experience in the non-surgical treatment of cancer.

A. Cognitive domain

The students after successful completion of their training, should have acquired knowledge in the following:

1. Theoretical and practical knowledge for competent, safe, compassionate & ethical multidisciplinary practice of oncology and should contribute to the future developments in oncology.
2. The epidemiology, etiology, pathology & natural history of human neoplastic diseases.
3. Knowledge, experience & skill in the clinical diagnosis of human neoplastic diseases.
4. Attain knowledge and a high level of technical expertise in all forms of radiation as a therapeutic tool used in radiotherapy
5. Knowledge of the adverse effects of radiation including radiation related accompaniments.
6. Knowledge and comprehension regarding the use of cytotoxic drugs and biological response modifiers etc. in all clinical and research settings with detailed knowledge of adverse effects of these drugs.
7. Knowledge and comprehension with the role of surgery in the management of neoplastic diseases.
8. Knowledge and ability to judiciously combine various modalities in comprehensive, multi-disciplinary management of cancer patients; coordinate with other specialty experts in the team and plan for use of radiation and cytotoxic drugs integrated into the overall treatment plan

9. A sound knowledge and capability to manage cancer patients as a whole, including
   - Management of oncological emergencies,
   - Complications associated with malignant diseases and its management,
   - Psychosocial problems
   - Prevention, rehabilitation and palliative care.
10. Knowledge and capacity to interpret current advances in cancer management and research (basic, clinical and applied aspects of research including radiobiology & molecular oncology).
11. Knowledge and capability to plan and coordinate community-based screening, early detection, and awareness programs including community-based research projects.
12. Basic knowledge of the different statistical methods used in collection, analysis and interpretation of data related to cancer (with special emphasis on planning & interpretation of clinical trials)
13. Knowledge and capability to set up the specialty department and facilities for Oncology in different parts of India.
14. A broad knowledge of different types of investigations in the management of patients with cancer.

B. Affective Domain:

The student:

1. Should be able to function as a part of a team, develop an attitude of cooperation with colleagues, and interact with the patient and the clinician or other colleagues to provide the best possible diagnosis or opinion.
2. Always adopt ethical principles and maintain proper etiquette in dealings with patients, relatives and other health personnel and to respect the rights of the patient including the right to information and second opinion.
3. Develop communication skills to word reports and professional opinion as well as to interact with patients, relatives, peers and paramedical staff, and for effective teaching.

C. Psychomotor domain

The student, at the end of the course, should have acquired the following skills:

I. Skills and Clinical Experience:

Considerable familiarity and skills in the application of imaging techniques, nuclear medicine procedures, pathology and other aids in the diagnosis and management of cancers. Post graduate students **need to have gained a wide range of experience in the areas of patient care which would include** investigation, diagnosis, treatment with radiation, chemotherapy, chemo- radiation and in palliative and supportive care and to have gained the practical experience detailed below:

1. Radiotherapy – Basic Techniques

a. Positioning the Patient

- Setting up of a patient in each of the three basic treatment positions (supine, prone and lateral) to allow the patient to be planned and treated effectively and without discomfort.
- Setting up the source skin distance for fixed FSD, and extended FSD treatment.
- Setting up patients using laser beam alignment,
- Making temporary and permanent marks on the patient for field positions (Gentian violet, tattoo).

b. Immobilisation Techniques

- Application of some of the following immobilisation techniques: head clamp, Velcro strap, polystyrene beads, vacuum bag, breast arm rest,
- The construction of thermoplastic beam direction shell.

c. Methods of Target Volume Determination

- Performance of planning

- using direct vision of the tumor (eg skin tumors),
- from surface landmarks (e.g the parotid bed, breast tumors),
- with direct screening using simulator (e.g lung tumors, bone metastases), including opacification techniques (e.g barium swallow, cystogram),
- by volume transfer to orthogonal radiographs (e.g head and neck tumors, brain tumors).

- Volume determination from planning CT scans for creatinga central axis plan and for 3-dimensional CT planning.

d. Outline Techniques

- Use of manual techniques (flexi-curves, plaster of Paris bandage) and CT derived outlines.

e. Basic Field Arrangements

- Planning of treatments (under supervision where necessary) using the following field arrangements:

  -Single direct field,
  -Opposed pair of fields using equal and unequal weightings,
  -Opposed pair using wedges,
  -Wedged right-angled pair,
  -Wedged oblique pair,

- Plans using 3 and 4 fields,
- Field arrangements as in Modern Radiotherapy techniques
- Total body irradiation.

f. Tissue Compensation

- Planning of patients requiring tissue compensation usingbolus, wedges and remote tissue compensators

g. Shielding

- Planning of patients using lead cut outs and lead masks forsimple superficial tumours,
- Knowledge of the thickness of lead required for superficial, orthovoltage and electron treatments at various energies,
- Prescription and insertion of eye shields.

h. Megavoltage Techniques

- Planning of patients incorporating simple lead blocking techniques using standard blocks and cast blocks from templates.

i. Electrons

- The indications for, and planning of, electron treatments, including the selection of electron energy.
- A technique for total skin electron therapy and experience of its use.

j. Dose Calculation

- Proficiency in the use of equivalent square tables,
- Performance of depth dose calculations for single fields and opposed fields using various energies,
- The principles applied to convert dose to machine units fora range of machines,
- The principles of computer based treatment planning.

k. Radiotherapy Prescriptions

- Writing radiotherapy prescriptions (countersigned where necessary) for all the field arrangements mentioned above.
- Understanding of dose specification as in ICRU 50 and 62.

l. Radiotherapy Machines

- Planning of patients for treatment on a full spectrum of equipment, including superficial x-ray therapy,megavoltage x-ray therapy and megavoltage electron therapy (also orthovoltage x-ray therapy and cobalt-60 therapy, if available).

m. Quality Assurance in External Beam Therapy

- Requesting portal imaging and interpreted their appearance satisfactorily in all sites

- Principles of in vivo dosimetry and interpretation of results.

n. Brachytherapy

- The insertion and removal of radioactive sources manually or using an appropriate after-loading device,
- Interpretation of subsequent check films,
- Interpretation of the corresponding dose calculation and writing of an appropriate prescription.
- Removal of live sources and the after-loading device,
- The placement of implants,
- Principles of oral and intravenous radionuclide therapy.

o. Radiation Safety

- The role of the radiation safety and radiation protection supervisor,
- The meaning of and requirements for controlled and supervised areas and their location,
- The procedure to be adopted in the case of a spill of radioactive material,
- Quality assurance practices in radiotherapy and the procedures for dealing with errors in treatment delivery.

2. Radiotherapy Assessment and the Care of Patients on Treatment:

a. Treatment Review Clinics

- Regular weekly treatment review clinics

b. Treatment Checks

- Assessment of patient position and treatment field placement(s) in relation to the target volume at the start of treatment.
- Performance of checks during the course of treatment on the implementation of the treatment plan, position of shielding for critical normal structures and the use of portal imaging,
- Assessment of changes occurring in patient parameters during treatment and resultant modification of treatment when appropriate,
- Assessment of normal tissue reactions to radiotherapy,
- Use of dose volume histograms and in vivo radiation dosimetry techniques.

c. Symptom Control

- Giving advice on skin care during radiation treatment and on the management of skin reactions, including desquamation,
- Managing mucosal reactions in oral cavity, oropharynx, Nasopharynx, trachea, esophagus, anus and vagina,
- Giving dietary advice during abdominal radiotherapy.
- Managing radiation induced nausea and vomiting, diarrhea, dysphasia, xerostomia and cystitis,
- Giving prophylaxis for radiation induced cerebral edema,
- Giving advice on timing and extent of hair loss with respect to radiation dose,
- Giving advice for hospitalization, if necessary.

d. Follow-up

- Managing acute and chronic radiation sequelae, such as pneumonitis, cystitis, chronic bowel complications, gynecological sequelae (vaginal stenosis, vaginal dryness, infertility and dyspareunia)

3. Supportive and Palliative Care

a. Pain Relief

- Drug treatment
  - Wide range analgesic techniques, including simple analgesics, mild and strong opioids, given bya variety of routes.
  - Management of the complications of analgesics, including constipation, nausea, gastro-intestinal discomfort and analgesic intolerance.
- Mechanical methods

- Prescription, siting and evaluation of TENS analgesia,
- Referral of patients with refractory pain for procedures such as a nerve block, intrathecal analgesia, rhizotomy or orthopedic stabilization.
- Radiotherapy
- Use of radiation to treat painful metastatic disease with single fractions, multiple fractions and hemi- body radiotherapy.

b. Nausea and Vomiting

- Treatment of nausea and vomiting arising in advanced illness using anti-emetics,
- Palliative management of sub-acute intestinal obstruction.

c. Anorexia and Dysphasia

- Management, where appropriate, with corticosteroids, progestogens and nasal gastric feeding.

d. Pleural Effusions and Ascites

- Drainage of pleural effusions and ascites,
- Other treatments such as pleurodesis.

e. Depression and Anxiety

- Knowledge regarding treatment of depression at all stages of cancer management, using counseling and drug techniques with anti-depressants.
- Knowledge regarding treatment of anxiety with counseling, anxiolytics and major tranquilizers.

f. Hospice Care

- Awareness of local hospice facilities,
- A one week (at least) attachment to a hospice or palliative care team.

g. Counseling

- Counseling of patients and relatives at all stages of the disease.

4. Investigational Techniques

a. Laboratory Investigations

- Interpretation of the results of hematological, biochemical and radioimmunoassay investigations.

b. Radiology

- Attendance at regular radiological review sessions involving a consultant clinical radiologist for the examination of plain x-rays, CT scans, magnetic resonance imaging and ultrasound covering the whole spectrum of cancer radiology,
- Current indications and techniques in interventional procedures.

c. Radiation Medicine Procedures

- Diagnostic Imaging – Gamma Camera, SPECT, PET scanner, PET-CT and PET-MRI image fusion studies in treatment planning, response evaluation and follow up.

d. Pathology

- Attendance at regular pathological review sessions involving a consultant pathologist

e. Genetics in diagnosis, treatment, surveillance & prognosis of cancer

f. Other Procedures

- Indirect laryngoscopy
- Lumbar puncture
- Skin biopsy
- Fiberoptic naso-endoscopy
- Pelvic EUA and cystoscopy

5. Site or Disease Specific Procedures

- Assessment, treatment and follow-up, in detail, for each of the anatomical sites and types of tumor,
- Presentation and assessment of patients discussed at multidisciplinary team meeting,
- Staging,
- Radiotherapy – adjuvant, radical and palliative,
- Concurrent Chemo Radiation therapy (CRT)

- Chemotherapy – Neoadjuvant, adjuvant and palliative
- Hormone and biological therapy,
- Palliative care
- Appropriate follow up,
- Acute and late side effects of treatment.
- Management of Oncological emergencies

6. Clinical Trials, Literature and Research

- The aims and format of Phase I to IV clinical trials,
- Obtaining informed consent, following study protocols andusing data forms,
- Research programs (although research experience is not a prerequisite),
- Major areas of current research and of recent important publications,
- Submission of a research project to an Ethics Committee,
- Structure and functioning of local and national clinical and research cancer networks,
- Ethics guidelines of research

7. Communication and Publication

- Effective communication with colleagues, patients and their careers,
- Giving clear and comprehensive descriptions of disease processes, investigations and treatment,
- Clear expression in English/ local script and production oflegible script,
- Preparing work for publication,
- Ethics of research publication.

8. Outpatient and Joint Clinics

- Participation in joint consultative clinics and regular general oncology outpatient sessions,
- Seeing review and new patients and planning their overallmanagement.
- Attending Pain and Palliative Care Clinics

9. Resource Management and Quality Assurance

- Introduction to the resource management and quality assurance of an oncology service, so as to be able to develop these skills at a later stage.

10. Prevention

- A broad knowledge of the environmental causes of cancer and possible strategies for prevention.
- Cancer Vaccines

11. Screening

- Details of screening programs for cervical, breast, Head & Neck, Lungs, Prostate, GIT and other cancers which might form a major proportion of cancer cases in the country in the years to come.

12. Genetics & Molecular biology

- The familial aspect of some cancers as in colorectal, breast, ovary, retinoblastoma, multiple cancer syndromes etc and the management of high-risk families and genetic counseling.

13. Modern Trends /Recent Advances

i. Anti angiogenic factors , Angiogenesis & carcinogenesis

ii. Monoclonal Antibodies - MABs & NIBs

iii. Essentials of Genomics: Genomes, Signal translation, Immunology, Cytogenetic, cell cycle, Apoptosis, Invasion and metastasis

iv. Gene Therapy,

v. Molecular therapy,

vi. Cancer vaccines.

Syllabus

Course contents:

A. Basic Sciences

1. Applied Anatomy and Physiology of all organs

A. Applied anatomy of oral cavity, larynx, pharynx, paranasal sinuses, CSF pathways, brain, salivary glands, middle ear, external orbit, breast, broncho- pulmonary segments, mediastinum, esophagus, liver, spleen, stomach, small and large bowels, pelvic and genitor-urinary organs (bladder, uterus, ovary, testis rectum, anal canal etc.), spinal segments

B. Lymphatic system and lymphatic drainage pathway of various organs

C. Relationship of vital structures

D. Surface Anatomy pertaining to various organs

E. Cross Sectional Anatomy pertaining to CT/MR/PET and ultrasound images

F. General principles of physiology of respiratory, cardio-vascular, nervous, biliary, reproductive and endocrine systems and fluid-electrolyte-metabolic balance

2. Various Investigative and Imaging Procedures including radio-isotope basedprocedures in Diagnosis, Staging, Treatment Planning and follow up of cancer patients

3. Pathology of Benign and Malignant Diseases

A. Carcinogenesis - epidemiological studies, molecular studies, genetic basis, oncogenes, tumour growth kinetics

B. Pre-cancerous conditions

C. Methods of dissemination of cancer and its biological behaviour

D. Degree of differentiation of cancer

E. Principles and methods of definite diagnosis
   i). Surgical biopsy - various procedures of biopsy
   ii). Exfoliative cytology
   iii). Fine Needle Aspiration Cytology (FNAC) and biopsy
   iv). Tumour markers

F. General histologic and cytologic features of malignancy including features of special staining, surface markers, intracellular markers

G. Classification of benign and malignant tumors and their interpretation

H. Molecular pathology, molecular basis of diagnosis and prognosis of cancers

I. Radiation pathology

4. Staging of various cancers:

i. Evolution of different staging systems for various cancers over the years.

ii. Clinical Staging, WHO Staging, TNM Staging, AJCC Staging and FIGO staging etc of various cancers, as applicable, with their inter-comparisons.

5. International Coding and classification of various neoplastic disorders

i. ICD-9, ICD-O and ICD-10 system of classification and coding of various tumours.

B. Radiation Physics

The following courses of study and the subjects are recommended for training in MD Radiotherapy and Oncology. It is essential that these topics be covered in detail for better understanding of the basics of radiation treatment, as per subject heads given below:

1. Atomic and Nuclear Structure

A. Atomic structure

1. Energy levels, binding energy
2. Transitions, characteristic radiations

B. Nuclear structure

1. Mass, atomic and neutron numbers
2. Nuclear binding energy
3. Fission, fusion
4. Nuclear reactors

2. Radioactive Decay

A. Modes of decay

1. N/P ratio, even-odd relationship
2. Beta decay
3. Positron decay and electron capture
4. Alpha decay
5. Isomeric transitions, gamma emission, internal conversion

B. Mathematics of Radioactive Decay

1. Units, half-life, graphing
2. Transient and secular equilibrium
3. Radionuclide generators

C. Natural Radioactivity

1. Naturally occurring isotopes
2. Decay series

D. Artificial Radioactivity

1. Production by neutron bombardment
2. Fission products
3. Production by charged particle bombardment
4. Radioactivity equilibriu

3. Production of X-rays

A. X-ray tubes

1. Requirements for X-ray production
2. Historical development

3. Focal spot size
4. Reflection and transmission targets
5. X-ray production efficiency

B. X ray circuits
1. Primary circuits
2. Secondary circuit
3. Filament circuit
4. Modes of rectification

4. High Energy Treatment Machines

A. Cobalt units
B. Van de graff generators
C. Linear accelerators
D. Betatrons
E. Resonance transformers
F. Cyclotrons for neutron therapy
G. Microtron, Synchrocyclotron and Particle Accelerators

5. Interactions of X - and Gamma-rays

A. Attenuation of a beam of x- or gamma-rays
1. Attenuation and absorption coefficients
2. Attenuation in the body

B. Modes of interaction
1. Photoelectric absorption
2. Compton scattering
3. Pair production
4. Photo-disintegration

6. Interactions of Particulate Radiations

A. Types of interactions
1. Elastic, inelastic
2. Excitation, ionization

B. Properties of particulate radiations
1. Specific ionization
2. LET

C. Interactions of heavy charged particles and pions
1. Bragg's peak
2. Applications in radiation therapy

D. Interactions of electrons

1. Interactions with electrons
2. Interactions with nuclei
3. Applications to radiation therapy

E. Neutron interactions
1. Slow neutron interactions
2. Fast neutron interactions
3. Applications with radiation therapy

F. Radioactive sources used in diagnosis and therapy - Productionand properties

7. Measurement of Radiation Exposure

A. Photon and energy flux density and fluence

B. The roentgen

C. Electronic equilibrium

D. Ionization chambers
1. Free-air chambers
2. Thimble chambers
3. Condenser chambers
4. Electrometers
5. Extrapolation chambers

E. Exposure calibration of an X - or gamma - ray beam
1. Selection of calibration variables
2. Selection of chamber
3. Positioning of chamber
4. Corrections to readings

F. Quality assurance checks on radiation therapy units

8. Radiation Quality

A. Measures of quality
1. HVL and effective energy

B. Factors influencing quality
1. Variations in quality across a beam
2. Filtration an acceleration potential

9. Measurement of Absorbed Dose

A. Units of radiation dose, dose equivalent, RBE-dose

B. Calculation of dose from exposure

C. Measurement of absorbed dose with an ionization chamber
1. Bragg-Gray cavity theory

D. Direct measurement of absorbed dose
1. Film

2. TLD
3. Calorimetry
4. Chemical dosimetry

10. Calibration of High Energy Photon and Electron Beams

A. Photons
B. Electrons
C. Protons

11. Dose Distribution, External Beam Therapy

A. Dosimetric variables
    1. Backscatter factor
    2. Percent depth dose
    3. Tissue - air ratio
    4. Scatter - air ratio
    5. Tissue - maximum and tissue-phantom ratios
    6. Isodose distributions
    7. Treatment time calculations
    8. Fixed SSD and isocentric treatment techniques
    9. Beam Modulation
B. Single and multiple field dose distributions
    1. Corrections for wedges
    2. Design for compensating filters
    3. Corrections for surface obliquities
    4. Corrections for heterogeneities
    5. Dose perturbations at interfaces
    6. Adjoining fields
    7. Integral dose
C. Dose distribution for rotational therapy
D. Calculation of dose in large, irregular fields

12. Dose Distribution, Sealed Source Therapy

A. Handling of sealed radioactive sources
B. Dose distributions for sealed implant sources
C. Design of sealed source implants
D. Radium and its substitutes
E. Special techniques for ^{192}Ir and ^{125}Ir
F. Other sealed sources in therapy

13. Computerized Treatment Planning

A. External X-and gamma-ray beams

1. Rectangular fields
2. Irregular fields
3. Inverse Planning

B. Electron beams

C. Implanted sources

1. Intracavitary sources
2. Interstitial implants
3. Surface mould

14. Radiation Protection from External Sources

A. Concepts and units

1. Quality factors
2. Dose equivalent
3. Protection regulations

B. Treatment room design

1. Primary radiation
2. Scatter
3. Leakage
4. Special problems with high energy photon and electron beam
5. Special problems with neutron, proton and □-meson

C. Sealed source storage

D. Protection surveys

E. Personnel monitoring

15. Radiation Protection from Internal Sources

A. Body burdens and critical organs

1. Effective half-lives for uptake and elimination.

B. Internal dose computations

1. Locally absorbed radiation
2. Penetrating radiation

C. Handling radionuclide therapy patients

D. Licensing procedure for using radionuclide's

16. Planning of a Radiotherapy Department

A. Building designs as per AERB safety codes

B. Choice of various equipment's and sources

C. Acceptance and Calibration Tests

D. Various maintenance steps and procedures

17. New Radiation Modalities:

A. Protons

1. Production
2. Processes of absorption
3. Depth dose patterns
4. Advantage compared with x-rays
5. Facilities available

B. Neutrons

1. Production
2. Processes of absorption
3. Depth dose patterns
4. Advantages compared with x-rays
5. Facilities available

C. Pions

1. Production
2. Processes of absorption
3. Depth dose patterns
4. Advantages compared with x-rays
5. Facilities available

D. High energy heavy ions

1. Production
2. Processes of absorption
3. Depth Dose Patterns
4. Advantages compared with x-rays
5. Facilities available

C. Radiobiology (Radiobiology and Laboratory Radiotherapy)

18. Mammalian Cell Radio sensitivity

A. Apoptosis, Interphase and reproductive death

B. Cell survival curves in vitro

C. Characterization of cell survival curves

D. Critical sites and target theory

a) DNA

b) Membranes

E. Dose response curves in vivo

1. Skin clone
2. Surviving crypts
3. Bone marrow colonies growing in spleen, monolayer culture

F. Quantitative normal tissue reaction based on systems

1. Pig skin
2. Rodent skin
3. Lung
4. Esophagus
5. Kidney
6. CNS and spinal cord

19. Factors that Modify Radiation Response

A. The Oxygen effects

1. Effect of oxygen concentration
2. Time of action of oxygen
3. Mechanism of the oxygen effect
4. Implications for radiotherapy
5. Methods to overcome problems of hypoxic cells

B. The age response function

1. The cell cycle
2. Age response for cells cultured in vitro
3. Age response for tissues in vivo
4. Age response for neutrons
5. The oxygen effect through the cell cycle
6. Implications for radiotherapy

C. Potentially Lethal damage

1. Repair in vitro
2. Repair in vivo
3. PLD and high LET radiations
4. Implications in radiotherapy

D. Sub lethal damage

1. Split-dose experiments with cell in vitro
2. Sub lethal damage repair in normal tissues
3. Sub lethal damage repair in tumors
4. Sub lethal damage and hypoxia
5. Sub lethal damage and high LET radiations
6. Dq as a measure of repair

E. Dose-rate

1. Dose-rate effects in cells in vitro
2. Dose-rate effect in normal tissues
3. Dose-rate effect in tumors

4. Interstitial therapy
5. Beam therapy at low dose rate

F. Radiosensitizers

1. The halogenated pyrimidines
2. Hypoxic cell Radiosensitizers
    a. Structure and mode of action
    b. Enhancement ratio
    c. Metronidazole/misonidazole
    d. Pharmacokinetics in the human
    e. Clinical limitations
3. Antibiotics

G. Radioprotectors

1. Free radical scavengers

20. Linear Energy Transfer

A. Definition
B. Track and energy average
C. LET for different types of radiation
D. OER as a function of LET

21. Relative Biological Effectiveness (RBE)

A. Definition
B. RBE for different cells and tissues
C. RBE as a function of dose
D. RBE and fractionation
E. RBE as a function of LET
F. Q factor

22. Cell and Tissue Kinetics

A. The cell cycle
B. Autoradiography
C. Constituent parts of the cell cycle
D. Percent labeled mitoses technique
E. Growth fraction
F. Cell loss factor
G. Growth kinetics of human tumors

23. Tissue Radio sensitivity

A. Classification based on radiation pathology
B. Types of cell populations
    1. Self renewal

2. Conditional renewal

3. Stem cell

4. Differentiated

24. Time-Dose and Fractionations

A. The 4 R's of radiobiology

B. The basis of fractionation

C. The Strandquist's plot

D. Nominal standard dose

E. Linear Quadrate equation

25. Hyperthermia

A. Methods of heating

1. RF microwaves

2. Ultrasound

3. Water baths

B. Systematic hyperthermia

C. Localized heating

D. Cellular response to heat

E. Repair of thermal damage

F. Thermo tolerance

G. Hyperthermia combined with ionizing radiations

H. Time sequence of heat and irradiation

I. Hypoxic cells and heat

J. Effect of pH on the response to hyperthermia

K. Response of transplanted tumors to heat

L. Response of spontaneous tumors to heat

M. Response of normal tissues to heat

N. Heat and the therapeutic gain factor

O. Hyperthermia and chemotherapy

26. Total Body Irradiation – Acute Effects

A. Prodromal radiation syndrome

B. Central nervous system / cerebrovascular syndrome

C. Gastrointestinal syndrome

D. Hematopoietic syndrome

E. Mean lethal dose: (LD_{50})

F. Treatment of radiation accident

27. Late Effects

A. Probabilistic/Deterministic (Stochastic/Non-Stochastic) effects

B. Non-specific life shortening

1. Definition
2. In animals
3. In man

C. Carcinogenesis

1. The latent period
2. Dose response curve in animals
3. Leukemia
4. Breast cancer
5. Thyroid cancer
6. Bone cancer
7. Skin cancer
8. Lung cancer
9. Other tumors
10. Malignancies in prenatally exposed children
11. Mechanisms of Radiation Carcinogenesis

A. Genetics of irradiation

1. Point mutations
2. Relationship to dose
3. Chromosome aberrations
4. Relationship to dose
5. Doubling dose
6. Genetically significant dose (GSD)
7. Genetic effect in humans
8. Background radiation in relation to the GSD

28. Radiation Effects in the Developing Embryo and Fetus

A. Intrauterine death
B. Congenital abnormalities including neonatal death
C. Growth retardation
D. Dependence of the above effects on dose, dose-rate and stage in gestation
E. Carcinogenesis following in utero exposure
F. Human experience of pregnant women exposed to therapeutic doses
G. Occupational exposure of potentially pregnant women
H. Elective booking or "10 day rule"
I. The "Practical threshold" for therapeutic abortion

29. Radiation Pathology:

Radio physiology of Human Tissues

A. Effects or irradiation of the skin

1. Clinical manifestations
2. Histological substratum of effects
3. Repair
4. Degree of sequelae
5. Injurious effects

B. Effects of irradiation of bone and cartilage

1. Effects on growing bones and cartilage
2. Effects on adult bones and cartilage
3. Clinical manifestations
4. Histological substratum of effects
5. Functional consequences and sequelae

C. Effects of irradiation of the kidney

1. Clinical manifestations
2. Histological substratum of effects
3. Acute and chronic functional repercussions
4. Permanent Sequelae

D. Effects of irradiation of the lung

1. Acute clinical effects
2. Ultimate effects
3. Histological substratum of effects
4. Measures to reduce final effects
5. Sequelae

E. Effects of irradiation of nervous tissues

1. Effects on the brain
2. Effects on the spinal cord
3. Effects on the peripheral nerves
4. Clinical manifestations
5. Histological substratum
6. Sequelae

F. Effects of irradiation of the ovary

1. Clinical manifestations
2. Histological substratum
3. Reversibility of effects
4. Therapeutic implications

G. Effects of irradiation of the testis

1. Clinical consequences
2. Histological substratum
3. Reversibility
4. Protective measures

H. Effects of irradiation of the eye

1. Clinical consequences
2. Histological substratum
3. Protective measures
4. Time-dose connotations
5. Sequelae-therapy

I. Effects of irradiation of lymphoid tissues

1. Clinical manifestations
2. Histological manifestations
3. Reversibility

J. Effects of irradiation of the bone-marrow

1. Clinical and laboratory manifestations
2. Chronology of effects
3. Histological substratum
4. Recovery
5. Therapeutic applications

K. Effects or irradiation of the oral, pharyngolaryngeal and esophageal mucousmembrane

1. Clinical manifestations
2. Histological manifestations
3. Repair
4. Sequelae

L. Effects of irradiation of the salivary glands

1. Acute manifestations
2. Histological substratum
3. Dental consequences
4. Prophylaxis

M. Radiation affects observable in clinical radiotherapy

1. Technological protection
2. Role of total dose
3. Role of fractionation
4. Measures of prevention
5. Therapeutic measures

N. Effects of irradiation of human embryo

1. Role of age
2. Role of dose
3. Teratogenic effects
4. Measures of prevention

O. SOMA Scales

D. Basics of Chemotherapy/ Clinical Chemotherapy

A. Classification, mechanisms of action and pharmacokinetics of anti-cancer (cytotoxic) drugs including Biological Response Modifiers
B. Rationality of using cytotoxic drugs as single agents and as multi-drug protocol in various clinical settings
C. Dosages/Modes/routes of administration of cytotoxic drugs
D. Complications/adverse effects of various cytotoxic drugs
E. Gene Therapy
F. Molecular or Targeted therapy of different cancers.
G. Assessment of New Agents. Principles of phase I, II, and III studies.
H. Newer chemotherapeutic agents.

2. CLINICAL CHEMOTHERAPY

2.1. Basic principles of chemotherapy
2.1.1. Chemotherapy drugs.
2.1.2. Newer chemotherapeutic agents.
2.1.3. Basis for designing different chemotherapy schedules. Standard chemotherapy schedules.
2.1.4. Chemotherapy practice in various malignancies
2.1.5. Chemotherapy practice & results/ toxicities in sequential & concomitant chemo radiotherapy.
2.1.6. Supportive care for chemotherapy.
2.1.7. The basic principles underlying the use of chemotherapeutic agents.

i) Classification and mode of action of cytotoxic drugs. The principles of cell kill by chemotherapeutic agents, drug resistance, phase specific and cycle specific action.
ii) Drug administration. The general principles of pharmacokinetics; factors affecting drug concentration 'in vivo' including route and timing of administration, drug activation, plasma concentration, metabolism and clearance.
iii) Principles of combinations of therapy, dose response curves, adjuvant and neo-adjuvant chemotherapy, sanctuary sites, high dose chemotherapy, and regional chemotherapy.
iv) Toxicity of drugs. Early, intermediate and late genetic and somatic effects of common classes of anticancer drugs. Precautions in the safe handling of cytotoxic drugs.
v) Endocrine manipulation and biological response modifiers. An understanding of the mode of action and side effects of common hormonal preparations used in cancer therapy (including corticosteroids). Use of the major biological response modifiers such as interferon's, interleukins and growth factors and knowledge of their side effects.
vi) Assessment of New Agents. Principles of phase I, II, and III studies.
vii) Gene Therapy
viii) Molecular or Targeted therapy of different cancers.

E. Principles of Radiotherapy allied specialties

I. Clinical Practice of Radiotherapy and Oncology

A. Principles of Radiotherapy

1. General – Radio sensitivity and Radio curability

- Tumor lethal dose, Tissue Tolerance and Therapeutic Ratio(TR)
- Factor influencing TR
- Target Volume
- Choice of Time, dose fractionation and technique

2. Teletherapy

- Radiation factors
- Megavoltage therapy
- Orthovoltage therapy
- Electron therapy
- Heavy particle therapy (Neutron, photon, pi-meson)

3. Brachytherapy

- Radium and its substitutes
- Practice of - surface, intracavitary and interstitial Clinical application
- Rules and techniques
- Newer developments
- After loading
- Low and high dose rates(LDR,MDR,PDR & HDR)

B. Techniques of Radiotherapy

- Small field beam directed therapy
- Extended and irregular field therapy Single, double and multiple field therapy
- Beam modification therapy (wedge filter / compensator etc.) Rotation and Arc therapy
- IMRT, IGRT, tomotherapy
- Newer Techniques
- Techniques in BrachytherapyIntracavitary Interstitial
- Mould application
- Modern development and after loading devices

C. Clinical Practice Radical (curative)
Pre-operative
Post-operative Supplementary
Combination (both Pre- & Post operative – Sandwich technique)

Palliative
Nutritional care and local hygiene during and after therapy

D. Treatment Planning and Presentation Mould room practices
Simulation

Computerized treatment planning system
Clinical dosimetry
Prescription and execution

E. General histological and cytological features of malignancy

F. Classification of benign and malignant tumours and their interpretation

F. Related Specialties: surgical oncology and medical oncology

A. Principles and practice of general surgery, gynecology and pediatric surgery as related to cancer

Surgical treatment decisions

Surgical diagnosis and staging of cancer

B. Cancer Chemotherapy and Hormones

Chemotherapy

- Principles and clinical practice
- Classification of drugs
- Clinical application of
  a. Single drug therapy
  b. Polychemotherapy and various combinations
  c. Adjuvant therapy
  d. Prophylactic therapy
- Complication of the chemotherapy and its management Recent developments
- Drug schedules

Hormone Treatment in Cancer

- General principles
- Role in cancers of the Breast, thyroid, prostate, kidney etc. Complications and their management

C. Clinical staging and TNM staging system

D. Terminal care of cancer patients – principles and practice of control of pain

E. Cancer registry and epidemiology

F. Prevention and early detection in cancer

G. Cancer education and oncology organization

H. Statistical methods

Manzla

G. Clinical Management of tumors:

- Head and Neck

  Lip/ Oral cavity/ Oropharynx/ Hypo pharynx/ Nasopharynx/ Supraglottis/ Vocal cord/

  Sub-glottis/ Middle ear/ Nose and nasal sinuses/ Orbit and optic nerveLachrymal gland/ Salivary gland/ Glomus jugulare tumours/ Carotid body tumours/ Other sites in the region

- Gastro-Intestinal Tract

  Esophagus/ Stomach/ Liver/ Pancreas and biliary tract/ Small bowel/ Colon and rectum/ Anal canal and peri-anal region

- Chest

  Pleura/ Trachea/ Lung/ Mediastinal and thymus
- Genito-Urinary Tract

  Kidney/ Ureter/ Bladder/ Urethra/ Prostate/ Penis/ Testis
- Female Genital Tract

  Uterine cervix/ uterine body/ Vagina/ Vulva/ Ovary/ Fallopian tube
- Central Nervous System

  Brain/ Spinal cord/ Craniopharyngioma/ Chordoma/Acoustic neuroma/ Meninges
- Soft Tissue Sarcomata and Bone Tumours

  Adult soft tissue sarcoma/ Childhood/adolescent sarcoma/ Chondrosarcoma/ Osteosarcoma/ Ewing's tumor
- Pediatric Tumours

  Medulloblastoma/ Neuroblastoma/ Nephroblastoma/ Retinoblastoma/ Embryonal sarcomas
- Lymph proliferative and Myeloproliferative Disorders

  Hodgkin's lymphoma/ Non-Hodgkin's lymphomas/ Plasma cell malignancies/Acute and chronic leukemia's
- Skin

  Basal cell carcinoma/ Squamous cell carcinoma/ malignant melanoma/ cutaneous lymphoma/ Kaposi's sarcoma
- Endocrine

  Breast/ Thyroid/ Parathyroid/ Pituitary/ Adrenal
- Other tumours and tumor- like conditions
- Metastatic cancer in unknown primary

H. For each of the tumor types and sites listed above, the post graduate students shall learn the:

- **Management**
  - Initial staging investigations including imaging and tumour markers
  - Role of PET-CT/ SPECT-CT in modern day management of cancers
  - Relevant prognostic factors
  - Assessment for treatment
  - Role of surgery
  - A management plan, or, where applicable, a range of such plans
  - Ionizing Radiation Regulations
  - Role of Chemotherapy : Neoadjuvant,Adjuvant,Concurrent & Palliative
  - Roles of surgery, radiotherapy and cytotoxic chemotherapy in multimodality approaches to cancer treatment
- **Pathology**
  - The range of tumors that can occur

- Their etiology, incidence and epidemiology
- A brief morphology of the common tumours
- The natural history of the disease including likely presentation, characteristic growth and metastatic pattern
- Staging classifications eg TNM, WHO, FIGO, AJCC, AFIP
- Use of tumor markers in diagnosis and treatment of tumours
- Use of specialized pathology techniques, eg immunocytochemistry
- Interpretation of clinicopathological data in the tumor site specialized multidisciplinary approach to patient management

➢ **Radiotherapy**

i. The role of irradiation in radical and palliative management

ii. Where radical radiotherapy is a treatment option:

1. Staging investigations
2. A definition of tumor volume and target volume boundaries
3. ICRU, AAPM, ICRP reports relevant to clinical oncology
4. An acceptable radio therapeutic technique, or, where applicable, arange of such techniques
5. The correct treatment position
6. Details of the target volume localization process
7. Use of CT axial images, 3D planning, Inverse Planning, IMRT, IGRT,Arc Therapy, Irregular shaped fields
8. Verification techniques such as laser alignment, skin tattoos, orthogonal and portal films
9. The approximate dose distributions for the chosen technique
10. An appropriate dose/fractionation regime
11. Relevant dose modifying factors (changes in fractionation, age, associated conditions, target volume, intercurrent infections, previous therapies)
12. Details of the set-up instructions for technologists
13. Appropriate responses to changes of patient parameters or interruptions during treatment
14. The possible acute and late side effects of the irradiation
15. Radiation dose modifying factors, chemotherapy timing in all forms of chemo radiation schedules

➢ **Drug Therapy: Comprehensive knowledge of Cytotoxic, hormonal and biological drugs.**

i. Basic knowledge and understanding of integrating drugs with Radiotherapy. The role of cytotoxic, hormonal and biological drugs therapies in radical and palliative management

ii). Biological Therapies

A basic knowledge of the clinical uses of currently used biological therapies including interferon's, colony stimulating factors, interleukins, erythropoietin, other growth factors targated therapy & immunotherapy preparations (imatinib, geftinib, nimotuzumab, trastuzumab, rituximab, erlotonib etc).

- **Outcomes**

  The expected outcomes of treatment

- ***Oncological Emergencies***
  - The management of all the complications when they arerelated to cancer:
    - Ureteric obstruction
    - Spinal cord compression
    - Hemorrhage
    - Mediastinal superior vena caval obstruction

I. Radiotherapy for Benign Disease

- The indications for radiotherapy in the treatment of benign conditions, including suitable techniques and dosage schedules, and likely benefits andrisks

J. Complications of Treatment

- The acute and late complications of oncological treatment and their management.
- The available medical and surgical techniques for the control of pain, nausea, vomiting and malignant effusions
- Treatment of various cancer related conditions and paraneoplastic syndromes
- Symptom control an continuing care

K. Current Research and Literature

- Current major research in progress in the form of multicentre trials
- Recent major publications in oncology journals
- Understanding evidence-based medicine and how to read literature.

L. Recent Advances and Special Topics

Recent advances coming up in various fields as applicable to oncology

A. Causes of treatment failure and retreatment

B. TLI and TBI – Role, Philosophy and Techniques

C. Supportive care in Radiation treatment in combination with chemotherapy/surgery

D. Infections, nutritional and other problems in cancer patients

E. Preventive Oncology

F. Psychosocial aspects of cancer and Rehabilitation

G. Hospice Program

H. Immunotherapy and Role of Monoclonal antibodies in diagnosis, staging and management of cancer

I. Oncological Emergencies

J. Care and Nursing of patients on Radiotherapy and Chemotherapy

K. Cancer Control Programmes

L. International Classification and Coding of Cancer (ICD-9, ICD-O,ICD-10)

M. Research Methodologies in Cancer

N. Recent advancement in clinical radiation therapy technique and equipment

O. Recent advancement in clinical chemotherapy and its application in various tumors.

This being a highly dedicated PG specialty introducing several new concepts/subjects in the course, it is recommended to divide the entire course into two components consisting of First Year of BASIC CONCEPTS OF THE SPECIALTY and the next two years of INTENSIVE CLINICAL TRAINING IN THE SPECIALTY.

The subjects recommended to be covered during the first year are:

- Basic Sciences including concepts of carcinogenesis & epidemiology of cancer
- Applied anatomy and physiology
- General pathology and pathology of tumours
- Medical physics related to Radiotherapy
- Radiobiology
- Radiation Pathology
- Classification, mechanisms of action and Pharmacokinetics of anti-cancer(cytotoxic) drugs
- Rationality of using cytotoxic drugs as single agents and as multi-drug protocol in various clinical settings
- Imaging techniques
- Staging of cancers of various sites.

The post graduate students should devote **next two years** in learning the science and art of practice of Oncology focusing upon radiotherapy and clinical chemotherapy along with knowledge of integration of other modalities in total management of cancer, as elaborated in the subsequent sections.

TEACHING AND LEARNING METHODS

Teaching Methodology

1. **Lectures:** Lectures are to be kept to a minimum. They may, however, be employed for teaching certain topics. Lectures may be didactic or integrated.
   a) **Didactic Lectures:** Recommended for selected common topics for postgraduate students of all specialties. Few topics are suggested as examples:
      1) Bio-statistics
      2) Use of library
      3) Research Methods
      4) Medical code of Conduct and Medical Ethics
      5) National Health and Disease Control Programmes
      6) Communication Skills

   These topics may preferably be taken up in the first few weeks of the first year.

b) **Integrated Lectures:** These are recommended to be taken by multidisciplinary teams for selected topics.

2. Theory lectures: seminars in radiation physics, radiobiology, radiation pathology, basic and clinical oncology, clinical radiation therapy, chemotherapy, radiation techniques, computer applications, research methodologies etc.
3. Lectures in other allied disciplines like Psychiatry, Experimental Medicine (with special stress on organization of various research activities & trials in oncology), Community Medicine including preventive oncology, primary and secondary Prevention of cancer, early detection and screening programmes in cancer, Planning of cancer control activities, rehabilitation and pain relief, etc.
4. **Journal Club & Subject seminars:** Both are recommended to be held once a week. All PG students are expected to attend and actively participate in discussion and enter in the Log Book relevant details. Further, every post graduate student must make a presentation from the allotted journal(s), selected articles at least four times a year and a total of 12 seminar presentations in three years. The presentations would be evaluated and would carry weightage for internal assessment. A time table with names of the student and the moderator should be announced at the beginning of every year.
5. **Panel Discussions and Debate.**
6. **Student Symposium**: Recommended as an optional multi disciplinary programme. The evaluation may be similar to that described for subject seminar.
7. **Inter-departmental meetings:** strongly recommended particularly with the Department of Radiodiagnosis at least once a week. These meetings should be attended by post graduate students and relevant entries must be made in the Log Book.
8. **Teaching Skills:** The postgraduate students shall be required to participate in the teaching and training programme of undergraduate students and interns.
9. **Brachytherapy Procedures:** Student should have done minimum of 10 brachytherapy procedures (5 Assisted & 5 Independent)
10. **Undertake audit**, use information technology tools and carry out research, both basic and clinical, with the aim of publishing his work and presenting his work at various scientific fora.
11. **Continuing Medical Education Programmes (CME):** At least two CME programmes should be attended by each student in 3 years.
12. **Conferences:** The student should attend courses, conferences and seminars relevant to the speciality.
13. A postgraduate student would be required to present one poster presentation, to read one paper at a national/state conference and to present one research paper which should be published/accepted for publication/sent for publication during the period of his postgraduate studies so as to make him eligible to appear at the postgraduate degree examination.
14. Department should encourage e-learning activities.

Note: During the training programme,

Each post graduate student shall be required to engage in a project under the supervision of a faculty member for a thesis or a dissertation.

15. **Log book** : During the training period ,the post Graduate student should maintain a log book indicating the duration of the postings/work done in wards ,OPDs, radiation treatment planning ,simulation , OT procedures. Log Book should indicate the procedure assisted and performed, and teaching sessions attended. The log Book should be verified by senior faculty and shall be checked and assessed periodically by faculty member imparting the training.

Rotation:

Postings:

- Posting in various divisions of the department – mould room, treatment planning, simulation room, Teletherapy and Brachytherapy facilities etc.

- Posting in Radiotherapy OPD and ward by rotation.
- Short postings in departments/divisions of Surgical Oncology, Medical Oncology, Palliative Care, Imaging, cancer registry, as per the direction from Head of the Department.

Common Course work

1. **Course in Research Methodology**
   - All postgraduate students shall complete online Basic Course in Biomedical research (BCBR) conducted by National Program on Technology Enhanced Learning (NPTEL).
   - The students shall have to register on the portal of the designated training institutions.
   - The students have to complete the course within one year of the commencement of the batch
   - The online certificate generated on successful completion of the course and examination thereafter, will be acceptable evidence of having completed this course.
   - The above certification shall be a mandatory requirement to be eligible to appear for the final examination of the respective postgraduate course.
   - This requirement shall be applicable for all postgraduate students.
2. **Course in Ethics**
   - All postgraduate students shall complete course in Ethics including Good Clinical Practices and Good Laboratory Practices, whichever is applicable to them, to be conducted by Institutes themselves or by any other method.
   - The students have to complete the course within one year of the commencement of the batch
   - No Postgraduate Student shall be permitted to appear in the examination without completing the above course.
3. **Course in Cardiac Life Support Skills (CLS)**
   - All postgraduate students shall complete a course in Basic Cardiac Life Support (BCLS) and Advanced Cardiac Life Support (ACLS) skills and get duly certified.
   - The students have to complete the course within one year of the commencement of the batch.
   - No Postgraduate Student shall be permitted to appear in the examination without the above certification.
4. **Awareness in basics of management and audit**
   Awareness in Medical Audit, Management, Health Economics, Health Information System, basics of statistics, exposure to human behavior studies and knowledge of pharmacy shall be imparted to the Post Graduate students.
5. **Others**
   - Training in other courses such as on Telemedicine, Artificial Intelligence (AI) in Medicine How to write a manuscript and make effective presentations; Use of Pubmed and other resources etc.

ASSESSMENT

Formative Assessment, ie , assessment during training . Formative assessment should be continual and assess medical knowledge, patient care, radiotherapy planning skill, procedural & academic skills, interpersonal skills, professionalism, self-directed learning, and ability to practice in the system.

General Principles: internal Assessment should be frequent, cover all domains of learning and used to provide feedback to improve learning, it should also cover professionalism and communication skills. Internal assessment should be conducted in theory and practical/clinical examinations.

- End year examination (Theory and Practical)
- Assessment of Entrust able Professional Activities.
- Quarterly appraisal feedback
    1. Journal based/recent advances learning
    2. Patient based/Laboratory or Skill based learning
    3. Self-directed learning and teaching
    4. Departmental and interdepartmental learning activity
    5. External and Outreach Activities /CMEs
- Workplace based assessment (Multisource/360^0 feedback)

The student to be assessed periodically as per categories listed in postgraduate student appraisal form (Annexure I).

Time line for formative assessment

Formative Assessment	Every Three months	Internal Assessment Examination before Final Examination
Format of Examination	• One theory paper • Practical examination	• Four theory papers • Practical examination including theory viva

SUMMATIVE ASSESSMENT, i.e., at the end of training

The summative examination would be carried out as per the Rules given in POSTGRADUATE MEDICAL EDUCATION REGULATIONS, 2000.

The examination shall be in three parts:

1. **Thesis**

.Thesis Protocol:

Activity	**January session**	**July session**
Submission to Department/Postgraduate Research Monitoring Committee	April/May	October/November
Submission to Institutional Ethic Committee (IEC)	June	December
Final approval letter by IEC	September	March

Duration of Thesis: Minimum of 24 months from the date of approval by the IEC.

Thesis Progress Monitoring: Every six months by the Departmental PG Research Monitoring Committee

Thesis submission: Six months before the commencement of theory examination i.e. by 30th June for January admission and 31st December by July admission

A post graduate student shall be allowed to appear for the Theory and Practical/Clinical examination only after the acceptance of the Thesis by the examiners

2. **Theory Examination:**
   There shall be four papers each of three hours duration. These are:

Paper	TOPIC	MARKS
Paper I (Basic Sciences)	Basic Principles in practice of Radiotherapy (Physics, Radiobiology, Pathology and Equipments) & Surgical Oncology.	100

Manish

Paper II (Clinical Radiotherapy)	Clinical Radiation Oncology and Techniques of Radiotherapy	100
Paper III (Clinical Chemotherapy)	Chemotherapy, Targeted therapy and Immunotherapy	100
Paper IV(Recent advances)	Recent Advances in Radiation and Clinical oncology	100
TOTAL		**400**

3. **Clinical/ Practical and oral/viva voce examination**
600 marks (20% weight age is given to internal assessment marks)

There would be four examiners. These would include two internal (one head of department and the other by rotation) and two external examiners. There would three semi-long cases. Candidate would also be assessed on histopathology slides, radiological investigations and oral viva-voce.

Practical Examination should consist of the following:

- Long and short cases - a minimum of one long case and two-three short cases should form the basis of clinical examinations
- Pathology specimens
- Imaging techniques as relevant to clinical oncology, combined radiotherapy, surgery, chemotherapy, radiotherapy techniques, brachytherapy applications, radiation protection, equipment's, instruments and other armamentarium/accessories relevant to various Chemotherapy/Radiotherapy procedures, chemo-ports, paracentesis catheters
- Computer application in Radiotherapy
- Simulation
- Mould room technology
- Radiotherapy Planning etc.

Oral/viva voce examination shall be comprehensive enough to test the post graduate student's overall knowledge of the subject.

	Activity	Marks
Practical/ Clinical Exam	OSCE/ Spotters/ Specimens	50
	Cases	300
Grand Viva	Theory viva	100
	Thesis Viva	15
	Assessment of Planning skills	15
Internal Assessment		120
Total		**600**

Pass criteria: ***Obtaining of 50% marks in Theory and Practical examination separately in each paper/head shall be mandatory for passing the examination. Hence, a candidate shall secure not less than 50% marks in each head of examination which shall include Theory and Practical including clinical and viva voce examination***

Note 1: During the training programme, each post graduate student should be required to engage himself/herself in an investigative project under the supervision of a faculty member and submit his/her thesis or dissertation according to the rules. The subject for the research should be related to clinical practice of oncology (radiotherapy/combined treatments/Lab Research

related with clinical practice).

Recommended Reading

A. Books (latest edition)

1. Basic books of anatomy, applied anatomy, physiology and basic pathology
2. Text books of:
    - **Radiotherapy** by Halston Paterson
    - **Radiotherapy** by H Fletcher
    - **Radiotherapy** by Moss
    - **Radiotherapy** by Halnan
    - **Oxford Text Book of Oncology**
    - **Comprehensive Text Book of Oncology** by Moosa
    - **Cancer Principles & Practice of Oncology** by DeVita et al
    - **Textbook of Oncology** by Ackerman & del Regato
    - **Principles & Practice of Radiation Oncology** by Perez & Brady
    - **Cancer Medicine** by Holland and Frie
    - **Transplantation in Hematology & Oncology** by Buchner, Jurgens et al
    - **Clinical Oncology** by Philip Rubin
    - **Cancer Treatment** by Haskell
    - **Medical Physics** by Meredith
    - **Medical Physics** by Selman
    - **Medical Physics** by FM Khan
    - **Radiation Pathology** by Rubin & Cassaret
    - **Radiobiology** by Eric J Hall Radiobiology by Stee
    - **Radiation Planning** by Lewis & Tapley
    - **Pediatric Oncology** by Suttow Gynecology Oncology by Disaia
    - **Radiation Oncology** by GK Rath & BK Mohanti

B. Journals and periodicals

Three international and two national journals (all indexed)

Annexure I

Postgraduate Students Appraisal Form

Clinical Disciplines

Name of the Department/Unit :

Name of the PG Student :

Period of Training : FROM.....TO.....

Sr. No.	PARTICULARS	Not Satisfactory	Satisfactory	More Than Satisfactory	Remarks
		1 2 3	4 5 6	7 8 9	
1.	Journal based / recent advances learning				
2.	Patient based /Laboratory or Skill based learning				
3.	Self directed learning and teaching				
4.	Departmental and interdepartmental learning activity				
5.	External and Outreach Activities / CMEs				
6.	Thesis / Research work				
7.	Log Book Maintenance				

Publications **Yes/ No**

Remarks*

_____

_____

_____

***REMARKS:** Any significant positive or negative attributes of a postgraduate student to be mentioned. For score less than 4 in any category, remediation must be suggested. Individual feedback to postgraduate student is strongly recommended.

SIGNATURE OF ASSESSEE **SIGNATURE OF CONSULTANT** **SIGNATURE OF HO**

LOG BOOK

For

Degree in MD Radiation Oncology

Name of student:

.....

Batch:

.....

PERSONAL DETAILS

Photograph

Name: ……

Age: …… Years

Gender: Male / Female

S/D/W/o: ……

Address:

Permanent:

……

……

Correspondence:……

…

Mobile number: ……

E-mail ID: ……

Details about MBBS:

Institution:

……

……

Year of passing: ……

MBBS Registration details:

Name of Medical Council: ……

Registration Number with Date:……

Signature of HOD **Signature of Student**

M.D- Radiation Oncology (Annual) Examination
PAPER III
CLINICAL CHEMOTHERAPY

Time: Three Hours **Max. Marks** 100

Attempt all questions.
All questions carry equal marks.
Use neatly drawn & well labeled diagrams wherever necessary.

Q1. **a)** Describe the Principles of Concurrent Chemo radiation in cancer (12.5)
b) Discuss the role and principles of Chemotherapy in the management of NSCLC (12.5)

Q2. **a)** Describe the evolution of chemotherapy in Metastatic Ca Breast (12.5)
b) Describe the Prognostic factors in Ca Colon. Describe the various chemotherapeutic schedules used in metastatic setting. (12.5).

Q3. **a)** Discuss the role of liquid biopsy in Carcinoma Lung. Discuss the treatment options for young female of metastatic Adenocarcinoma lung in reference to different sensitizing mutations (12.5)
b) Discuss the management of Ewing's sarcoma Rt Tibia in 15 yr old child (12.5)

Q4. Write short notes on:

a) Management of Hypercalcemia
b) Nivolumab
c) Management of metastatic Renal cell carcinoma
d) PERCIST criteria (5x5)
e) Castration resistant Prostate

M.D- Radiation Oncology Examination
(Recent Advances)
PAPER IV

Recent Advances in Radiation Oncology

Time: Three Hours **Max. Marks** 100

Attempt all questions.
All questions carry equal marks.
Use neatly drawn & well labeled diagrams wherever necessary.

Q1. A 68 year old male on routine Screening for Prostate Cancer has PSA 14 ng/ml. Rectal examination reveals nodule on the left lobe of Prostate. Prostatic biopsy reveals Adenocarcinoma with Gleasons score 7. Discuss the best modality of External Beam Radiation Therapy (EBRT) & its steps in the planning for this patient (20)

Q2. What is the accelerated Partial Breast Irradiation (APBI) & its indication? Discuss in detail different modalities of APBI & its dose fractionation schedule (20)

Q3. What is IMRT? Describe in detail in IMRT in a case of Carcinoma Maxilla. (20)

Q4. Write short notes on:
a) Clinical trial
b) Oncotype Dx Genomic tests
c) Tumor markers
d) HPV Vaccination (5X4= 20)

Q5. A) Role of SRS and SRT in intracranial tumors (10)
B) Adjuvant treatment in Glioblastoma Multiformis (10)

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