

Himachal Pradesh Public Service Commission

No. 3-13/2023-PSC (R-I)

Dated 28-03-2025

Syllabus for the descriptive type Subject Aptitude Test (SAT) for the recruitment to post of Assistant Professor (Radiotherapy) Class-I (Gazetted) (on regular basis) in Dr. Radhakrishnan Government Medical College, Hamirpur, H.P. under the Department of Medical Education & Research, H.P. The SAT paper shall be of 03 hours duration having 120 Marks. The SAT paper shall have two parts i.e. Part-I and Part-II and cover the following topics of MD or MS (Radiotherapy), DMRT (Radiotherapy) level.

PART-I (60 MARKS)

Basic Sciences:-

1. Applied Anatomy and Physiology

- A.** Applied anatomy of oral cavity, larynx, pharynx, paranasal sinuses, CSF pathways salivary glands, middle ear, external orbit, breast, bronchopulmonary segments, mediastinum, oesophagus, liver, spleen, stomach, small and large bowels, pelvic and genitor-urinary organs (bladder, uterus, ovary, testis rectum, anal canal etc.), spinal segments,
- B.** Lymphahtic 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 US/CT/MR/PET 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 based procedures 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 tumours and their interpretation,
- H. Molecular pathology, molecular basis of diagnosis and prognosis of cancers,
- I. Radiation pathology.

4. Staging of various cancers:

- Evolution of different staging systems for various cancers over the years,
- 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

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

6. Radiation Physics

i. Atomic and Nuclear Structure

A. Atomic structure

- Energy levels, binding energy,
- Transitions, characteristic radiations

B. Nuclear structure

- Mass, atomic and neutron numbers,
- Nuclear binding energy,
- Fission, fusion,
- Nuclear reactors.

ii. Radioactive Decay

A. Modes of decay

- N/P ratio, even-odd relationship,
- Beta decay,
- Positron decay and electron capture,
- Alpha decay,
- Isomeric transitions, gamma emission, internal conversion

B. Mathematics of Radioactive Decay

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

C. Natural Radioactivity

- Naturally occurring isotopes,
- Decay series

D. Artificial Radioactivity

- Production by neutron bombardment,
- Fission products,
- Production by charged particle bombardment,
- Radioactivity equilibrium.

iii. Production of X-rays

- A. X-ray tubes**
 - Requirements for X-ray production,
 - Historical development,
 - Focal spot size,
 - Reflection and transmission targets,
 - X-ray production efficiency.
- B. X ray circuits**
 - Primary circuits,
 - Secondary circuit,
 - Filament circuit,
 - Modes of rectification.

iv. High Energy Treatment Machines

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

v. Interactions of X - and Gamma-rays

- A. Attenuation of a beam of x- or gamma-rays**
 - Attenuation and absorption coefficients,
 - Attenuation in the body
- B. Modes of interaction**
 - Photoelectric absorption,
 - Compton scattering,
 - Pair production,
 - Photo-disintegration.

vi. Interactions of Particulate Radiations

- A. Types of interactions**
 - Elastic, inelastic,
 - Excitation, ionization
- B. Properties of particulate radiations**
 - Specific ionization,
 - LET
- C. Interactions of heavy charged particles and pions**
 - Bragg's peak,
 - Applications in radiation therapy
- D. Interactions of electrons**
 - Interactions with electrons,
 - Interactions with nuclei,
 - Applications to radiation therapy
- E. Neutron interactions**
 - Slow neutron interactions,

- Fast neutron interactions,
- Applications with radiation therapy.

F. Radioactive sources used in diagnosis and therapy – Production and properties.

vii. Measurement of Radiation Exposure

- A.** Photon and energy flux density and fluence,
- B.** The roentgen,
- C.** Electronic equilibrium,
- D.** Ionization chambers
 - Free-air chambers,
 - Thimble chambers,
 - Condenser chambers,
 - Electrometers,
 - Extrapolation chambers
- E.** Exposure calibration of an X - or gamma - ray beam
 - Selection of calibration variables,
 - Selection of chamber,
 - Positioning of chamber,
 - Corrections to readings
- F.** Quality assurance checks on radiation therapy units.

viii. Radiation Quality

- A.** Measures of quality
 - HVL and effective energy
- B.** Factors influencing quality
 - Variations in quality across a beam,
 - Filtration an acceleration potential.

ix. 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
 - Bragg-Gray cavity theory
- D.** Direct measurement of absorbed dose
 - Film,
 - TLD,
 - Calorimetry,
 - Chemical dosimetry.

x. Calibration of High Energy Photon and Electron Beams

- A.** Photons
 - Stopping power ratios and energy absorption coefficients,
 - Acq,
 - C
- B.** Electrons

- CE.
- xi. Dose Distribution, External Beam Therapy**
 - A. Dosimetric variables**
 - Backscatter factor,
 - Percent depth dose,
 - Tissue - air ratio,
 - Scatter - air ratio,
 - Tissue - maximum and tissue-phantom ratios,
 - Isodose distributions,
 - Treatment time calculations,
 - Fixed SSD and isocentric treatment techniques,
 - Beam Modulation
 - B. Single and multiple field dose distributions**
 - Corrections for wedges,
 - Design for compensating filters,
 - Corrections for surface obliquities,
 - Corrections for heterogeneities,
 - Dose perturbations at interfaces,
 - Adjoining fields,
 - Integral dose,
 - C. Dose distribution for rotational therapy,**
 - D. Calculation of dose in large, irregular fields.**
- xii. 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.**
- xiii. Computerized Treatment Planning**
 - A. External X-and gamma-ray beams**
 - Rectangular fields,
 - Irregular fields,
 - Inverse Planning
 - B. Electron beams,**
 - C. Implanted sources**
 - Intracavitary sources,
 - Interstitial implants,
 - Surface mould.
- xiv. Radiation Protection from External Sources**
 - A. Concepts and units**
 - Quality factors,
 - Dose equivalent,

- Protection regulations
 - B. Treatment room design**
 - Primary radiation,
 - Scatter,
 - Leakage,
 - Special problems with high energy photon and electron beam,
 - Special problems with neutron, proton and π -meson
 - C. Sealed source storage**
 - D. Protection surveys**
 - E. Personnel monitoring.**
- xv. Radiation Protection from Internal Sources**
- A. Body burdens and critical organs**
 - Effective half lives for uptake and elimination.
 - B. Internal dose computations**
 - Locally absorbed radiation,
 - Penetrating radiation.
 - C. Handling radionuclide therapy patients**
 - D. Licensing procedure for using radionuclides.**
- xvi. Planning of a Radiotherapy Department**
- A. Building designs,**
 - B. Choice of various equipments and sources,**
 - C. Acceptance and Calibration Tests,**
 - D. Various maintenance steps and procedures.**
- xvii. New Radiation Modalities:**
- A. Protons**
 - Production,
 - Processes of absorption,
 - Depth dose patterns,
 - Advantage compared with x-rays,
 - Facilities available
 - B. Neutrons**
 - Production,
 - Processes of absorption,
 - Depth dose patterns,
 - Advantages compared with x-rays,
 - Facilities available.
 - C. Pions**
 - Production,
 - Processes of absorption,
 - Depth dose patterns,
 - Advantages compared with x-rays,
 - Facilities available.
 - D. High energy heavy ions**

- Production,
- Processes of absorption,
- Depth Dose Patterns,
- Advantages compared with x-rays,
- Facilities available.

7. Radiobiology (Radiobiology and Laboratory Radiotherapy)

i. Mammalian Cell Radiosensitivity

- A.** Apoptosis, Interphase and reproductive death,
- B.** Cell survival curves in vitro,
- C.** Characterization of cell survival curves,
- D.** Critical sites and target theory
 - DNA,
 - Membranes.
- E.** Dose response curves in vivo
 - Skin clone,
 - Surviving crypts,
 - Bone marrow colonies growing in spleen, monolayer culture
- F.** Quantitative normal tissue reaction based on systems
 - Pig skin,
 - Rodent skin,
 - Lung,
 - Esophagus,
 - Kidney,
 - CNS and spinal cord,

ii. Factors that Modify Radiation Response

- A.** The Oxygen effect
 - Effect of oxygen concentration,
 - Time of action of oxygen,
 - Mechanism of the oxygen effect,
 - Implications for radiotherapy,
 - Methods to overcome problems of hypoxic cells.
- B.** The age response function
 - The cell cycle,
 - Age response for cells cultured in vitro,
 - Age response for tissues in vivo,
 - Age response for neutrons,
 - The oxygen effect through the cell cycle,
 - Implications for radiotherapy.
- C.** Potentially Lethal damage
 - Repair *in vitro*,
 - Repair *in vivo*,
 - PLD and high LET radiations,
 - Implications in radiotherapy
- D.** Sublethal damage
 - Split-dose experiments with cell in vitro,
 - Sublethal damage repair in normal tissues,

- Sublethal damage repair in tumours,
- Sublethal damage and hypoxia,
- Sublethal damage and high LET radiations,
- Dq as a measure of repair

E. Dose-rate

- Dose-rate effects in cells *in vitro*,
- Dose-rate effect in normal tissues,
- Dose-rate effect in tumours,
- Interstitial therapy,
- Beam therapy at low dose rate

F. Radiosensitizers

- The halogenated pyrimidines,
- Hypoxic cell radiosensitizers
 - Structure and mode of action,
 - Enhancement ratio,
 - Metronidazole/misonidazole,
 - Pharmacokinetics in the human,
 - Clinical limitations
- Antibiotics

G. Radioprotectors

- Free radical scavengers.

iii. Linear Energy Transfer

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

iv. 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.

v. 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 tumours.

vi. Tissue Radiosensitivity

- A. Classification based on radiation pathology,

B. Types of cell populations

- Self renewal,
- Conditional renewal,
- Stem cell,
- Differentiated.

vii. 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.

viii. Hyperthermia

- A.** Methods of heating
 - RF microwaves,
 - Ultrasound,
 - Water baths.
- B.** Systematic hyperthermia,
- C.** Localized heating,
- D.** Cellular response to heat,
- E.** Repair of thermal damage,
- F.** Thermotolerance,
- 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 tumours to heat,
- L.** Response of spontaneous tumours to heat,
- M.** Response of normal tissues to heat,
- N.** Heat and the therapeutic gain factor,
- O.** Hyperthermia and chemotherapy.

ix. Total Body Irradiation – Acute Effects

- A.** Prodromal radiation syndrome,
- B.** Central nervous system / cerebrovascular syndrome,
- C.** Gastrointestinal syndrome,
- D.** Haematopoietic syndrome,
- E.** Mean lethal dose: (LD50),
- F.** Treatment of radiation accident.

x. Late Effects

- A.** Probabilistic/Deterministic (Stochastic/Non-Stochastic) effects,
- B.** Non-specific life shortening
 - Definition,
 - In animals,
 - In man.

C. Carcinogenesis

- The latent period,
- Dose response curve in animals,
- Leukemia,
- Breast cancer,
- Thyroid cancer,
- Bone cancer,
- Skin cancer,
- Lung cancer,
- Other tumours,
- Malignancies in prenatally exposed children.

xi. Mechanisms of Radiation Carcinogenesis

A. Genetics of irradiation

- Point mutations,
- Relationship to dose,
- Chromosome aberrations,
- Relationship to dose,
- Doubling dose,
- Genetically significant dose (GSD),
- Genetic effect in humans,
- Background radiation in relation to the GSD.

xii. Radiation Effects in the Developing Embryo and Foetus

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.

PART-II (60 Marks)

1. Radiation Pathology:

I. Radiophysiology of Human Tissues

A. Effects of irradiation of the skin

- Clinical manifestations,
- Histological substratum of effects,
- Repair,
- Degree of sequelae,
- Injurious effects

B. Effects of irradiation of bone and cartilage

- Effects on growing bones and cartilage,

- Effects on adult bones and cartilage,
 - Clinical manifestations,
 - Histological substratum of effects,
 - Functional consequences and sequelae
- C. Effects of irradiation of the kidney**
- Clinical manifestations,
 - Histological substratum of effects,
 - Acute and chronic functional repercussions,
 - Permanent Sequelae
- D. Effects of irradiation of the lung**
- Acute clinical effects,
 - Ultimate effects,
 - Histologic substratum of effects,
 - Measures to reduce final effects,
 - Sequelae
- E. Effects of irradiation of nervous tissues**
- Effects on the brain,
 - Effects on the spinal cord,
 - Effects on the peripheral nerves,
 - Clinical manifestations,
 - Histological substratum,
 - Sequelae
- F. Effects of irradiation of the ovary**
- Clinical manifestations,
 - Histological substratum,
 - Reversibility of effects,
 - Therapeutic implications
- G. Effects of irradiation of the testis**
- Clinical consequences,
 - Histological substratum,
 - Reversibility,
 - Protective measures
- H. Effects of irradiation of the eye**
- Clinical consequences,
 - Histological substratum,
 - Protective measures,
 - Time-dose connotations,
 - Sequelae-therapy
- I. Effects of irradiation of lymphoid tissues**
- Clinical manifestations,
 - Histological manifestations,
 - Reversibility
- J. Effects of irradiation of the bone marrow**
- Clinical and laboratory manifestations,
 - Chronology of effects,
 - Histologic substratum,
 - Recovery,

- Therapeutic applications
- K.** Effects of irradiation of the oral, pharyngolaryngeal and esophageal mucous membrane
 - Clinical manifestations,
 - Histological manifestations,
 - Repair,
 - Sequelae
- L.** Effects of irradiation of the salivary glands
 - Acute manifestations,
 - Histological substratum,
 - Dental consequences,
 - Prophylaxis
- M.** Radiation effects observable in clinical radiotherapy
 - Technological protection,
 - Role of total dose,
 - Role of fractionation,
 - Measures of prevention,
 - Therapeutic measures
- N.** Effects of irradiation of human embryo
 - Role of age,
 - Role of dose,
 - Teratogenic effects,
 - Measures of prevention
- O.** SOMA Scales.

2. Basics of 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.

3. Principles of Radiotherapy allied specialties

I. Clinical Practice of Radiotherapy and Oncology

A. Principles of Radiotherapy

- General – Radiosensitivity and Radiocurability
 - Tumor lethal dose, Tissue Tolerance and Therapeutic Ratio (TR),
 - Factor influencing TR,
 - Target Volume,
 - Choice of Time, dose fractionation and technique
- Teletherapy
 - Radiation factors,
 - Megavoltage therapy,
 - Orthovoltage therapy,
 - Electron therapy,
 - Heavy particle therapy (Neutron, photon, pi-meson).

- Brachytherapy
 - Radium and its substitutes,
 - Practice of - surface, intracavitary and interstitial,
 - Clinical application,
 - Rules and techniques
 - Newer developments,
 - Afterloading,
 - Low and high dose rates
- 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 Brachytherapy
 - Intracavitary,
 - Interstitial,
 - Mould application,
 - Modern development and after loading devices
- C. Clinical Practice**
 - Radical (curative),
 - Palliative,
 - Pre-operative,
 - Post-operative,
 - Supplementary,
 - Combination (both Pre- & Post operative – Sandwich technique),
 - Nutritional care and local hygiene during and after therapy
- D. Treatment Planning and Presentation**
 - Mouldroom practices,
 - Simulation,
 - Computerised treatment planning system,
 - Clinical dosimetry,
 - Prescription and execution
- E. General histologic and cytologic features of malignancy**
- F. Classification of benign and malignant tumours and their interpretation.**

II. Related Specialties: surgical oncology and medical oncology

- A. Principles and practice of general surgery, gynaecology and paediatric surgery as related to cancer**
 - Surgical treatment decisions,
 - Surgical diagnosis and staging of cancer
- B. Cancer Chemotherapy and Hormones**
 - i. Chemotherapy**
 - Principles and clinical practice,

- Classification of drugs.
- Clinical application of
 - Single drug therapy,
 - Polychemo therapy and various combinations,
 - Adjuvant therapy,
 - Prophylactic therapy
- Complication of the chemotherapy and its management,
- Recent developments,
- Drug schedules

ii. 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 system

- Staging procedures,
- Methods of clinical staging an TNM classification

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.

4. Clinical Management in tumors of:

a. Head and Neck

- Lip,
- Oral cavity,
- Oropharynx,
- Hypopharynx,
- Nasopharynx,
- Supraglottis,
- Vocal cord,
- Sub-glottis,
- Middle ear,
- Nose and nasal sinuses,
- Orbit and optic nerve,
- Lachrymal gland,
- Salivary gland,
- Glomus Jugulare tumours,,
- Carotid body tumours,
- Other sites in the region.

b. Gastro-Intestinal Tract

- Oesophagus,
- Stomach,
- Liver,

- Pancreas and biliary tract,
- Small bowel,
- Colon and rectum,
- Anal canal and peri-anal region.

c. Chest

- Pleura,
- Trachea,
- Lung,
- Mediastinum and thymus.

d. Genito-Urinary Tract

- Kidney,
- Ureter,
- Bladder,
- Urethra,
- Prostate,
- Penis,
- Testis.

e. Female Genital Tract

- Uterine cervix,
- Uterine body,
- Vagina,
- Vulva,
- Ovary,
- Fallopian tube.

f. Central Nervous System

- Brain,
- Spinal cord,
- Craniopharyngioma,
- Chordoma,
- Acoustic neuroma,
- Meninges.

g. Soft Tissue Sarcomata and Bone Tumours

- Childhood/adolescent sarcoma,
- Chondrosarcoma,
- Osteosarcoma,
- Ewing's tumour.

h. Paediatric Tumours

- Medulloblastoma,
- Neuroblastoma,

- Nephroblastoma,
- Retinoblastoma,
- Embryonal sarcomas.

i. Lymphoproliferative and Myeloproliferative Disorders

- Hodgkin's lymphoma,
- Non-Hodgkin's lymphomas,
- Plasma cell malignancies,
- Acute and chronic leukaemias.

j. Skin

- Basal cell carcinoma,
- Squamous cell carcinoma,
- Malignant melanoma,
- Cutaneous lymphoma,
- Kaposi's sarcoma.

k. Endocrine

- Breast,
- Thyroid,
- Parathyroid,
- Pituitary,
- Adrenal.

l. Other tumours and tumour- like conditions

m. Metastatic cancer in unknown primary.

5. Tumour types and sites:-

a. Management

- Initial staging investigations including imaging and tumour markers,
- Role of PET-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,
- Ionising Radiation Regulations,
- Roles of surgery, radiotherapy and cytotoxic chemotherapy in multimodality approaches to cancer treatment.

b. Pathology

- The range of tumours that can occur,
- Their aetiology, 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 tumour markers in diagnosis and treatment of tumours,
- Use of specialized pathology techniques, e.g. immunocytochemistry,
- Interpretation of clinicopathological data in the tumour site specialised multidisciplinary approach to patient management

c. Radiotherapy

- i. The role of irradiation in radical and palliative management,
- ii. Where radical radiotherapy is a treatment option:
 - Staging investigations,
 - A definition of tumour volume and target volume boundaries,
 - ICRU, AAPM, ICRP reports relevant to clinical oncology,
 - An acceptable radiotherapeutic technique, or, where applicable, a range of such techniques,
 - The correct treatment position,
 - Details of the target volume localization process,
 - Use of CT axial images, 3D planning, Inverse Planning, IMRT, IGRT, Irregular shaped fields,
 - Verification techniques such laser alignment, skin tattoos, orthogonal and portal films,
 - The approximate dose distributions for the chosen technique,
 - An appropriate dose/fractionation regime,
 - Relevant dose modifying factors (changes in fractionation, age, associated conditions, target volume, intercurrent infections, previous therapies),
 - Details of the set-up instructions for technologists,
 - Appropriate responses to changes of patient parameters or interruptions during treatment,
 - The possible acute and late side effects of the irradiation,
 - Radiation dose modifying factors, chemotherapy timing in all forms of chemo radiation schedules.

d. Drug Therapy: Basic knowledge and understanding of integrating with Radiotherapy

- The role of cytotoxic, hormonal and biological drugs therapies in radical and palliative management

e. Outcomes

- The expected outcomes of treatment.
- *Biological Therapies*
 - A basic knowledge of the clinical uses of currently used biological therapies including interferons, colony stimulating factors, interleukins, erythropoietin, other growth factors and preparations such as imatinib, gefitinib, nimotuzumab, trastuzumab, rituximab, erlotinib etc.

f. Oncological Emergencies

- The management of the following complications when they are related to cancer:

- Ureteric obstruction,
- Spinal cord compression,
- Haemorrhage,
- Mediastinal superior vena caval obstruction.

6. Radiotherapy for Benign Disease

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

7. Complications of Treatment

- The acute and late complications of oncological treatment and their management including:
 - Skin reactions,
 - Nausea and vomiting,
 - Diarrhoea,
 - Oedema,
 - Bone marrow toxicity,
 - Neutropenic sepsis,
 - Drug reactions,
 - Cytotoxic extravasation,
 - Alopecia,
 - Cataract,
 - Skin atrophy and ulceration,
 - Colitis, proctitis, gut strictures and perforation,
 - Renal effects,
 - Cardiac effects,
 - Pulmonary effects,
 - Fibrosis and lymphoedema,
 - Endocrine effects (thyroid, pituitary and salivary gland),
 - Effects on fertility,
 - Incidence of second and radiation induced cancers.

8. Symptom Control and Continuing Care

- 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 including
 - Hypercalcaemia,
 - Ectopic hormone production,
 - Raised intra cranial pressure,
 - Anaemia.

9. Current Research and Literature

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

10. Recent Advances and Special Topics

Special Topics

- Recent advances coming up in various fields as applicable to oncology,
- Causes of treatment failure and retreatment,
- TLI and TBI – Role, Philosophy and Techniques,
- Supportive care in Radiation treatment in combination with chemotherapy/surgery,
- Infections, nutritional and other problems in cancer patients,
- Preventive Oncology,
- Psychosocial aspects of cancer and Rehabilitation,
- Hospice Program,
- Immunotherapy and Role of Monoclonal antibodies in diagnosis, staging and management of cancer,
- Oncological Emergencies,
- Care and Nursing of patients on Radiotherapy and Chemotherapy,
- Cancer Control Programmes,
- International Classification and Coding of Cancer (ICD-9, ICD-O, ICD-10),
- Research Methodologies in Cancer.