निजामती कर्मचारी अस्पताल

प्राविधिक सेवा, मेडिसिन समूह, रेडिएसन अंकोलोजी उपसमूह, रजिष्ट्रार पद, आठौं तहको खुल्ला प्रतियोगितात्मक परीक्षाको पाठ्यक्रम

यस पाठ्यक्रम योजनालाई दुई चरणमा विभाजनगरिएको छ :

प्रथम चरण :– लिखित परीक्षा (Written Examination) पूर्णाङ्क :– २००

द्वितीय चरण :– अन्तर्वार्ता (Interview) पूर्णाङ्क :– ३०

१. प्रथम चरण (First Phase): **परीक्षा योजना** (Examination Scheme)

Paper	Subject		Marks	Full Marks	Pass Marks	No. Questions & Weightage	Time
I	General Subject	Part I: Management	50	100	40	6 × 5 = 30 (Short answer) 2 × 10 = 20 (Long answer)	3.00 hrs
		Part II: General Health Issues	50			6 × 5 = 30 (Short answer) 2 × 10 = 20 (Long answer)	
II	Technical Subject			100	40	6 × 10 = 60 (Long answer) 2 × 20 = 40 (Critical Analysis)	3.00 hrs

२. द्वितीय चरण (Second Phase)

Subject	Full Marks	Examination System
Interview	30	Oral

द्रष्टव्य :

१. लिखित परीक्षाको माध्यम भाषा नेपाली वा अंग्रेजी अथवा नेपाली र अंग्रेजी दुवै हुन सक्नेछ ।

२. अस्पतालको प्राविकि सेवा अन्तर्गतका सबै समूह/सबै उपसमूहहरुको लागि प्रथमपत्रको पाठ्यक्रमको विषयवस्तु एउटै हुनेछ । तर द्वितीयपत्र Technical Subject को पाठ्यक्रम समूह/उपसमूह अनुरुप फरक फरक हुनेछ ।

३. प्रथम र द्वितीय पत्रको लिखित परीक्षा छुट्टाछुट्टै हुनेछ । परीक्षामा सोधिने **प्रश्नसंख्या र अङ्कभार** यथासम्भव सम्बन्धित पत्र, विषयमा दिईए अनुसार हुनेछ ।

४. वस्तुगत बहुवैकल्पिक (Multiple Choice) प्रश्नहरुको गलत उत्तर दिएमा प्रत्येक गलत उत्तर बापत २० प्रतिशत अङ्क कट्टा गरिनेछ । तर उत्तर नदिएमा त्यस बापत अङ्क दिइने छैन र अङ्क कट्टा पनि गरिने छैन ।

५. वस्तुगत बहुवैकल्पिक हुने परीक्षामा परीक्षार्थीले उत्तर लेख्दा अंग्रेजी ठूलो अक्षर (Capital letter) A, B, C, D मा लेख्नुपर्नेछ । सानो अक्षर(Small letter) a, b, c, d लेखेको वा अन्य कुनै सङ्केत गरेको भए सबै उत्तरपुस्तिका रद्द हुनेछ ।

६. बहुवैकल्पिक प्रश्नहरु हुने परीक्षामा कुनै प्रकारको क्याल्कुलेटर (Calculator) प्रयोग गर्न पाइने छैन ।

७. विषयगत प्रश्नहरुको हकमा एउटै प्रश्नका दुई वा दुई भन्दा बढी भाग (Two or more parts of a single question) वा एउटा प्रश्न अन्तर्गत दुई वा बढी टिप्पणीहरु (Short notes) सोध्न सकिने छ ।

८. विषयगत प्रश्नमा प्रत्येक पत्र/विषयका प्रत्येक खण्डका लागि छुट्टाछुट्टै उत्तरपुस्तिकाहरु हुनेछन् । परिक्षार्थीले प्रत्येक खण्डका प्रश्नहरुको उत्तर सोही खण्डका उत्तरपुस्तिकामा लेख्नुपर्नेछ ।

९. यस पाठ्यक्रम योजना अन्तर्गतका पत्र/विषयका विषयवस्तुमा जेसुकै लेखिएको भएतापनि पाठ्यक्रममा परेका कानून, ऐन, नियम, विनियम तथा नीतिहरु परीक्षाको मितिभन्दा ३ महिना अगाडि (संशोधन भएका वा संशोधन भई हटाईएका वा थप गरी संशोधन भई) कायम रहेकालाई यस पाठ्क्रममा परेको सम्झनु पर्दछ ।

१०. प्रथम चरणको परीक्षाबाट छनौट भएका उम्मेदवारहरुलाई मात्र द्वितीय चरणको परीक्षामा सम्मिलित गराइनेछ ।

११. पाठ्यक्रम लागु मिति : आ.व.२०७९/०८० देखि

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Paper I: General Subject
Part I: Management
(6 × 5) + (2 × 10) = 50 Marks

1. **Management**
   - 1.1. Health care management system in Nepal and other parts of the world
   - 1.2. Fundamental principles of healthcare institution and hospital management.
   - 1.3. Effective hospital management principles
   - 1.4. Purpose of medical and non-medical data and records
   - 1.5. Ethics and responsibility of management
   - 1.6. Concept of management and its application in health care including hospital
     - 1.7.1 Management: Concept, principles, functions, scope and role, level and skills of manager
     - 1.7.2 Planning: Concept, principles, nature, types, instruments and steps
     - 1.7.3 Leadership: Concept, function, leadership styles, leadership and management
     - 1.7.4 Coordination: Concept, types, techniques of effective coordination
     - 1.7.5 Communication and counselling: Concept, communication processes and barrier to effective communication, techniques for improving communication
     - 1.7.6 Decision making: Importance, types, rational process of decision making, problem solving techniques, improving decision making
     - 1.7.7 Participative management: Concept, advantage and disadvantage, techniques of participation
     - 1.7.8 Time management: Concept, essential factors and strategies for effective time management
     - 1.7.9 Conflict management: Concept, approaches to conflict, levels of conflict, causes of conflict and strategies for conflict management
     - 1.7.10 Stress management: Concept, causes and sources of stress, techniques of stress management
     - 1.7.11 Change management: Concept, sources of organizational change, resistance to change, management of resistance to change
     - 1.7.12 Appreciative inquiry: Concept, basic principle and management
     - 1.7.13 Human resource management: Concept, functions and different aspects
     - 1.7.14 Health manpower recruitment and development
     - 1.7.15 Financial management: Concept, approaches, budget formulation and implementation, Auditing and topics related to fiscal administration

Part II: General Health Issues
(6 × 5) + (2 × 10) = 50 Marks

2. **General Health Issues**
   - 2.1. Present constitution of federal republic of Nepal (including health and welfare issues)
   - 2.2. Organizational structure of Ministry of Health at national/federal, regional/state, district (if applicable), municipal and village council level
   - 2.3. Professional council and related regulations
   - 2.4. National Health Policy
   - 2.5. Health Service Act and Regulation
   - 2.6. Second Long term health plan
   - 2.7. Health Management Information System, forms, indicators, annual reports
   - 2.8. Human Development Indices, Sustainable Development Goals
   - 2.9. Health volunteers in the national health system, its rationale, use and effectiveness

2.10. Local governance and community participation in health service delivery
2.11. Health Insurance and financing in health care
2.12. Alternative health care system: Ayurveda, homeopathy, Unani, Chinese etc.
2.13. Indigenous and traditional faith health and health practices
2.14. International Health Agencies: Roles and responsibilities of WHO, UNICEF, UNFPA, Inter-agency relationships, Government-agency coordination: Joint Annual Review meeting
2.15. Supervision, types and its usage in health sector
2.16. Monitoring and evaluation system in health sector
2.17. National Health Training Centre
2.18. National and International Disaster Plan, Coordination
2.19. General introduction of Civil Service Hospital and its Bylaws

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Paper II : Technical Subject

Section (A) – 60 Marks

1. Radiation Physics

1.1 **Atom and Particles:** Definition; structures-nucleus, orbital shells, energy levels, binding energy; atomic number, atomic weight, isotope, isomer, isobar, proton, neutron, electron and positron

1.2 **Photon Interaction:** Coherent scattering, photoelectric effect, compton scattering, pair production, annihilation radiation and photonuclear reactions

1.3 **Attenuation:** Process of attenuation, exponential attenuation, coefficients of attenuation, energy transfer and absorption

1.4 **Electron Interactions:** Ionisation, excitation, heat production; radioactive interaction (bremsstrahlung), relative rate of energy loss and directional changes through collisional and radioactive processes; stopping power, range, scattering power, linear energy transfer

1.5 X-ray and basic principles of X-ray production

1.6 **Principles of Image Production and Use in Radiation Therapy:** CT Scan, Plain film, Fluoroscopy, MRI, Ultrasonography, Nuclear medicine imaging including PET, Imaging techniques used to verify treatment accuracy e.g. port films, electronic portal imaging, cone beam CT

1.7 **External Photon Beam Radiation Therapy**

- 1.7.1 Radiotherapy machines (Betatron, Van De Graff generator, Cobalt, Linear accelerator): constructions and process of photon production
- 1.7.2 Alteration of the beam aperture using Cerrobend blocking, multileaf collimators and independent jaws
- 1.7.3 Design and function of multileaf collimators including awareness of issues created by rounded leaf edges
- 1.7.4 Types of wedge filters
- 1.7.5 Characteristics of kV and MV photon beams:
- 1.7.6 Measurements of an external photon beam, including choice of suitable radiation detector:
  - 1.7.6.1 Beam measurement: radiation quality, output & inverse square law
  - 1.7.6.2 Measurement protocols i.e. IAEA megavoltage absolute dosimetry protocol for megavoltage photon beams
  - 1.7.6.3 Dose distribution - kV and MV beam profiles, depth dose curves, construction of isodose charts
- 1.7.7 Dose distribution in tissue produced by external beam photon radiation:
  - 1.7.7.1 Radiation components i.e. primary and scattered radiation
  - 1.7.7.2 Descriptors of dose distribution: percentage depth dose, beam profile, isodose charts, flatness and symmetry, penumbra, surface dose and skin sparing, terms used to calculate dose
  - 1.7.7.3 Factors affecting dose distribution and beam output: effects of field size and shape, source-skin distance, beam quality or energy and beam modifying devices on dose distribution and beam output
  - 1.7.7.4 Effects of tissue heterogeneity and patient irregularity: effects on dose distribution of patient contour, bone, lung, air cavities and prostheses; dose within bone cavities, interface effects, effects of electronic disequilibrium
  - 1.7.7.5 Effects on dose distribution of irregular or offset fields and associated clinical implications of changes in beam aperture: use of Cerrobend blocking, multileaf collimators and independent jaws

1.7.7.6 Dose modification techniques: methods of compensation for patient contour variation and/or tissue inhomogeneity including wedging and compensating filters; shielding of dose-limiting tissues; the use of bolus and build-up material

1.7.7.7 Physical aspects of the treatment techniques: Fixed SSD and isocentric techniques; Simple techniques: parallel opposed fields, multiple fields; Complex techniques: rotation therapy (full or partial), conformal therapy, IMRT, VMAT, IGRT

1.8 **Electron Beam Radiation Therapy**

1.8.1 Process of generation of electron beam from a linear accelerator

1.8.2 Characteristics of an electron beam – energy spectra, energy specification, variation of mean energy with depth, photon contamination

1.8.3 Dose distribution in tissue from an electron beam:

1.8.3.1 Percentage depth dose, beam profiles, isodose charts, flatness and symmetry, penumbra, surface dose

1.8.3.2 Effects of field size and shape, source-skin distance, energy, beam collimation on dose distribution and beam output

1.8.3.3 Effects of heterogeneity and patient irregularity i.e. effect on dose distribution of surface obliquity, air gaps, lung, bone, air filled cavities, external and internal shielding

1.8.3.4 Methods of field shaping for different beam energies and effect on surface dose

1.8.3.5 Beam measurement: radiation quality, output, measurement protocols i.e. IAEA megavoltage dosimetry protocol for mega electron volt (MeV) electron beams

1.9 **Proton Beam Radiotherapy**

1.9.1 Production of proton beams for clinical use

1.9.2 Key principles and advantages of the cyclotron and synchrotron

1.9.3 Dose distribution in tissue produced by proton beam radiation:

1.9.3.1 Beam profile and percentage depth dose

1.9.3.2 Clinical modification of Bragg peak and beam collimation

1.9.3.3 Beams produced by passive scattering foils and active scanning

1.10 **Treatment Planning and Delivery for Photon and Electron Beams**

1.10.1 Different equipment and methods for patient simulation; Processes of 2D and 3D planning; principles of intensity modulated radiation therapy and inverse treatment planning

1.10.2 Methods of determining body contour, location of internal structures including critical tissues and target volume including comparison of CT, MRI and PET

1.10.3 Choice of beam energy, field size, beam arrangement and the use of bolus

1.10.4 Use of field junctions in terms of: Photon-photon junctions, Photon-electron junctions, Electron-electron junctions

1.10.5 Dose calculation algorithms, superposition/convolution, Monte Carlo and pencil beam methods, their comparative advantages and limitations

1.10.6 Accuracy of treatment planning and delivery:

1.10.6.1 Methods of patient monitoring and ensuring reproducibility of patient positioning throughout treatment and planning

1.10.6.2 Image-guided radiation therapy

1.10.6.3 Accuracy of calibration, stability of beam parameters, accuracy of isodose calculation

1.10.6.4 Determination of mechanical and radiation accuracy of treatment machines and simulators
1.10.6.5 Systematic and random errors
1.10.6.6 Avoidance and detection of dose delivery errors
1.10.6.7 Potential errors arising from computer control of set up and treatment machine operation
1.10.6.8 In-vivo dosimetry techniques

1.11 **Radiation Measurement Devices**
1.11.1 Ionisation chambers, semi-conductor detectors and optically stimulated luminescence dosimeters (TLD and OSL)
1.11.2 Photographic film, radiochromic film, Geiger-Muller counters, scintillation counters, chemical dosimeters
1.11.3 Use of radiation phantoms and dedicated dosimetry tools for fixed SSD and isocentric patient treatments

1.12 **Radioactivity**
1.12.1 Activity, apparent activity, specific activity, air-kerma rate constant and reference air-kerma rate
1.12.2 Radionuclide decay processes: alpha, beta, positron, gamma, electron capture, internal conversion
1.12.3 Radionuclide production: natural and artificial radioactivity
1.12.4 Exponential radioactive decay: decay constant, half life (physical, biological, effective), mean life, daughter products, radioactive equilibrium

1.13 **Sealed Source Radionuclides**
1.13.1 Source construction including filtration
1.13.2 Properties: spectra of radiation emitted, half-life, usual specific activity
1.13.3 Measurement of source activity and dose rates, choice of suitable detectors and calibration
1.13.4 Radionuclides: caesium-137, iridium-192, iodine-125, palladium-106, strontium-90, radium-226, cobalt-60, yttrium-90
1.13.5 Management: handling, cleaning, inspection, storage and transport
1.13.6 Sealed source brachytherapy:
1.13.6.1 Types of procedures - surface applications, eye plaques, interstitial implants, intracavitary techniques
1.13.6.2 Source dose rate and dose distributions
1.13.6.3 Delivery techniques: remote afterloading machines, manual afterloading
1.13.6.4 ICRU dose specification system: current ICRU recommendations for interstitial and gynecological treatment specifications
1.13.6.5 Current dosage systems: Paris system, production of conformal dose distributions using a single, stepping source
1.13.6.6 Procedures for beta emitters: surface and ophthalmic applications, intravascular techniques, techniques of delivery – unique applicators and methods of use

1.14 **Unsealed Source Radionuclides**
1.14.1 Concepts of uptake, distribution and elimination
1.14.2 Physical, biological and effective half life
1.14.3 Methods of dose estimation: Medical Internal Radiation Dose (MIRD) and other methods of estimating dose to target tissues and critical organs
1.14.4 Management: safe handling, storage, transport, clean up of spills

1.15 **Radiation Protection**

1.15.1 ALARA principle, radiation incident and radiation accident
1.15.2 International Commission on Radiation Protection (ICRP) recommendations and national radiation protection standards
1.15.3 Practical dose minimization practices and procedures
1.15.4 Typical environmental dose levels and doses from diagnostic medical exposures
1.15.5 Medical exposure in contrast to exposure of the public and occupational exposure (justification, optimization and dose limits)
1.15.6 Minimization of dose to patients, staff and general public including safety procedures for staff, control of areas and radiation sources, personal monitoring, area monitoring, construction of rooms to house sources and radiation generators
1.15.7 Recommended dose limits for fetal exposure and human data from which these have been derived
1.15.8 Documentation and reporting requirements relating to radiation incidents and accidents

2. Radiation Biology

2.1 Law of Bergonie and Tribondeau
2.2 Evolution of fractionated treatment :The ram's testis experiment, evolution of standard fractionation schedules, treatment protraction and adverse effects of protraction
2.3 Cell: Normal cell structure; structure of eukaryotic genes e.g. open reading frame, untranslated regions, introns, exons, regulatory elements; chromosome packaging; DNA replication and the importance of maintaining genomic integrity; RNA transcription and translation; epigenetic effects on gene expression
2.4 Cell Cycle: Phases and functions; Check points and their molecular controls; Major cell cycle regulators e.g. pRB, p53, cyclins, cyclin-dependent kinases; Cell cycle kinetic parameters; Extra cellular agents affecting cell growth e.g. growth factors, hormones; Growth factor receptors; Signal transduction e.g. MAPK/ERK, RAS, RAF pathways
2.5 Mechanism of malignant cell transformation and progression
2.5.1 Activation of oncogenes/loss of tumor suppressor genes: Mechanisms including point mutations, insertions, deletions, translocations, and amplifications; stable and unstable aberrations; Methods of quantification including comparative genomic and in-situ hybridization, spectral karyotyping
2.5.2 Knudson's 2-hit hypothesis
2.5.3 Epigenetic and telomeric changes: Global demethylation, promoter hyper-methylation
2.5.4 Aberrant histone acetylation
2.5.5 Tumor angiogenesis and vasculogenesis
2.6 Tumor Growth: Gompertzian growth of untreated cancers including the concepts of tumour doubling time and potential doubling time; determinants of tumour growth rate including cell cycle time, growth fraction, cell loss factor; effect of tumour microenvironment on growth rate
2.7 Radiation Induced Cellular Damage
2.7.1 Evidence for DNA being the clinically relevant target for cell killing and other targets of radiation damage
2.7.2 Types of DNA lesions caused by ionizing radiation including double strand breaks (DSB), single strand breaks (SSB), cross links and base damage
2.7.3 DNA damage repair mechanisms including sub-lethal damage and potentially lethal damage

2.7.4 Assays for DNA damage including: gamma-H2AX, Comet assay, pulsed field electrophoresis, plasmid based assay, micronucleus assay and chromosomal aberrations
2.7.5 Radiation sensitivity in different phases of the cell cycle
2.7.6 Modes of cell death including timing of cell death and relative importance following ionizing radiation including: mitotic catastrophe, apoptosis, radiation-induced senescence, necrotic death, autophagy
2.7.7 Concepts of reproductive death and clonogenicity; Bystander effect
2.7.8 Titration of radiation dose according to tumour cell 'burden' including macroscopic versus microscopic disease

2.8 DNA double strand break repair
2.8.1 Sensing DNA DSB
2.8.2 Cell cycle arrest
2.8.3 Histone modifications
2.8.4 Recruitment of DNA DSB repair proteins
2.8.5 DNA DSB repair pathway
2.8.6 Homologous recombination and Non-homologous end-joining
2.8.7 The genetic diseases that affect DNA repair/ clinically apparent radio-sensitivity (e.g. ataxia telangectasia)

2.9 Quantification of cell survival following irradiation
2.9.1 Concept of cell survival curves
2.9.2 In-vitro and in-vivo techniques to generate survival curves
2.9.3 Dose rate effects on cell survival
2.9.4 The linear quadratic formula in terms of: The biophysical basis of α and β in the linear quadratic formula, clinically derived α/β ratios for different types of cancer, acute and late responding normal tissues; limitations of linear quadratic formula
2.9.5 Relationship between dose/fraction and tissue α/β ratio

2.10 Fractionations and "Rs" of radiobiology
2.10.1 Conventional, hyper, hypo and accelerated fractionation
2.10.2 Intrinsic Radiosensitivity, Repair, Reoxygenation, Redistribution, Repopulation

2.11 Biological Effective Dose

2.12 Hypoxia and the Oxygen effect
2.12.1 Modification of radiation induced DNA damage by oxygen
2.12.2 Oxygen enhancement ration (OER)
2.12.3 Tumor hypoxia: clinical significance
2.12.4 Methods used to overcome the effect of tumour hypoxia including their rationale: e.g. fractionation, hypoxic cell sensitizers, hypoxic cell cytotoxins, hyperbaric oxygen, high LET radiation, and hyperthermia
2.12.5 Consequences of molecular responses to hypoxia including: angiogenesis, increased propensity for metastasis and genetic instability

2.13 Radiation quality
2.13.1 Types of ionizing radiation; Linear Energy Transfer (LET) and its relationship to direct and indirect DNA damage, free radicals and free radical scavengers

2.14 Dose response
2.14.1 Dose response curve: shape, determinants of steepness of curve
2.14.2 Therapeutic ratio: concept and significance
2.14.3 Radiocurability and radioresponsiveness
2.14.4 Factors influencing tumor control: physical factors including dose, dose rate, radiation quality, temperature; chemical factors including oxygen, radio-

sensitizers and radio-protectors; biological Factors including cell type and radiosensitivity, clonogen number, host factors; technical Factors including geographic miss; tumour control probability curves

2.15 Effects of radiation on normal tissues: Acute, sub-acute and late toxicity from radiation; meaning of latency with regard to normal tissue effects; functional sub-units of tissues/organs; flexible and hierarchical kinetic models; abscopal effect; post radiation regeneration of normal tissues; concept of normal tissue/organ tolerance; mechanism of effect and consequences of radiation on: parenchymal tissues, connective tissues, vascular systems and immune system

2.16 Acute syndromes following high doses of total body radiation
- 2.16.1 Acute radiation syndrome: prodormal period, latent period, critical phase (manifestation of disease) and recovery or death
- 2.16.2 Cerebrovascular syndrome
- 2.16.3 Hematological syndrome
- 2.16.4 Gastrointestinal syndrome
- 2.16.5 Methods of biological dosimetry for unplanned / uncontrolled radiation exposure including: blood counts, chromosome aberrations in peripheral blood lymphocytes (dicentric assay, translocation assay), gamma-H2AX, mitotic index, micronucleus and comet assays

2.17 Effects of radiation on human embryo and fetus
- 2.17.1 Major phases of fetal development, including CNS growth and corresponding gestational age; Nature of and reasons for effects caused in utero; Factors influencing effect type and risk including dose and stage of gestation; Definition of doubling dose

2.18 Quantification of radiation effects on normal tissues
- 2.18.1 Principles of toxicity scoring systems used in current clinical practice including selection of appropriate endpoints and quantification
- 2.18.2 Examples of toxicity scoring systems used in current clinical practice e.g. RTOG, Common Toxicity Criteria, LENT/SOMA
- 2.18.3 Tolerance doses of normal tissues/organs including the QUANTEC data and its limitations

2.19 Radiation carcinogenesis
- 2.19.1 Concept of stochastic and deterministic effects
- 2.19.2 The shape of the dose-response curve for this effect including the peak for leukaemias
- 2.19.3 Relevance of integral dose in radiotherapy to second cancer induction risk

2.20 Re-irradiation
- 2.20.1 Re-irradiation tolerance of normal tissues derived from experimental and clinical studies for both early and late effects
- 2.20.2 Time interval between therapy courses and concept of forgotten dose
- 2.20.3 The radiobiological principles for consideration of re-treatment including initial radiotherapy dose, volume, volume of overlap and technique used
- 2.20.4 Effect of radiation modifiers used in treatment of the first tumour e.g. concurrent chemotherapy

2.21 Radiobiological principles in brachytherapy, stereotactic ablative radiotherapy, radiosurgery, tomotherapy, IMRT and particle therapy

2.22 Molecular analysis
- 2.22.1 Nucleic acid hybridization including Northern and Southern analysis, DNA microarrays, competitive genomic hybridization

2.22.2 Protein analysis: Western analysis, immunoprecipitation, immune-histochemistry, proteomics (2-dimensional gels, mass spectrometry)
2.22.3 PCR (polymerization chain reaction), quantitative RT-PCR
2.22.4 DNA sequencing
2.22.5 Detection of single nucleotide polymorphisms, mutations in tumors
2.22.6 Knockout, knockin and transgenic mice
2.22.7 RNA interference (RNAi)
2.22.8 Tissue microarrays (TMAs)
2.22.9 In-situ hybridization

2.23 Oncopathology
2.23.1 Major histological types of cancer
2.23.2 Typical cytological features of malignant cells
2.23.3 Typical biological behaviour of benign and malignant neoplasms
2.23.4 Neoplasia, differentiation, anaplasia, aneuploidy
2.23.5 Cancer stem cells and cancer cell lineages, monoclonality
2.23.6 Tumour heterogeneity
2.23.7 Pathways of spread
2.23.8 Molecular basis of cancer and cancer genetics
2.23.9 Mechanisms of cell death
2.23.10 Tumour immunology

Section (B) – 40 Marks

3. Haematological Malignancies

3.1 **Mylodysplastic Syndrome:** Classification, French-American-British classification, WHO, Myelodysplastic syndrome, unclassified signs and symptoms, pathophysiology, genetics 5q- syndrome

3.2 **Acute and Chronic Leukemia**: Pathology, genetic abnormalities, infective precursors, investigation and evaluate relevant diagnostic tests, including molecular and cytogenetic studies e.g. indicating Ph+ disease; significance of minimal residual disease and the duration of disease remission; uses of radiation therapy, including indications for cranial, craniospinal or total body irradiation in both myeloablative and non myeloablative transplants and total marrow irradiation

3.3 **Hodgkin's Lymphoma:** Pathology, WHO classification system, appropriate staging investigations including the role of PET; contemporary combined modality therapy and the historical changes in the role of radiation therapy in the curative treatment of HL; involved field and involved nodal radiation

3.4 **Non-Hodgkins Lymphomas**: Pathology, WHO classification, appropriate staging investigations (including PET, bone marrow biopsy), stratify patients according to contemporary prognostic groupings, involved field radiation therapy, treatment principles for extranodal lymphomas, indications and techniques for applying fields extending beyond "involved field" radiation therapy, including subtotal nodal irradiation, total nodal irradiation and TBI, role of chemotherapy, molecularly targeted agents and radioimmunotherapy

3.5 **Plasma Cell Dyscrasias:** Pathology, Monoclonal Gammopathy of Undetermined Significance (MGUS), solitary plasmacytoma in both osseus and extraosseus sites and multiple myeloma. diagnostic tests including serum IgG and IgA, creatinine, calcium, urinary protein excretion, and radiology (skeletal survey, CT, and MRI), differences in PTV and prescription for solitary plasmacytoma compared to multiple myeloma, use of

hemi-body radiation therapy, use of chemotherapy as the primary treatment modality, including the most effective regimens, timing of interventions with systemic therapies

3.6 **Myeloproliferative Disorders:** Classification, causes, diagnosis chronic myelogenous leukemia, essential thrombocythemia, polycythemia vera, primary myelofibrosis, treatment

3.7 **Stem cell Transplant: N**ormal haematopoiesis and stem cell biology, principles and practice of HSCT, indications and principles of stem cell transplant, sources of stem cells preparative regimen, principles of conditioning radiotherapy, procedure, complications, prognosis

3.8 **Palliative Care:** Introduction, WHO definition; definition and types of pain, pain assessment, use of different pain scales; Palliative measures for other symptoms including: respiratory tract, gastrointestinal tract, neurological symptoms, cutaneous and mucosal symptoms, anorexia, cachexia; Ethical issues in Palliative care; Psycho social issues; Palliative Radiotherapy

4. Principles and Practice of Radiation Oncology

4.1 Anatomy

4.2 Diagnostic work up: Radiological, Cyto-Histopathological, Biochemical, Tumor markers, Radio nuclear imaging

4.3 Tumor Classifications and Staging Systems (TNM, FIGO)

4.4 Management of malignant diseases: Treatment protocols, Sequalae of treatment

4.5 Cancers of various organs

4.6 System wise disease management

- 4.6.1 Eye and orbit
- 4.6.2 Head and neck tumors
- 4.6.3 CNS tumors
- 4.6.4 Thoracic tumors
- 4.6.5 Breast

4.7 Pre treatment verification protocols

4.8 Treatment delivery protocols

4.9 Radiation therapy treatment originating in various sites: treatment for Overall cancer management of various solid tumors

- 4.9.1 Cancer of Head and neck
- 4.9.2 Cancer of Lung and Mediastinun
- 4.9.3 Cancer of Gastro Intestinal Track
- 4.9.4 Cancer of Genito Urinary System
- 4.9.5 Cancer of the Breast
- 4.9.6 Cancer of Endocrine System
- 4.9.7 Sarcomas of Soft Tissues & Bone
- 4.9.8 Benign & Malignant Mesotheliomas
- 4.9.9 Cancer of skin
- 4.9.10 Malignant Melanoma
- 4.9.11 Neoplasms of CNS
- 4.9.12 Cancers of childhood
- 4.9.13 Lymphomas
- 4.9.14 Leukemias and other Haematological Malignancies
- 4.9.15 Paraneoplastic Synddromes
- 4.9.16 Cancers of unknown primary site
- 4.9.17 AIDS – related malignancies

4.9.18 Oncological Emergencies
4.9.19 Treatment of Metastatic Cancers
4.9.20 Gynaecological Cancers

4.10 Radiotherapy Treatment protocols for treating cancers of various sites
4.10.1 Pre Treatment verification protocols
4.10.2 Importance of Imaging with Computed tomography, MR imaging and PET – CT In radiation Therapy
4.10.3 Saggital, coronal and axial planes of body
4.10.4 Identification of normal anatomic plane in the Body
4.10.5 Topographic anatomy to locate internal organs of the body
4.10.6 Image formation and orientation for CT, MR, PET and Fusion concepts of various modalities
4.10.7 Basic Principles of Digital imaging
4.10.8 Image acquisition (Simulation, Portal imaging, Online image Guidance)
4.10.9 Digital reconstruction DRR
4.10.10 Patient positioning and dynamic target localization
4.10.11 Image extraction
4.10.12 Quality control of Imaging
4.10.13 Computed Tomographic Imaging in radiation oncology
4.10.14 Data acquisition (raw data, Beams Eye view)
4.10.15 Anatomical structures (artifacts, contrast resolution, windows, distortion, spatial resolution)
4.10.16 Image reconstruction
4.10.17 Image backup and storage

4.11 Radiotherapy Treatment Delivery Protocols for malignant diseases of various sites
4.12 Techniques of Radiotherapy delivery
4.13 Treatment approaches for Metastatic Disease and palliation
4.13.1 Common sites of metastases, detection, therapeutic approach
4.13.2 Role and scope of radiation oncology
4.13.3 Newer Treatment approaches