

**द्वितीय पत्र - सेवा सम्बन्धी**

**Section A- 30 Marks**

**1. CLINICAL ONCOLOGY**

**1.1 TUMORS**

- 1.1.1 Tumor definition
- 1.1.2 Benign tumors and malignant tumors
- 1.1.3 Spread of tumors

**1.2 CLINICAL PRESENTATION**

- 1.2.1 Symptoms & signs
- 1.2.2 Diagnostic procedure
  - 1.2.2.1 Hemogram
  - 1.2.2.2 Biochemical
  - 1.2.2.3 Tumor marker
  - 1.2.2.4 Radiological- X-ray, U.S.G., C.T, M.R.I
  - 1.2.2.5 Pathological – FNAC, FNAB, Incision biopsy, excision biopsy
  - 1.2.2.6 Surgery

**1.3 STAGING**

- 1.3.1 TNM Classification

**1.4 MALIGNANCIES & TREATMENT**

- 1.4.1 Ca- Brain
- 1.4.2 Ca-Larynx
- 1.4.3 Ca-Tongue
- 1.4.4 Ca-Breast
- 1.4.5 Ca-Lung
- 1.4.6 Ca-Cervix
- 1.4.7 Ca-Oesophagus

**Section B- 20 Marks**

**2. RADIOTHERAPY TECHNIQUE**

**2.1 PRINCIPALS OF RADOTHERAPY**

- 2.1.1 Tumor histology
- 2.1.2 Grade, sensitivity,
- 2.1.3 Anatomical site, critical organs
- 2.1.4 General condition of the patient, extent of tumor, previous treatments
- 2.1.5 Radical/Palliative and prophylaxis.

**2.2 TYPES AND METHODS OF RADIOTHERAPY**

- 2.2.1 Tele-therapy Technique
- 2.2.2 Brachytherapy Technique

**2.3 RADIOTHERAPY RESOURCES**

- 2.3.1 Low energy beams
- 2.3.2 High energy beams
- 2.3.3 Electron beams

**2.4 TREATMENT PLANNING**

- 2.4.1 Tumor localization and verification
- 2.4.2 Isodose Curves
- 2.4.3 Single field, parallel opposed field, multiple field.
- 2.4.4 Rotation therapy
- 2.4.5 Beam Modification

## **Section C- 20 Marks**

### **3. RADIOTHERAPY PHYSICS**

#### **3.1 ATOMIC STRUCTURE**

- 3.1.1 General introduction
- 3.1.2 Electron shells & energy levels
- 3.1.3 Excitation and ionization.
- 3.1.4 Mass number, atomic number, atomic mass unit, binding energy
- 3.1.5 Emission of electromagnetic waves, spectra.
- 3.1.6 Properties of electromagnetic waves.
- 3.1.7 Properties of electromagnetic waves.
- 3.1.8 Concept of photon and quanta.
- 3.1.9 Nuclear fission and fusion.

#### **3.2 RADIOACTIVITY**

- 3.2.1 Radioactive elements.
- 3.2.2 Radioactive series, different types of radioactive disintegration.
- 3.2.3 Properties of radioactive particles.
- 3.2.4 Radioactive decay law.
- 3.2.5 Half-life, mean life.
- 3.2.6 Nuclear stability.
- 3.2.7 Alpha, beta and gamma disintegration

#### **3.3 X-RAYS & GAMMA RAYS**

- 3.3.1 Historical background of x-rays.
- 3.3.2 Mechanism & production of x-rays.
- 3.3.3 Properties of x-rays.
- 3.3.4 Continuous and characteristic spectra.
- 3.3.5 Gamma rays
- 3.3.6 Properties of gamma rays.

#### **3.4 INTERACTION OF RADIATION WITH MATTER**

- 3.4.1 Classical scattering.
- 3.4.2 Photoelectric interaction.
- 3.4.3 Compton scattering.
- 3.4.4 Pair production.
- 3.4.5 Transmission of a homogenous and heterogeneous beam through matter.

#### **3.5 CLINICAL DOSIMETRY**

- 3.5.1 Radiation absorbed dose.
- 3.5.2 Relationship between Kerma, Exposure and absorbed dose.
- 3.5.3 Cavity theory.
- 3.5.4 Measurement of absorbed dose.
- 3.5.5 Phantom.
- 3.5.6 Dose calibration parameters.
- 3.5.7 Depth dose distribution.
  - 3.5.7.1 Percentage depth dose.
  - 3.5.7.2 Tissue-air ratio.
  - 3.5.7.3 Tissue maximum ratio.
- 3.5.8 Principle of ionization chamber & electrometer.

**3.6 RADIATION BIOLOGY**

- 3.6.1 Cell cycle,
- 3.6.2 Effect of radiation on the normal cell, tissue and organs.
- 3.6.3 Radiation sensitivity.
- 3.6.4 Physical and biological factors affecting radiation sensitivity
  - 3.6.4.1 LET
  - 3.6.4.2 RBE
  - 3.6.4.3 OER
- 3.6.5 Cell survival curves
- 3.6.6  $4R^s$  of radiobiology.

**Section D- 30 Marks**

**4. RADIOTHERAPY EQUIPMENT & QUALITY ASSURANCE**

**4.1 TELETHERAPY EQUIPMENTS**

- 4.1.1 Superficial and orthovoltage equipment.
- 4.1.2 Cobalt-60 tele therapy equipment.
- 4.1.3 Linear accelerator.
- 4.1.4 Simulator.
- 4.1.5 Brachytherapy equipment
  - 4.1.5.1 Low dose rate (LDR)
  - 4.1.5.2 Medium dose rate (MDR)
  - 4.1.5.3 High dose rate (HDR)

**4.2 QUALITY CONTROL**

- 4.2.1 Cobalt-60.
- 4.2.2 Linear Accelerator.
- 4.2.3 Brachytherapy.
- 4.2.4 Simulator.

**4.3 RADIATION PROTECTION**

- 4.3.1 Concept of radiation protection.
- 4.3.2 Justification, Optimization and Limitation.
- 4.3.3 Units.
- 4.3.4 Maximum Permissible dose.
- 4.3.5 Personnel monitoring.
- 4.3.6 Protective materials.

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द्वितीय पत्रको एकाई, अङ्कभार र प्रश्नसंख्या निम्न बमोजिम हुनेछ ।

द्वितीय पत्रका एकाई	A	B	C	D
द्वितीय पत्रका एकाई	1	2	3	4
प्रश्न संख्या	3	2	2	3

**Model Questions**

1. Describe the parameters taken during the treatment planning of the patient in radiotherapy.
2. What is brachytherapy? Describe high dose rate after loading system and its advantages over manual and low dose rate after loading system.
3. What is cell cycle? Define cell cervical curves and its model.
4. What is simulator? Why it is necessary in radiotherapy planning?
5. Write short notes on
  - a. Biological effect of radiation
  - b. SSD/SAD Technique
  - c. Radiation protection on radiotherapy