POSTGRADUATE INSTITUTE OF MEDICINE
UNIVERSITY OF COLOMBO

MD (CLINICAL ONCOLOGY) PART I EXAMINATION – NOVEMBER 2023

Date:- 06th November 2023 **Time:-** 2.00 p.m. – 4.15 p.m.

PAPER I

If the examiners cannot read your writing, they will be unable to give you full credit for your knowledge.

PHYSICS

Answer all questions.
Each question carries 100 marks.
Each question to be answered in separate book.

1.

1.1. (a) Define the term "Effective Dose" and briefly explain importance of Effective Dose in Radiation Protection. (20 marks)

(b) List Effective dose limits recommended for radiation workers and female radiation workers when they become pregnant. (20 marks)

1.2. (a) What is the name of the Sri Lanka law governing the control of the use of ionizing radiation? (10 marks)

(b) What are the licence periods recommended for tele gamma facility and medical linear accelerator facility by the Atomic Energy (Licence) Rule No. 1 of 2015 promulgated under the above legislation? (10 marks)

1.3. (a) What is meant by very short lived radioactive wastes? (10 marks)

(b) List three basic methods of radioactive waste management. (10 marks)

(c) Briefly discuss wastes generated in iodine therapy and radiation protection advice given to the patients at the time of release. (20 marks)

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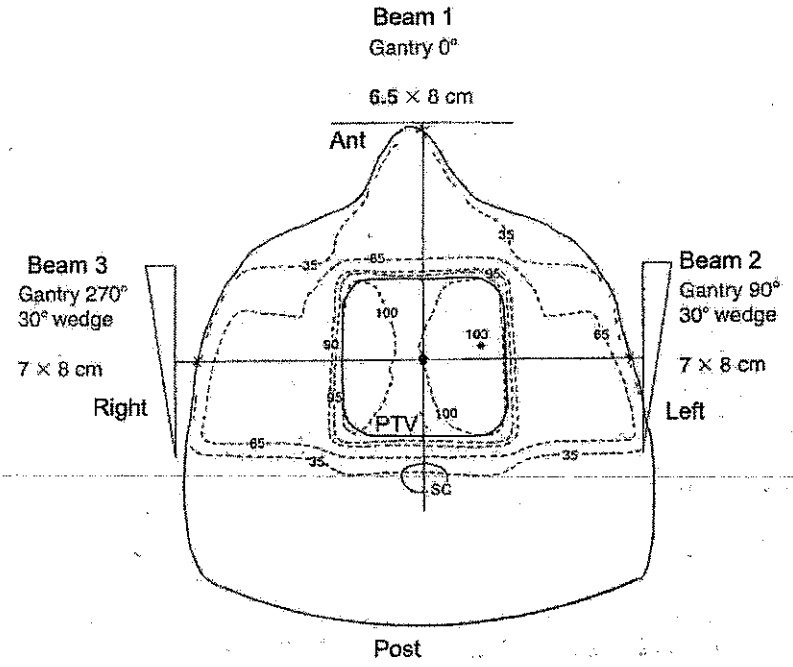

Machine calibration condition:
Reference depth of ionization chamber at 1.5 cm depth in water at 100 cm source chamber distance (SCD). Dose rate is 1 cGy/MU for 10 cm x 10 cm field size.

Description	Beam 1 (Ant)	Beam 2 (Left)	Beam 3 (Right)
Gantry angle	0°	90°	270°
Treatment field size (cm^2)	6.5 x 8	7 x 8	7 x 8
Tissue depth to beam isocenter (cm)	8.0	7.0	7.0
Tissue maximum ratio (TMR)	0.822	0.854	0.854
Wedge transmission factor (30°)	-	0.640	0.640
Collimator scatter factor	0.980	0.984	0.984
Phantom scatter factor	0.970	0.972	0.972

(a) Find the dose rate in water at the points of dose maximum for open and wedge beams. (15 marks)

(b) Assuming 2D manual planning and considering equal dose to the center of PTV from each beam, calculate the number of monitor units (MUs) per field per fraction. (30 marks)

(c) Is the total radiation dose to spinal cord acceptable? Give reasons for your answer. (10 marks)

(d) How do you confirm the radiation safety of the eyes from this treatment? (15 marks)

(e) Briefly describe the differences when the above patient is planned with a CT based computerized system. (15 marks)

Contd...../4

5.3. Briefly explain how photon contamination occurs in an electron beam and include the magnitude of its effect on patient dose. (15 marks)

5.4. A nearly circular superficial tumour with a diameter of 7 cm and maximum depth from skin of 2.5 cm has been planned to treat using electrons from a Linear accelerator.

(a) Estimate the most appropriate electron beam energy. Justify your answer. (15 marks)

(b) What is the size of electron applicator you would use and the diameter of the shielding cutout? (10 marks)

6.

6.1. State the dose rates for LDR, MDR and HDR after-loading brachytherapy systems. (15 marks)

6.2. Name two radionuclides used in HDR remote after-loading brachytherapy and give their physical characteristics. (20 marks)

6.3. A patient with cervical cancer is planned to treat with an HDR remote after loading brachytherapy system.

(a) Sketch a diagram to show the shape of 100% dose line on AP view and lateral view. (10 marks)

(b) Briefly describe how the dose coverage and optimization process is achieved by a single HDR source. (15 marks)

(c) What is the method used for rectal dose reduction? (10 marks)

6.4. Name the radiation safety and protection devices that should be available when operating the HDR Brachytherapy system. (15 marks)

6.5. List three advantages of remote after-loading brachytherapy when compared to manual after-loading brachytherapy. (15 marks)

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MD (CLINICAL ONCOLOGY) PART I EXAMINATION – NOVEMBER 2023

Date:- 06th November 2023 **Time:-** 4.30 p.m. – 5.15 p.m.

PAPER I

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MEDICAL STATISTICS

Answer all questions.
Each question carries 100 marks.
Each question to be answered in a separate book.

1. A randomized clinical trial was conducted for comparing Intravenous paclitaxel (IVpac) verses oral Paclitaxel and encequidar (Opac + E) in women with metastatic breast cancer. The primary end point was confirmed radiographic response. A confirmatory scan was obtained on week 22. Each scan was evaluated by two radiologists who independently evaluated tumour response. Secondary end point included progression-free survival (PFS). The sample size was calculated to detect a 15% difference with 80% power assuming a confirmed response rate of 20% with IVpac. Two interim analyses were conducted of the primary end point after 90 and 180 evaluable patients completed (adjusted P value 0.001 and 0.004, respectively).

1.1. What is meant by primary and secondary end points? (20 marks)

1.2. What was the purpose of evaluating by two radiologists? Explain the process of incorporating the decision of the radiologists for the data analysis? (20 marks)

1.3. Explain the above description of sample size calculation. (20 marks)

1.4. Explain the above description of performing interim analysis. (20 marks)

1.5. Outline a data analysis plan for the secondary end point. (20 marks)

Contd...../2-

2. A matched case control study was conducted to assess the risk factors for Heart failure (HF) among childhood cancer survivors. The matched factors were sex, and age at first cancer diagnosis. The study showed that survivors who received a mean heart radiation therapy (RT) dose of 5 to 15 Gy have an increased risk of HF (odds ratio, 5.5; 95% CI, 2.5 to 12.3), when compared with no heart RT.

2.1. Briefly describe the methodology of the above study. (30 marks)

2.2. What is the purpose of matching? Explain your answer. (20 marks)

2.3. Briefly describe the data analysis plan for the above study. (30 marks)

2.4. Interpret the results. (20 marks)

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MD (CLINICAL ONCOLOGY) PART I EXAMINATION – NOVEMBER 2023

Date:- 07th November 2023 **Time:-** 9.00 a.m. – 9.45. a.m.

PAPER II

If the examiners cannot read your writing, they will be unable to give you full credit for your knowledge.

PATHOLOGY

Answer all questions.
Each question carries 100 marks.
Each question to be answered in a separate book.

1. A 62-year-old male presented with episodes of epistaxis for 4 months duration. His CT scan revealed an infiltrative tumour in the left sino - nasal tract eroding the maxillary sinus.

1.1. List five (05) possible malignant lesions for this clinical presentation. (10 marks)

1.2. Write histopathological features of each. (60 marks)

1.3. Describe the immunohistochemical features for each that help to differentiate your diagnosis. (30 marks)

2. A 40-year-old man had a biopsy of a lesion in the right cerebral hemisphere. A pathological diagnosis of glioblastoma was made.

2.1. According to 2021 WHO classification of CNS tumours, what are the pathological criteria to arrive at this diagnosis? (30 marks)

2.2. What is the likely prognosis of the patient? (10 marks)

2.3. How does the prognosis of this tumour differ from WHO grade IV IDH mutant astrocytoma? (10 marks)

2.4. On initial pathological assessment of H & E section, pathologist had a differential diagnosis of a high grade glial tumour, metastatic carcinoma or a lymphoma. State three most suitable immunohistochemical markers to arrive at the correct diagnosis. (30 marks)

2.5. List the tumours categorized as adult type diffuse gliomas in the 2021 WHO classification. (20 marks)

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MD (CLINICAL ONCOLOGY) PART I EXAMINATION – NOVEMBER 2023

Date:- 07th November 2023 **Time:-** 10.00 a.m. – 10.45. a.m.

PAPER II

If the examiners cannot read your writing, they will be unable to give you full credit for your knowledge.

RADIOBIOLOGY

Answer all questions.
Each question carries 100 marks.
Each question to be answered in a separate book.

1.

1.1.

1.1.1. Draw and differentiate between cell survival curves for neutrons and for gamma irradiation. (15 marks)

1.1.2. Using the cell survival curves in 1.2.1 describe the linear-quadratic model of cell killing. (15 marks)

1.2. Name the three (03) types of radiation induced lethal chromosomal aberrations and explain why these occur as a linear quadratic function of the dose. (20 marks)

1.3.

1.3.1. Differentiate between hypofractionation and hyperfractionation. (18 marks)

1.3.2. Briefly discuss the specific therapeutic advantages of the two types of dose fractionation mentioned in 1.3.1. (18 marks)

1.3.3. Provide two examples each of the following cancers and recommend the type of fractionation radiotherapy for each cancer type.

1.3.3.1. high α/β ratio cancers (7 marks)

1.3.3.2. low α/β ratio cancers (7 marks)

Contd...../2

2.

2.1. Define the following:

2.1.1. Linear Energy Transfer (LET) (10 marks)

2.1.2. Relative Biologic Effectiveness (RBE) (10 marks)

2.1.3. Oxygen Enhancement Ratio (OER) (10 marks)

2.1.4. Plot the variations of OER and RBE as a function of LET. (10 marks)

2.2. Explain the mechanism of the interaction of radiation with oxygen. (10 marks)

2.3. If 10^8 cells were irradiated according to single hit kinetics so that the average number of hits per cell is one, how many cells would survive? (20 marks)

2.4. Using an appropriate cell survival curve, discuss three (03) of the 6Rs of radiobiology. (30 marks)

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MD (CLINICAL ONCOLOGY) PART I EXAMINATION – NOVEMBER 2023

Date:- 07th November 2023 **Time:-** 11.00 a.m. – 11.45 a.m.

PAPER II

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PHARMACOLOGY

Answer all questions.
Each question carries 100 marks.
Each question to be answered in a separate book.

1.

1.1. Explain the mechanism of action of methotrexate in the treatment of breast cancer. (30 marks)

1.2. Explain three (03) mechanisms of drug resistance to methotrexate. (30 marks)

1.3. Discuss the basis of selecting individual medicines for a combination chemotherapy regime. (20 marks)

1.4. Explain the mechanisms of drug interactions that may occur when the following drugs are co-administered.

1.4.1. Methotrexate and salicylate (10 marks)

1.4.2. 6-Mercaptopurine and allopurinol (10 marks)

Contd...../2-

2.

2.1. Define the term adverse drug reaction. (10 marks)

2.2. List five (5) key characteristics of type A adverse drug reaction. (20 marks)

2.3. Define the term pharmacovigilance. (10 marks)

2.4. A patient who is on multiple anti-cancer medicines presents with jaundice. The oncologist believes that the jaundice is caused by one of the new anti-cancer medicines that he has prescribed for this patient.

2.4.1. What is meant by the term causality assessment in pharmacovigilance? (10 marks)

2.4.2. List five (5) essential criteria required for causality assessment. (30 marks)

2.4.3. Discuss four (4) difficulties in doing causality assessment for adverse drug reactions associated with anti-cancer medicines. (20 marks)