POSTGRADUATE INSTITUTE OF MEDICINE
UNIVERSITY OF COLOMBO

MD (CLINICAL ONCOLOGY) PART I EXAMINATION – AUGUST 2014

Date :- 18th August 2014 **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

Each question carries 100 marks.
Each question to be answered in a separate book.
Question one is compulsory.
Answer five questions of the six questions from 2 to 7.

1.

1.1.

(a) Define absorbed dose and effective dose (20 marks)

(b) What are the units of measurement of absorbed dose and effective dose? (10 marks)

1.2. In designing a bunker for 6 MV linear accelerator

(a) List three (03) types of radiation that must be considered (15 marks)

(b) List the most important four (04) factors required for estimation of thickness of walls and doors (10 marks)

(c) The entrance to the bunker is normally via a maze. Give the reason in one sentence. (10 marks)

1.3.

(a) Give two (02) examples of stochastic effects (10 marks)

(b) What are the most sensitive weeks for the human fetus to ionizing radiation (10 marks)

(c) List three (03) possible DNA damages of a cell which is exposed to ionizing radiation (15 marks)

Contd...../2-

2. Radionuclides which contain excess neutrons emit beta particles, and lack neutrons emit positrons.

2.1 Briefly explain the above mentioned two processes. (30 marks)

2.2 Mention two (02) uses of the above two different types of radionuclides in Oncological practice. (20 marks)

2.3 What is meant by physical half-life and effective half-life of a radionuclide? (20 marks)

2.4 Give physical half lives of ^{131}I, ^{99m}Tc and ^{60}Co radionuclides (15 marks)

2.5 List three (03) parameters of a radionuclide that determine the absorbed dose to the patient in radionuclide therapy. (15 marks)

3.

3.1 Explain the following terms in relation to ICRU (International Commission on Radiological Units and Measurements) report No:62

(a) Set up margin (SM) (20 marks)

(b) Internal margin (IM) (20 marks)

3.2 How is the IM related to Internal Target Volume (ITV) (10 marks)

3.3 What is meant by Organ at Risk (OAR) (10 marks)

3.4 What are the two types of Organ at Risk, and give one example of each (20 marks)

3.5 Define the conformity index (10 marks)

3.6 What is the requirement to achieve a higher conformity index value in Radiotherapy (10 marks)

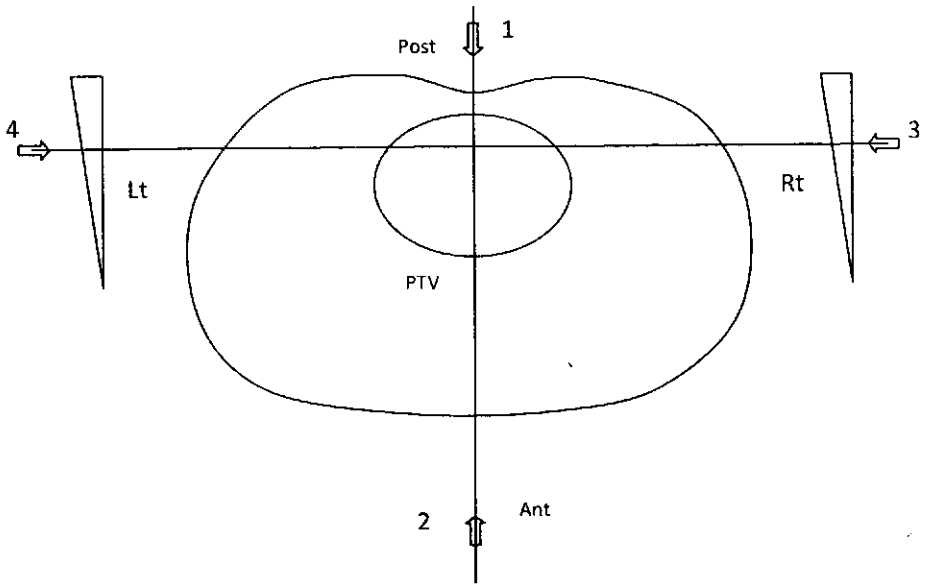
Contd.../3-

4.

4.1 Define Percentage Depth Dose (PDD) in radiotherapy using a diagram (20 marks)

4.2 List four (04) parameters that influence the PDD (20 marks)

4.3 Inoperable Rectal cancer patient is to be treated using a 10 MV photon beam from a clinical linear accelerator machine at 100 cm source axis distance (SAD) in prone position as shown in the figure below. The prescribed dose to the tumour center is 45Gy in 25 fractions over 5 weeks.



The output of the 10 MV machine is measured with an ionization chamber at 2.5 cm depth (d_{max}) in water, source chamber distance 100 cm.
Dose rate at D_{max} for 10 cm x 10cm field size is 1 cGy/MU

Description	Beam 1 Ant Pelvis	Beam 2 Post Pelvis	Beam 3 Right Pelvis	Beam 4 Left Pelvis
Tissue depth to beam isocenter (cm)	5.0	16.0	14.5	14.5
Gantry angle	0°	180°	245°	245°
Treatment Field size (cm^2)	10 x 14	10 x 14	9W x 14	9W x 14
Tissue maximum ratio	0.967	0.709	0.738	0.738
Collimator scatter factor	1.012	1.012	1.008	1.008
Phantom scatter factor	1.010	1.010	1.006	1.006
Wedge Transmission factor (15°)	-	-	0.750	0.750

Contd..../4-

Considering 2D manual planning for a box technique,

(a) Find the dose rate in water at d_{max} for each beam. (20 marks)

(b) Assuming equal dose at the isocenter from all beams, calculate the number of monitor units (MUs) per field per fraction. (20 marks)

4.4 Illustrate two (02) different field arrangements with appropriate wedges which are preferable for the above treatment. (10 marks)

4.5 List two (02) advantages of using SAD technique compared to SSD technique when multiple fields are used. (10 marks)

5.

5.1 Briefly describe the secondary asymmetric collimators and tertiary multi-leaf collimators of a clinical Linear Accelerator machine. (20 marks)

5.2 What is the advantage and disadvantage of the multi-leaf collimators having a curved edge? (15 marks)

5.3 What are the shielding thicknesses of Pb required in 10 MV x-ray and ^{60}Co gamma ray in external beam therapy? (10 marks)

5.4 Briefly discuss the differences between the standard shielding blocks and customized blocks used in high energy photon beam therapy. (20 marks)

5.5 Why is lead (Pb) not used to prepare customized shielding blocks? (15 marks)

5.6 Explain why the shielding blocks are placed at a particular height from the patient skin. (20 marks)

Contd...../5-

6.

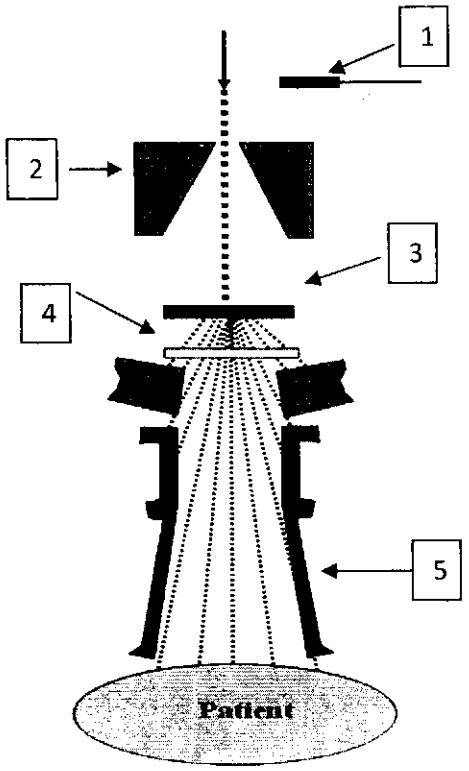
6.1 Define the terms R_{90}, R_{50} and R_p in Electron Beam Therapy (15 marks)

6.2 Sketch the typical central axis percentage depth dose (PDD) curve for a 12 MeV, 10 x 10 cm^2 field electron beam incident perpendicularly on a soft tissue at 100 cm SSD. (Indicate R_{90}, R_{50} and R_p) (20 marks)

6.3 What changes are likely on the PDD curve if the above electron beam passes through 4 cm of lung? (15 marks)

6.4 Identify the components from 1 to 5 of the given diagram which illustrates the linear accelerator machine in electron mode. (25 marks)

6.5 Write down the physical importance of each component. (25 marks)



Contd..../6-

7.

7.1 Write down the distribution rules for planar implants in Manchester system. (20 marks)

7.2 Define point A and draw a diagram to show point A when treating cervix cancer with brachytherapy where the uterus does not lie in the mid line of the body. (20 marks)

7.3 Draw a diagram to show the dosimetric points for the Organs at Risk when treating uterine cervical cancer with brachytherapy. (20 marks)

7.4 How do you minimize the dose to the rectum in practice for HDR Brachytherapy? (20 marks)

7.5 How is the strength of a Brachytherapy source defined? Give its units. (20 marks)

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Date :- 18th August 2014 **Time :-** 4.30 p.m. – 5.15 p.m.

PAPER I

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MEDICAL STATISTICS

Each question carries 100 marks.
Each question to be answered in a separate book.
Answer TWO (02) questions of the THREE (03) questions given below.

1. A randomized control trial was conducted to assess the efficacy of a new drug versus standard treatment for cervical carcinoma following surgery. Block randomization was carried out and the results were analysed according to the intention to treat principle. The following table shows the results.

	Quality of life	
	Improved	Not improved
New drug	80	120
Standard treatment	40	160

1.1. What is/are the advantages and disadvantages of block randomisation compared to simple randomisation? (20 marks)

1.2. What measures you would take to conceal the treatment allocation? (15 marks)

1.3. State the purpose of applying intention to treat analysis? (15 marks)

1.4. Calculate relative risk and number needed to treat. (20 marks)

1.5. Write an abstract of the above study for submitting to the College Scientific Sessions. (30 marks)

Contd...../2-

2. Investigators are interested to design a study to determine the risk factors for breast carcinoma. As one of the investigators of the above study, how would you design/write the methodology considering the following components.

    2.1. Study design (10 marks)

    2.2. Study population (40 marks)

    2.3. Data collection (10 marks)

    2.4. Data analysis (30 marks)

    2.5. Ethical issues (10 marks)

3. Compare and contrast the following

    3.1. Statistical significance and Clinical significance (25 marks)

    3.2. Direct standardisation and Indirect standardisation (25 marks)

    3.3. Parametric tests and Non-parametric tests (25 marks)

    3.4. Log rank test and Cox proportional hazards regression (25 marks)

POSTGRADUATE INSTITUTE OF MEDICINE
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MD (CLINICAL ONCOLOGY) PART I EXAMINATION – AUGUST 2014

Date :- 19th August 2014 **Time :-** 9.00 a.m. – 9.45 a.m.

PAPER II

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PATHOLOGY

Each question carries 100 marks.
Each question to be answered in a separate book.
Answer TWO (02) questions of the THREE (03) questions given below.

1. A 56 year old female presents with an enlarged left supraclavicular lymph node.

1.1. List five (05) possible causes (15 marks)

1.2. Draw a diagram to show the diagnostic pathway to arrive at a diagnosis (25 marks)

1.3. Discuss briefly how a pathological diagnosis can be made for two (02) of the above causes you have given using the pathway. (30 marks for each)

2. Write short notes on :

2.1. Rhabdomyosarcoma (25 marks)

2.2. Follicular lymphoma (25 marks)

2.3. Mucoepidermoid carcinoma of salivary gland. (25 marks)

2.4. Yolk sac tumour of ovary. (25 marks)

Contd..../2-

3.

3.1. List four (04) malignant paediatric renal tumours. (20 marks)

3.2. Describe the pathological features of two (02) malignant paediatric renal tumours using the following headings:

(a) Macroscopic appearances

(b) Histology and Immunohistochemistry

(c) Prognostic factors. (80 marks)

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MD (CLINICAL ONCOLOGY) PART I EXAMINATION – AUGUST 2014

Date :- 19th August 2014 **Time :-** 10.00 a.m. – 10.45 a.m.

PAPER II

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RADIOBIOLOGY

Each question carries 100 marks.
Each question to be answered in a separate book.
Answer TWO (02) questions of the THREE (03) questions given below.

1.

1.1. Radiobiological basis for fractionation is summarized in the form of 4 or 5 R's . List 4 R's. (10 marks)

Consider a situation where exponentially growing cells were maintained at 37^0C in 95% air/5% CO_2 and irradiated with either a single dose of 8 Gy of X-rays or two 4 Gy fractions separated by either 2 hours or 8 hours. Surviving fractions for the three treatments were 0.02, 0.15 and 0.08 respectively.

(a) Which process or processes you have listed above would best account for these differences in survival? Briefly state your reasons. (05 + 15 marks)

(b) State your reasons why the other processes cannot be considered. (20 marks)

1.2. What is the accepted gold standard for measuring the radiosensitivity of a cell population? Why is it considered to be a relevant parameter for radiotherapy? (05 + 10 marks)

(a) The most common model used today for survival after irradiation dose is the linear-quadratic model. Write the equation for this model and state the idea on which the model is based. (05 + 20 marks)

(b) What is α/β ratio? (10 marks)

Contd..../2-

2.

2.1.

(a) State two (02)microenvironmental factors that can influence cells in a tumour. (10 marks)

(b) Give two (02) commonly used methods to measure pO2 in human tumours. (10 marks)

(c) Give three (03) methods that have been used to increase oxygen delivery to tumours? What were the drawbacks if any? (30 marks)

(d) State a clinical trial with the tumour sites and the strategy used to improve tumour oxygenation . (10 marks)

2.2. For a standard course of radiotherapy how would the following properties of a tumor affect tumor control? (40 marks)

(a) low SF2

(b) short Tpot

(c) slow reoxygenation

(d) large number of tumor clonogens

(e) early onset of repopulation

3.

3.1. Name the radiation-induced developmental defect linked to the given gestational stage. (25 marks)

(a) preimplantation

(b) organogenesis

(c) early fetal period (6 – 12 weeks)

(d) late fetal period (> 12 weeks)

(e) entire gestation period

Contd...../3-

3.2.

(a) List three (03) factors on which response of normal tissue or organ to radiation would depend. (15 marks)

(b) What are the advantages of prolongation of treatment? (10 marks)

(c) State two (02) disadvantages of excessive prolongation of treatment. (20 marks)

(d) Name a strategy that uses multiple treatments per day. (05 marks)

(e) State the aim of this strategy. (25 marks)

POSTGRADUATE INSTITUTE OF MEDICINE
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MD (CLINICAL ONCOLOGY) PART I EXAMINATION – AUGUST 2014

Date :- 19th August 2014 **Time :-** 11.00 a.m. – 11.45 a.m.

PAPER II

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CHEMOTHERAPY (PHARMACOLOGY)

Each question carries 100 marks.
Each question to be answered in a separate book.
Answer TWO (02) questions of the THREE (03) questions given below.

1. A 55 year old patient with bronchial carcinoma was managed on codeine for cancer related pain. Following an increase in pain, his analgesia was changed to oral morphine. Subsequently he had to be given morphine parenterally.

1.1	Explain how the body handles oral morphine	(15 marks)
1.2	Explain how dose titration of oral morphine is carried out in this patient.	(40 marks)
1.3	Explain why the subcutaneous route is the preferred route when morphine is administered parenterally	(15 marks)
1.4	List two side effects of oral morphine and explain how they are managed.	(15 marks)
1.5	Explain the significance of pharmacogenetics in relation to use of codeine as an analgesic in pain management.	(15 marks)

Contd..../2-

2. A phase III randomized controlled clinical trial is conducted comparing standard treatment plus a new monoclonal antibody with standard treatment plus placebo in the treatment of metastatic ovarian carcinoma at the Cancer Institute Maharagama following Good Clinical Practice Guidelines (GCP). You are requested to take part in it as a sub-investigator by your consultant who is the principal investigator.

2.1 Explain how you would take informed consent from patients taking part in this trial indicating the information that you would give the patients prior to taking consent. (25 marks)

2.2 List the type of adverse events that are considered as serious adverse events in a clinical trial according to GCP guidelines. (15 marks)

2.3 One patient developed severe gastrointestinal haemorrhage and was found to have thrombocytopenia with a platelet count of 20,000/dl and Hb of 6g/dl. Indicate the actions you are required to take pertaining to the clinical trial. (30 marks)

2.4 Discuss the advantages and disadvantages that your patients may experience when participating in this clinical trial. (30 marks)

3.

3.1. When a drug is administered orally in the treatment of cancer,

(a) Name the most important pharmacokinetic parameter which determines the selection of the route of administration. (10 marks)

(b) Give five (05) factors which are known to affect the pharmacokinetic parameter you have given above in (a) (20 marks)

3.2 Majority of anti-cancer medicines have narrow therapeutic indices

(a) Explain the term therapeutic index. (15 marks)

(b) Explain briefly why majority of ant-cancer medicines have narrow therapeutic indices. (15 marks)

3.3.

(a) Administration of sodium bicarbonate is recommended in the treatment of methotrexate overdose. Explain the pharmacokinetic basis for the above recommendation (20 marks)

(b) A patient who is on Imatinib for chronic myeloid leukaemia developed severe neutropenia when he was prescribed erythromycin for a mild skin infection. Explain the pharmacological basis for the above adverse event. (20 marks)