POSTGRADUATE INSTITUTE OF MEDICINE
UNIVERSITY OF COLOMBO

MD (CLINICAL ONCOLOGY) PART I EXAMINATION – AUGUST 2015

Date :- 24th August 2015 **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 question from 2 to 7.

1.

1.1.

(a) Briefly explain what is meant by external radiation hazards. (05 marks)

(b) Name three (03) basic methods used to control external radiation hazards. (15 marks)

(c) Give a practical example of each of these methods. (30 marks)

1.2.

(a) What is meant by low level radioactive wastes? (10 marks)

(b) Give the three (03) steps in the delay and decay method used in management of waste generated in radioisotope therapy. (15 marks)

1.3.

(a) Access control is applied as a requirement for a "control area". List three other administrative and technical requirements found in a control area. (15 marks)

(b) List two (02) dose quantities measured by Thermo Luminescent Dosimeters used for individual monitoring. (10 marks)

Contd...../2-

2.

2.1. Give the three (03) methods of interaction between photon and media and the corresponding energy at which this will occur. (30 marks)

2.2. In the interaction of 50kV x-rays, why do bone and soft tissue show density differences on x-ray films? (10 marks)

2.3. State two factors that determine the energy of the ejected electron in the above process. (10 marks)

2.4. Define Absorbed Dose and Kerma with regarding to ionizing radiation. (20 marks)

2.5. Give the units of each of the above quantities. (10 marks)

2.6. Sketch a graph of Kerma and Absorbed Dose in water for a 6 MV photon beam. (20 marks)

3.

3.1. Explain the following terms in relation to ICRU (International Commission on Radiological Units and Measurements) report No:50

3.1.1. Treated Volume (TV) (15 marks)

3.1.2. Irradiated Volume (IV) (15 marks)

3.2. Briefly explain the following terms in External Beam Radiotherapy

3.2.1. inter-fractional variations (10 marks)

3.2.2. intra-fractional variations (10 marks)

3.3. Give two (02) ways to minimize the inter-fractional variations for the tumours in pelvic region? (10 marks)

3.4. Briefly explain the Segmental MLC-IMRT delivery technique? (20 marks)

3.5. List two (02) advantages and two disadvantages of IMRT treatment planning compared to 3D CRT treatment planning. (20 marks)

Contd..../3-

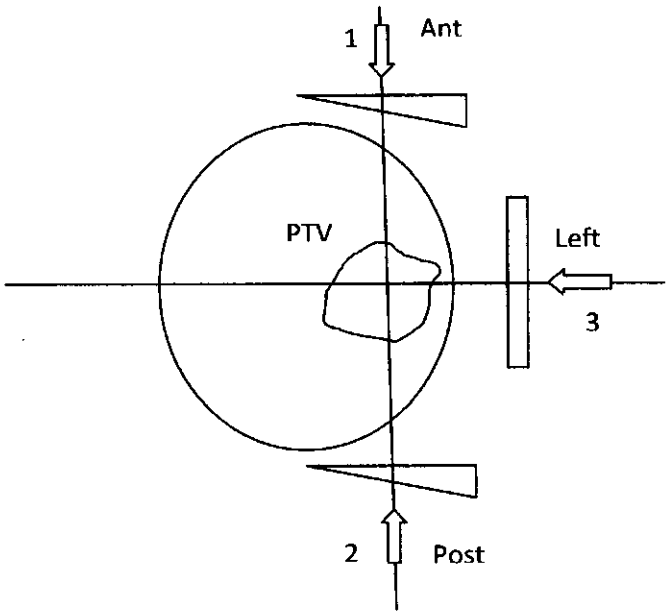
4.

4.1. Define Tissue Maximum Ratio (TMR) in Radiotherapy using a diagram. (15 marks)

4.2. A patient with low grade glioma in the left temporal region is to be treated using a 6MV photon beam from a Linear Accelerator machine at 100 cm SAD (Source Axis Distance) as shown in the figure below. The prescribed dose to the tumour center is 54 Gy in 30 fractions over 6 weeks and the relevant beam data is given below.

Machine calibration conditions:
Ionization chamber at 1.5 cm depth in water and Source chamber distance is 100 cm

Field size = 10 x 10 cm^2 and Calibration dose rate = 1 cGy/MU



Description	Beam 1	Beam 2	Beam 3
Tissue depth to beam isocenter (cm)	9	8	5
Gantry angle	0°	180°	90°
Treatment field size (cm^2) *	8w x 11	8w x 11	7 x11w
Tissue maximum ratio	0.823	0.852	0.938
Wedge angle	30°	30°	15°
Wedge transmission factor	0.746	0.746	0.872
Collimator scatter factor	0.993	0.993	0.988
Phantom scatter factor	0.995	0.995	0.992

*w indicates wedged beams

Contd...../4-

(a) Using the above data, calculate showing each step, the dose rate at d_{max} in water for all three wedged beams. (30 marks)

(b) Assuming 2D manual planning and considering equal dose to the tumour center from all beams, calculate the MUs per field per fraction. (30 marks)

4.3. What is the role of the wedge filter in beam No: 3 in the above treatment plan? (10 marks)

4.4. List three (03) serial organs at risk (OAR) in the above plan. (15 marks)

5.

5.1. Complete the following table to name the three (03) forms of wedges used in clinical radiotherapy and one (01) advantage and one (01) disadvantage. (45 marks)

Wedge Type	Advantage	Disadvantage

5.2. Sketch the beam profiles at the plane of d_{max} and 10 cm depth for 20x20 cm^2 open field for a 10 MV photon beam incident perpendicularly to the surface of a water phantom at 100cm SSD. (20 marks)

5.3. Define field size in the above diagram (10 marks)

5.4. Define the photon beam flatness and explain how it is measured from the above graph. (20 marks)

5.5. What component in the Linear Accelerator modifies beam profile? (05 marks)

Contd..../5-

6.

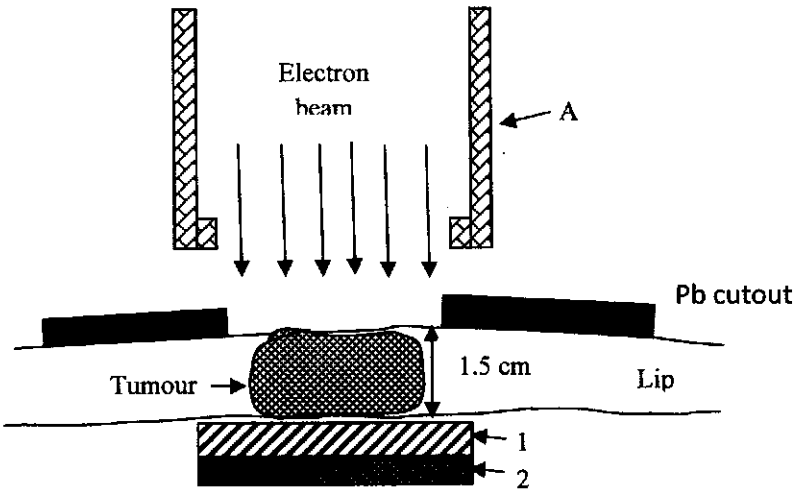
6.1. Define the following for an electron beam

(a) Therapeutic range

(b) Practical range (20 marks)

6.2. Give two (02) parameters which influence each of the above ranges of electrons (20 marks)

6.3. A lower lip tumour with a depth of 1.5cm, is to be treated with electrons as shown in the figure below.



(a) Identify the component A (10 marks)

(b) Suggest the suitable electron beam energy. (10 marks)

(c) What would be the field size of the Pb cutout if the dimension of the tumour is 1cm x 3 cm? (10 marks)

(d) What types of materials are used to compose the internal shielding labelled 1 & 2 and explain why? (20 marks)

(e) Determine the minimum thickness of material 2 required in the shield to provide adequate protection under the shielding. (10 marks)

Contd..../6-

7.

7.1. Define Activity, Apparent Activity and Specific Activity of brachytherapy sources. Give the units for each of these terms. (30 marks)

7.2. List the dose ranges for HDR, MDR and LDR brachytherapy. (15 marks)

7.3. Write down the four (04) distribution rules of the Paris system regarding single plane implant brachytherapy. (20 marks)

7.4. Briefly explain the Basal dose points for a single plane implant in the Paris system. (15 marks)

7.5. List five (05) radiation safety procedures to be followed when working with interstitial brachytherapy sources. (20 marks)

POSTGRADUATE INSTITUTE OF MEDICINE
UNIVERSITY OF COLOMBO

MD (CLINICAL ONCOLOGY) PART I EXAMINATION – AUGUST 2015

Date :- 24th August 2015 **Time :-** 4.30 p.m. – 5.15 p.m.

PAPER I

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

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 company has devised a new non-invasive rapid test called Pros-I for the diagnosis of prostate carcinoma.

   1.1. You have been asked to study the validity of this test at the General Hospital. Briefly describe the steps of a study you would apply. (20 marks)

   1.2. Following the above study, the test is applied in a Base Hospital on 500 clinic patients with a known prevalence of prostate carcinoma of 25%. Three hundred (300) men tested positive, with a post test probability of disease of 40%.

      1.2.1. Tabulate the data in a 2x2 table. (10 marks)

      1.2.2. Calculate the sensitivity and specificity, Likelihood ratio (positive) and Likelihood ratio (negative) of the test. (30 marks)

      1.2.3. Would you like to use this test for diagnosing prostate carcinoma? Justify your answer. (20marks)

   1.3. State two (02) advantages of applying Receiver Operator Characteristic (ROC) curve. (20 marks)

Contd...../2-

2. A study was conducted to determine the survival of endometrial carcinoma. Four hundred patients were included. Survival analysis was performed. Results are presented in the following Tables 1 and 2 and Figure 1.

Table 1 Comparison of survival time by severity of endometrial carcinoma

	Median survival (days)
Endometrial carcinoma Stage 1	190
Endometrial carcinoma Stage 2	131

Figure 1 Survival Functions

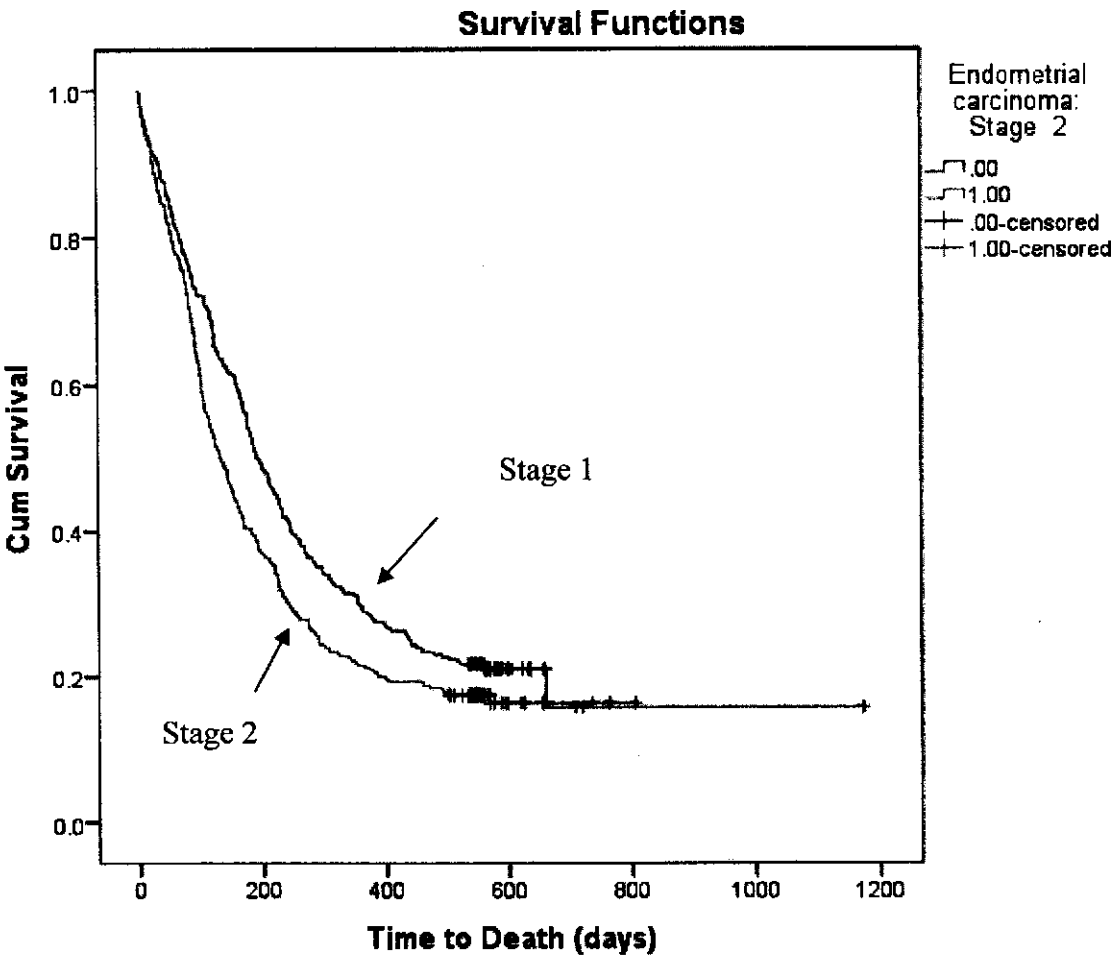


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Table 2 Results of multiple Cox proportional regression analysis

	Regression coefficient	Standard Error	Hazard ratio	95% CI for Hazard Ratio	
				Lower	Upper
Endometrial carcinoma: Stage 2	0.23	0.09	1.26	1.06	1.50
HRT	0.31	0.11	1.36	1.11	1.68
Age <50 years	-0.22	0.10	0.80	0.66	0.98

1.1. Briefly describe the methodology of the above study. (20 marks)

1.2. State the reason for reporting median survival. (10 marks)

1.3. Describe Figure 1 presented above. (30 marks)

1.4. Name a statistical test used to compare the data presented in Figure 1 (10 marks)

1.5. Interpret hazard ratio and 95% confidence interval for stage 2 endometrial carcinoma. (20 marks)

1.6. State a reason for applying Cox proportional regression. (10 marks)

3. Write two (02) advantages and two (02) disadvantages of each of the following :

3.1. Cross-over trial (20 marks)

3.2. Cluster sampling (20 marks)

3.3. Correlation coefficient (20 marks)

3.4. Confidence interval (20marks)

3.5. Case control study (20 marks)

POSTGRADUATE INSTITUTE OF MEDICINE
UNIVERSITY OF COLOMBO

MD (CLINICAL ONCOLOGY) PART I EXAMINATION – AUGUST 2015

Date :- 25th August 2015 **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

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 45 year old female presents with a lump in her left breast.

   1.1. List five (05) possible causes giving examples. (25 marks)

   1.2. Briefly describe the value of five (05) pathological investigations available for the diagnosis and management of the above lesion (60 marks)

   1.3. Give five (05) important histopathological prognostic factors of invasive breast carcinoma. (15 marks)

2. Write short notes to include (a) clinical features (b) histology (c) immunohistochemistry and (d) prognostic factors on :

   2.1. Small cell carcinoma of lung. (25 marks)

   2.2. Synovial sarcoma. (25 marks)

   2.3. Nodular sclerosis type classical Hodgkins lymphoma. (25 marks)

   2.4. Warthin's tumour of salivary gland. (25 marks)

Contd..../2-

3. A 50 year old female presents with a recent rapid unilateral enlargement of a previously diffusely enlarged thyroid gland.

   3.1. Name four (04) possible neoplastic lesions you would consider. (20 marks)

   3.2. For two (02) of the above lesions, describe briefly the pathological features including (80 marks)

   (a) macroscopic appearance

   (b) microscopic appearance

   (c) immunohistochemistry

   (d) prognostic factors

POSTGRADUATE INSTITUTE OF MEDICINE
UNIVERSITY OF COLOMBO

MD (CLINICAL ONCOLOGY) PART I EXAMINATION – AUGUST 2015

Date :- 25th August 2015 **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

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 patient is receiving treatment for head and neck cancer. The prescription is for a dose of 66Gy in 33 fractions treating daily Monday to Friday. After 4 weeks (20 fractions) the patient develops influenza and does not attend for 4 days.

   1.1. What effect will this have on his radiotherapy? (10 marks)

   1.2. Give three mechanisms by which a delay may alter the efficacy of radiotherapy. (15 marks)

   1.3. Give two (02) ways in which this gap may be compensated. (10 marks)

Contd..../2-

1.4. Some months later, the department decides to change its fractionation schedule to deliver the entire treatment in 4 weeks (20 fractions).

(a) What is the biologically equivalent dose to 66 Gy in 33 fractions which would be given in 20 fractions to achieve the same tumour control? (25 marks)

(b) What is the biologically equivalent dose to 66 Gy in 33 fractions which would be given in 20 fractions to achieve the same dose to the spinal cord? (25 marks)

1.5.

(a) Name two (02) common tumours which have a low α/β ratio (10 marks)

(b) Which of the two options above in 1.4.(a) would be better for a tumour with a low α/β ratio? (05 marks)

2.

2.1. Give three biochemical products from the effects of a photon passing through a mammalian cell. (15 marks)

2.2. Name two (02) types of DNA damage (10 marks)

2.3. Define relative biological effect (RBE) (10 marks)

2.4. Give four (04) different radiation modalities used in clinical practice which have an RBE of 1.0 (20 marks)

2.5. Define LET (10 marks)

2.6. What is the unit of LET? (10 marks)

2.7. Draw a graph showing the relation between LET and RBE (25 marks)

Contd..../3-

3.

3.1. Draw a typical cell survival curve when a cell colony is irradiated with 250 kV x rays. (10 marks)

3.2. Identify on the diagram

(a) The α component

(b) The β component

(c) D_0

(d) Dq

(e) n

(f) the surviving fraction after 2 Gy (SF2) (30 marks)

3.3.

(a) What is repair in radiobiology ? (10 marks)

(b) List factors on which repair is dependent. (10 marks)

(c) What is the main feature which distinguishes regeneration from repair? (10 marks)

(d) Give the time scales of repair and regeneration. (10 marks)

3.4. An 8 Gy x-ray dose delivered at 1 Gy/h is less toxic than the same dose delivered at 1Gy/minute.

State if the following are true or false explanations for this. In a sentence or two give your reasons.

(a) Fewer free radicals are generated (05 marks)

(b) Cell division occurs during exposure (05 marks)

(c) Sublethal damage repair occurs during irradiation (05 marks)

(d) Free radical scavenging and chemical restitution is permitted (05 marks)

POSTGRADUATE INSTITUTE OF MEDICINE
UNIVERSITY OF COLOMBO

MD (CLINICAL ONCOLOGY) PART I EXAMINATION – AUGUST 2015

Date :- 25th August 2015 **Time :-** 11.00 a.m. – 11.45 a.m.

PAPER II

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

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 patient with breast cancer is going to be started on non hormonal targeted therapy

   1.1. Name two (02) drug targets on which drugs act in breast cancer therapy giving 1 example of a drug acting on each of the targets mentioned. (20 marks)

   1.2. Explain the indications and mechanisms of action of each of the drugs mentioned in 1.1 (40 marks)

   1.3. A new molecule is developed which acts on a newly identified target. Briefly explain the different pre clinical and clinical stages of testing the new molecule will have to go through prior to being used for treatment of breast cancer, indicating the aspects that would be studied in each stage of testing. (40 marks)

Contd.../2-

2.

2.1. Give four (04) factors which limit the efficacy of treating cancers with cytotoxic drugs. (20 marks)

2.2. Explain the mechanisms of action of the following drugs

2.2.1. 6-Mercaptopurine (10 marks)

2.2.2. Alkylating agents (10 marks)

2.2.3. Vincristine (10 marks)

2.3. Explain the indications and mechanisms of action of the following :

2.3.1. Use of anastrozole to treat breast cancer. (25 marks)

2.3.2. Use of colony stimulating factors in patients receiving chemotherapy. (25 marks)

3. Two new anti-cancer medicines with similar mode of actions have been introduced into the market recently. You find out that the recommended doses of both drugs are the same (50mg/kg). However, according to the product information leaflet one drug (Drug A) had to be given intravenously, whereas the other drug (Drug B) is recommended to be given orally. You also noted that the Drug A is recommended to be given three times a day whereas Drug B is recommended to be given once a day.

3.1. Explain the pharmacological basis for the difference observed in the route of administration between Drug A and Drug B. (20 marks)

3.2. What is the pharmacokinetic parameter that could have been responsible for the difference in the frequency of administration? (05 marks)

Contd..../3-

3.3. Give five (05) factors which affect the pharmacokinetic parameter you have given in 3.2. (25 marks)

You selected Drug B and prescribed the recommended dose to a patient. You observed the patient in the ward for one week. In the absence of any issues for concern, you discharged the patient only on Drug B instructing him to continue it for another 3 weeks. When the patient was reviewed in the clinic 3 weeks later, you find that he has developed severe neutropenia. You assumed that the neutropenia was an adverse drug reaction (ADR) to Drug B.

3.4. What is the most likely type of the above mentioned ADR? (10 marks)

3.5. Explain two (02) key characteristics of the type of ADR mentioned in 3.4 (20 marks)

When you inquired from the patient, he informed that he was prescribed some medicines by his family doctor for a sore throat five days before the clinic visit.

3.6. Give four (04) pharmacological reasons why the above incident could have contributed to the development of severe neutropenia in this patient (20 marks)

POSTGRADUATE INSTITUTE OF MEDICINE
UNIVERSITY OF COLOMBO

MD (CLINICAL ONCOLOGY) PART I EXAMINATION – AUGUST 2015

Date :- 25th August 2015 **Time :-** 12.00 noon – 12.45 p.m.

PAPER II

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

CANCER BIOLOGY

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. Name three (03) types of genetic defects which are described in the pathogenesis of acute myeloid leukaemia (AML) (15 marks)

1.2. Give two (02) examples for each type of genetic defect described in 1.1. What is the genetic test category/categories which is/are used to detect each type of defect? (25 marks)

1.3. List the cellular regulatory mechanisms which are altered in AML. (30 marks)

1.4. Name the genetic mutations which result in alteration of three (03) of the mechanisms mentioned in 1.3. (30 marks)

Contd...../2-

2.

2.1. Draw a diagram of the mammalian cell cycle on which you identify;

(a) the five phases of the cell cycle (25 marks)

(b) three cell cycle checkpoints (15 marks)

2.2. Draw a graph to show the change in volume with time of a malignant clone of cells arising from a single cell and forming a clinical tumour (10 marks)

2.3. What is this pattern of growth called? (05 marks)

2.4. When the tumour is first clinically detectable:

(a) What volume will the tumour have reached? (05 marks)

(b) How many volume doublings will it have undergone? (05 marks)

(c) How many cancer cells will it contain? (05 marks)

2.5. Define the following:

(a) Growth fraction (10 marks)

(b) Cell loss factor (10 marks)

(c) Potential tumour doubling time (10 marks)

3.

3.1. What are tumour antigens? (05 marks)

3.2. Briefly describe five (05) types of tumour antigens, giving examples. (40 marks)

3.3. Briefly describe the immune response against the above five (05) types of tumour antigens. (40 marks)

3.4. Give three (03) examples where tumour antigens have been utilized for therapeutic use. (15 marks)