POSTGRADUATE INSTITUTE OF MEDICINE
UNIVERSITY OF COLOMBO

MD (CLINICAL ONCOLOGY) PART I EXAMINATION
NOVEMBER 2016

Date :- 7th November 2016 **Time :-** 2.00 p.m. - 4.15 p.m.

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 (05) questions of the six (06) questions from 2 to 7.

1.

1.1. Define the term "Equivalent Dose" and list the two units used to measure this quantity. (20 marks)

1.2. In Sri Lanka, Thyroid cancer patients treated with Iodine-131 are kept about three days in isolation rooms. Explain why? (20 marks)

1.3. List three (03) biological and two (02) non biological wastes generated in related to Iodine therapy. (10 marks)

1.4. Give two (02) examples for stochastic effects. (10 marks)

1.5. What are the most sensitive weeks of human fetus to ionizing radiation when the exposure is about 200 mSv (10 marks)

1.6. List possible damages if fetus is exposed to above dose during the above period. (10 marks)

1.7 List four (04) most essential parameters to be provided by the hospital to design shielding of a radio iodine therapy room. (20 marks)

Contd..../2-

2.

2.1. What is meant by the unit of 1 Bq radioactivity and how is it related to Ci? (10 marks)

2.2. Write down the decay process of ^{60}Co radionuclide and mention the types of radiation emitted from it. (20 marks)

2.3. List three (03) physical properties that make the ^{60}Co radionuclide suitable for external beam radiotherapy. (15 marks)

2.4. Write down the types of radiation that are received by the patient and the operator (radiographer) during the patient set up and the treatment delivery from a ^{60}Co teletherapy machine. (15 marks)

2.5. Explain why the source replacement of a ^{60}Co teletherapy machine is required after one half life. (20 marks)

2.6. Briefly explain the procedure if the ^{60}Co source fails to return at the end of a radiotherapy exposure. (20 marks)

3.

3.1. Define the following terms with reference to ICRU report 50

3.1.1. CTV (Clinical Target Volume) (15 marks)

3.1.2. PTV (Planning Target Volume) (15 marks)

3.2. Discuss the advantages and disadvantages of treatment with a pair of parallel opposed fields (equally weighted coaxial beams) in radiotherapy? (15 marks)

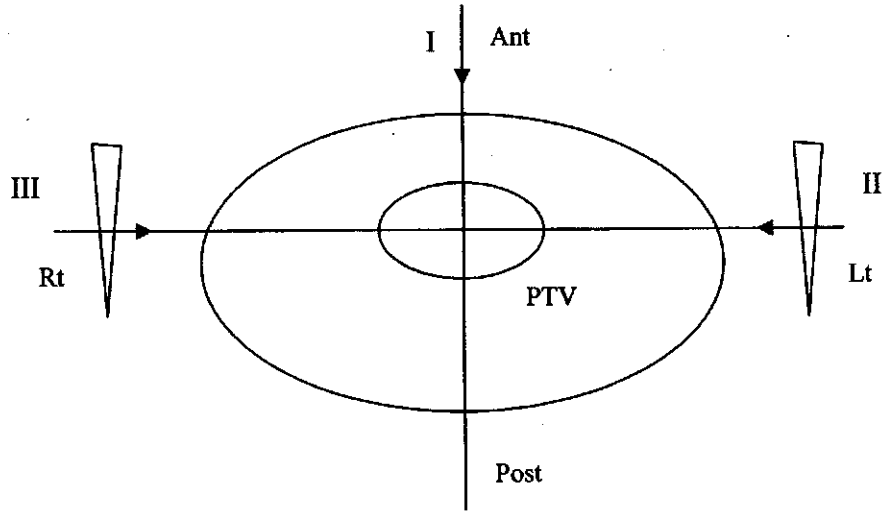
3.3. How does the dose distribution of a pair of parallel opposed megavoltage fields depend on patient thickness and beam energy? (20 marks)

3.4. Draw a diagram illustrating the photon energy spectrum of both ^{60}Co and a 6MV beam of a clinical linear accelerator. (20 marks)

3.5. List three (03) measures used to ensure reproducibility of patient positioning for external beam radiotherapy. (15 marks)

Contd...../3-

4. A patient with a carcinoma of bladder is to be treated with three field technique using a 10 MV 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 64 Gy in 32 fractions over 6½ weeks.
Machine calibration conditions:
Dose rate = 1 cGy/MU for 10 x 10 cm^2 field size, ionization chamber at 2.5 cm depth in water and source chamber distance 100 cm



Description	Beam I Ant Pelvis	Beam II Lt Pelvis	Beam III Rt Pelvis
Tissue depth to the tumour center (cm)	7.5	17.0	18.0
Gantry angle	0°	90°	270°
Treatment Field size (cm^2)	10 x 11	9W x 11	9W x 11
Tissue maximum ratio	0.902	0.680	0.659
Wedge Transmission factor (30°)	-	0.622	0.622
Collimator scatter factor	1.003	0.999	0.999
Phantom scatter factor	1.002	0.998	0.998

4.1. Find the dose rate in water at dmax for open beam and wedge beams.
(20 marks)

4.2. Assuming equal dose contribution to the tumour center from all beams, calculate the number of monitor units (MUs) required per field per fraction.
(30 marks)

Contd..../4-

4.3. Illustrate two (02) different field arrangements with appropriate wedges which may be suitable for the above treatment. (20 marks)

4.4. Describe the changes you expect if the above treatment plan was mistakenly delivered to the patient at 100 cm SSD (Source surface distance)? (20 marks)

4.5. Give two (02) methods to verify the target volume irradiation in this case. (10 marks)

5. The following radiation measuring devices are available.
(a) $0.1cm^3$ thimble chamber (b) 0.6 cm3 thimble chamber
(c) well ionization chamber (d) Geiger counter
It is planned to determine the absorbed dose to water for 6 MV photon beam of the Linear Accelerator machine.

5.1. Choose the most appropriate dosimeter for this purpose and sketch a labeled diagram of it. (20 marks)

5.2. What is the reason for your choice? (10 marks)

5.3. Briefly describe how the selected dosimeter measures ionizing radiation. (15 marks)

5.4 State the use of the other three dosimeters in the radiotherapy department (30 marks)

5.5 How often should this measurement be taken? (05 marks)

5.6. Give four (04) other regular checks that should be taken daily from a linear accelerator. (20 marks)

Contd..../5-

6.

6.1. Draw the diagram of the central axis depth dose curves in water, for 6 MeV and 12 MeV electron beams of field size 15 x 15 cm^2 at 100 cm SSD. (30 marks)

6.2 Using this diagram, identify and list the differences for each of the following clinically relevant parameters

6.2.1 Surface dose (10 marks)

6.2.2 Depth of dose maximum (dmax) (10 marks)

6.2.3 Therapeutic range (10 marks)

6.2.4 Practical range (Rp) (10 marks)

6.2.5 Dose deposited deeper than the practical range (10 marks)

6.3 Briefly explain the influences of percentage depth dose curve for 6 MeV, when the central axis of electron beam is incident on water at 30° angle from the perpendicular direction. (10 marks)

6.4 What is the cause for radiation dose deposition beyond the practical range? (10 marks)

7.

7.1 Write down the distribution rules for planar implants in the Manchester system regarding interstitial Brachytherapy. (30 marks)

7.2 How does this differ from the Paris rules? (10 marks)

7.3. List three (03) physical properties of ^{192}Ir source that makes it suitable for temporary implants in Brachytherapy (15 marks)

7.4. What is meant by mgRa equivalent? (10 marks)

7.5 A patient with a floor of the mouth tumour size 4.0 cm x 3.0 cm x 1 cm is to be treated using ^{192}Ir wires as interstitial Brachytherapy.

Illustrate the source distribution within the tumour volume according to Paris system. (15 marks)

7.6. What is meant by after loading in Brachytherapy ? (20 marks)

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MD (CLINICAL ONCOLOGY) PART I EXAMINATION
NOVEMBER 2016

Date :- 7th November 2016 **Time :-** 4.30 p.m. - 5.15 p.m.

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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 study was conducted to assess the impact of organizational characteristics and processes of care on hospital mortality in patients with cancer admitted to intensive care units (ICU). The following paragraph was reported.

   "The response rate was 68%. Median number of patients with cancer per ICU was 50 (interquartile range 18 to 74). After adjusting for relevant patient characteristics, perform emergency surgery (odds ratio (OR), 2.6; 95% confidence interval (CI), 2.01 to 3.4) conduct of training programmes in critical care the ICU (OR, 0.67: 95% CI, 0.49 TO 0.90), number of implemented clinical protocols (OR, 0.92; 95%CI, 0.87 to 0.98) and daily meetings between oncologists and intensivists for care planning (OR, 0.69; 95% CI, 0.52 to 0.91) were associated with lower mortality".

1.1. State the study design of the above study. (10 marks)

1.2. Define the study population. (10 marks)

1.3. What is the importance of knowing the response rate ? (10 marks)

1.4. State a reason to report median number of patients. (10 marks)

1.5. What is meant by 'interquartile range'? (10 marks)

1.6. What is meant by 'adjusting'? (10 marks)

1.7. What was the method applied for the 'adjusting' of the above study? (10 marks)

1.8. Interpret one of an odd ratios and its 95% confidence interval reported above. (30 marks)

Contd..../2-

2. A research team is planning to conduct a randomized, double-blind phase III trial to assess the efficacy of ipilimumab compared to placebo in patients with diagnosed extensive-stage disease small-cell lung cancer (SCLC) who received chemotherapy.

   Primary endpoint was number of survivors who were followed up for five months.

   2.1. Explain the meaning of the double blind in a trial. (20 marks)

   2.2. Explain the ethical issues in relation to use of placebo. (20 marks)

   2.3. List the information required to calculate the sample size for the above study. (30 marks)

   2.4. State a plan for data analysis for the above study. (30 marks)

3. Write notes on the following:

   3.1. Grades of Recommendation Assessment, Development and Evaluation (GRADE) (25 marks)

   3.2. Information bias (25 marks)

   3.3. External validity (25 marks)

   3.4. Censored data (25 marks)

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MD (CLINICAL ONCOLOGY) PART I EXAMINATION
NOVEMBER 2016

Date :- 8th November 2016 **Time :-** 9.00 a.m. - 9.45 a.m.

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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.

1.1. List the sub types in the current (2008) WHO classification of Hodgkin's lymphoma. (25 marks)

1.2. State three (03) sub types which have a better prognosis. (15 marks)

1.3. List three (03) clinical features of the condition. (15 marks)

1.4. Briefly describe the microscopic appearance of Hodgkin's lymphoma. (30 marks)

1.5. What are the three (03) main immunohistochemical markers used to diagnose Hodgkin's lymphoma? (15 marks)

2. Write short notes on :

2.1. Granulosa cell tumour of the ovary (25 marks)

2.2. Medullary carcinoma of the thyroid. (25 marks)

2.3. Ewing sarcoma (25 marks)

2.4. Nasopharyngeal carcinoma (25 marks)

Contd...../2-

3. A 60 year old female presents with dyspeptic symptoms for six months. An upper GI endoscopy reveals an ulcerative growth in the body of the stomach.

3.1. List five (05) possible neoplastic causes. (25 marks)

3.2. Show how immunohistochemical markers will differentiate each of these five causes for diagnosis. (40 marks)

3.3. Explain how immunohistochemical markers will inform management and prognosis giving examples from the above. (20 marks)

3.4. Name five (05) types of gastric polyps. (15 marks)

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NOVEMBER 2016

Date :- 8th November 2016 **Time :-** 10.00 a.m. - 10.45 a.m.

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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. Name the most lethal form of ionizing radiation- induced damage inflicted on a living cell, and list the three (03) possible important biologic endpoints manifested due to this damage. (20 marks)

1.2. Name the two (02) types of radiation induced lethal chromosomal aberrations and explain why these aberrations are a linear quadratic function of the dose. (15 marks)

1.3. Provide three (03) examples to illustrate that radiosensitivity of living tissue varies with maturation. (15 marks)

1.4. During the course of radiotherapy, a tumor containing 10^{12} cells receives 50 Gy. If the D_0 is 2.2 Gy, how many tumor cells will be left? (20 marks)

1.5. Briefly draw and compare the cell survival curves for alpha particles and for gamma rays. (30 marks)

Contd...../2-

2.

2.1.

2.1.1. Plot a cell survival curve for Chinese hamster cells, exposed *in vitro* to two fractions of x-rays and incubated at 37° C for various time intervals between the two doses. (20 marks)

2.1.2. Provide an explanation of this curve. (20 marks)

2.2.

2.2.1. Define the following :

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

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

(c) Relative Biologic Effectiveness (RBE) (10 marks)

2.2.2. Describe the relation between

(a) and (b) (10 marks)
(a) and (c) (10 marks)
(b) and (c) (10 marks)

3.

3.1. What are the consequences of the following, giving the biological basis of each:

3.1.1. Whole body radiation of 30 Gy. (20 marks)

3.1.2. Whole body radiation of 10 Gy. (20 marks)

3.1.3. Whole body radiation of 2 Gy. (20 marks)

3.2

3.2.1. What are radioprotectors? (10 marks)

3.2.2. Name a simple yet effective radioprotector. (05 marks)

3.3. Name four (04) types of common radiation induced malignancies in humans. (20 marks)

3.4. How does whole body radiation cause cancer? (05 marks)

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MD (CLINICAL ONCOLOGY) PART I EXAMINATION
NOVEMBER 2016

Date :- 8th November 2016 **Time :-** 11.00 a.m. - 11.45 a.m.

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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. Explain the Mechanisms of resistance of cancers to the following drugs.

   1.1. Methotrexate. (40 marks)

   1.2. Tamoxifen (30 marks)

   1.3. "Combination chemotherapy with conventional cytotoxic agents accomplishes several important objectives not possible with single-agent therapy." Explain the basis for the above statement. (30 marks)

2.

   2.1. Define the following pharmacokinetic parameters and outline briefly the clinical relevance of them in oncology practice.

      2.1.1. Plasma elimination half life (25 marks)

      2.1.2. Volume of distribution (25 marks)

   2.2. Outline briefly five (05) factors which predispose to clinically significant drug interactions in oncology practice. (25 marks)

   2.3. Explain the key five (5) criteria considered in the causality assessment of adverse drug reactions. (25 marks)

Contd...../2-

3.

3.1. Briefly explain the three (03) main types of chemotherapy induced nausea and vomiting. (30 marks)

3.2. For two of the types given in 3.1. describe the characteristics of the patients who are likely to develop them. (30 marks)

3.3. List four (04) drug classes used for chemotherapy induced nausea and vomiting giving an example of a drug from each class. (20 marks)

3.4. Briefly explain the mechanism of action of two drugs mentioned in 3.3 (20 marks)

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MD (CLINICAL ONCOLOGY) PART I EXAMINATION
NOVEMBER 2016

Date :- 8th November 2016 **Time :-** 12.00 noon - 12.45 p.m.

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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.

1.1.1. Why is P53 considered the "gate keeper" in tumourigenesis? (15 marks)

1.1.2. What regulatory mechanism controls P53 in normal cells? (10 marks)

1.1.3. What is the response of P53 to DNA damage ? (25 marks)

1.2

1.2.1. Describe how apoptosis differs from necrosis (15 marks)

1.2.2. What is the role of anti apoptotic Bcl2 proteins in normal cells ? (10 marks)

1.2.3. Where are they located in a normal cell ? (05 marks)

1.2.4. Describe how anti apoptotic Bcl2 proteins are inhibited. (10 marks)

1.2.5. How does Bcl2 inhibition activate apoptosis? (10 marks)

Contd...../2-

2.

2.1. Name the three (03) main categories of genes that mediate carcinogenesis. (30 marks)

2.2. Name the type of genetic mutations that lead to cancer. (20 marks)

2.3. Briefly outline why BRCA1/BRCA2 mutations predispose to cancer. (30 marks)

2.4. What is the rationale for using PARP inhibitors in the treatment of BRCA mutation positive cancer. (20 marks)

3.

3.1. Name two (02) components, each, of the innate and specific immune systems that act against tumours. (10 marks)

3.2. Briefly describe how these components act against tumours. Select one example each from the innate and specific immune systems. (20 marks)

3.3. Describe the three phases of immune editing of tumours. (30 marks)

3.4. Give four (04) cell types which are important when the immune system promotes tumourigenesis. Describe the role of each in tumourigenesis. (40 marks)