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POSTGRADUATE INSTITUTE OF MEDICINE
UNIVERSITY OF COLOMBO

MD (CLINICAL ONCOLOGY) PART I EXAMINATION – AUGUST 2017

Date :- 28th August 2017 **Time :-** 2.00 p.m. – 4.15 p.m.

PAPER I

If the examiner 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.

(a) Define the term "Radiation Absorbed Dose". (10 marks)

(b) Define the unit "Gray". (05 marks)

(c) Explain why biological damage to the body from all ionizing radiation cannot be expressed in this unit. (15 marks)

(d) Name two (02) suitable units to measure radiobiological damage to body. (10 marks)

1.2.

(a) Briefly explain what is meant by external radiation hazards. (15 marks)

(b) List three (03) measures that can be found in radiotherapy bunkers for restriction of public exposure in radiotherapy. (15 marks)

(c) List two (02) instances where inverse square law is used to reduce dose to staff in radiotherapy or radionuclide therapy. (10 marks)

1.3. Exposure to ionizing radiation causes both Stochastic and Deterministic effects.

(a) Give two (02) examples for each effect. (10 marks)

(b) What is the threshold dose recommended for the human fetus? (10 marks)

Contd...../2-

2.

2.1. List four (04) specific properties of X rays distinct from non-ionizing EM radiations. (20 marks)

2.2. Explain why the image quality of an x ray (conventional) simulator is better than a radiotherapy portal film. (20 marks)

2.3.

(a) Define LET and state the units. (10 marks)

(b) What is meant by high LET and low LET radiations? (20 marks)

(c) Give two (02) examples of each type. (10 marks)

2.4. Define Half Value Layer. (10 marks)

2.5. Why is the 2nd HVL thickness larger than the 1st HVL thickness when an X ray beam passes through a medium (10 marks)

3.

3.1. The following terms are related to ICRU (International Commission on Radiological Units and Measurements) report No: 50 and 62.

(a) Define Gross Tumour Volume (GTV) (15 marks)

(b) Define Clinical Target Volume (CTV) (15 marks)

(c) Give four (04) examples and reasons why a margin is defined between CTV and ITV (Internal Target Volume). (20 marks)

(d) Give four (04) examples and reasons why a margin is defined between ITV and PTV (Planning Target Volume) (20 marks)

3.2. Draw an example of a cumulative Dose Volume Histogram (DVH). (15 marks)

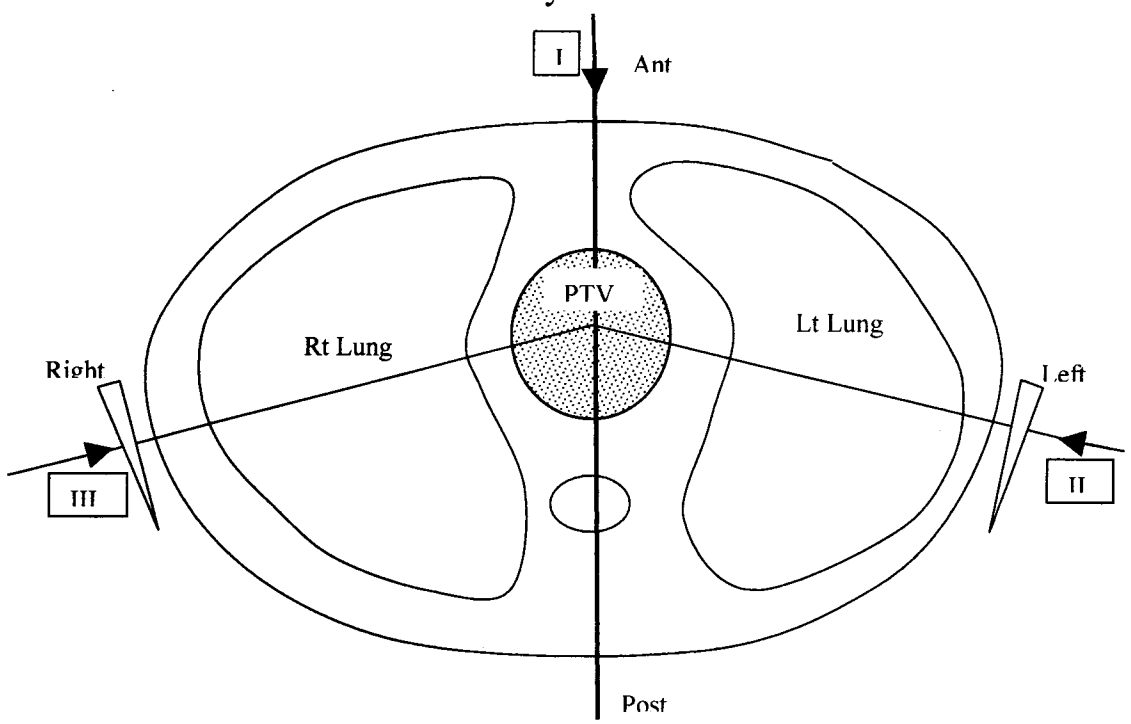
3.3. Give three (03) uses of DVH in radiotherapy treatment planning. (15 marks)

Contd...../3-

4. It is planned to treat an oesophageal cancer patient using a three field technique from a Linear accelerator machine with 10 MV photon beam at 100 cm SSD as shown in the figure below. The prescribed dose to the center of PTV is 54 Gy in 27 fractions over 5½ weeks.

   Machine Calibration conditions:

   Source to Surface Distance (SSD) = 100 cm
   Reference depth of calibration = 2.5 cm in water (d_{max})
   Field size = 10 x 10 cm^2
   Calibration dose rate = 1 cGy / MU



Description	I Ant	II Lt oblique	III Rt oblique
Treatment field size (cm^2)	8 x14	6 x 14	6 x 14
Gantry angle	0°	105°	255°
Percentage depth dose (PDD) (*without lung correction)	80.2 %	70.2 %	70.4 %
Skin to PTV center depth (cm)	8	14	15
Average lung depth for relevant beams(cm)	0	5	6.5
Wedge Transmission Factor (15°)	1.000	0.840	0.840
Collimator scatter factor	1.001	0.982	0.982
Phantom scatter factor	1.002	0.990	0.990

Contd...../4-

4.1.

(a) Assuming 2D planning and equal weighting from all three beams, calculate the applied dose per field per fraction after inhomogeneity correction. (30 marks)

(b) Calculate the number of monitor units required for each beam. (15 marks)

4.2. Calculate the equivalent square field sizes for 8 x 14 cm^2 and 6 x 14 cm^2 rectangular fields. (10 marks)

4.3. Estimate the maximum skin dose from this treatment. (10 marks)

4.4. Give three (03) reasons why the above beam arrangement with three fields is more suitable for this treatment than parallel opposed beams. (15 marks)

4.5. List two (02) serial and two (02) parallel organs related to the above treatment volume. (20 marks)

5.

5.1. Briefly explain the role of the following components in a clinical linear accelerator machine.

(a) Klystron tube (10 marks)

(b) Bending magnet (10 marks)

(c) Flattening filter (10 marks)

(d) Monitor ionization chamber (10 marks)

5.2. What is the main difference between a Magnetron and a Klystron? (10 marks)

5.3. What happens if the primary ionization chamber fails during treatment? (10 marks)

5.4. List four (04) quality control parameters of a linear accelerator on daily basis and give their tolerances. (20 marks)

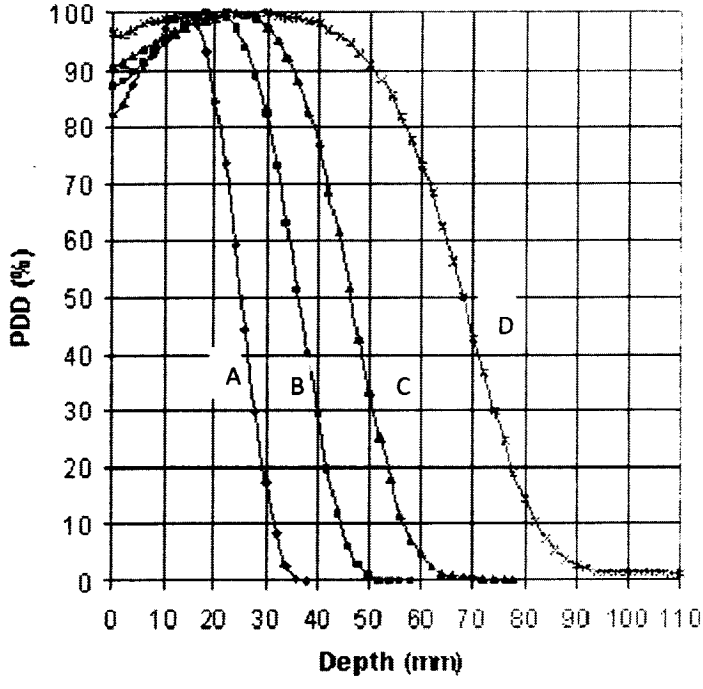
5.5. Draw the depth dose curve for a 6 MV photon beam for 10 x 10 cm^2 field size indicating the surface dose, depth of dose maximum and 10 cm percentage depth dose. (20 marks)

Contd...../5-

6.

6.1. Write the three ways in which high energy electrons interact with matter. (15 marks)

6.2. The following diagram shows the central axis depth dose curves in water, for several electron beams of field size 10 x 10 cm^2 at 100 cm SSD. Using this diagram identify the typical electron energy of each beam and justify your answer. (40 marks)



6.3. Use a diagram to illustrate the 90%, 50% and 10% typical isodose curves in the principal plane in water for 10 x 10 cm^2 field for a 16 MeV electron beam at 100 cm SSD. (20 marks)

6.4. Draw a diagram to show the isodose variation of the above beam in 6.3 if it passes through 1x1x1 cm^3 bone equivalent material placed in water on the central axis close to the surface. (20 marks)

6.5. What is the approximate energy of a 16 MeV electron beam at a depth of 5 cm in water? (05 marks)

Contd...../6-

7.

7.1. What are the three (03) different dose rates used in brachytherapy? (15 marks)

7.2. Write down the single plane implant rules of Paris system for interstitial brachytherapy? (20 marks)

7.3. Briefly explain how the average basal dose is determined for three parallel lines in a single plane interstitial brachytherapy. (15 marks)

7.4. List four (04) physical characteristics of the ^{192} Ir radioactive source. (20 marks)

7.5. What is pulsed dose rate brachytherapy (15 marks)

7.6. List three (03) disadvantages of pulsed dose rate brachytherapy when compared to high dose rate brachytherapy (15 marks)

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MD (CLINICAL ONCOLOGY) PART I EXAMINATION – AUGUST 2017

Date :- 28th August 2017 **Time :-** 4.30 p.m. – 5.15 p.m.

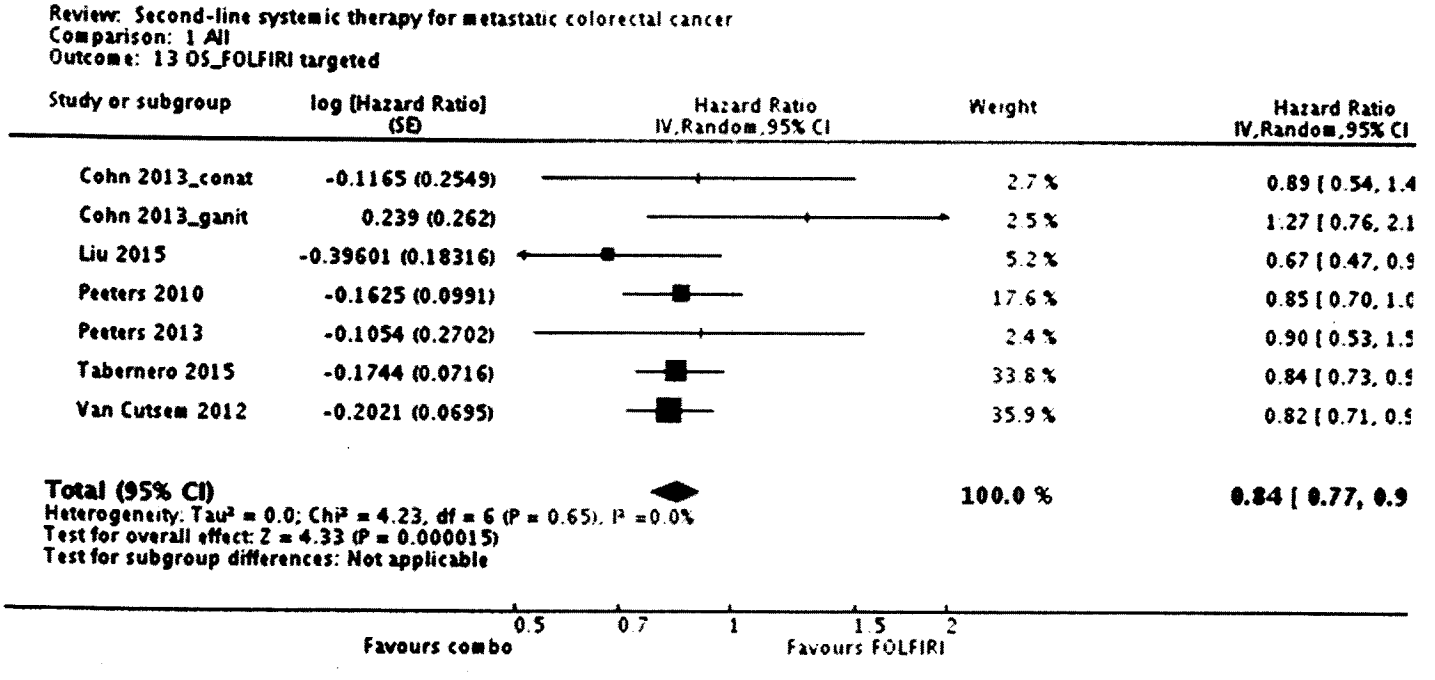
PAPER I

If the examiner 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 systematic review was conducted to determine the efficacy of second-line systemic therapy in people with metastatic colorectal cancer (CRC) that progressed, recurred or did not respond to first-line systemic therapy for overall survival (OS). All the studies which were included demonstrated 'low risk of bias'.
   The following forest plot shows the comparison between the targeted agents (second-line systematic therapy) compared to conventional chemotherapy for OS.



Contd...../2-

1.1. Define hazard ratio. (10 marks)

1.2. List four (04) criteria for assessing risk of bias in randomised control trials. (20 marks)

1.3. Briefly explain how you would conclude that one of the above criteria is 'low risk of bias'. (20 marks)

1.4. State a reason for giving different weights to primary studies. (10 marks)

1.5. Interpret the overall effects of the results of the forest plot. (20 marks)

1.6. What is publication bias? (20 marks)

2. Investigators are interested to design a study to assess the validity of HPV/DNA testing for Cervical Cancer Screening. As one of the investigators of the above study, how would you design a protocol considering the following components?

2.1. Study design (10 marks)

2.2. Selection of the study population (15 marks)

2.3. Data collection (15 marks)

2.4. Sample size (10 marks)

2.5. Statistical data analysis (30 marks)

2.6. Ethical issues (20 marks)

3. Compare and contrast the following:

3.1. Cumulative incidence and Incidence density (25 marks)

3.2. Multiple Linear Regression and Multiple Logistic Regression (25 marks)

3.3. Case control and Cohort studies (25 marks)

3.4. Cross-over designs and Parallel group designs (25 marks)

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MD (CLINICAL ONCOLOGY) PART I EXAMINATION – AUGUST 2017

Date:- 29th August 2017 **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.
Question two (02) questions of the three (03) questions given below

1. A 69 year old male patient with past history of colonic carcinoma was found to have a solitary liver lesion in the CT scan. The radiologist suggested the possibility of a metastasis.

1.1. State four (04) differential diagnoses other than metastatic carcinoma for the above lesion. (20 marks)

1.2. How does immunohistochemistry help you in the differential diagnosis? Illustrate your answer with at least six (06) immunohistochemical markers including markers for metastatic carcinoma. (60 marks)

1.3. State four (04) aetiological factors which contribute to the development of hepatocellular carcinoma. (20 marks)

2. Write short notes to include clinical presentation, histological features, immunohistochemistry and prognostic factors on:

(a) Embryonal Rhabdomyosarcoma (25 marks)

(b) Follicular lymphoma (25 marks)

(c) Glioblastoma multiforme (25 marks)

(d) Seminoma of the testis (25 marks)

Contd...../2-

3.

3.1. List five (05) primary malignant tumours arising in the breast. (25 marks)

3.2. Describe briefly the value of histology (05 examples) and immunohistochemistry (05 examples) in the diagnosis and management of malignant breast lesions. (50 marks)

3.3.

(a) What is the basis of the molecular classification of invasive breast carcinoma? (05 marks)

(b) Describe the major categories of this molecular classification. (20 marks)

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MD (CLINICAL ONCOLOGY) PART I EXAMINATION – AUGUST 2017

Date:- 29th August 2017 **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.
Question two (02) questions of the three (03) questions given below

1.

1.1. Name the three (03) major types of DNA damage caused by bond breaks that arise from ionizing radiation. (15 marks)

1.2.

(a) Differentiate between direct and indirect actions of ionizing radiation on DNA. (15 marks)

(b) Write the basis of the two DNA double strand break repair mechanisms available in cells. (10 marks)

1.3.

(a) Name five (05) different biological factors that influence probability of local tumour control after fractionated radiotherapy. (15 marks)

(b) Illustrate three of the factors listed under 1.3.1, using an appropriate cell survival curve. (30 marks)

1.4. Describe the variation of radiosensitivity of a cell in different phases of the mamalian cell cycle. (15 marks)

Contd...../2-

2.

2.1. In the Linear Quadratic model, $S = e^{-\alpha D - \beta D^2}$, where S is the fraction of cells surviving a dose D.

2.1.1. What do the constants α and β denote? (10 marks)

2.1.2. What does the α/β ratio describe? (10 marks)

2.1.3. What is the α/β ratio for acute skin reactions? (03 marks)

2.1.4. Provide two (02) examples each of
(a) high α/β ratio cancers. (06 marks)
(b) low α/β ratio cancers. (06 marks)

2.1.5. Define and give the specific therapeutic advantages of:
(a) hypofractionation (20 marks)
(b) hyperfractionation (20 marks)

2.2. A tumour consists of 10^9 clonogenic cells. The effective dose-response curve given in daily dose fractions of 2 Gy has no shoulder and a D_0 of 2.5 Gy. If the clonogenic cells underwent three cell doublings during treatment, calculate the total dose required to give a 90% chance of tumour cure? (25 marks)

3.

3.1.

3.1.1. Define the following:

(a) Oxygen Enhancement Ratio (OER) (10 marks)

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

3.1.2. Compare with diagrams the OER for x-rays, α particles and for fast neutrons. (20 marks)

3.1.3. Graphically present the variation of OER and RBE as a function of Linear Energy Transfer. (20 marks)

3.2.

(a) Describe the two (02) mechanisms of tumour hypoxia. (20 marks)

(b) Describe two (02) ways by which hypoxia may be overcome in radiotherapy. (20 marks)

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POSTGRADUATE INSTITUTE OF MEDICINE
UNIVERSITY OF COLOMBO

MD (CLINICAL ONCOLOGY) PART I EXAMINATION – AUGUST 2017

Date:- 29th August 2017 **Time**:- 11.00 a.m. -11.45 a.m.

PAPER II

If the examiner 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.
Question two (02) questions of the three (03) questions given below

1. Morphine is the opioid of choice for oral treatment of severe pain in palliative care.

1.1. Explain how the body handles oral morphine. (15 marks)

1.2. Explain how the initial dose titration of morphine is done and how maintenance is achieved. (40 marks)

1.3. Explain why dose changes are needed in renal impairment and state what adjustments are done for renal impairment. (15 marks)

1.4. Explain the significance of pharmacogenetics in use of opioids as analgesics. (15 marks)

1.5. Write on opioid-induced hyperalgesia. (15 marks)

2.

2.1. In the treatment of prostate cancer explain the mechanism of action of:

(a) Docetaxel (15 marks)
(b) Goserelin (15 marks)
(c) Bicalutamide (15 marks)
(d) Abiraterone Acetate (15marks)

2.2. In the treatment of breast cancer explain the pharmacological basis for the use of:

(a) Trastuzumab (20 marks)
(b) Anastrazole (20 marks)

Contd…/2-

3.

3.1. Define the term bioavailability. (05 marks)
Explain two (02) factors which influence the systemic bioavailability of an oral anticancer drug. (15 marks)

3.2. Name the steps of the pharmacokinetic process. (10 marks)
For each step describe a drug interaction in cancer therapy giving an example. (40 marks)

3.3. Define the term plasma elimination half-life. (10 marks)
Describe four (04) factors which influence the plasma elimination half-life of anticancer drugs. (20 marks)

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MD (CLINICAL ONCOLOGY) PART I EXAMINATION – AUGUST 2017

Date:- 29 August 2017 **Time**:- 12.00 noon -12.45 p.m.

PAPER II

If the examiner 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.
Question two (02) questions of the three (03) questions given below

1.

1.1.
(a) List two (02) factors which activate intrinsic pathway of apoptosis. (10 marks)

(b) Briefly outline the role of Cytochrome c in the intrinsic pathway of apoptosis. (20 marks)

(c) Evasion of apoptosis is a hallmark feature of cancer cells. State two (02) mechanisms by which cancer cells evade apoptosis. (10 marks)

1.2. Autophagy can sometimes facilitate cancer survival. Explain (30 marks)

1.3. Reprogramming of energy metabolism is considered as an emerging hallmark of cancer.

(a) How does the cancer cell reprogramme its energy metabolism? (10 marks)

(b) How is this feature used as a clinical application? (20 marks)

Contd...../2-

2.

2.1. How does an epigenetic change differs from a genetic change? (10 marks)

2.2. Name one (01) test each that can be used to identify

(a) a point mutation

(b) alteration in gene expression (10 marks)

2.3. Name the genes which are commonly mutated in the following cancer syndromes, indicate the mode of inheritance and the cellular function that is disrupted by the mutation. (30 marks)

(a) Lynch syndrome (hereditary non polyposis colorectal cancer)

(b) Familial adenomatous polyposis

2.4. Describe the phenotype-genotype correlation seen in familial adenomatous polyposis. (20 marks)

2.5.

(a) Name the down stream effectors of epidermal growth factor receptor (EGFR) signaling pathways which when mutated lead to resistance to anti cancer drugs. (20 marks)

(b) What are the mechanisms by which secondary mutations arise in EGFR following treatment with first generation tyrosine kinase inhibitors. (10 marks)

3.

3.1. Define tumour immunotherapy. (10 marks)

3.2. Describe one (01) advantage of immunotherapy compared to conventional therapy. (10 marks)

3.3. List seven (07) strategies used in tumour immunotherapy (including experimental). (35 marks)

3.4. Select three (03) of the above strategies and describe three (03) features for each of them. (45 marks)