POSTGRADUATE INSTITUTE OF MEDICINE
UNIVERSITY OF COLOMBO

MD (RADIOTHERAPY & ONCOLOGY) PART I EXAMINATION
JANUARY 1990

Date: 29th January 1990 Time: 2.00 p.m. - 4.30 p.m.

PAPER I

Answer Part A & B in separate books
If the examiners cannot read your writing they will be unable to give you full credit for your knowledge.

PART A
PHYSICS

(Two of the following three questions to be answered.)

1. A bladder tumor is to be treated using fixed SSD technique, with one anterior and two posterior oblique fields on a cobalt-60 Unit. (See the annexed diagram) The doses to the points marked A, B, C, D, and O (tumor center) from each field for an applied dose of 100 rads are given below.

			A	B	C	D	O
Anterior field		90	65	58	65	70	
RT posterior oblique	40	38	52	58	45		
LT posterior oblique	40	55	48	38	45		

   a) Calculate applied dose from each field if the total central tumor dose is 4800 rads.

   b) Estimate the skin dose from each field.

   c) Is this dose distribution acceptable?

   d) How would you improve the uniformity of the dose distribution.

   e) How might the dose distribution in the above example be corrected to allow for the effects of oblique incidence.

POSTGRADUATE INSTITUTE OF MEDICINE
UNIVERSITY OF COLOMBO

MD (RADIOTHERAPY & ONCOLOGY) PART I EXAMINATION
JANUARY, 1990

Date: 30th January1990 Time: 9.00 a.m. - 11.30 a.m.

PAPER II

Answer Part A, B and C in separate books.
If the examiners cannot read your writing they will be unable to give you full credit for your knowledge.

PART A
PATHOLOGY OF NEOPLASTIC DISORDERS

(One of the following two questions to be answered.)

1. What malignant tumors commonly occur in the uterus? Describe the clinico pathological features of carcinoma of the body of the uterus

2. Write short notes on the pathology of the following :

   a) Adenocarcinoma of the lung
   b) Carcinoid tumors
   c) Pleomorphic adenoma of the parotid gland
   d) Chemodectomas

PART B
RADIOBIOLOGY AND PRINCIPLES OF CHEMOTHERAPY

(One of the following two questions to be answered.)

1. Describe how the understanding of radiobiology has influenced the practice of radiotherapy.

2. Discuss the reasons why some tumors develop resistance to chemotherapy.

PART C
PATHOLOGY OF NEOPLASTIC DISEASE (APPLIED)

(One of the following two questions to be answered.)

1. A male in his mid forties presents with a palpable midline intraabdominal mass above the level of the umbilicus. What malignant neoplastic conditions would you consider in the differential diagnosis?
   Describe how you would proceed to arrive at a firm diagnose of this lesion.

2. Discuss the optimum physical qualities required in a sealed radioactive isotope source to be used for brachytherapy. Illustrate your answer by reference to radium, cesium, cobalt, iridium and iodine.

3. Define the terms stochastic and non-stochastic effects. Explain with examples of each effect caused by ionizing radiation.
   Describe the procedures that should be adopted to minimize these effects to staff and public when using sealed and unsealed radiation sources for therapy.

POSTGRADUATE INSTITUTE OF MEDICINE
UNIVERSITY OF COLOMBO

MD (RADIOTHERAPY & ONCOLOGY) PART I EXAMINATION
JANUARY, 1991

Date: 28th January 1991 Time: 2.00 p.m.- 4.30 p.m.

PAPER I

Two separate answer books are provided. One for each section of the paper. If the examiners cannot read your writing they will be unable to give you full credit for your knowledge.

PART A
PHYSICS

(Two of the following three questions to be answered.)

1. A tumor of the larynx is to be treated on cobalt - 60 unit with two lateral oblique wedged fields. The doses to the points marked A, B, C, D, 0 & S from each field for a given dose of 100 Gy are given below (See the annexed diagram)

Point	A	B	C	D	O	S
Dose (Field I)	82	70	85	95	85	50
Dose (Field II)	80	95	85	70	85	40

(a) If a tumor dose of 68 Gy is to be delivered to point O
Calculate I given total dose from each field
II total dose to spinal cord

(b) Estimate the skin dose at each entry port assuming the fields do not overlap on the surface.

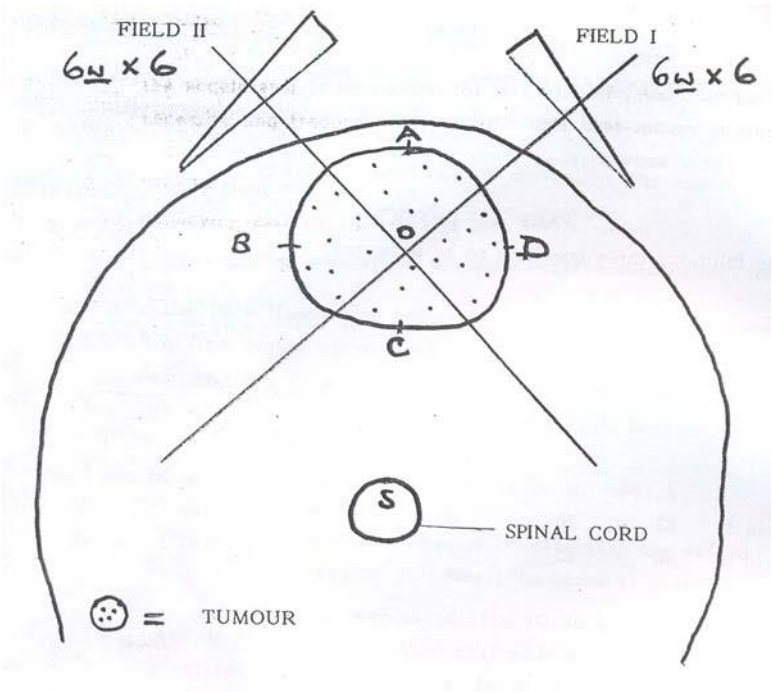
(c) Is this dose distribution acceptable?
If the dose distribution is desired to be more uniform how would you achieve it?

(d) What is the effect on dose to point A, O and C if the treatment is carried out erroneously (I) with each wedge turned through 180' (II) with no wedges ?

PHYSICS

QUESTION 1

DIAGRAM



2. It is proposed to install a linear accelerator in a Radiotherapy Department equipped only with cobalt-60 units. What should be the optimum energy of this unit? Give your reasons.
What are the quality assuarance checks that should be carried out before the accelerator is introduced for clinical use? Also comment on the necessity and frequency of routine checks after commissioning of the unit.

3. Why is personnel monitoring necessary in a Radiotherapy Department employing external beam and sealed source therapy.
Discuss how different personnel monitoring methods meet these requirements.

PART B
MEDICAL STATISTICS

(One of the following two questions to be answered.)

1. A group of 60 patients were treated with drug A, and another group of 80 patients were given drug B. After two weeks 12 patients of group A and 20 patients of group B were free of the disease. Doctor in charge of study was convinced that drug B was superior.

   (a) What statistical tests could be employed to determine the level of significance ?

   (b) What method would you prefer and reasons for using the method?

   (c) Describe the computation of the method.

2. Write short notes on five of the following:-

   (a) Properties of a Normal Curve

   (b) Simple random sample.

   (c) Reasons for using samples.

   (d) Standard error of the mean.

   (e) “qx " column of a life table

   (f) Averages.

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MD (RADIOTHERAPY & ONCOLOGY) PART I EXAMINATION
JANUARY, 1991

Date: 30th January1991 Time: 9.00 a.m. - 11.30 a.m.

PAPER II

Answer Part A, B and C in separate books.
If the examiners cannot read your writing they will be unable to give you full credit for your knowledge.

PART A
PATHOLOGY OF NEOPLASTIC DISORDERS

(One of the following questions to be answered.)

1. Write notes on the pathology of:

   (a) Juvenile melanoma
   (b) Choriocarcinoma
   (c) Adenoid cystic carcinoma of salivary gland.
   (d) Chordoma

2. What neoplasms are known to arise in bone?
   Give an account of the clinicopathological features of any two malignant tumors you mention.

PART B
RADIOBIOLOGY & PRINCIPLES OF CHEMOTHERAPY

(One of the following two questions to be answered.)

1. Describe the pathological and clinical consequences, which may arise from irradiation of the spinal cord.

2. Describe the different uses of cytotoxic drugs. Discuss the contraindications for chemotherapy.

PART C
PATHOLOGY OF NEOPLASTIC DISEASE (APPLIED)

(One of the following two questions to be answered)

1. List the neoplasms that arise in the kidney? Give a short account of the renal tumors of childhood.

2. Give a classification of the malignant tumors of the lung and major bronchi. Give an account of the clinicopathological features of small cell carcinoma of the lung.

POSTGRADUATE INSTITUTE OF MEDICINE
UNIVERSITY OF COLOMBO

MD (RDIOTHERAPY & ONCOLOGY) PART I EXAMINATION
JANUARY, 1992

Date: 27th January 1992 Time: 2.00 p.m.- 4.30 p.m.

PAPER I

Two separate answer books are provided. One for each section of the paper.
If the examiners cannot read your writing they will be unable to give you full credit for your knowledge.

PART A
PHYSICS

(Two of the following three questions to be answered.)

1. The diagram (see the separate sheet) shows a computed isodose display for a proposed treatment of oesophagus using a cobalt-60 unit.

   (a) Is this dose distribution acceptable? Could you improve it ?

   (b) What is the given dose from each field if a dose of 1 Gy delivered to the central point from each field ? (Assume percentage depth dose at central point relative to dose at builds up depth in a water phantom for anterior field as 50 and for each oblique field as 40)

   (c) What is the treatment time for each field if the dose rates at the build up depth are 1.5 Gy/mt and 1.25 Gy/mt respectively for anterior and for each oblique field? (Assume a wedge filter of transmission factor 0.8 is used for each oblique field.)

   (d) Estimate the change in absorbed dose to the central point due to the oblique fields traversing 10 cm of lung tissue.

2. Discuss how dosimetric characteristics influence the clinical decision in the choice of the suitable radiotherapy modality to treat carcinoma of the cheek. Your answer should refer to the use of 6 MV X-rays, 100 KV X-rays, high-energy electrons, and an iridium implant.

3. Discuss the radiation protection problems and the methods of controlling such problems that arise with the use of radionuclides in brachytherapy. You should refer to gold, iodine, iridium, and radium.

PART B
MEDICAL STATISTICS

(One of the following two questions to be answered.)

1. The effectiveness of two painkiller drugs A and B were studied on 30 patients. Drugs were allocated randomly. Each patient was given one drug for one week and other drug the following week. Results were: -

Improvement Records

	None	Slight	Good	Very good	Total
Drug A	8	6	12	4	30
Drug B	12	8	6	4	30

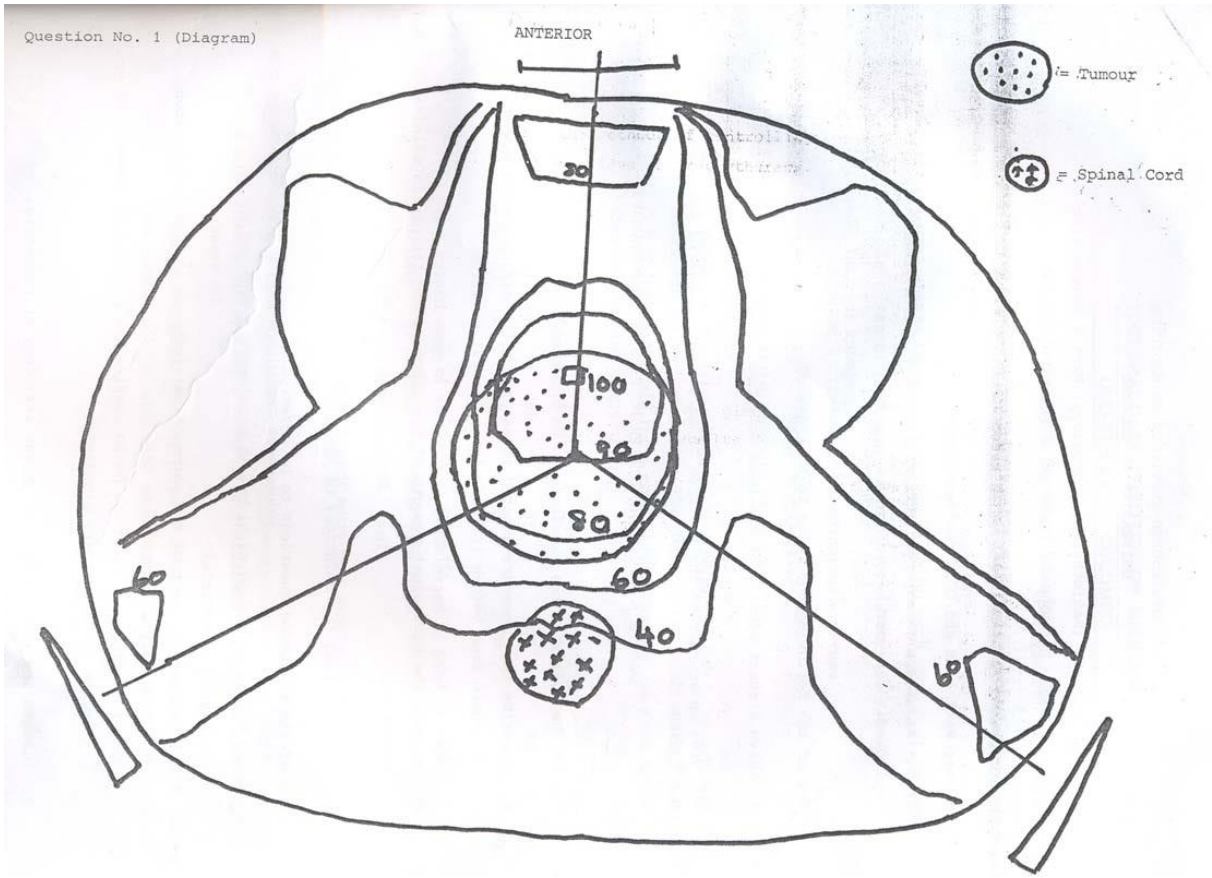
(a) State the null hypothesis
(b) Is one painkiller significantly better than the other?
(c) Interpret the results.
(d) Number of degrees of freedom used in above situation.

Chi-square Table	Level of Significant	Degree of freedom 1	2	3	4
	0.05	3.84	5.99	7.91	9.49
	0.01	6.63	9.21	11.34	13.28

3. Write short notes on five of the following ;

(a) Mean and median.
(b) Standard deviation and standard error of the mean.
(c) Coefficient of Variation and coefficient of Correlation.
(d) Point estimate and interval estimate.
(e) Parameter and statistic.
(f) Crude deaths rate and age specific death rate.

QUESTION NO. 1 (DIAGRAM)



POSTGRADUATE INSTITUTE OF MEDICINE
UNIVERSITY OF COLOMBO

MD (RADIOTHERAPY & ONCOLOGY) PART I EXAMINATION
JANUARY, 1992

Date: 28th January 1992 Time: 9.00 a.m. 11.30 a.m.

PAPER II

Answer Part A, B and C in separate books.
If the examiners cannot read your writing they will be unable to give you full credit for your knowledge.

PART A
PATHOLOGY OF NEOPLASTIC DISORDERS

(One of the following questions to be answered.)

1. Give a short account of the germ cell tumors of the ovary.

2. Give an account of the features of malignant tumors of skeletal muscle.

PART B
RADIOBIOLOGY & PRINCIPLES OF CHEMOTHERAPY

(One of the following two questions to be answered.)

1. Describe the procedure adopted to establish the efficacy of a new cytotoxic drug before it comes into clinical practice.

2. Discuss the biological aspects of Hypothermia and its rise in clinical practice.

PART C
PATHOLOGY OF NEOPLASTIC DISEASE (CLINICAL)

(One of the following questions to be answered.)

1. What neoplastic conditions will cause a patient to present with a history of Haematuria ?

   Give a short account of the pathological features of malignant lesions of the urinary bladder.

   What investigations would you do to confirm the nature and presence of a neoplasm of the urinary bladder?

2. Discuss the role of viruses in the aetiology of neoplasia.

POSTGRADUATE INSTITUTE OF MEDICINE
UNIVERSITY OF COLOMBO

MD IN RADIOTHERAPY & ONCOLOGY PART I EXAMINATION
JUNE 1999

Date: 7th June 1999 Time: 9.00 a.m. - 12 noon

PAPER I

Answer Part A & B in separate books
If the examiners cannot read your writing they will be unable to give you full credit for your knowledge.

PART A
PHYSICS

(Two of the following three questions to be answered.)

1. A patient with AP thickness of 16 cm is to be treated on a linear accelerator using a 30-cm x 30-cm parallel opposed beams at 100 cm SSD
Following beam data applies:
Out put at Dmax for 10 cm x 10 cm at 100 cm SSD IcGy/MU
Collimator scatter factor for 30 cm x 30 cm 1.02
Phantom scatter factor for 30 cm x 30 cm 1.01
Maximum field obtainable at 100 cm SSD 30 cm x 30 cm

Depth (cm)	2	4	6	8	10	12	15	16
Dose (30cmx3O cm) at 100 cm SSD	100	93	87	80	75	70	65	65

(a) Calculate
I Applied dose per fraction from each field assuming a total central dose of 40 Gy has to be given in 20 daily fractions, treating both fields at each fraction.

II treatment time in monitor units (MU) per field for each fraction..

III minimum SSD for this treatment if the mid-plane field size of 45 cm x 45 cm if required.

IV field size on the surface of the patient for the SSD in III.

(b) Comment on the effect on out put and depth doses for variations in SSD.

(c) How can, the accurate position of the shielding blocks be verified, if shielding is required for this treatment.

(d) Briefly explain the IAEA procedure for out put calibration of a linear accelerator.

2.

(a) Indicate with aid of diagrams main differences between a head of a linear accelerator and head of a Co-60 unit.

(b) What are limits of leakage radiation for Co-60 and for a linear accelerator.

(c) Sketch accurately scaled iso dose distributions for 10 cm x 10 cm for I Co-60 II 10 MV Photons III 10 MeV electrons.

(d) Indicate the penumbra regions for above dose distributions.

(e) What beams in (c) are suitable for treatment of carcinoma of (I) oesophagus (II) larynx (III) lower lip. Give reasons.

(f) What are the beam alignment and positioning checks that should be carried out? State the tolerance limits.

(g) Explain how beam alignment and positioning errors affect accurate dose delivery.

(3) It is desired to treat a lesion measuring 6 cm x 4 cm x 3 cm with an iridium wire implant according to Paris system, using the manual technique.

(a) Indicate how wires should be arranged.
(b) Specify the reference iso dose for this geometry.
(c) What is the total treatment time from HDR technique with a 10 Ci Iridium source, assuming 100 mCi of iridium wire were used and total treatment time were 7 days for the manual technique.
(d) Compare the merits of the UDR technique with the manual technique for this treatment.
(e) What QA checks should be carried out on the HDR system to ensure accurate dose delivery and safety of patients.
(f) Compare the suitability of Ir-192 and Co-60 for HDR technique.

PART B
MEDICAL STATISTICS

(One of the following two questions to be answered.)

1. Suppose we perform a clinical trial to assess the effect of a new treatment for cancer of the oesophagus. Of 100 patients who were given the standard treatment, 12 lived for a 3-year period and 11 lived for a 5-year period. Of 47 patients who were given the new treatment, 12 survived for a 3-year period and only 2 survived for a 5-year period.

    a) Is there any statistical evidence that the new treatment is helpful for the 3-year prognosis of the patient ?

    b) Suppose a patient has survived for 3 years. Is there any statistical evidence for a treatment effect on the prognosis for the next 2 years?

    (The answer should be substantiated by appropriate statistical tests and methodology)

2. Write short notes on any five of the following :

    (a) The normal curve
    (b) 95% confidence interval
    (c) p-value
    (d) Hypothesis testing
    (e) Regression
    (f) t-tests
    (g) Types of data

POSTGRADUATE INSTITUTE OF MEDICINE
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MD (RDIOTHERAPY & ONCOLOGY) PART I EXAMINATION
JUNE, 1999

Date: 7th June 1999 Time: 2.00 p.m. - 5.00 p.m.

PAPER II

Three separate answer books are provided. One for each section of the paper.
If the examiners cannot read your writing they will be unable to give you full credit for your knowledge.

PART A
PATHOLOGY OF NEOPLASTIC DISORDERS (APPLIED)

One of the following questions to be answered.

1. Write an essay on pathology of Bordeline tumors of the ovary.

2. Write short notes on :

   a. Merkel cell tumor.
   b. Adenoid cystic carcinoma of salivary glands.
   c. Lennerts lymphoma.
   d. Endodermal sinus tumors.

PART B
RADIOBIOLOGY AND PRINCIPLES OF CHEMOTHERAPY

One of the following two questions to be answered.

1. Discuss the importance dose in cancer chemotherapy.

2.
   (a) Discuss the nature of tumor growth using a 'Growth Curve'.

   (b) Give a schematic representation of the cell cycle and mention a laboratory method used commonly to quantify dividing cells.

(c) How does the sensitivity of cells in different phases of the cell cycle vary when exposed to:

1. low LET radiation
2. high LET radiation
3. Chemo-irradiation.

(d) Discuss the therapeutic aims of adding chemotherapy to an existing radiotherapy schedule and the biological process that such a combination might seek to exploit.

PART C
PATHOLOGY OF NEOPLASTIC DISORDERS (CLINICAL)

(One of the following questions to be answered.)

1. A 22-year euthyroid female has a right-sided solitary nodule in the Thyroid. List the investigational procedures used to arrive at a Diagnosis. Describe in detail the pathology of tumors that can arise in this patient.

2. What malignant tumors commonly occur in the cervix? Describe the clinico-pathological features of carcinoma of the cervix.

POSTGRADUATE INSTITUTE OF MEDICINE
UNIVERSITY OF COLOMBO

MD IN RADIOTHERAPY & ONCOLOGY PART I EXAMINATION
JANUARY, 2000

Date: 17th January 2000 Time: 2.00 p.m. - 5.00 p.m.

PAPER I

Answer Part A & B in separate books.
If the examiners cannot read your writing they will be unable to give you full credit for your knowledge.

PART A
PHYSICS

(Two of the following three questions to be answered.)

1. Referring to the underlying physical principles indicate the most suitable instrument for the following measurements.

   a. Absorbed dose at a depth in a water phantom from a high energy x-ray beam

   b. Dose rate at skin surface from a high energy x ray beam.

   c. Dose rate in the control room of a x-ray therapy unit.

   d. Radioactivity within a patient for detection of thyroid metases.

2.

   a. Differentiate between the terms

      i. Tumor volume
      ii. Target volume
      iii. Treatment volume
      iv. Irradiated volume

   b. A section of a body, which is uniformly 20cm thick, is to be treated with opposing fields at 100cm SSD on an 8 MV linear Accelerator. Mid-line dose of 40 Gy is to be delivered in 20 tractions treating both fields daily.

Following depth dose data is available.

Depth (cm)	0	2	5	10	15	18	20
PDD	15	100	89	71	56	48	43

i. Calculate the treatment time in monitor units per Fraction assuming the unit is calibrated to deliver .01Gy per monitor unit under conditions of full scatter at depth dmax.

ii. sketch the dose profile along the beam axis.

iii. Describe the predominant process by which the 8MV x-rays interact with tissue and relate this to the features of the dose profile.

iv. How is beam quality specified for a high-energy x-ray beam.

v. Explain how electrons are accelerated in a linear accelerator.

3. A lesion of the scalp measuring 6cm in diameter is to to be treated with planar circular Iridium 192 mould manually at a treatment distance of 1.5 c.m. according to the Manchester Dosage System, Total amount of Iridium required is 1.5 GBq and AKR constant is 33 Gy hr-1GBq-1 at I metre.

a. State how Iridium should be distributed in the mould

b. Comment on the dose uniformity within the treatment surface.

c. Calculate the dose rate at 2 meters from the mould.
Is this dose level acceptable for another patient occupying a bed at this distance from the mould. Give reasons.

d. What checks should be made on Iridium sources before using them for clinical work.

e. Describe the radiation protection measures necessary for storage, handling and disposal of radiation sources.

PART B
MEDICAL STATISTICS

(Answer one of the two questions given below.)

1. In a study of the effects of a drug on diastolic blood pressure (mmHg) ten (10) patients had their blood pressure measured before and after treatment. The results are given in the table below.

Diastolic blood pressure before treatment (mm.HG)	Diastolic blood pressure after treatment (mm.HG)
96	86
119	103
108	92
119	107
126	127
110	98
128	112
95	109
125	122
112	112

1.1. Is there any evidence that the drug reduces diastolic blood pressure (Substantiate your answer with appropriate statistical tests) (40 marks)

1.2 Outline the steps you would take to improve the validity of the findings if you were designing a similar study. (60 marks)

2. Discuss the differences between :

a) Clinical significance and statistical significance. b) Meta - analysis and literature review

c) Association and causation

d) Case - control and cohort studies (100 marks)

POSTGRADUATE INSTITUTE OF MEDICINE
UNIVERERSITY OF COLOMBO

MD (RADIOTHERAPY & ONCOLOGY) EXAMINATION - PART I
JANUARY, 2000

Date: 18th January 2000 Time: 9.00 a.m. - 12 noon

PAPER II

Three separate answer books are provided. One for each section of the paper. If the examiners cannot read your writing they will be unable to give you full credit for your knowledge.

PART A
PATHOLOGY OF NEOPLASTIC DISORDERS (APPLIED)

(One of the following questions to be answered.)

1. Write an account on clinico - pathological features of bronchial carcinoma

2. Write notes on the pathology of :

   a) Lymphomas of mucosa associated lymphoid tissue (MALT lymphoma)
   b) Malignant pleural effusions
   c) Pre malignant lesions of the uterine cervix.

PART B
RADIOBIOLOGY AND PRINCIPLES OF CHEMOTHERAPY

(One of the following two questions to be answered.)

1. Describe in detail the guidelines required for safe handling of cytotoxic drugs in a clinical oncology department.

2. Write notes on any two of the following :

   a) Oxygen effect in tumors

   b) Relate the symptoms appearing in the skin to the radiation damage

   c) Information that can be obtained from cell survival curves.

PART C
PATHOLOGY OF NEOPLASTIC DISORDERS (CLINICAL)

(One of the following questions to be answered.)

1. Write an account on non-metastatic manifestations of malignancy.

2.
   a. List 3 tumors which could be responsible for a breast lump in a 40 year old female.

   b. Describe in detail the pathology of the tumors you have listed.

   c. Discuss the role of fine needle aspiration (FNAB) in the diagnosis of tumors of the breast.

POSTGRADUATE INSTITUTE OF MEDICINE
UNIVERSITY OF COLOMBO

MD (CLINICAL ONCOLOGY) PART I EXAMINATION
OCTOBER 2000

Date: 2nd October 2000 Time: 2.00 p.m. - 5.00 p.m.

PAPER I

Answer Part A & B in separate books
If the examiners cannot read your writing they will be unable to give you full credit for your knowledge.

PART A
PHYSICS

(Select and answer 4 of the following 5 questions)

1. The ICRU 50 describes 5 different treatment and planning volumes for assessing tumor coverage.
   a) What are the factors to be considered when defining

      (1) CTV (Clinical Tumor Volume) and
      (2) PTV (Planned Tumor Volume)

   b) List the steps taken to generate a PTV from the point where a decision is made for external 3-D treatment planning.

   c) A 50 years old man diagnosed with mediastinal mass. The external beam treatment plan is to deliver 40 Gy to 100% isodose line (midplane dose) in 20 factions for phase 1. The isodose line is normalized at the isocentre, A cumulative dose volume histogram (DVH) is generated from a parallel opposed pair field arrangement for the PTV (target volume), spinal cord and lungs. The cumulative DVH graph is at Figure A.

      Answer the following questions:

      i) What is the maximum dose to the PTV?
      ii) What is the maximum to the spinal cord?
      iii) What % of the PTV is covered by the 100% of isodose line?
      iv) What is the volume of the spinal cord, which receives more than 24 Gy.

   d) What is 3D Conformal Radiotherapy? Discuss the advantages of 3D conformal radiotherapy over conventional radiotherapy.

2.

a) Describe the principle of a High Dose Rate (HDR) Remote Brachytherapy After loader ?

b) List 3 advantages of HDR remote after loader vs manual after loading.

c) List 2 disadvantages of the remote after loaders.

d) Name 2 radionuclides used for brachytherapy after loading system?

e) What radiation safety and protection devices should be available when operating a HDR system ?

f) Describe a method used for the calibration of a HDR brachytherapy source.

3. An equipment specification brochure for a medical linear accelerator provides the following information on its features on photon energy and characteristics:

Nominal Energy (MV)	Dmax (cm)	%Depth Dose at 10cm depth	Maximum Dose Rate (MU/min)	Flatness	Symmetry
6	1.5+-n 0.2	67.0+-1.0	600	+- 3.0%	+- 2.0%

a) What is meant by the term “Nominal Energy” ?

b) What is the mean energy of the photon beam? Explain how it is derived.

c) Sketch the depth dose curve for this photon beam up to a depth of 20 cm. Indicate the Dmax and % dd at 10 cm.

d) What are the advantages and disadvantages of having a medical linear accelerator in a Radiotherapy Department already having several Co-60 units ?

e) What would the optimum photon energies if it is a dual energy unit. Give reasons for your answer.

4.

a) Define the term HVL (Half Value Layer) and how it is related to the linear attenuation coefficient.

b) What are the 3 cardinal principles for radiation protection ?

c) A secretary who is working for 6 hours a day and seated 4 meters from a radioactive source. At 2 m from the source, the measured dose rate shows a reading of 250 Sv/hour. It is reckoned that a shielding of 2 TVL (Tenth Value Layer) is needed to reduce the radiation to an acceptable level. What dose will she receive in a week, behind the shielding ?

d) Assuming that she works 5 days a week and 50 weeks in year, what is her annual dose ?

e) Is the annual dose within the recommended limit of the ICRP 60 for member of the public ?

5.

a) Define the term TAR (Tissue air ratio).
A patient's pelvis is treated with parallel-opposed Co-60 fields, 15 cm X l5 cm, set-up at SAD (Source Axis Distance) 80 cm. The prescribed midplane dose on the axis is 45 Gy in25 fractions. The A/P thickness is 24 cm. Both fields are given daily. Assume the following beam data:

* Output in air at 80 cm for a 10cm x 10cm field is 125 cGy/min
* Field Correction factor for 15cm x 15cm field is 1.022
* TAR at 12 cm is 0.709 and
* Shutter time is + 0.02 min

b) What is the dose per fraction at the isocentre ?

c) What is the time setting for each field ?

d) Sketch the central axis dose distributions for the parallel-opposed field of the above field size for a separation of 24 cm on the same diagram for
i. Cobalt-60 and
ii. 10 MeV X-ray

e) Which photon beam is a better option for the patient. Give reasons for your selection.

f) List the advantages of using the isocentric techniques.

PART B
STATISTICS

(Answer one of the two questions given below)

6. The effectiveness of a new anti-cancer drug was tested against standard therapy. 50patients were randomly assigned to either the new drug or standard therapy such that each treatment group had 25 patients. The average life span of patients who received the new drug was 15.2 years with a standard deviation of 4.5 years. The average life span of patients who received the standard therapy was 10.8 years with a standard deviation of 2.1years.

   a) State the null and alternate hypotheses to be tested.

   b) Carry out a statistical test to test the above hypotheses.

   c) Interpret your results.

7

   7.1 Write short notes on the following:

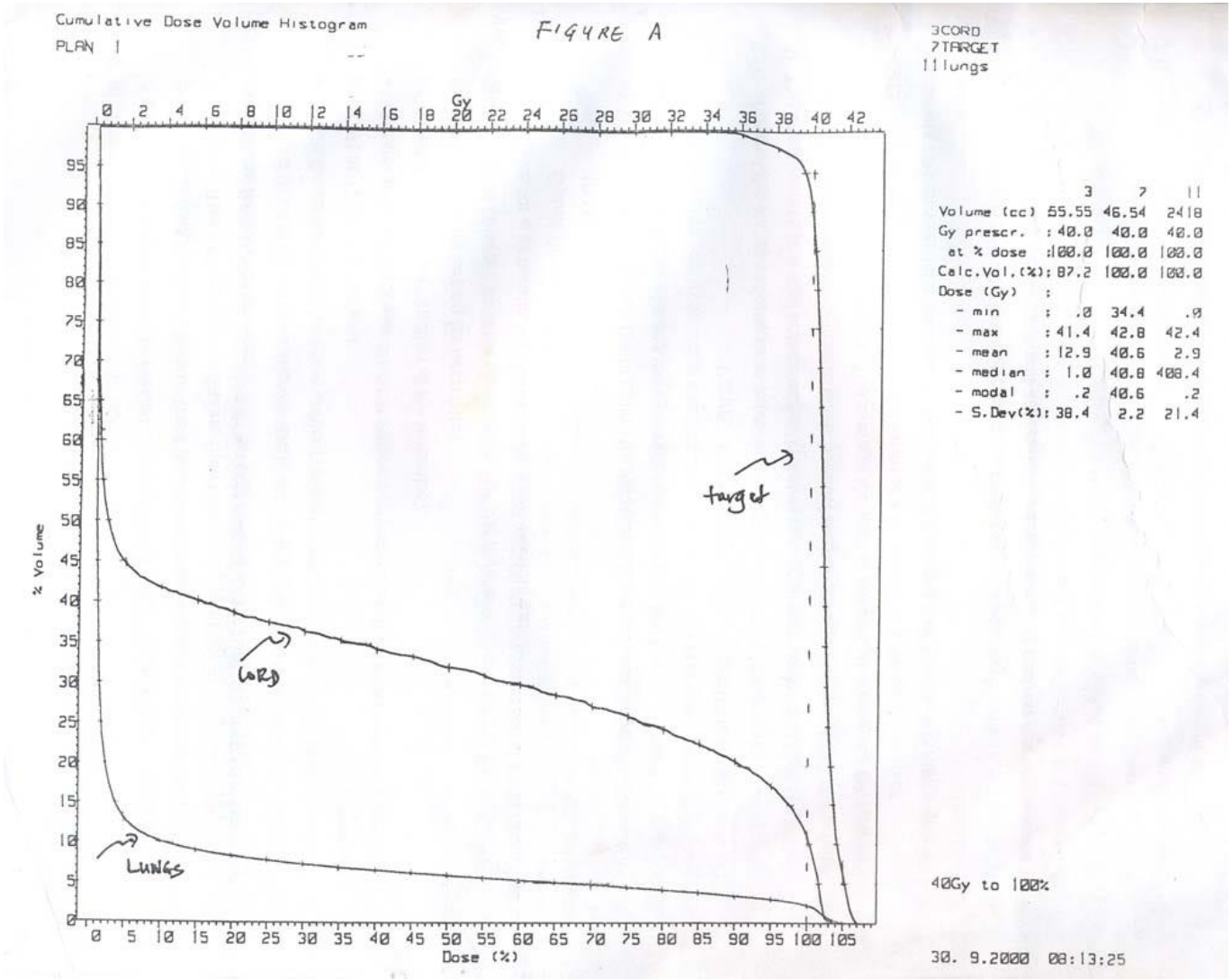
      a) 95% confidence interval

      b) Bias in sampling

   7.2 List the differences between :

      a) Odds ratio and Relative risk

      b) Type I (alpha) error and Type II (beta) error


Cumulative Dose Volume Histogram
PLAN 1
FIGURE A
3CORD
7TARGET
11lungs
Gy
% Volume
Dose (%)
target
CORD
LUNGS
3 7 11
Volume (cc) 55.55 46.54 2418
Gy prescr. : 40.0 40.0 40.0
at % dose :100.0 100.0 100.0
Calc.Vol.(%): 87.2 100.0 100.0
Dose (Gy) :
- min : .0 34.4 .0
- max : 41.4 42.8 42.4
- mean : 12.9 40.6 2.9
- median : 1.0 40.8 408.4
- modal : .2 40.6 .2
- S.Dev(%): 38.4 2.2 21.4
40Gy to 100%
30. 9.2000 08:13:25

POSTGRADUATE INSTITUTE OF MEDICINE
UNIVERSITY OF COLOMBO

MD (CLINICAL ONCOLOGY) PART I EXAMINATION
OCTOBER, 2000

Date: 3rd October 2000 Time: 9.00 a.m. - 12.00 noon

PAPER II

Four separate answer books are provided. One for each question of the paper. If the examiners cannot read your writing they will be unable to give you full credit for your knowledge.

PART A
PATHOLOGY OF NEOPLASTIC DISORDERS (APPLIED)

(Two of the following questions to be answered.)

1. Give a classification of malignant ovarian tumors.
   Write an account of clinico-pathological features of germ cell tumors of ovary.

2. Write short notes on:
   a) Anti-oncogenes
   b) Epstein-Barr Virus (EBV) and human cancer.
   c) Carcinoid tumors of bowel
   d) Papillary carcinoma of the thyroid

3. What differential diagnosis is implied by the term "Small round cell tumors of Childhood " ?
   What pathological investigations are important in the diagnosis ?
   Discuss the clinico pathological features of two of the tumors mentioned.

PART B
PRINCIPLES OF CHEMOTHERAPY

(One of the following two questions to be answered.)

1. A 42-year-old hypertensive patient with an ovarian cancer has been prescribed Paclitaxol 240 mg. and Cis platin 100 mg. Describe in detail the manner you would administer them. What immediate side effects would you expect?

2. Write notes on any 3 of the following

    1. Anthracyclin therapy
    2. Intra thecal Chemotherapy
    3. Drug Resistance
    4. Clinical Trials

PART C
CANCER BASIC SCIENCES INCLUDING RADIOBIOLOGY

1.

    (i) Single cell survival curves are generally classified as Type A (exponential) or Type C (with shoulder). Discuss the various interpretations that are given for each shape.

    (ii) Explain the main factor, which determine the tolerance of normal tissues in the small intestine to radiation.

2. Write notes on:

    (i) Oxygen effect in tumors

    (ii) Relate the symptoms appearing in the skin to the radiation damage

    (iii) Stochastic effects

    (iv) Plating efficiency

POSTGRADUATE INSTITUTE OF MEDICINE
UNIVERSITY OF COLOMBO

MD (CLINICAL ONCOLOGY) PART I EXAMINATION
APRIL, 2004

Date :- 26th April, 2004 Time: 1.30 p.m. - 4.30 p.m.

PAPER I

Answer Parts A and B in separate books.
If the examiners cannot read your writing they will be unable to give you full credit for your knowledge.

PART A
PHYSICS

(Answer Four of the five questions.)

1.

(a) Explain with reference to basic physical processes, why the x-ray image from a Linear Accelerator is different to that from a diagnostic x-ray machine. (40 marks)

(b) Filtration is used in each of the following settings:

(i) Aluminium added filter in diagnostic x-ray machine
(ii) Thoraeus filter in orthovoltage machine.
(iii) Beam flattening filter in a medical linear accelerator (for MV x-rays)

(A) What are the physical processes in each of these ? (30 marks)

(B) What are the reasons for the use of filtration in each of these ? (30 marks)

2. A patient with lateral thickness of 12 cm is to be treated on a telecobalt unit. Field size required to cover the tumour is 12 cm x 6 cm and the tumour is located 4 cm from the right lateral and 8 cm from the left lateral skin. Prescribed dose to the centre of the tumour is 50Gy in 25 fractions. A lateral opposed isocentric technique is used with 2:1 weightage at the tumour centre from right side to left side of the tumour.

Using the following beam data :

TAR at 4 cm for 12 cm x 6 cm = 0.925
TAR at 8 cm for 12 cm x 6 cm = 0.768
Output in air at 80 cm for 10 cm x 10 cm field = 250 cGy /min
Output factor (field correction factor) for 12 cm x 6 cm = 0.984

(a) Calculate the dose for fraction for the each field at the isocentre. (20 marks)

(b) Calculate the treatment time for each field. (30 marks)

(c) If the patient's skin on which the radiation beam incident is oblique and irregular, discuss the most effective procedure to get a uniform dose distribution to the tumour. (30 marks)

(d) List the advantages of using an isocentric technique compared to the SSD technique. (20 marks)

3.

(a) Explain briefly the types of after-loading systems in brachytherapy and their advantages and disadvantages. (40 marks)

(b) A lesion on the dorsum of the hand is to be treated with a 4.0 cm diameter circular mould at a treating distance of 1 cm. The mould is to be worn for approximately 8 hours per day to give a prescribed dose of 60 Gy in 6 days.

(i) How many milligrams of radium equivalent is required. (Use the table provided). (30 marks)

(ii) What isotope would you select to treat the patient and give reasons for your choice. (30 marks)

4.

(i) (a) Explain briefly the following topics related to ionising radiation.
Stochastic effect (15 marks)
Deterministic effect (15 marks)

(b) Give two examples for each that can happen in the body as a results of those effects. (10 marks)

(ii) Compare the thermoluminecent dosimeter (TLD) with the film badge. (30 marks)

(iii)

(a) The exposure rate in air at 50 cm from an Ir - 192 source is 20 R/h. Calculate the activity of the source. (10 marks)

(b) Calculate the exposure rate at 1 m from the source. (10 marks)

(c) What would be the thickness of lead required to reduce the exposure rate to 1.25 R/h at 1 meter distance. (10 marks)

(Gamma factor for lr - 192 source is 4.8 R/h mCi^{-1} at lcm
HVL of lead for this gamma radiation is 12 mm)

5. A Sri Lankan radiotherapy centre is to replace its aging (T780c) Telecobalt machine with a Linear Accelerator. Discuss briefly your recommendations on the following with respect to the above replacement.

(a) Room construction (30 marks)
(b) Beam energy selection (40 marks)
(c) Cost and maintenance (30 marks)

PART B
STATISTICS

(Answer one of the two questions given below.)

6. The effectiveness of a pain relieving drug was assessed in 10 terminally ill cancer patients. Pain was assessed as a pain score on a scale of 1 to 10. The results are given below:

Patient	Pain scores	
	Before giving drug	After giving drug
1	6.5	5
2	7	4.5
3	5.5	3
4	8	4
5	6	2.5
6	7.5	5.5
7	4.5	2
8	5	2
9	8.5	4.5
10	6	3

a) State the hypotheses to be tested. (20 marks)
b) Perform an appropriate statistical test. (50 marks)
c) Interpret the result. (30 marks)

Percentage points of different distributions

Distribution	Degrees of freedom	Area under the curve (I-sided)			
		0.90	0.95	0.975	0.99
t	9	1.383	1.833	2.262	2.821
t	10	1.372	1.812	2.228	2.764
t	11	1.363	1.796	2.201	2.718
Chi square	1	2.71	3.84	5.02	6.63
Chi square	2	4.61	5.99	7.38	9.21

7. Comment on three of the following four parts (all parts carry equal marks) :

a. A study was conducted to compare 2 treatment options for endometrial carcinoma. Among patients receiving treatment option A, the 5-year recurrence rate was 10% (95% confidence interval ranging from 7.5% to 12.5%). Among patients receiving treatment option B, the recurrence rate was 5% (95% confidence interval ranging from 2% to 8%).

b. In a comparative study of 2 treatment options for carcinoma of the colon, the recurrence rate of treatment option A was 20% and that of treatment option B was 10%. Among patients receiving treatment option A, the majority were older patients and in more advanced stage of the disease as compared to those receiving treatment option B.

c. In a large study of 2 treatment options for prostate cancer comprising over 1000 patients, treatment option A resulted in an average survival of 10.8 years while treatment option B resulted in an average survival of 10.9 years. This difference was statistically significant. The quality of life was significantly better among patients receiving treatment option A.

d. A new screening test for carcinoma of the prostate is to be introduced into the market. The new screening test has a sensitivity of 70% and specificity of 90%. The currently available screening test has a sensitivity of 90% and a specificity of 95%.The new screening test is half the cost of the currently available screening test.

POSTGRADUATE INSTITUTE OF MEDICINE
UNIVERSITY OF COLOMBO

MD (CLINICAL ONCOLOGY) PART I EXAMINATION – APRIL, 2004

Date :- 27th April, 2004 Time: 9.30 a.m. - 12.30 p.m.

PAPER II

Separate answer books are provided. One for each question of the paper. If the examiners cannot read your writing they will be unable to give you full credit for your knowledge

PART A
PATHOLOGY

(One of the following two questions to be answered.)

1.

(a) List the neoplastic lesions that can affect the thyroid gland. (10 marks)

(b) Describe the clinico-pathological features of three primary malignant tumours of the thyroid. (75 marks)

(c) Discuss the value of fine needle aspiration biopsies in thyroid disease (15 marks)

2. Write short notes on : (all parts carry equal marks)

(a) Pathogenesis of gastric carcinoma
(b) Burkitt lymphoma
(c) Lobular carcinomas of breast
(d) Testicular seminoma

PART B
RADIOBIOLOGY

(One of the following two questions to be answered.)

1. Discuss the physico chemical changes occurring in the critical target of a cell due to action of X-rays. (75 marks)

   Illustrate how the cell absorbs X-rays. (25 marks)

2. List the types of radiation damage to mammalian cells and give the features associated with each of them. (20 marks)

   Explain the mechanism of repair of the damage when radiation dose is given in fractions. (50 marks)

   What clinical applications could be derived from this process ? (30 marks)

PART C
CHEMOTHERAPY

(One of the following two questions to be answered.)

1. Describe the mechanisms of chemotherapy, induced emesis. (75 marks)

   Briefly outline the management of chemotherapy induced emesis. (25 marks)

2. Write short notes on the following: (each part carries equal marks)

   (a) Pharmacokinetics and Pharmacodynamics

   (b) Phase II clinical trials

   (c) Concept of dose intensity

PART D
CANCER BIOLOGY

(One of the following two questions to be answered.)

1. Discuss the following statements :

   (a) Tyrosine Kinase and its relevance to cancer therapy. (50 marks)

   (b) Monoclonal antibodies in clinical practice. (50 marks)

2.

   (a) Name two methods that can be used to detect point mutations. (30 marks)

   (b) In 2-3 sentences, describe the biochemical consequences of point-mutations. (40 marks)

   (c) In one sentence each describe two other mechanisms by which oncogenes can be activated. (30 marks)

POSTGRADUATE INSTITUTE OF MEDICINE
UNIVERSITY OF COLOMBO

MD (CLINICAL ONCOLOGY) PART I EXAMINATION
JULY, 2005

Date: 25th July, 2005 Time: 1.30 p.m. - 4.30 p.m.

PAPER I

Answer Parts A and B in separate books.
If the examiners cannot read your writing they will be unable to give you full credit for your knowledge.

PART A
PHYSICS

Answer Four of the five questions given below.

1.

(a) Comparing a portal image taken from a 6MV linear accelerator x-ray beam with a simulator image, which gives a better quality image to interpret ?
Give reasons for your answer. (35 marks)

(b) List the indications for using the following radiation detectors in a radiotherapy department ?

i. Thermoluminescent Dosimeter (TLD) (10 marks)
ii. Thimble ionisation chamber (10 marks)
iii. Geiger-Miillar tube (G-M Tube) (10 marks)
iv. Well-ionisation chamber. (10 marks)
Why is it important to annually calibrate the above detectors.(5 marks)

(c) List four daily quality control checks recommended by the AAPM TG-40 protocol for a single energy medical Linear Accelerator (x-ray only).
Indicate their acceptable tolerance values. (20 marks)

2. Diagram I shows 2D- planned computer isodose distribution, which has been corrected for lung inhomogeneity. on a central slice of a middle third oesophageal cancer patient. As phase I external beam therapy, this treatment is planned with one anterior open beam and two posterior oblique beams with 30° wedges to treat isocentricaJly at 100 cm from the focus. Beam energy is 6 MV and the prescription is 45 Gy in 25 fractions.to the isocenter.

3. Explain briefly in three sentences what you mean by "Three Dimensional Conformal Radiation Therapy" (3D-CRT). (25 marks)

List the three principal requirements, other than human resources, you should have in the radiotherapy department in order to establish 3D-CRT. (15 marks)

Write short notes on the following topics which refer to 3D-CRT

i. Image registration. (15 marks)
ii. Image segmentation. (15 marks)
iii. Digitally Reconstructed Radiograph (DRR). (15 marks)
iv. Cumulative Dose Volume Histograms (DVE. (15 marks)

4.

(i) Briefly discuss the physical characteristics of three different radionuclides used in brachytherapy. (30 marks)

(ii) What are the requirements for an idal implant of the Paris dosimetry system. (25 marks)

(iii) Define the basal dose rate and the reference dose rate for the two plane implant with a triangular arrangement of five wires for the Paris system. (25 marks)

(iv) What are the major features of the Manchester dosimetry system of a single plane interstitial implant. (20 marks)

5.

a.) What are the three fundamental principles set by the international Commission on Radiological Protection (ICRP) for Radiation Protection. (15 marks)

b.) List three practical methods employed to reduce persona1 radiation dose. (15 marks)

c.) What is meant by Stochastic & Deterministic effect and give two examples for each effect. (30 marks)

PART B
MEDICAL STATISTICS

Answer one of the two questions given below.

1. The prognosis for young children with medulloblastoma is poor, and survivors are at high risk for cognitive deficits. A trial of the treatment of this brain tumor by intensive postoperative chemotherapy alone was conducted. After surgery, children received three cycles of intravenous chemotherapy (cyclophosphamide, vincristine, methotrexate, carboplatin, and etoposide) and intraventricular methotrexate. Treatment was terminated if a complete remission was achieved. Leukoencephalopathy and cognitive deficits were evaluated. The response to chemotherapy is given in the table.

Stage	Surgery		Response to chemotherapy		Overall response
	Complete	Incomplete	Yes	No	
	Number (%)		Number		
MO/M1 (No Metastases)	17(40)	14(33)	11	3	a
M2/M3	6 (14)	6 (14)	5	7	b
Total	23 (53)	20 (47)	16	10	c

* Only among patients with metastases or residual tumour after surgery.

1.1 State the study design. (10 marks)

1.2 State the advantages and disadvantages of using this study design in preference to a randomized controlled trial. (25 marks)

1.3 Calculate the overall response of chemotherapy in patients with residual tumour and/or metastases after surgery for the last column in the table (entries a, b, and c). (15 marks)

In children who had complete resection (17 patients), residual tomour (14), and macroscopic metastases (12), the overall survival rates(+_SE) were 93+- percent. 56+-14 percent, and 38+_15 percent, respectively.

1.4 Determine if there is a statistically significant difference in the five-year overall survival rates between children who had complete resection and children with residual tumour without macroscopic metastases. (30 marks)

1.5 Interpret the following statement.

"After treatment, the mean lQ was significantly lower than that of healthy controls within the same age group but high than that of patients **in the** previous trial who had received radiotherapy." (20 marks)

2. Benign breast disease is an important risk factor for breast cancer. All women who received a diagnosis of benign breast disease at the Mayo Clinic between 1967 and 1991 were studied. Breast-cancer events were obtained from medical records and questionnaires. To estimate relative risks, the number of observed breast cancers was compared with the number expected on the basis of standard rates in a control population. A part of the results is given in the table below.

Characteristic	No. of Women	Person-Years	No. of Observed Events	No. of Expected Events	Relative Risk (95% Cl)
Overall	9087	144,881	707	453.0	1.56(1.45-1.68)
Menopausal status					
Prenenopausal (age <45 yrs)	2948	54,419	169	106.1	1.59(1.36-1.85)
Perimenopausal (age 45-55)	2583	45,872	245	153.4	1.60(1.40-1.81)
Postmenopausal (age > 55)	3556	44,590	293	193.6	1.51(1.35-1.70)

2.1 Explain briefly how person years were calculated. (10 marks)
2.2 Explain briefly how the expected number of events was calculated. (10 marks)
2.3 Explain briefly how the relative risk was calculated. (10 marks)
2.4 Discuss briefly potential sources of bias in this study. (25 marks)
2.5 Interpret the findings in the figure attached. (45 marks)

POSTGRADUATE INSTITUTE OF MEDICINE
UNIVERSITY OF COLOMBO

MD (CLINICAL ONCOLOGY)-PART I EXAMINATION
JULY 2005

Date: 26th July, 2005 Time: 9.30 3.m.-12.30 p.m.

PAPER II

Answer Parts A, B, C and D in separate books

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

PART A
RADIOBIOLOGY

Answer One of the two questions.

1.

a) Discuss how you would study the variation in radiosensitivity of cells In the cell cycle. (65 marks)

b) Explain how this variation in sensitivity may be important in radiotherapy. (35 marks)

2.

a) Define oxygen enhancement ratio (10 marks)

b) Illustrate the cell survival curve for cells in well-oxygenated and hypoxic conditions irradiated in vivo. (10 marks)

c) Explain two possible mechanisms of reoxygenation in tumours with approximate time scales. (70 marks)

d) Using a diagram illustrate how OER changes with linear energy transfer. (10 marks)

PART B
PATHOLOGY

Answer One of the two questions.

1. A 30 year old is found to have an anterior mediastinal mass:

a. What investigations would help in arriving at a diagnosis? (15 *marks)*

b. What are the possible pathological lesions the patient may have ? (20 marks)

c. Discuss the histopathological features of two of the primary malignant tumours you have mentioned. (65 marks)

2. A 5 year-old child is found to have a mass involving the kidney:
Describe the pathological features of the possible malignant tumours.
What special investigations would help in arriving at a diagnosis ?
(100 marks)

PART C
CHEMOTHERAPY

Answer <u>One</u> of the two questions.

1.

a. Describe briefly the phannacokinetics and phannacodynamics of methotrexate. (60 marks)

b. In a clinical situation it has become necessary to give 3.5 grams of methotrexate over 24 hours. List the steps taken to administer this dose safely. (40 marks)

2. Write short notes on **THREE** of the following:

a. Clinical trials used to evaluate a novel anti-cancer agent.

b. Effects of chemotherapeutic agents on the gonads.

c. Erythropoetin.

d. Colony Stimulating Factors.

(equal marks for each)

PART D
CANCER BIOLOGY

Answer <u>One</u> of the two questions.

1.

a. List two activators for each of the two pathways of the complement Cascade (30 marks)

b. Outline the correct order of events to show how these pathways combine in one common pathway to bring about lysis of cancer cells (40 marks)

c. In one sentence describe another biological function of the complement cascade in eliminating cancer cells. (30 marks)

2. Write short notes on each of the following:

a. RAS oncogene (25 marks)

b. Telomerases (25 marks)

c. Polymerase chain reaction (25 marks)

d. Microsatellite instability (25 marks)

POSTGRADUATE INSTITUTE OF MEDICINE
UNIVERSITY OF COLOMBO

MD (CLINICAL ONCOLOGY) PART I EXAMINATION
JULY/AUGUST. 2006

Date :- 31st July 2006 Time:- 2.00 p.m. - 5.00 p.m.

PAPER I

Parts A and B must be answered.

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

PART A
PHYSICS

Answer six Questions of the seven questions given below.
Each question carries 100 marks.
Each question to be answered in a separate book.

1. ICRU 50 and 62 define and describe several target and critical structure volumes.

(a) Define

(i) Gross Tumor Volume (GTV) (15 marks)

(ii) Clinical Target Volume (CTV) (15 marks)

(b)

(i) Give reasons to define a margin between CTV and ITV (Internal Target Volume). (08 marks)

(ii) List three examples to justify your answer. (12 marks)

(c)

(i) Give reasons to define a margin between ITV and PTV (Planning Target Volume). (08 marks)

(ii) List three examples to justify your answer. (12 marks)

(d) What is meant by "inter-fraction variations" and "intra-fraction variations" related to external beam radiotherapy ? (16 marks)

(e) Sketch a Dose Volume Histogram (DVH) of a PTV fulfilling the minimum requirement of ICRU 50. (14 marks)

2. Answer all of the following questions:

(a)

(i) Define Kenna. (12 marks)

(ii) What is the SI unit of Kenna? (04 marks)

(b)

(i) Define absorbed dose. (12 marks)

(ii) What is the SI unit of absorbed dose? (04 marks)

(c) Sketch a graph indicating the relationship between Kenna and absorbed dose in water for a 10 MV photon beam. (25 marks)

(d) Explain the difference between Kerma and absorbed dose. (25 marks)

(e)

(i) Draw a labeled diagram of a thimble ion- chamber. (10 marks)

(ii) What is meant by the calibration factor for a particular ion-chamber ? (08 marks)

3. A T_2,No Tumor in the anterior *2/3* of the tongue which has crossed the midline is to be treated with external radiotherapy. It is planned to deliver a dose of 50 Gy in 20 fractions in 4 weeks by to the midline of the PTV. Field arrangements are made with two lateral opposing beams each of size 10 cm x 8 cm. The center of each field entry marks are kept on left and right lateral mandibular areas of the face. The separation between the field entry marks is 13 cm. The centre of the PTV is at the mid point of the field separation. The patient will be treated using a 80 cm SSD technique.

Treatment machine: Cobalt-60, 80 cm SSD Dose rate at the d_{max} at 80 cm SSD in water for 10 cm x 8 cm is 2.5 Gy/min.

Percentage Depth Dose (PDD) data for 10 cm x 8 cm at 80 cm SSD.

Depth cm	PDD
0.0	40.0
0.5	100.0
6.5	70.6
12.5	45.6
13.0	44.0

(a) What is the applied dose per fraction per field ? (25 marks)

(b) What is the treatment time per fraction per field? Ignore the shutter correction. (25 marks)

(c) Calculate the maximum dose per fraction the skin may get from this treatment. (20 marks)

(d)

(i) Give your comments on the dose distribution in the central axis using the above data (15 marks)

(ii) What is your opinion when the separation is increased up to 25 cm, such as in antero-posterior pelvic irradiation ? (15 marks)

4. Answer all of the following questions:

(a) What are the functions of the following in a linear accelerator ?

i. Magnetron (10 marks)
ii. Scattering foil (10 marks)
iii. Bending magnets (10 marks)

(b) What is the main difference between a Magnetron and Klystron ? (25 marks)

(c) List four quality control parameters of a linear accelerator required on daily basis and give their tolerance limits. (30 marks)

(d) How do you check the congruence of light and radiation field ? (15 marks)

5.

(a) What is 3-Dimensional Conformal Radiation Therapy (3D-CRT) ? (25 marks)

(b) Explain the advantages of having a Multileaf collimator (MLC) in the Linear Accelerator head for delivering 3D- conformal treatment.

(c)

(i). What is meant by image fusion in treatment planning ? (10 marks)

(ii) Give two sites where this may be advantageous and explain why this is so ? (15 marks)

(d) In 3D-CRT, list two principle methods used to evaluate how well a computed plan meets the desired dose criteria. (25 marks)

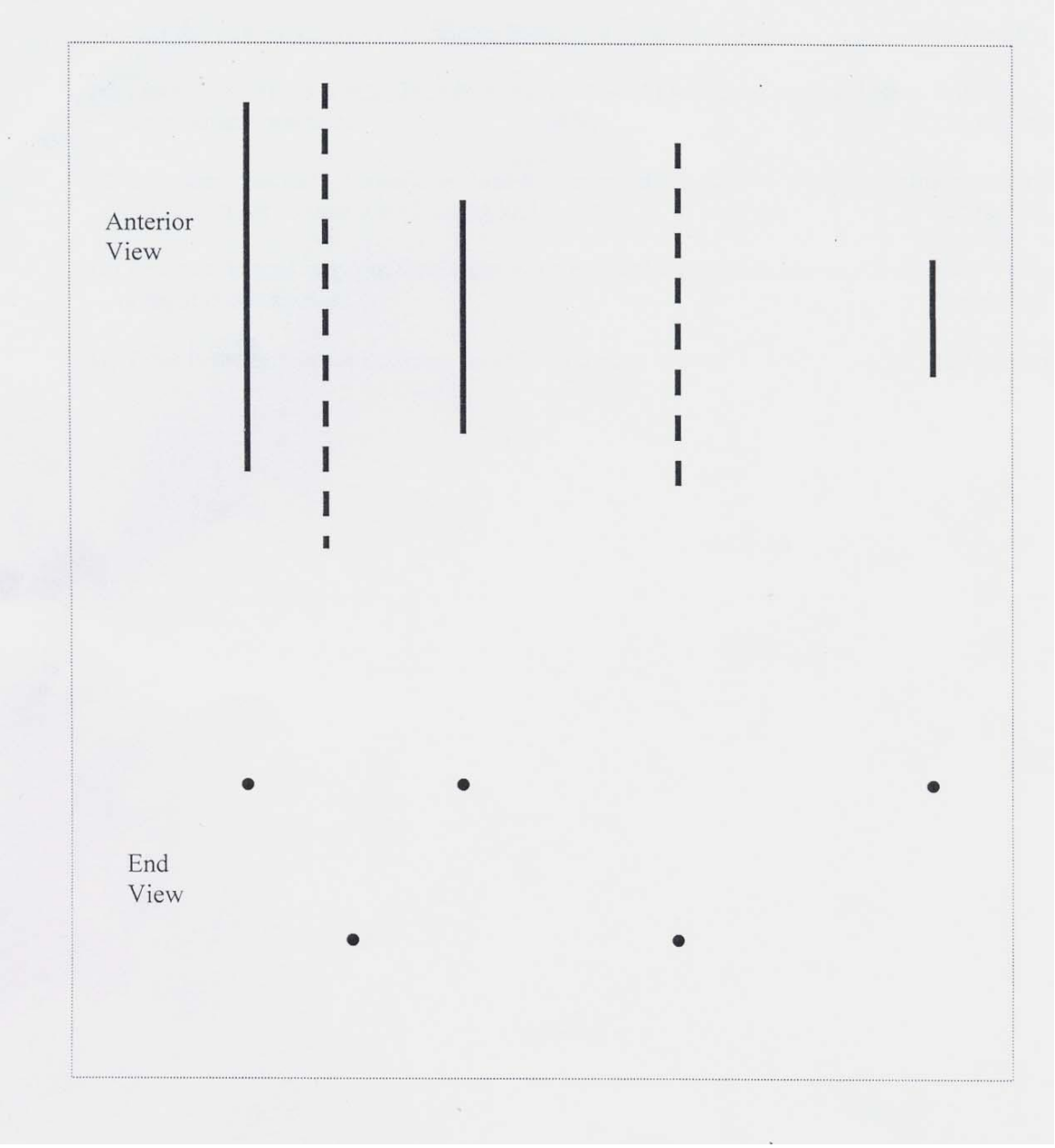
6. Answer all the following questions:

(a) List the physical properties of Ir-192 and Cs-137 that are used in brachytherapy remote after loading systems. (30 marks)

(b) Give four advantages of Ir-l92 for use in high dose rate remote after loading systems. (20 marks)

(c) List four rules for an ideal Paris system implant. (20 marks)

(d) The diagram shows the orthogonal views of a two plane triangular iridium wire implant. Identify two reasons of this implant that do not conform to the Paris system implant. (20 marks)



(e) How is the reference dose rate related to the basal dose rate in Paris system implant ? (10 marks)

7. Answer all the following questions:

(a) List three characteristics of a controlled area in radiotherapy. (15 marks)

(b) List three radiation safety measures found in a controlled area. (15 marks)

(b) List two instances where the inverse square law is used to reduce the dose to staff in radiotherapy practice. (10 marks)

(d) List three checks that should be done to verify radiation safety prior to treatment using a brachytherapy remote after loading unit. (15 marks)

(e) List two reasons why the dose constraints for public exposure are smaller than for occupational exposure. (25 marks)

(f) What is the difference between the units Gray and Sievert ? (20 marks)

PART B
MEDICAL STATISTICS

Answer <u>two Questions</u> of the three questions given below.
Each question carries 100 marks.
Each question to be answered in a separate book.

1. The following was taken from an abstract published in the.New England Journal of Medicine.

Background A regimen of epirubicin, cisplatin, and infused fluorouracil (ECF) improves survival among patients with incurable locally advanced or metastatic gastric adenocarcinoma. This study was done to assess whether the addition of a perioperative regimen of ECF to surgery improves outcomes among patients with potentially curable gastric cancer.

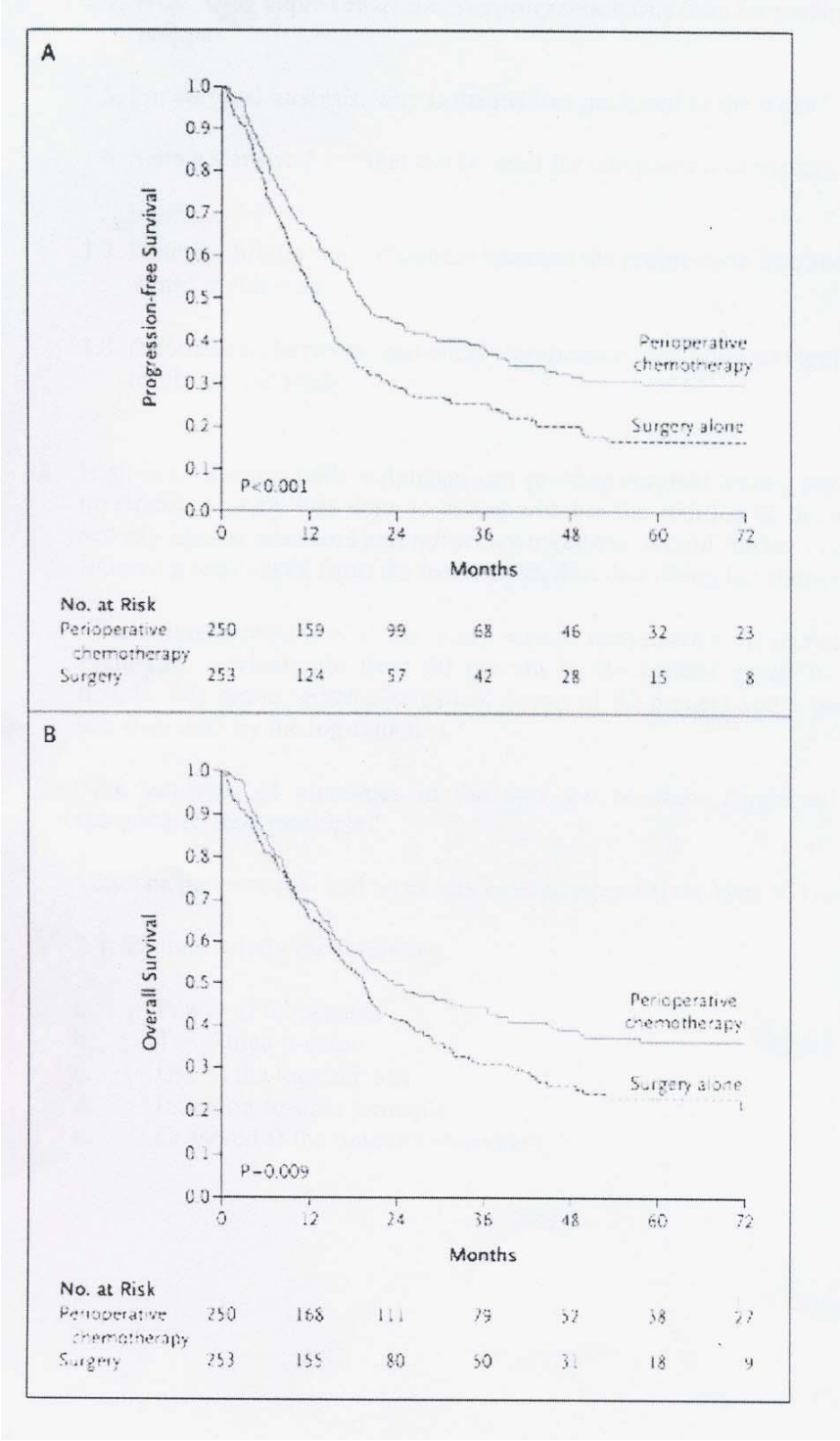
Methods Patients with resectable adenocarcinoma of the stomach, esophagogastric junction, or lower esophagus were randomly assigned to either perioperative chemotherapy and surgery (250 patients) or surgery alone (253 patients). The course of chemotherapy was given over a I-month period. The primary end point was overall survival.

1.1. What is meant by randomization and why is it done? (15 marks)

1.2. Give reason(s) why this study was not done as a double blind trial. (15 marks)

1.3. List 4 considerations in the calculation of sample size for this study. (20 marks)

A part of the results of this study are given in the graphs below



1.4. What is the approximate median progression free time for patients of the two groups? (10 marks)

1.5. For survival analysis, why is the median preferred to the mean ? (10 marks)

1.6. State a statistical test that can be used for comparison of median survival times. (05 marks)

1.7. Describe briefly the differences between the progression free and overall survival times in this data. (15 marks)

1.8. Differentiate between 'statistical significance' and 'clinical significance' using the results of this study. (10 marks)

2. High-dose therapy with melphalan can prolong survival among patients with multiple myeloma. A study was done to assess whether the addition of thalidomide, which has activity against advanced and refractory myeloma, would further improve survival. The following were taken from the methods section describing the statistical analysis.

"The primary objective of the study was to demonstrate an increase in the five-year event-free survival rate from 40 percent in the control group to 50 percent in the thalidomide group, given a statistical power of 82 percent and a two-sided P value of less than 0.05 by the log-rank test."

"The analyses of outcomes in the two groups were conducted according to the intention-to-treat principle."

"Data on patients who had no events were censored at the time of last contact"

2.1. Explain briefly the following:

a. Power of 82 percent.
b. Two-sided p-value
c. Use of the log rank test
d. Intention-to-treat principle
e. Censored at the time of last contact (50 marks)

The following table gives the incidence of severe adverse events during the study.

Adverse event	Thalidomide group (N=314) n(%)	Control group (N=337) n(%)	p-value
Thrombosis or Embolism	95 (30)	58 (17)	<0.001
Syncope	38 (12)	13 (4)	<0.001
Neutropenia	296 (94)	306 (91)	0.09

2.2. Define incidence. (10 marks)

2.3. Calculate the relative risk for thrombosis or embolism. (15 marks)

2.4. Calculate the risk attributable to Thalidomide for syncope. (15 marks)

2.5. Name a statistical test that may have been used to calculate p-values. (10 marks)

3. Write short notes on the following :

3.1. Stratification in clinical trials. (20 marks)

3.2. Actuarial analysis (20 marks)

3.3. Meta-analysis (20 marks)

3.4. Type I error (20 marks)

3.5. Multivariate analysis (20 marks)

POSTGRADUATE INSTITUTE OF MEDICINE
UNIVERSITY OF COLOMBO

MD (CLINICAL ONCOLOGY) PART I EXAMINATION
JULY/AUGUST. 2006

Date: - 1st August 2006 Time :- 9.00 a.m. -12.00 noon

PAPER II

Parts A, B, C and D must be answered.

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

PART A
RADIOBIOLOGY

Answer two Questions of the three questions given below.
Each question carries 100 marks.
Each question to be answered in a separate book.

1

a) What is a clonogenic cell ? (10 marks)

b)

i. Draw a survival curve and label the axes. Use this plot to illustrate the key features of the linear quadratic (LQ) model of survival for low LET radiation. (25 marks)

ii. Indicate on the graph how the a/ß ratio is determined. (10 marks)

iii. Write the expression for the cell survival curve for the LQ model. (l0 marks)

c) Briefly explain what a high a/ß ratio indicates. (25 marks)

d) Explain briefly the linear quadratic relationship between chromosome aberrations and cell survival with the help of a graphical illustration. (20 marks)

2.

a) Define oxygen enhancement ratio (15 marks)

b) Outline the oxygen fixation hypothesis (25 marks)

d) Give briefly the rationale for the clinical strategies listed below based on anyone of the following criteria. viz. either standard practice, useful in some circumstances or experimental. (60 marks)

i. fractionation
ii. correction of anaemia
iii hyperthermia
iv hypoxic cell sensitizer
v hypoxic cytotoxins

3.

a) There are advantages in giving the total radiation dose as a number of small fractions during radiotherapy.

List the biological factors these advantages are based on. (12 marks)

State wherever possible how each of these influence the response of normal and neoplastic tissues to a fractionated therapy. (25 marks)

b) Conventional radiotherapy is given in doses of 1.8 - 2.0 Gy/day. If the dose/day is changed there may be changes in the relative effects on tumours, acute reacting and late reacting normal tissues. The changes may improve or worsen the therapeutic ratio.

Draw the table as illustrated in the question and for each cell in the table state whether the factor is less, the same or more (18 marks)

(c) Discuss the rationale for each fractionation schedule in the table. (45 marks)

	Dose/fraction	Total Dose	Time
Hyperfractionation Accelerated Fractionation			
Hypofractionation			

PART B
PATHOLOGY

Answer <u>two Questions</u> of the three questions given below.
Each question carries 100 marks.
Each question to be answered in a separate book.

1. In testicular tumours

   (a) Mention two risk factors for germ cell tumours of the testis (10 marks)

   (b) What is the precursor lesion for germ cell tumours ? (10 marks)

   (c) Mention three important microscopic features of Classical Seminoma (30 marks)

   (d) Mention two most likely primary malignant testicular tumours in a 60-year-old male (20 marks)

   (e) Describe briefly the histological features of one of these turn ours mentioning any special stains that will be useful in arriving at a diagnosis. (30 marks)

2. Answer all of the following questions.

   (a) Mention three types of cells that are present in the normal epidermis other than squamous cells (15 marks)

   (b) Describe briefly the histological features of Malignant Melanoma. (40 marks)

   (c) Mention three non melonocytic turn ours that can histologically mimic malignant melanoma in the skin. (15 marks)

   (d) Describe briefly the histology of one of the turn ours mentioned in (c) above (15 marks)

   (e) Mention two special laboratory techniques that will be useful in arriving at a diagnosis of melanoma (15 marks)

3. In breast carcinoma

(a) What are the main histological parameters used in grading invasive ductal breast carcinoma ? (15 marks)

(b) What important information should be provided in a histopathology report of a patient, who has undergone mastectomy and axillary clearance for breast carcinoma. (50 marks)

(c) Discuss the importance of hormone receptor assay and HER 2*/neu* (C-erb B-2) assay in breast carcinoma (35 marks)

PART C

CHEMOTHERAPY

Answer <u>two Questions</u> of the three questions given below.
Each question carries 100 marks.
Each question to be answered in a separate book.

1. Bis-Phosphonates are widely used in the treatment of malignant disease.

(a) Name two main indications for their use. (15 marks)

(b) In two sentences explain the actions of Bis- Phosphonates. (15 marks)

(c) In less than 10 sentences explain the pharmacokynetics of Pamidronate. (50 marks)

(d) What dosage of Pamidronate sodium will you use to malignant bone disease and what are the side effects encountered ? (15 marks)

(e) What special type of side effect is seen with nitrogen containing Bis-Phophonates ? (05 marks)

2. Answer all of the following.

(a) Explain the difference between the objective of Phase I and Phase II clinical trials. (40 marks)

(b) How do the criteria required for patients to enter into these clinical trials differ? (30 marks)

(b) Write short notes on
i. dose escalation in a Phase I clinical trial (10 marks)
ii. maximum tolerated dose (10 marks)
iii. end points of a Phase II clinical trial (10 marks)

3. Explain the following terms:

(a) AUC (15 marks)

(b) Elimination half life. (15 marks)

(c) Give the name of one drug which is prescribed according to it's AUC. (05 marks)

(d) What is meant by a dose of AUC 6. Explain how the dose of. the drug is derived from the 'Calvert formula' (50 marks)

(e) Give three toxicities seen with the drug mentioned in (c). (15 marks)

PART D
CANCER BIOLOGY

Only two questions to be answered in this part.
Each question to be answered in a separate book.

1

(a) Briefly describe how the following are used in diagnosis and monitoring of acute and chronic myeloid leukaemias. (50 marks)

i. Karyotypes
ii. PCR

(b) Discuss the prognostic importance of structural chromosome anomalies in these diseases. (50 marks)

2.

(a) Name three opportunistic neoplasms seen in patients with Acquired Immunodeficiency Syndrome. (30 marks)

(b) Name two cells of the innate immune system involved in immune surveillance against cancer cells. (20 marks)

(c) What is the lymphocyte subset, which is commonly infected by the human immunodeficiency virus ? (10 marks)

(d) In one sentence, describe the immunological basis for the occurrence of opportunistic neoplasms in AIDS. (30 marks)

(e) What is the laboratory method which is employed to assess lymphocyte subsets ? (10 marks)

3. Write short notes on the following :

(a) Complement cascade (25 marks)

(b) Angiogenesis (25 marks)

(c) Topoisomerase (25 marks)

(d) Tumour Volume Doubling Time (25 marks)

POSTGRADUATE INSTITUTE OF MEDICINE
UNIVERSITY OF COLOMBO

MD (CLINICAL ONCOLOGY) PART I EXAMINATION
JULY 2007

Date : 3rd July 2007 Time : 9.00 a.m. -12.00 noon

PAPER I

Parts A and B must be answered.

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

PART A - 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 question Nos. 2 to 7.

1.

(a) Briefly describe the basic principles of radiation protection. (30 marks)

(b) Giving an example of each what do you mean by
i. a stochastic event.
ii. a non stochastic event. (20 marks)

(c) Define the term "Effective Dose" and state what is expected to be achieved by limiting Effective dose and Equivalent dose to an individual. (20 marks)

(d) Give three methods by which patient dose can be measured and give one advantage and disadvantage of each. (30 marks)

2. A patient with carcinoma of the left maxillary antrum has been planned to deliver 60 Gy dose in 30 fractions in 6 weeks to the PTV using a telecobalt machine. The patient is a middle aged person and the left eye is partly involved with the tumor but he has normal vision from the right eye.

Anterior and Left lateral wedge fields are used, tumor (field) length is 8 cm. The left lateral wedge field is angled by 100 towards the anterior field.

Treatment is planned for 80 cm isocentric technique (SAD technique) and the machine isocentre and the tumor centre is the same. Patient lies in a supine position and a 2 mm thick thermoplastic shell is placed over the full face and head of the patient for immobilization but field port~ on the shell are cut and removed. A mouth-bite is also used during the treatment delivery.

	Anterior Field	Left Lateral Field
Field size cm^2	8x 7W	8 x 8W
Tumor depth cm	4.0	3.5
Gantry angle	0^0	800
Tissue Air Ratio (TAR)	0.920	0.94
Weight	100 %	100%
Beam output **with the 45^0 wedge** At 80cm from the source in air For tissue Gy / min.	2.06	2.07

(a) Assuming the dose distribution for above plan is acceptable,

i. Calculate the prescribed dose per field per fraction. (10 marks)
ii. Calculate the treatment time per field per fraction. (40 marks)

(b) Briefly explain the possible reason why;

i. the left lateral wedge field is angled by 10° towards the anterior field ? (10 marks)

ii. the field ports on the shell are cut and removed ? (10 marks)

iii. the mouth bite is used during the treatment delivery ? (10 marks)

(c) Suppose the skull base is not involved therefore one corner of the left lateral field is shielded to preserve the optic chiasm and hypothalamus.

i. What is the recommended thickness of lead for shielding ? (10 marks)

ii. If the previous treatment calculation is delivered without any alterations, how does the shielding affect the dose distribution within the PTV and why ? (10 marks)

3.

(a) What is 3D-Conformal Radiotherapy (3D-CRT) (15 marks)

(b) Discuss the advantages of 3D-CRT over conventional radiotherapy. (20 marks)

(c) According to ICRU 50 and ICRU 62 publications, define

i. Clinical Target Volume (CTV)
ii. Internal Target Volume (ITV)
iii. Planning Target Volume (PTV) (45 marks)

(d) List the steps taken to generate a PTV from the point where a decision is made for external 3D treatment planning. (20 marks)

4.

(a) Sketch the depth dose curve for a 10 x 10 cm2 field size in water, indicate maximum dose build up depth (dmax) and Percentage Depth Dose (PDD) at 10 cm depth; for,

i. 6 MV x-ray beam from Linear Accelerator. (20 marks)
ii. 250 kVp x-ray beam from orthovoltage therapy x-ray tube. (20 marks)

(b) State in one sentence for each, how the quality index is specified for the beams given in part (a) ? (20 marks)

(c) What material /materials are used as added filtration for 250 kVp orthovoltage therapy ? (20 marks)

(d)

i. How does it affect the patient if the filter is not used accidentally ? (10 marks)
ii. What precautions can be taken to avoid such accidents ? (10 marks)

5.

(a)

i. What are the advantages and disadvantages of having a medical linear accelerator (with x-rays and electrons) in a radiotherapy department already having several Co-60 units ? (30 marks)

ii. If the linear accelerator is a dual energy unit what would be the optimum photon energies ? Give reasons for your answer. (20 marks)

(b) Explain briefly why the acceptance tests and commissioning should be completed before the linear accelerator machine is released for clinical use. (30 marks)

(c) List three radiation safety measures that should be carried out after installation of a linear accelerator machine. (20 marks)

6.

(a) Describe the half-life, energy emission and decay process of the following radionuclides used in brachytherapy

i. Cs-137
ii. Co-60
iii. Ir-192 (30 marks)

(b) Give the distribution rules for Ra-226 in the Manchester dosage system for circular planar mould. (20 marks)

(c) Describe the principle of a high dose rate brachytherapy remote after loading system. (20 marks)

(d) List three advantages of the use of Ir-192 in high dose rate remote after loading brachytherapy systems. (30 marks)

7.

(a) List four interaction processes as electrons travel through a medium. (20 marks)

(b) On the same diagram, draw the depth dose curves for a 6 Me V and 15 Me V electron beam indicating D_{max} , D_{so} and R_p for each. (40 marks)

(c) List an advantage and disadvantage of radioactive 1-131 used to treat thyroid cancers. (20 marks)

(d) What are the factors to be considered before the patient undergoes radioactive 1-131 treatment. (20 marks)

PART B - MEDICAL STATISTICS

Answer <u>two Questions</u> of the three questions given below.
Each question carries 100 marks.
Each question to be answered in a separate book.

1. A study was carried out among breast carcinoma patients to determine the prognostic factors (estrogen receptor, ki-67 and Her2*/neu)* for women with Breast carcinoma :S 40 years of age compared to women with Breast carcinoma over 40 years of age. The following table shows the results (numbers and percentages in each category) of the study.

Age	≤ 40	> 40
Estrogen receptor negative	23 (33.8)	50 (21.9)
Estrogen receptor positive	45 (66.2)	178 (78.1)

(a) Name the study design. (Marks 10)

(b) State the null-hypothesis and alternate hypothesis. (Marks 20)

(c) Calculate the Odds Ratio. (Marks 10)

(d) What other information do you need to interpret the Odds ratio ? (Marks 10)

(e) Name two statistical tests that can be applied to the above data. (Marks 15)

(f) List potential sources of bias in this study (Marks 15)

(g) Name a statistical method that could be applied to conclude that estrogen receptor negativity is associated with age after controlling for other confounding factors. (Marks 20)

2. To assess the effect of visual screening on oral cancer mortality, 13 Health centers were chosen and seven were randomized to three rounds of oral visual inspection at 3 year intervals and six other Health centers to the control group. Persons positive on screening were referred for clinical examination, biopsy and treatment.

	Intervention Group	**Control** Group	**95% Confidence** Interval for Rate Ratio
Person years of observation	234405	187281	
Number of oral cancer cases	190	156	
Incidence rate (per 100,000)	81.1	83.3	(0.66 – 1.44)
Number of deaths	70	85	
Mortality rate (per 100,000)	29.9	45.4	(0.45 – 0.95)

(a) State the study design (Marks 10)

(b) How would the randomization reduce bias in the design ? (Marks 20)

(c) Explain briefly how person years of observation were calculated ? (Marks 10)

(d) Calculate the Rate ratios (Marks 20)

(e) Calculate the Risk differences (Marks 20)

(f) Interpret the results of the study ? (Marks 20)

3. Write notes on the following

(a) Log rank test (Marks 30)

(b) Independent sample t –test (Marks 30)

(c) Systematic Reviews (Marks 40)

POSTGRADUATE INSTITUTE OF MEDICINE
UNIVERSITY OF COLOMBO

MD(CLINICAL ONCOLOGY) PART I EXAMINATION
JULY 2007

Date : 3rd July 2007 Time : 1.00 p.m. -4.00 p.m.

PAPER II

Parts A, B, C and D must be answered.

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

PART A-RADIOBIOLOGY

Answer two Questions of the three questions given below.
Each question carries 100 marks.
Each question to be answered in a separate book.

1.

a) List 5 disadvantages of hypoxia in a tumour (5 x 5 marks)

b) List 3 advantages of hypoxic cells that can be used against when treating cancer. (5 x 3 marks)

c) Give 2 methods used to measure oxygenation status in the clinic and name a type of cancer where hypoxia is clearly shown. (5 x 3 marks)

d) Outline the underlying mechanisms of hypoxia (20 marks)
and write briefly on methods used to improve effectiveness of radiotherapy if tumour hypoxia is present (25 marks)

2.

a) Give an equation based on the LQ approach used to change the total radiation dose required when dose per fraction is changed. (10 marks)

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

c) The standard treatment for carcinoma X in your hospital is 35 x 2Gy fractions. The initial 6 fractions were given as 4 Gy fractions by error.

i Name the principle of this initial error ? (10 marks)

ii What is the schedule to get an equal late injury ? (20 marks)

iii What is the schedule to get an equal tumour effect ? (20 marks)

iv Would you consider ii and iii as under or over dosing and indicate it as a percentage (20 marks)

v What is the principle you would use to correct this to achieve identical tumor effect **and** late injury as expected with 35 x 2 Gy. (10 marks)

3.

a) Give the three main factors that influence the biological effects of ionizations. (15 marks)

b) Ionising radiation generates damaging free radicals throughout the cell. Name three non protein thiols that may scavenge a proportion of the free radicals (15 marks)

c) Irradiation leads to a loss of viscosity in DNA solutions. What is the cause for this ? (06 marks)

d) Give the type and where ever possible the number of DNA lesions per cell detected after a clinically used dose. (20 marks)

e) Complete the following chart. For each cell in the table state increased, decreased, little or no effect or not known

Modifier	Cell Kill	dsb	ssb	Base damage
High LET radiation				
Hvpoxia				
Thiols				
Hyperthermia				

(4 x 11 marks)

PART B – PATHOLOGY

Answer <u>two Questions</u> of the three questions given below.
Each question carries 100 marks.
Each question to be answered in a separate book.

1. Describe the morphological and immunohistochemical features of the following tumours

   (a) Classical Hodgkin Lymphoma-Nodular sclerosis type (35 marks)

   (b) Lymphoblastic lymphoma (35 marks)

   (c) Mycosis fungo ides (30 marks)

2. Write short notes (including histological features) on the following

   (a) Duct carcinoma of breast (25 marks)

   (b) Adenoid cystic carcinoma (25 marks)

   (c) Rhabdomyosarcoma (25 marks)

   (d) Small cell carcinoma of lung (25 marks)

3. (a) List the pre malignant lesions and conditions of colorectal carcinoma. (35 marks)

   (b) What are the important histological features that would help in prognostication and management of colorectal carcinoma. (50 marks)

   (c) Mention three important genetic changes that give rise to colorectal carcinoma. (15 marks)

PART C – CHEMOTHERAPY

Answer <u>two Questions</u> of the three questions given below.
Each question caries 100 marks.
Each question to be answered in a separate book.

1. A 40 year old woman with metastatic breast cancer is started on tamoxifen.

   (a) Explain the pharmacological basis for the use of tamoxifen in this patient. (40 marks)

   (b) Outline the mechanisms by which resistance to tamoxifen may develop. (30 marks)

   (c) She later changes to anastrazole. What is the mechanism of action of this drug and how does it differ from tamoxifen ? (30 marks)

2. You are an oncologist working in a tertiary care hospital for cancer patients in Sri Lanka. You are contacted to participate in an International Multicentre Phase **III** clinical trial to evaluate the efficacy of a new combined drug regimen for induction phase treatment of acute lymphoblastic leukaemia.

   (a) Describe the clinical trial design used in a phase **III** clinical trial. (20 marks)

   (b) Explain the necessary approvals you would need to obtain from relevant authorities and participants before conducting this trial. (30 marks)

   (c) Explain the steps you would take as an investigator to avoid or minimize bias in conducting this clinical trial. (30 marks)

   (c) Describe the appropriate end points to evaluate the efficacy of the new drug regimen in this clinical trial. (20 marks)

3.

   (a) Explain the term adverse drug reaction. (20 marks)

   (b) Explain briefly the mechanisms of gastrointestinal adverse drug reactions of cytotoxic drugs giving appropriate examples. (50 marks)

   (c) Explain how you could minimize the occurrence and severity of the adverse drug reactions. described in (b). (30 marks)

PART D - CANCER BIOLOGY

Answer <u>two Questions</u> of the three questions given below.
Each question caries 100 marks.
Each question to be answered in a separate book.

1.

(a) List three types of tumour antigens. (15 marks)

(b) In one sentence, state the difference between NK cells and T lymphocytes in the recognition of tumour antigens. (15 marks)

(c) Name a surface marker for
i. T lymphocytes
ii. B lymphocytes
iii. Stem cells (15 marks)

(d) What is the laboratory method used in detecting CD4+ cells in HIV infection ? (10 marks)

(e) What is the effect of HIV infection on the lymphocyte subpopulations? (25 marks)

(f) List four opportunistic infections more commonly seen in HIV positive patients. (20 marks)

2. Write short notes on :
(a) The cyclin family (25 marks)
(b) Retinoblastoma gene (25 marks)
(c) Factors limiting proliferation of tumour cells (25 marks)
(d) Human papilloma virus (25 marks)

3.

(a) Name two methods that can be used to detect point mutations. (20 marks)

(b) Describe the biochemical consequences of point mutation in the *Ha-ras* proto-oncogene. (40 marks)

(c) Describe two other mechanisms by which oncogenes can be activated, giving an example of each. (40 marks)

POSTGRADUATE INSTITUTE OF MEDICINE
UNIVERSITY OF COLOMBO

MD (CLINICAL ONCOLOGY) PART I EXAMINATION
JULY 2008

Date : 22nd July 2008 Time:- 9.00 a.m. - 12.00 noon

PAPER I

Parts A and B must be answered.
If the examiner cannot read your writing they will be unable to give you full credit for your knowledge.

PART A – 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 question Nos. 2 to 7.

1.

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

1.2.

1.2.1. Briefly explain what is meant by external radiation hazards. (10 marks)

1.2.2. List basic methods used to control the external radiation hazards. (l5 marks)

1.2.3. Explain one method in three to four sentences giving practical examples. (10 marks)

1.3.

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

1.3.2. List three basic methods of radioactive waste management. (l5 marks)

1.3.3. Assume that a patient treated with 200 mCi of Iodine -131 (^{131}I) had died few hours after administration. Briefly explain the safety measures to be taken by each party at various stages prior to burial or cremation. (20 marks)

2.

2.1.

2.1.1. Briefly describe the concepts of systematic and random errors in radiotherapy. (25 marks)

2.1.2. How is this used to define the planning target volume (PTV). (20 marks)

2.1.3. Give four sources of geometric error when using a linear accelerator. (20 marks)

2.1.4. Give three sources of dosimetric error when using a linear accelerator. (15 marks)

2.1.5. Give four quality control parameters checked on a daily basis before use of a linear accelerator and give their tolerance limits. (20 marks)

3. A patient with carcinoma of the prostate has been planned to deliver 60Gy dose of radiation in 30 fractions in 6 weeks to the PTV using a telecobalt machine. Radiotherapy is based on 2D-planning and patient outline through the centre of the PTV with the fields arrangement is shown in the figure 1. Tumour (field) length is 9 cm. One Anterior field and two Posterior oblique fields are used at 80 cm SSD.

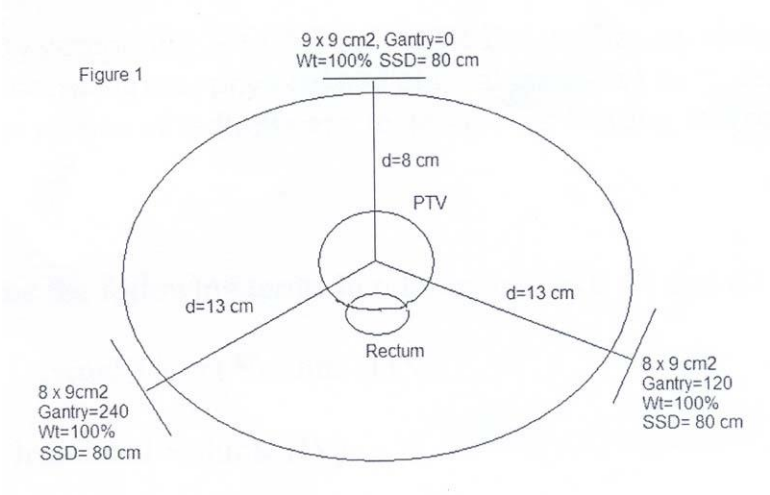


Fig. 1

Percentage Depth Dose table (PDD) for Co-60 gamma ray beams at 80 cm SSD

Depth (cm)	8x8 cm^2	8x9 cm^2	9x9 cm^2
0.5	100	100	100
8.0	62.7	63.05	63.4
13.0	43.2	43.6	44.0

Dose rate to water at the d^{max} at 80 cm SSD for 9x9 cm^2 field=2.58 Gy/min
Dose rate to water at the d^{max} at 80 cm SSD for 8x9 cm^2 field=2.56 Gy/min

Assuming that the dose distribution is acceptable

3.1. Calculate applied dose per field per fraction. (30 marks)

3.2. Calculate the treatment time per field per fraction. (10 marks)

For the same patient, more conformal tumour coverage can be obtained by using 3D-conformal Radiation Therapy (3D-CRT) with 15 MV x-ray beam from the linear accelerator with MLCs or by using high dose rate (HDR) brachytherapy from 192- Ir remote afterloader.

3.3. List main steps in the treatment planning process from imaging to first treatment delivery **in the 3D-CRT technique.** (30 marks)

3.4. By comparing 3D-CRT and HDR Brachytherapy techniques, briefly discuss various physical and clinical issues for each delivery technique in the choice of radiotherapy technique for treating this patient. (30 marks)

4. Define the following terms in relation to ICRU 50 and 62.

4.1. Internal Target Volume (ITV). (10 marks)

4.2. Irradiated Volume (IV). (10 marks)

Two curves in the figure 2 and figure 3 depict Percentage Depth Doses (PDD) measured with different depths in water for two different types of radiation beams used for radiotherapy.

Figure 2

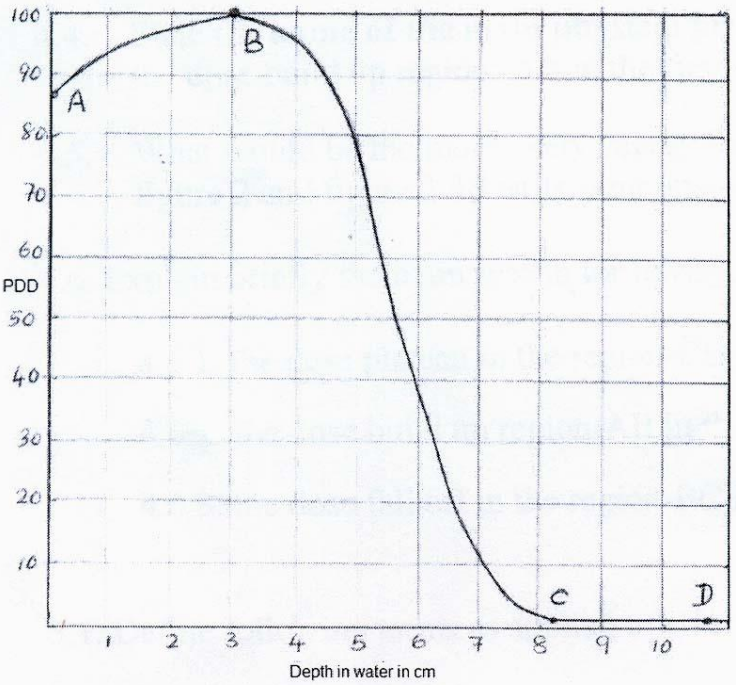
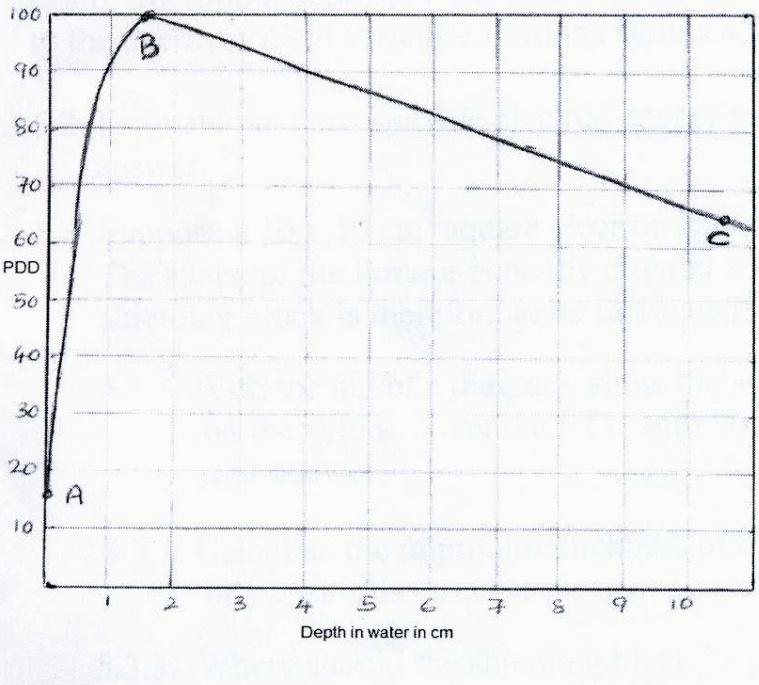


Figure 3



4.3. Identify the type of radiation in figure 2 and figure 3. (10 marks)

4.4. State the **name of the main physical process** which correctly explains the dose build up region -AB in the figure 2. (20 marks)

4.5. What would be the most likely energy for the depth dose curves in figure 2 and figure 3 ? Justify your answer. (20 marks)

4.6. Explain briefly the main reason for having;

4.6.1. the dose plateau in the region-CD in the figure 2. (10 marks)

4.6.2. the dose build up region-AB in the figure 3. (10 marks)

4.6.3. the dose fall off in the region-BC in the figure 3. (10 marks)

5.

5.1. Define following terms as applied to electron beam

5.1.1. R90 (05 marks)
5.1.2. R50 (05 marks)
5.1.3. Rp (05 marks)

A superficially located tumour site has been arranged to treat with an electron beam. Maximum depth of PTV from the skin is 2.7 cm and the minimum depth to the nearby critical structure *from* the skin is 4.6 cm.

5.2. Estimate the most suitable electron energy to treat this tumour. Justify your answer. (20 marks)

5.3. Suppose a 10 x 10 cm2 square electron applicator is used to treat this tumour. The shape of the tumour is nearly circular with a radius of 6 cm and a shielding block is therefore to be fabricated. .

5.3.1. With the aid of a diagram, show the appropriate size of the field on the skin to cover the PTV with 90% isodose surface.' Justify your answer. (25 marks)

5.3.2. Calculate the minimum thickness of the shielding (Lead or Cerobend) block for this electron energy. (25 marks)

5.3.3. Where should the shielding block be placed to obtained the appropriate results, Explain your answer. (15 marks)

6.

6.1. List the main functions of the following devices in the head of the medical Linear accelerator

6.1.1. Primary collimator. (15 marks)

6.1.2. Secondary -asymmetric collimator (15 marks)

6.1.3. Tertiary -multileaf collimator (15 marks)

6.2.

6.2.1. Define the wedge angle. (05 marks)

6.2.2. At what depth is the wedge angle is defined for a high energy Linear accelerator and why ? (05 marks)

6.2.3. Explain the role of a wedge filter in radiotherapy planning. (15 marks)

6.3.

6.3.1. What is the role of the beam flattering filter in a linear accelerator (15 marks)

6.3.2. What is the role of the scattering foil in a linear accelerator? (15 marks)

7.

7.1. Orthogonal x -ray films are often useful for Brachytherapy, What are orthogonal films and what are the advantages and disadvantages in Brachytherapy ? (25 marks)

7.2. Write down the distribution rules for planar implants in Manchester system. (25 marks)

7.3. Name two radionuclides which are widely used for permanent implants and list their physical properties. (20 marks)

7.4. Calculate the radiation exposure at 1 m distance from 10 mCi Ir-192 source for 10 mins.
(exposure rate constant for 1r-192 is 4.69 R cm^2 h^{-1} m Ci^{-1}) (30 marks)

PART B- MEDICAL STATISTICS

Answer <u>two questions</u> of the three questions given below.
Each question carries 100 marks.
Each question to be answered in a separate book.

1. A non randomized study was conducted to assess the efficacy of letrozole compared to placebo following 5 years of adjuvant tamoxifen in postmenopausal hormone receptor-positive early stage breast cancer patients. Survival analysis was performed for disease-free survival and distant disease-free survival using the Kaplan-Meier method. At the median follow up of 5 years, disease-free survival (Hazard ratio 0.37, p<O.OOI) and distant disease-free survival (Hazard ratio 0.39, p<0.004) were superior in the letrozole group.

    1.1. What are the ethical issues of using placebo in the above study ? (15marks)

    1.2. What is the rationale for using the Kaplan-Meier method ? (25 marks)

    1.3. Name and explain a statistical test that can be applied to the above Data. (25 marks)

    1.4. What suggestions would you make to improve the quality of the above study and give reasons ? (25 marks)

    1.5. Name a statistical method that could be applied to control for multiple prognostic factors. (l0 marks)

2. Write notes on the following

    2.1. Receiver operator characteristic curve (ROC) (25 marks)

    2.2. Fositive predictive value (25 marks)

    2.3. Randomization. (25 marks)

    3.4. Type I error (25 mark)

3. A study was conducted to compare the risk of cancer in women with Turner's syndrome and the general population. Standardised incidence ratios (SIR) and 95% confidence intervals (95%CI) were calculated. .

Table: Cancer incidence by site

Cancer	SIR	95% CI
Colon and rectum	1.1	[0.5, 2.3]
Breast	0.3	[0.2, 0.6]
Central nervous system	4.3	[2.3, 7.4]

3.1. State the study design. (10 marks)

3.2. Define and describe SIR. (30 marks)

3.3. List three sources of bias in the design and explain ? (30 marks)

3.4. Interpret the results of the study ? (30 marks)

POSTGRADUATE INSTITUTE OF :MEDICINE
UNIVERSITY OF COLOl\1BO

MD (CLINICAL ONCOLOGY) PART I EXAMINATION
JULY 2008

Date : 22nd July 2008 Time : 2.00 p.m. - 5.00 p.m.

PAPER II

Parts A, B, C and D must be answered.

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

PART A-RADIOBIOLOGY

Answer two Questions of the three questions given below.
Each question carries 100 marks.
Each question to be answered in a separate book.

1.

1.1. There are three main types of fractionation schedules used in clinical practice. What are the potential advantages and disadvantages of the different types of schedules from a radiobiological point of view ? (45 marks)

1.2. The standard treatment for squamous carcinoma of head and neck in your hospital is 35 x 2Gy fractions. A young trainee had recommennded 1.2Gy/ fraction instead. Consider a/~ for late fibrosis to be 3.5 Gy

1.2.1. Considering late effects how many fractions need to be given ? (20 marks)

1.2.2. What would the total dose be ? (10 marks)

1.2.3. What is the effective dose to the tumour ? (αβ for tumour lOGy) (10 marks)

1.2.4. Would this be an increase or decrease in the effective dose and what is the magnitude as a percentage ? (10 marks)

1.2.5. This recommended treatment is based on. what principle ? (05 marks)

2. Select from each of the following the correct statement and give the reason wherever possible for your, selection. In one or two sentences state why the rest are incorrect. (2x50 marks)

2.1. Concerning tumor growth kinetic parameters

2.1.1. Cell loss factor <p often decreases several weeks after the start of radiotherapy.

2.1.2. The growth fraction (GF) is the ratio of the number of viable cells to the sum of viable and non-viable cells.

2.1.3. If the volume doubling time (TD) is 60 days and the potential doubling time (Tpot) is 3 days, then the cell loss factor is 5%.

2.1.4. Typically, the cell loss factor, φ is of minor importance in determining a tumor volume doubling time.

2.2. An 8 Gy X-ray dose delivered at 1 Gy/hr is less toxic than the same dose delivered at 1 Gy/min

2.2.1. fewer free radicals are generated

2.2.2. cell division occurs during exposure

2.2.3. sublethal damage repair occurs during the irradiation

2.2.4. Free radical ,scavenging and chemical restitution is permitted

3.

3.1. Schematically outline and name the proliferative organization of normal tissue systems. (25 marks)

3.2. Give two examples for each system (10 marks)

3.3. Briefly explain how the time of appearance and dose dependence of Radiation damage in normal tissue is dependant on the proliferative organization given in 3.1. (40 marks)

3.4. .

3.4.1. Name the most important mode of cell death after irradiation (05 marks)

3.4.2. Name a cell type that differs from the above mode of cell death and give the method of death (10 marks.)

3.4.3. How do rapidly and slowly proliferating normal tissues respond to radiation induced cell killing ? (10 marks)

PART B – PATHOLOGY

Answer <u>two Questions</u> of the three questions given below.
Each question carries 100 marks.
Each question to be answered in a separate book.

1. A 60 year old smoker presents with an abnormal chest X ray and small pleural effusion.

   1.1. What pathological investigations are useful in confirming the diagnosis of lung carcinoma. (30 marks)

   1.2. Describe briefly the histological and immunohistochemical features of adenocarcinoma of lung, mentioning two sub types. (55 marks)

   1.3. Give three important pathological prognostic features of this tumour. (15 marks)

2. Mention three important histological prognostic indices in each of the following tumours-

   2.1. Breast carcinoma (20 marks)

   2.2. Soft tissue sarcoma (20 marks)

   2.3. Colorectal carcinoma (20 marks)

   2.4. Malignant melanoma (20 marks)

   2.5. Prostate carcinoma (20 marks)

3.

3.1. Describe the histological and immunohistochemical features of Ewing sarcoma. (25 marks)

3.2. Give two malignant tumours that share similar histological features with the following :

3.2.1. Diffuse large B cell lymphoma. (20 marks)

3.2.2. Embryonal rhabdomyosarcoma. (20 marks)

3.2.3. Carcinoid tumour. (20 marks)

3.3. What imunohistochemical marker would be useful in confirming the diagnosis of each of these tumours ? (15 marks)

PART C – PHARMACOLOGY

Answer <u>any two Questions</u> of the three questions given below.
Each question carries 100 marks.
Each question to be answered in a separate book.

1. Write short notes on each of the following.

1.1. The mechanisms of resistance to cytotoxic drugs. (40 marks)

1.2. The mechanism of action of methotrexate. (30 marks)

1.3. The basis for the use of trastuzumab in the treatment of breast cancer. (30 marks)

2. A new chemical developed for the treatment of adenocarcinoma of the bowel has completed the preclinical trials successfully. Explain the process by which it should be further tested in clinical trials to be established in routine treatment of adenocarcinoma of the bowel. (100 marks)

3. Define the term,

3.1. "oral bioavailability" and explain the basis for the use of sustained release morphine tablets in the management of cancer pain. (25 marks)

3 .2. "volume of distribution" and explain the mechanisms by which the toxicity of etoposide is increased in advanced liver disease. (25 marks)

3.3. "steady state" and explain how the time to reach steady state concentration for a given drug is predicted. . (25 marks)

3.4. "first pass metabolism" and explain the mechanisms by which ketoconazole may increase the toxicity of paclitaxel. (25 marks)

PART D - CANCER BIOLOGY.

Answer <u>two Questions</u> of the three questions given below.
Each question carries 100 marks.
Each question to be answered in a separate book.

1.

1.1 Outline the role of cytotoxic lymphocYtes in eliminating tumour cells. (60 marks)

1.2. State three mechanisms adopted by the tumours to evade immune attack. (40 mark)

2. Balanced chromosomal translocations are a feature of acute and chronic leukaemias. Such translocations result in the production of fusion proteins involved in the pathogenesis of the condition.

2.1 Describe how balanced translocations result in the production of fusion proteins using chronic myeloid leukaemia as an example. (50 marks)

2.2 Discuss why reverse transcriptase (RT) PCR is more useful than karyotyping in detecting these translocations. (30 marks)

2.3. What is the clinical relevance of these translocations ? (20 marks)

3.

3.1. Give three characteristics which distinguished the malignant cell from a normal cell. (15 marks)

3.2 With reference to the development of colorectal cancer

3.2.1. What is meant by multi-step carcinogenesis ? (25 marks)

3.2.2. Explain the role of tumour suppressor genes giving examples. (20 marks)

3.2.3. What is the function of the *ras* oncogene (20 marks)

3.2.4. What is the basis of a hereditary non polyposis colorectal cancer (HNPCC) (20 marks)

POSTGRADUATE INSTITUTE OF MEDICINE
UNIVERSITY OF COLOMBO

MD (CLINICAL ONCOLOGY) PART I (REPEAT) EXAMINATION MARCH 2009

Date : 3rd March 2009 Time : 9.00 a.m. - 12.00 noon

PAPER I

Parts A and B must be answered.

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

PART A-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 question Nos. 2 to 7.

1

1.1 Define the term "Equivalent dose" in a tissue or organ of the body. (10 marks)

1.2 What is the equivalency of 1 Roentgen exposure of X rays and gamma rays to the human body in Sieverts for radiation protection purposes. (20 marks)

1.3 What are the Effective dose limits recommended in Sri Lanka legislation for radiation workers and general public ? (40 marks)

1.4 Human fetus is normally sensitive to ionizing radiation from 3 weeks after conception till end of the pregnancy.

1.4.1. What is the most sensitive period in weeks of the human fetus to ionizing radiation ? (10 marks)

1.4.2. List possible effects even with low frequency during this period for exposure of fetus to about 100 mSv acute dose. (20 marks)

2. For x-ray photon beams

2.1 Define the mass attenuation coefficient. (12 marks)

2.2 State the most dominant process of interactions in water for the following energy ranges
(a) 50 keV to 250 keV (b) 250 keV to 1 MeV (c) 1 MeV to 10 MeV
. (15 marks)

2.3 Briefly discuss the dependence of atomic number in the medium for photon interaction processes in the above energy ranges. (30 marks)

2.4 What is meant by dose build up region and how is it important in Radiotherapy. (25 marks)

2.5 State the typical depths for dose maximum in water for the following beam energies of 10 x 10 cm^2 field size.
(a) orthovoltage therapy (b) Co-60 gamma rays (c) 6 MV x-rays
(d) 15 MV x-rays (e) 6 MeV electrons (f) 15 MeV electrons
(18 marks)

3.

3.1. With reference to ICRU 50 & 62 reports, define the following -

3.1.1. Planning Target Volume (PTV). (10 marks)

3.1..2 Treated Volume (TV) (10 marks)

3.2 Consider the two treatment planning situations given below for the same patient, comment on the most likely PTV to TV difference.

Situation one: using simple rectangular open fields using telecobalt machine.

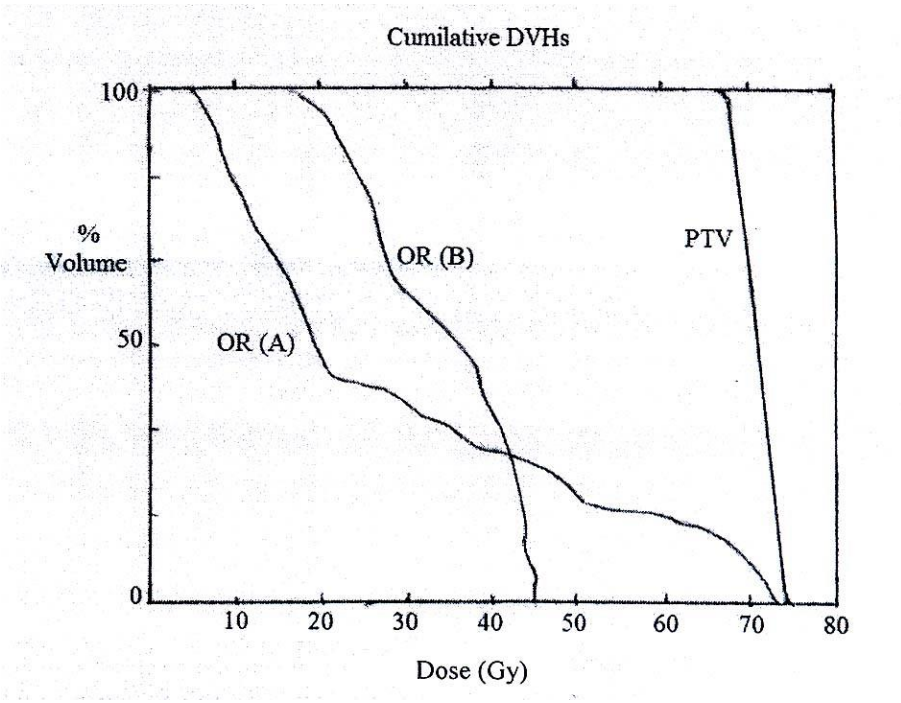
Situation two: using 3D conformal photon beams delivered by MLCs using 6MV linear accelerator. (30 marks)

3.3. When evaluating more than one possible treatment plan for a given patient.

3.3.1. Describe two advantages in using cumulative Dose Volume Histograms (DVHs). (10 marks)

3.3.2. Describe one disadvantage in using DVHs. (05 marks)

3.4. Fig.l represents a DVH, Dose prescription to PTV is 70 Gy.



3.4.1. According to the ICRU 50 & 62 reports, is the criterion for dose homogeneity across the PTV acceptable ? Give reasons.
(15 marks)

3.4.2. Identify two classes of Organs at Risk (OAR). Which of this is represented in the DVHs OAR(A) and OAR(B) above.
(20 marks)

4

A patient with a carcinoma of bladder is to be treated supine at 80 cm Source Axis Distance (SAD) with a four field box technique from a cobalt teletherapy machine. Planning Target Volume (PTV) length is 8 cm and the prescribed dose is 64 Gy in 32 fractions. The depth to the tumour centre from the surface of the central axis of anterior, posterior, left lateral and right lateral fields is 8cm, 10cm, 16cm, and 16cm respectively. Field sizes for anterior & posterior beams are 9cm x 9cm and left lateral & right lateral are 8cm x 9cm.

Field size (cm^2)	Depth (cm)	TAR	Dose rate to water in air at 80 cm (cGy/ min)
9 x 9	8	0.774	337.83
9 x 9	10	0.699	337.83
8 x 9	16	0.505	336.75

Assuming that tumour centre receives the same dose from all beams

4.1 Calculate the treatment time for each field. (40 marks)

4.2 Define other possible field arrangements with appropriate wedges to be considered for the above treatment. (15 marks)

4.3 Discuss the clinical advantages when the above plan is transferred to treat isocentrically on a 15 MV Linear accelerator machine. (15 marks)

4.4 What steps would be required to convert this plan to a 3-D conformal plan. What are the considerations in defining the PTV. (30 marks)

5 A modem medical linear accelerator (Linac) is available with two photon energies and many electron energies.

5.1. Using simple diagrams show the major design features of the Linac head arrangement between the end of the wave guide and the secondary collimator when the machine is used for generating:

5.1.1. a photon beam for patient treatment. (20 marks)

5.1.2. an electron beam for patient treatment. (20 marks)

One such Linac is designed to generate photon beams with nominal energy 6 MV and 15 MV.

5.2 What is meant by "Nominal Energy" ? (10 marks)

5.3 What is the beam quality index for a Linac photon beam recommended by IAEA (TRS 398 protocol). Show in a diagram how this is measured. (30 marks)

5.4 A modem Linac compared to telecobalt machine needs even more quality control tests to be performed routinely to maintain its specifications, explain briefly why is so ? (20 marks)

6

6.1.1 Draw a central axis depth dose curve for a 10 x 10 cm^2, 9 Me V electron beam incident perpendicularly on the water phantom (Indicate R_{IOO}, R_{90} and Rp). (15 marks)

6.1.2 Indicate in the same diagram, the effect on the depth dose curve of reducing field size to 3 x 3 cm^2, 9 Mev. (15 marks)

6.1.3 Indicate in the same diagram, the effect on the depth dose curve of increasing energy to 15 MeV, 10 x 10 cm^2 field. (15 marks)

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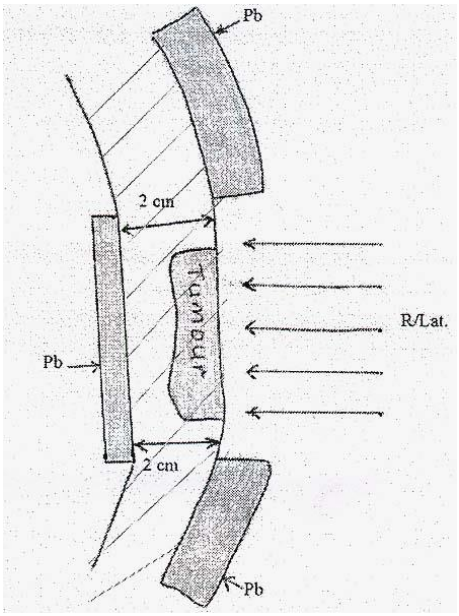

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Fig. 2

A 9 Me V electron beam is to be used to treat a carcinoma on the right cheek as illustrated in the above diagram.
A lead cut-out is placed on the skin to define the treatment area and another lead sheet is placed inside the mouth between the buccal mucosa and the jaw to protect underlying tissue.

6.2 Calculate the minimum thickness of lead required to provide adequate protection to tissue under the cut-out. (15 marks)

6.3 Briefly discuss the effect on the buccal mucosa just above the lead sheet caused by the internal shielding and state a method to minimize that effect. (20 marks)

6.4 Electron beam apposition perpendicular to the cheek is important, explain why ? (20 marks)

7. A cervix cancer patient is planned for high dose rate gynaecological brachytherapy.

7.1 Define point A according to the Manchester system. (10 marks)

7.2 Give three other dosimetry points which should be considered for treatment plan evaluation and why ? (30 marks)

7.3 How in dose reduction for critical organs of this treatment be achieved clinically ? (10 marks)

7.4 List three physical properties for each of two radionuc1ides which are used for HDR remote after loading systems. (30 marks)

7.5 Briefly discuss four physical features of a common HDR remote after loading system. (20 marks)

PART B - MEDICAL STATISTICS

Answer <u>two questions</u> of the three questions given below.
Each question carries 100 marks
Each question to be answered in a separate book.

1. One hundred and forty nine anaemic (haemoglobin :s **11** g/d!) patients with cancers were recruited for a study. All patients received darbepoetin 150 Jlg once weekly for 12 weeks and then randomly assigned to sodium ferric gluconate 125 mg intravenously for the first 6 weeks (n=73) or no iron (n=76). The primary endpoint of the study was the haematopoietic response. The data were analyzed according to 'intention to treat' principle. The results are given below.

	Darbepoetin plus Intravenous iron	Darbepoetin only
Hemoglobin (g/dl)		
Mean	12.2	9.90
Standard deviation	0.78	0.82

1.1. State the objective of the above study. (15 marks)

1.2. Why were the two groups chosen by randomization ? (15 marks)

1.3. Apply a statistical test to assess the haematopoietic response of the above study ? (25 marks)

1.4. Interpret your finding. (15 marks)

1.5. What assumptions would you make for applying the above test ? (15 marks)

1.6. What do you understand by the phrase 'intention to treat' principle ? (15 marks)

2. A study was conducted to determine the prevalence of 'arm lymphoedema' among patients with metastatic breast cancer and to assess the association between 'arm lymphoedema and receiving any physical rehabilitation intervention (APRI). One hundred and sixty three patients were selected applying a simple random sampling from a population. The study revealed that 40 patients had 'arm lympoedema'. Multiple logistic regression analysis revealed that arm lympoedema had a association with APRI (Odds ratio 7.2; 95% confidence interval 3.61 to 14.4).

2.1. Name the study design. (10 marks)

2.2. Describe the method of simple random sampling. (20 marks)

2.3. List the considerations in determining the sample size for the prevalence study (20 marks)

2.4. Calculate the prevalence of 'arm lymphoedema'. (10 marks)

2.5. Calculate the 95% confidence interval for the prevalence of 'arm lymphoedema' and interpret this. (25 marks)

2.6. Give reasons for applying multiple logistic regression. (15 marks)

3. Write notes on the following

3.1. Lead time bias. (25 marks)

3.2. Log rank test. (25 marks)

3.3. Standardized mortality ratio. (25 marks)

3.4. Receiver operator characteristic curve (ROC). (25 marks)

POSTGRADUATE INSTITUTE OF MEDICINE
UNIVERSITY OF COLOMBO

MD.(CLINICAL ONCOLOGY) PART I (REPEAT) EXAMINATION
MARCH 2009

Date : 3rd March 2009 Time : 2.00 p.m. - 5.00 p.m.

PAPER II

Answer Parts A,B,C and D in separate books.

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

PART A - RADIOBIOLOGY

Answer two Questions of the three questions given below.
Each question carries 100 marks.
Each question to be answered in a separate book.

1.

1.1. List three factors that determine growth rate of a tumour. (15 marks)

1.2. What are the processes that cause tumours to grow with a doubling time that is longer than the cell cycle time ? (10 marks)

1.3. With the help of a figure illustrate how a tumour volume would respond to treatment. Name the components of the response. (15 marks)

1.4. Write one or two sentences on the cell kinetic compartments of a tumour. (4 x I5 marks)

2. .

2.1. State the principles of hyper fractionation and accelerated radiotherapy. (30 marks)

2.2. Explain briefly the radiobiological constraint in giving multiple fractions per day. (30 marks)

2.3. Name any two clinical trials you have studied where modified fractionations have been used. (10 marks)

2.4. Using the LQ model convert a dose regimen of 60 Gy in 2 Gy fractions to one using 3 Gy fractions to get the same level of late normal tissue effects. (20 marks)

2.5. Would this increase or decrease the chance of cure? Give your reason in a sentence or two. (10 marks)

3.

3.1.

3.1.1. What is a cell survival curve ? (10 marks)

3.1.2. Draw survival curves for low LET and high LET radiation. (10 marks)

3.1.3. Why is radiation with an LET of about 100 keV /µm. optimal in terms of producing a biological effect. (25 marks)

3.1.4. Define cell death for non proliferating cells and stem cells due to radiation. (10 marks)

3.2.

3.2.1. What are radiosensitizers ? (10 marks)

3.2.2. Name two types of sensitizers with different modes of action that have found practical use in clinical radiotherapy. (10 marks)

3.2.3. Briefly state how these two types bring about a differential effect. (25 marks)

PART B – PATHOLOGY

Answer <u>two Questions</u> of the three questions given below.
Each question carries 100 marks.
Each question to be answered in a separate book.

1.

1.1. List the types of T cell Non Hodgkin lymphoma. (25 marks)

1.2. Describe the clinical and histological features of Mycosis Fungoides. (65 marks)

1.3. What immunohistochemical markers would be useful in the diagnosis of Mycosis Fungoides. (10 marks)

2. Describe the histological and immunohistochemical features of the Following-

2.1. Synovial sarcoma. (40 marks)

2.2. Plasmacytoma. (30 marks)

2.3. Medullary carcinoma of the thyroid. (30 marks)

3. Write short notes on –

3.1. Mucoepidermoid carcinoma. (40 marks)

3.2. Adenolymphoma (Warthin tumour). (30 marks)

3.3. Pleomorphic adenoma of salivary gland. (30 marks)

PART C – PHARMACOLOGY

Answer <u>any two questions</u> of the three questions given below.
Each question carries 100 marks.
Each question to be answered in a separate book.

1. Mr. Perera a 65 year old male, was diagnosed to have prostatic carcinoma. He was treated with a gonadotrophin analogue (goserelin) and an anti androgen (flutamide).

   1.1. Explain the pharmacological basis of the therapeutic use of the drugs mentioned above. (50 marks)

   The disease progressed and Mr Perera was diagnosed to have hormone refractory prostate cancer. Treatment with Docetaxel was initiated.

   1.2. Explain briefly the mechanism of action of docetaxel. (20 marks)

   1.3. What are the side effects of docetaxel seen at initiation of treatment and the precautions taken to minimise them. (30 marks)

2.

   2.1. Describe the important pharmacological principles taken into consideration when designing combination chemotherapy regimens for clinical use. (40 marks)

   2.2 Explain the term first pass metabolism and its clinical significance using morphine as an example. (20 marks)

   2.3. Outline the principles of initiating oral morphine for pain relief (30 marks)

   2.4. Explain the pharmacokinetic basis for the toxicity of morphine in renal failure. (10 marks)

3.

3.1. Define the term "drug interaction". (10 marks)

3.2. List five pharmacological mechanisms through which a drug can interact with another drug. (15 marks)

3.3. List the consequences of drug interactions. (15 marks)

3.4. Giving diclofenac to a patient who is on methotrexate precipitates severe and in some cases fatal aggravation of methotrexate toxicity. Explain the pharmacological basis of this drug interaction. (30 marks)

3.5. Write on any five precautions to be taken to minimise occurrence of clinically significant drug interactions in oncology practice. (30 marks)

PART D - CANCER BIOLOGY

Answer <u>two Questions</u> of the three questions given below.
Each question carries 100 marks.
Each question to be answered in a separate book.

1. Explain the mechanism of action of the following in combating cancer cells. .

1.1. Macrophages. (50 marks)

1.2. Natural Killer Cells. (20 marks)

1.3. Complements. (30 marks)

2. A woman with breast cancer is found to have a mutation in the BRCAI gene.

2.1. What types of malignancy has she an increased risk of developing. (15 marks)

2.2. What are the risks of her children having the same mutation ? (20 marks)

2.3. Her daughter wishes to know whether she has inherited the mutation. What type of genetic test will help clarify the issue ? (15 marks)

2.4. The daughter is found to have the mutation. What is her risk of developing breast cancer ? (10 marks)

2.5. She now wishes to know when she will get the cancer. What advice would you give her ? (20 marks)

2.6. The daughter's son wants to know whether he is at an increased risk of cancer. What advice would you give him ? (20 marks)

3. Write short notes on the following

3.1. Tumour suppressor genes. (25 marks)

3.2. Tumour angiogenesis. (25 marks)

3.3. Viral carcinogenesis. (25 marks)

3.4. Telomeres. (25 marks)

POSTGRADUATE INSTITUTE OF MEDICINE
UNIVERSITY OF COLOMBO

MD (CLINICAL ONCOLOGY) PART I EXAMINATION
AUGUST 2009

Date : 4th August 2009 Time : 9.00 a.m. – 12.00 noon.

PAPER 1

Parts A and B must be answered.

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

PART A - 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 question Nos. 2 to 7.

1.

1.1.

(a) Briefly explain " Stochastic Effect" giving two examples. (20 marks)

(b) List the possible deterministic effects, if the human body is uniformly exposed to an acute dose of about 600 mSv. (10 marks)

1.2.

(a) List the three principles of radiation protection as identified by the ICRP. (15 marks)

(b) Briefly explain in 2-3 sentences each principle in 1.2.(a). (30 marks)

1.3.

(a) List two radioactive materials used in medicine which generate low level waste. (10 marks)

(b) Briefly explain how low level wastes generated in nuclear medicine are managed. (15 marks)

2.

2.1.

(a) How does a radionuclide differ from a stable atom ? (15 marks)

(b) State the relationship between the units Ci and Bq. (10 marks)

(c) What is meant by half life and mean life of radioisotopes ? (30 marks)

2.2.

(a) Write the major application for each of the following radioisotopes used in radiotherapy.
^{131}I, ^{125}I, ^{137}Cs, ^{192}Ir and ^{32}P (15 marks)

(b) Name the main type of radiation emitted from each radioisotope which is useful for the clinical application mentioned in 2.2. (a). (15 marks)

2.3. Alpha emitting radionuclides are not routinely used for patient treatments, explain why ? (15 marks)

3

3.1. Define the following terms in relation to ICRU 50 & 62 reports

(a) Clinical Target volume (CTV) (10 marks)

(b) Internal margin (IM) (10 marks)

3.2. When treating carcinoma of the prostate list four clinical issues which should be considered related to the IM and the CTV between the first day and last day of external beam therapy. (20 marks)

3.3.

(a) Draw the typical percentage depth dose (PDD) curve in water for 10 x 10 cm^2 field size for 6 MV photon beam at 100 cm source surface distance (SSD). (10 marks)

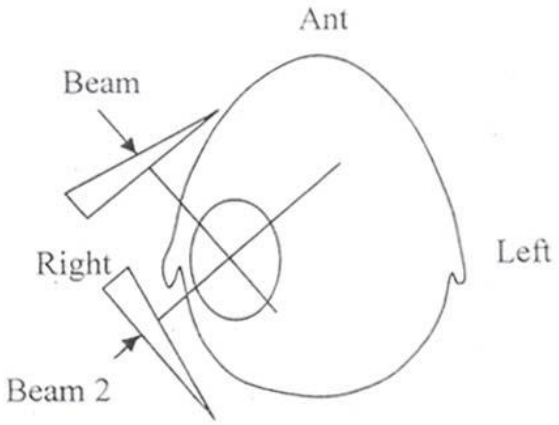
(b) Draw the PDD curves in water for 5 x 5 cm^2 and 15 x 15 cm^2 field sizes for 6MV photon at 100 cm SSD on the same graph. (10 marks)

3.4. Explain briefly the major differences between 3-Dimensional Conformal Radiation Therapy (3D-CRT) and Intensity Modulated Radiation Therapy in the following.

(a) Computer Treatment Planning (20 marks)

(b) Treatment Delivery (20 marks)

4. A patient with a right parotid carcinoma is to be treated using a 6 MV photon beam from a linear accelerator as shown in the figure. The patient is supine and the treatment is planned for 100 cm source axis distance (SAD) technique with two beams. The prescribed dose is 60 Gy in 30 fractions over 6 weeks and beam data is given in the table.



Machine Calibration conditions:

Source Chamber Distance = 100 cm, d_{max} = 1.5 cm,
Field size = 10 x 10 cm^2.
Calibration dose rate at d_{max} = 1 cGy / MU

Description	Beam 1	Beam 2
Tissue depth to beam isocenter (cm)	**3.5**	**3.0**
Gantry angle	**320^0**	**230^0**
Treatment Field size (cm^2)	**8 x 8**	**8 x 8**
Tissue maximum ratio (8 x 8 cm^2)	**0.960**	**0.975**
Wedge transmission factor (45^0, 8 x 8 cm^2)	**0.490**	**0.490**
Collimator scatter factor for 8 x 8 cm^2	**0.980**	**0.980**
Phantom scatter factor for 8 x 8 cm^2	**0.990**	**0.990**

4.1.

(a) Calculate the dose rate for the 8 x 8 cm^2 open beam in water at d_{max} (15 marks)

(b) Considering an equal contribution to the central dose from each field, calculate the number of monitor units per field per fraction. (40 marks)

4.2.

(a) What is meant by integral dose ? (15 marks)

(b) Briefly explain the clinical significance of having integral dose information for a treatment plan comparison. (10 marks)

4.3. List four advantages of customized blocks (cerrobend) over multileaf collimators in external beam therapy. (20 marks)

5.

5.1.

(a) Define wedge angle in external beam therapy. (10 marks)

(b) Wedges are placed at a particular height from the patient skin, explain why ? (10 marks)

5.2. Wedges can either be used as a beam modifier or as a tissue compensator in radiotherapy treatment planning. Illustrate each application of wedges using schematic diagrams. (30 marks)

5.3.

(a) Give an advantage and a disadvantage of using physical wedges instead of tissue compensators in external beam therapy. (20 marks)

(b) Write down the typical angles of hard wedges used with Telecobalt machines. (10 marks)

5.4. List the practical advantages of using dynamic / virtual wedges compared to physical / hard wedges in modern linear accelerators. (20 marks)

6.

6.1. In a schematic diagram, show 90%, 50% and 10% typical isodose curves in the principal plane in water for a 10 x 10 cm^2, 12 MeV electron beam, at 100 cm SSD. (20 marks)

6.2.

(a) In a separate diagram, show possible cold / hot spots for the same beam arrangement in 6.1. (a) when a piece of hard bone, (1 cm long, 0.5 cm wide and 0.5 cm height) is introduced at 1 cm depth in water in the beam central axis. (20 marks)

(b) Name the physical process responsible for altering the dose distribution in 6.2. (a) (10 marks)

6.3. Briefly describe three different situations where bolus materials can be applied in electron beam therapy. (30 marks)

6.4. What is a spoiler and why is it used in electron beam therapy ? (20 marks)

7.

7.1.

(a) Give three advantages and three disadvantages of brachytherapy over external beam therapy ? (18 marks)

(b) List four ideal physical properties for a brachytherapy radioactive source. (12 marks)

7.2. The Exposure rate of an Iridium 192 source is 1.75 R/hr at 20 cm distance.

(a) What is the activity of the source ? (20 marks)
(Gamma Factor is ^{192}Ir = 4.57 R-cm/mCi-hr)

(b) Calculate the exposure rate at 1m from the source. (10 marks)

7.3.

(a) Give the distribution rules for the Paris system of interstitial brachytherapy. (20 marks)

(b) What is the hyperdose sleeve ? (20 marks)

PART B – MEDICAL STATISTICS

Answer <u>two questions</u> of the three questions give below.
Each question carries 100 marks.
Each question to be answered in a separate book.

1. A phase iii trial was conducted including 532 newly diagnosed glioblastoma patients. They were assigned to receive either standard radiotherapy or identical radiotherapy with concomitant temozolomide followed by up to six cycles of adjuvant temozolomide. Survival analysis was applied according to Kaplan-Meier method and Cox proportional regression analysis. Hazards ratio for death in the radiotherapy and temozolomide group relative to the radiotherapy group was 0.63 and 95% confidence interval 0.53 to 0.75.

   1.1. What is meant by phase III trial ? (10 marks)

   1.2. What procedure would you suggest to minimize selection bias ? Give reasons for your answer. (20 marks)

   1.3. Explain briefly Kaplan-Meier method. (20 marks)

   1.4. Name the statistical test that could be applied to compare two survival curves. (10 marks)

   1.5. Give reasons for applying Cox proportional regression. (10 marks)

   1.6. Interpret the results of the above study. (30 marks)

2. A cross sectional study was conducted to assess a newHPV test as a screening test for cervical cancer. From the sample of 2388 women, 70 had cervical cancer according to the reference standard. Cutoff value of the newHPV test was determined using " Receiver operator characteristic curve " (ROC). Sensitivity and positive predictive value of the newHPV test were 90% and 14.7% respectively.

2.1. Determine the prevalence of cervical cancer in the population. (10 marks)

2.2. Calculate the specificity of the newHPV test. (20 marks)

2.3. Calculate the false positive rate. (10 marks)

2.4. Explain how the cutoff value was determined using ROC curve. (20 marks)

2.5. Would you recommend the newHPV test for screening cervical cancer ? Explain your answer. (40 marks)

3. Write notes on the following –

3.1. Linear regression (25 marks)

3.2. Evidence Based Medicine and levels of evidence. (25 marks)

3.3. Number needed to treat (NNT) (25 marks)

3.4. Chi-squared test (25 marks)

POSTGRADUATE INSTITUTE OF MEDICINE
UNIVERSITY OF COLOMBO

MD (CLINICAL ONCOLOGY) PART I EXAMINATION
AUGUST 2009

Date : 4th August 2009 Time : 2.00 p.m. – 5.00 p.m..

PAPER 1I

Parts A, B, C and D must be answered.

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

PART A - RADIOBIOLOGY

Answer two questions of the three questions given below.
Each question carries 100 marks.
Each question to be answered in a separate book.

1. Linear Quadratic (LQ) model has been used to describe survival curves in relation to radiobiological mechanisms such as chromosome type aberrations.

   1.1. Draw a survival curve for mammalian cells exposed to densely ionizing and sparsely ionizing radiation in accordance to the LQ model and give the parameters which describe the curves. (30 marks)

   1.2. Name the type of radiation induced aberrations and write briefly on the mechanisms thought to be responsible for the cell killing in the model. (10+30 marks)

   1.3. Using the LQ equation determine the cell surviving fraction following a dose of 2 Gy ($\alpha = 0.3$ Gy^{-1}, $\beta = 0.1$ Gy^{-2}). (30 marks)

2. Exponentially growing cells maintained at 37^0C in air are irradiated with the following three treatments.

(a) Single dose of 8 Gy of X rays

(b) Two 4 Gy fractions separated by (i) 2 hrs (ii) 8 hrs. the surviving fractions for the three treatments were 0.02, 0.15 and 0.08 respectively.

2.1. Name and briefly explain the processes that account for these findings. (10+30 marks)

2.2.

(a) What is RBE ? (10 marks)

(b) Give the relationship between RBE and LET (20 marks)

2.3. In a sentence or two comment on the following with regard to high LET radiation damage compared with low LET radiation damage.

(a) Presence of sulfydry1 compounds

(b) Greater sparing with low dose rate (30 marks)

3.

3.1. Why does the volume doubling time of a tumour rarely equal the potential doubling time ? (10 marks)

3.2. Name the parameter that appears to decrease several weeks after commencement of radiotherapy and what is its effect. (15 marks)

3.3. What tumour kinetic parameter is used to consider accelerated radiotherapy. (05 marks)

3.4. Determine the volume doubling time for a tumour with cell loss factor of 90% and a T_{pot} of 20 d. (25 marks)

3.5. A standard treatment protocol for a given cancer is 60 Gy in daily 2 Gy fractions. If the fraction size is reduced to 1.3 Gy calculate the total dose to be given to maintain the same level of tumour control. (α/β ratio for tumour is 10 Gy) (30 marks)

(a) What is expected from the reduction of the fraction size ? (05 marks)

(b) What assumptions would you make to calculate the dose ? (10 marks)

PART B - PATHOLOGY

Answer <u>two questions</u> of the three questions given below.
Each question carries 100 marks.
Each question to be answered in a separate book.

1. A 55 year old female presents with a recent rapid unilateral enlargement of a previously diffusely enlarged thyroid gland.

    1.1. Name six possible neoplastic and non neoplastic lesions you would consider. (30 marks)

    1.2. Describe briefly the histological features of three malignant lesions that you have mentioned. (70 marks)

2. A 58 year old male is found to have a solitary nodule in the liver.

    2.1. What four tumour markers would help in arriving at a diagnosis ? (20 marks)

    2.2. Name two possible primary neoplasms and describe the histological features of one of these. (50 marks)

    2.3. Mention three immunohistochemical markers that can predict the primary site in a suspected metastatic deposit in this patient. (30 marks)

3. Give five pathological features for each that would predict the prognosis of the following tumours.

    (a) Ovarian carcinoma (25 marks)

    (b) Soft tissue sarcoma (25 marks)

    (c) Renal cell carcinoma (25 marks)

    (d) Skin melanoma (25 marks)

PART C - CHEMOTHERAPY

Answer <u>two questions</u> of the three questions given below.
Each question carries 100 marks.
Each question to be answered in a separate book.

1. Mrs. Silva is terminally ill with breast cancer and needs adequate pain control. The physician uses the WHO 3- step ladder concept.

   1.1. Explain briefly the WHO 3-step ladder concept of pharmacological treatment of pain. (10 marks)

   1.2. Explain the pharmacological mechanism of action of morphine in the relief of pain. (40 marks)

   1.3. Oral morphine undergoes first pass metabolism. Explain the term first pass metabolism. (20 marks)

   1.4. Explain the term co-analgesic. Explain the mechanism of action and name a drug that is used as a co-analgesic. (30 marks)

2.

   2.1. What is meant by a phase 1 trial of a drug ? (20 marks)

   2.2. Give three main end points from a phase 1 clinical trial. (30 marks)

   2.3. Explain why phase 1 clinical trials in oncology are different to phase 1 trials in other areas of medicine. (50 marks)

3.

   3.1. Name four drugs used in oncological practice that are monoclonal antibodies. (40 marks)

   3.2. Explain in detail the mechanism of action of two of these drugs. (60 marks)

PART D - CANCER BIOLOGY

Answer <u>two questions</u> of the three questions given below.
Each question carries 100 marks.
Each question to be answered in a separate book.

1. Explain using three to four sentences each why

    1.1. patients with Acquired Immune Deficiency Syndrome (AIDS) have a higher risk of developing cancers. (25 marks)

    1.2. graft-versus-host disease occurs following bone marrow transplantation. (25 marks)

    1.3. pneumococcal vaccination is recommended prior to elective splenectomy. (25 marks)

    1.4. Local administration of BCG vaccine results in regression of bladder cancer. (25 marks)

2. A man is diagnosed with metachronous colorectal cancer at the age of 45 years and is due to undergo surgery for resection of the tumour.

    2.1. Which genes have mutations that are associated with HNPCC ? (20 marks)

    2.2. What gene is associated with familial adenomatous polyposis ? (10 marks)

    2.3. What would be a rational approach for genetic testing to detect a germ-line mutation in this patient with a view to minimizing testing cost ? (40 marks)

    2.4. What is the use of Bethesda guidelines in genetic testing ? (10 marks)

    2.5. What is the use of the Amsterdam criteria in genetic testing ? (20 marks)

3. Write briefly on how malignant tumours

    3.1. Achieve limitless potential for replication. (40 marks)

    3.2 become insensitive to growth inhibitory signals. (60 marks)

POSTGRADUATE INSTITUTE OF MEDICINE
UNIVERSITY OF COLOMBO

MD (CLINICAL ONCOLOGY) PART I (REPEAT) EXAMINATION
DECEMBER 2009

Date : 14th December 2009 Time : 2.00 p.m. – 5.00 p.m..

PAPER 1

Parts A and B must be answered.

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

PART A - 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 question Nos. 2 to 7.

1.

1.1

(a) What is ionization of an Atom with respect to gamma radiation? (10 marks)

(b) List three most possible damages to the DNA by direct absorption of radiation energy. (15 marks)

(c) What damage is most probable for an alteration of a human cell ? (10 marks)

(d) Explain in 2-3 sentences how a damaged DNA leads to modification of a cell. (15 marks)

1.2

(a) What is the annual Effective Dose Limits recommended for radiation workers and general public by the ionizing radiation protection regulations of Sri Lanka ? (20 marks)

(b) What are the two major natural sources of radiation which produce radiation in our living environment ? (10 marks)

1.3

(a) List two control areas found in radiotherapy practices. (l0 marks)

(b) List two requirements found in control areas (engineering and administration). (10 marks)

2.

2.1.

(a) Briefly discuss differences in image quality between kV and MV imaging (15 marks)

(b) Explain why such differences arise. (20 marks)

2.2. Define Linear Energy Transfer (LET) (15 marks)

2.3.

(a) What are meant by low-LET and high-LET radiation ? (20 marks)

(b) Give two examples for each type. (10 marks)

2.4. Sketch how LET vary with depth in water for 20 MeV electron and 200 MeV Proton . (20 marks)

3.

3.1 According to ICRU 50 and 62 reports, define

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

(b) Irradiated Volume (IV) (15 marks)

(c)

3.2. List dosimetric factors which are influenced on the central axis dose maximum in a water phantom for a given field size for 6 MV x-ray beam from a linear accelerator. (15 marks)

3.3.

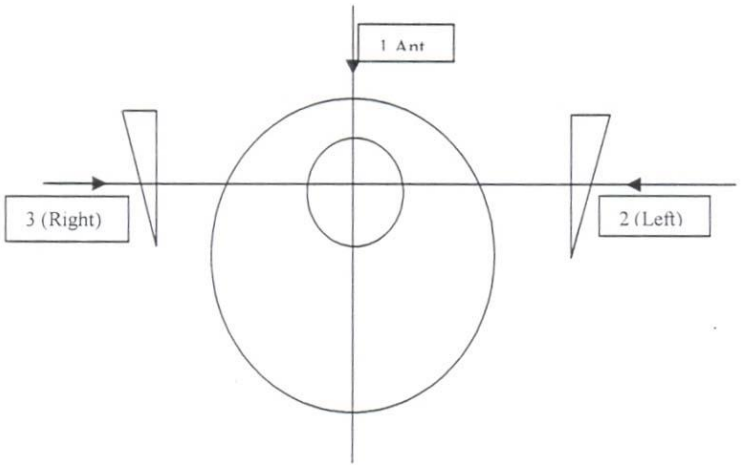
(a) Most radical external beam therapy plans are successful with multiple fields arrangements than a single field setting, explain why ? (25 marks)

3.4. Define, following tenns in external beam radiotherapy with a suitable graph

(a) Beam flatness (15 marks)

(b) Beam symmetry (15 marks)

4. A brain tumour is to be treated by a 6 MV x-ray beam using three fields isocentric setup at 100 cm SAD as shown in figure below. The dose rate at D_{max} for 10 x 10 cm^2 field is 1 cGy/MU and the prescribed dose to the tumour centre is 54 Gy in 27 fractions.



	I (Ant)	**2 (Left)**	**3 (Right)**
Field size (cm^2)	6x6	7Wx6	7W x 6
Tissue depth to beam isocentre	6cm	7cm	7cm
Gantry angle	0°	90°	270°
Tissue Maximum Ratio	0.873	0.847	0.847
Wedge transmission Factor (30°)	-	0.780	0.780
Collimator Scatter Factor	0.968	0.972	0.972
Phantom Scatter Factor	0.984	0.986	0.986

4.1 Assuming that the tumour centre receives equal dose from all beams,

(a) Find the dose rate at D_{max} for open beams for 6x 6 cm^2 and 6x7 cm^2 fields (10 marks)

(b) Calculate the number of monitor units for each field per fraction. (30 marks)

4.2

(a) Briefly describe the difference between differential DVH and . cumulative DVH (20 marks)

(b) Sketch graphs for above two situations, labeling PTV and critical structure for a normal radiotherapy plan with 54 Gy prescribed dose to PTV. (20 marks)

4.3 List advantages of using DVHs tools in computer treatment planning process in view of treatment plan assessment. (20 marks)

5. Thermoluminescent Dosimeters (TLDs) are used for relative dosimetry in radiotherapy.

5.1 What is meant by relative dosimetry ? (20 marks)

5.2 Briefly explain the physical process of TLD (25 marks)

5.3 List three main applications of TLDs in radiotherapy. (15 marks)

5.4 Name two relative dosimeters other than TLDs. (20 marks)

5.5 Give two advantages and two disadvantages for above dosimeters in 5.4 with respect to TLDs. (20 marks)

6

6.1 List the main interaction processes may occur when a megavoltage electron beam interact with a medium (15 marks)

6.2.

(a) Draw the central axis percentage depth dose (PDD) curve when 15 MeV, l0 x 10 cm^2 electron beam interacts perpendicularly with water surface indicating $D_{max,}$ R_{90}, R_{50}, R_p and surface dose. (20 marks)

(b) If the above electron beam incidence obliquity on water surface, how the above parameters are changed. (State increase, decrease or static) (20 marks)

(c) In the same diagram, illustrate the PDD curve for the above 6.2 (a) beam traveling through 5 cm of lung inhomogeneity at 2 cm depth. (10 marks)

6.3 List the factors determine the output at D_{max} on the central axis for 15 MeV electron beam. (15 marks)

6.4 When a shielding block is used for 15 MeV electron energy, determine the appropriate Cerrobend thickness. (20 marks)

7.

7.1 Using Manchester technique, a tumor of the tongue of 3 cm wide, 5 cm long and 0.5 cm thick, is to be treated with a single-plane implant to a prescribed dose of 60Gy in about seven days. Clinically it is not possible to cross the lower end of the implant. mg Ra eq h for 10Gy is 303.5

(a) Show the diagrammatic representation of placing the needles with distance. (15 marks)

(b) Calculate total mg Ra eq required for the treatment in 7 days. (20 marks)

(c) Explain the source distribution in each needles with the amount of mg Radium. (15 marks)

7.2. List the type of dose-rates in Brachytherapy. (10 marks)

7.3 What are the radiation safety procedures of handling manual LDR Brachytherapy sources ? (20 marks)

7.4 List important four (04) properties of Ir-192 that makes it suitable for temporary Brachytherapy Implants ? (20 marks)

PART B - MEDICAL STATISTICS

Each question carries 100 marks.
Each question to be answered in a separate book.
Answer <u>two questions</u> of the three questions given below.

1. A hospital based case control study was conducted to determine serum adiponectin as a predictor of Non-Hodgkin's Lymphoma among the children of 1-12 years of age. The results were given below.

	Cases	**Controls**
Adiponectin (g/dl)		
Mean	15.7	12.6
Standard deviation	7.36	5.94
Maternal smoking		
Number (percentage)		
Yes	55 (45.5)	46(38)
No	66 (54.5)	75(62)

1.1. Describe how would you select the cases and controls ? (10 marks)

1.2. List two measures to minimize bias in measuring serum adiponectin levels. (20 marks)

1.3. Name the statistical tests for the comparison of

1.3.1. Serum adiponectin levels
1.3.2. Maternal smoking (20 marks)

1.4. If this was a matched design, name the statistical tests for the comparison of
1.4.1. Serum adiponectin levels
1.4 .2 Maternal smoking (20 marks)

1.5. Explain why and how would you get the informed consent for the study ? (20 marks)

1.6. Name a statistical method to control potential confounding factors including maternal smoking. (10 marks)

2. Patients with cancer who were receiving highly ematogenic chemotherapy were randomized to either single dose palonosetron or granisetron 30 min before chernotherapy, both with dextramethasone. Primary end point was the proportion of complete response (defined as no emetic episodes during first 24 hours post chemotherapy). Intention to treat analysis was performed. The difference between the two proportions of complete response was 2.3% (95% confidence interval -2.7 to 7.3%).

2.1. State the objective of the above study (20 marks)

2.2. Explain the procedure for randomization and how would the randomization reduce bias ? (20 marks)

2.3. What suggestions would you make to improve the quality of the trial (20 marks)

2.4. What do you understand by the phrase 'intention to treat analysis' ? (20 marks)

2.5. Interpret the results of the above study. (20 marks)

3. Write notes on the following :-

3.1. Kaplan-Meier method (25 marks)

3.2. Person correlation coefficient (25 marks)

3.3. Systematic reviews (25 marks)

3.4. Standardize mortality ratio (25 marks)

POSTGRADUATE INSTITUTE OF MEDICINE
UNIVERSITY OF COLOMBO

MD (CLINICAL ONCOLOGY) PART I (REPEAT) EXAMINATION
DECEMBER 2009

Date : 15th December 2009 Time : 9.00 a.m. -12.00 noon

PAPER II

Sections A, B, C and D must be answered.

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

SECTION A – PATHOLOGY

Answer two questions of the three questions given below.
Each question carries 100 marks.
Each question to be answered in a separate book.

1.

1.1. Discuss briefly the importance of grading of malignant neoplasms. (25 marks)

1.2. Discuss the parameters used in the grading of the following tumours.

1.2.1. Breast carcinoma (25 marks)

1.2.2. Soft tissue sarcomas (25 marks)

1.2.3. Tumours of the Central Nervous System (25 marks)

2.

2.1. Mention two epithelial and two non epithelial neoplasms that can cause a pathological fracture in a 56 year old female. (20 marks)

2.2. Discuss briefly the histological and immunohistochemical features of three of the above mentioned tumours mentioning any other laboratory investigations that may be useful in arriving at a diagnosis. (80 marks)

3. Write short notes on the following :-

3.1. Germ cell tumours of the testis (30 marks)

3.2. Burkitt lymphoma (30 marks)

3.3. Value of immunohistochemistry in tumour pathology (40 marks)

SECTION B – RADIOBIOLOGY

Answer two questions of the three questions given below.
Each question carries 100 marks.
Each question to be answered in a separate book.

1.

1.1. What is cell survival curve ? (10 marks)

1.2. Draw a survival curve on linear scales and name the shape. (10 marks)

1.3. Why is it that conventionally the surviving fraction is drawn on a logarithmic scale while the dose is on a linear scale ? (20 marks)

1.4. When the dose rate at which cells are irradiated increases from 0.1 Gy/min. to 1 Gy/min. for X rays what is the parameter that changes ? In a sentence or two give the reason. (20 marks)

1.5. According to the linear quadratic model what causes the survival curve to bend and what is the effect of a split dose ? (20 marks)

1.6. Using linear-quadratic survival curve equation, calculate the approximate surviving fraction following a dose of 2 Gy delivered at a low dose rate over a 6 hour period. Assume no repopulation takes place during the irradiation. (use $\alpha = 0.3\ Gy^{-1}$ and $\beta = 0.1\ Gy^{-2}$). (20 marks)

2.

2.1. What is the approximate time required for most cell types irradiated in vitro to complete sublethal damage ? (10 marks)

2.2. When cells are maintained under suboptimal growth conditions for 6 hours after a single dose of X-rays, the cell surviving fraction is noted to increase.
Name the type of radiation damage demonstrated by this (10 marks)

2.3. If you propose to change your usual fractionation schedule of 2 Gy given once per day to a hyperfractionated regimen consisting of 2 fractions of 1.4 Gy each per day

2.3.1. What is the minimum acceptable time interval between the fractions ? (10 marks)

2.3.2. Name a tissue which is exceptional to this (10 marks)

2.3.3. Give your reasons for allowing the time interval. (20 marks)

2.3.4. What is the rationale for switching to hyperfractionation ? (40 marks)

3. When early responding tissues are compared with late responding tissues comment briefly on the following (20 x 5 marks)

3.1. compensatory proliferation and radiotherapy

3.2. α / β ratios

3.3. neutron RBE for fractionated irradiations

3.4. shape of dose response curves

3.5. injury when an X-ray dose is delivered as a series of small fractions, rather than as a few large fractions

SECTION C – CHEMOTHERAPY (PHARMACOLOGY)

Answer two questions of the three questions given below.
Each question carries 100 marks.
Each question to be answered in a separate book.

1. As an Oncologist you are requested to design a phase III clinical trial to evaluate the efficacy of a new drug in the treatment of recent onset breast cancer.

1.1. Describe in detail the steps in the research protocol you will design for the trial. (40 marks)

1.2. Define bias and explain three important steps you would take to minimize/avoid "bias" in conducting this trial. (30 marks)

1.3. Explain the term "informed consent" and list five (05) important aspects of information you as an investigator would give to the study subject to obtain consent. (30 marks)

2. The Oncologist prescribes carboplatin for a 70 year old female patient with advanced ovarian cancer after making a risk benefit assessment of carboplatin and cisplatin. The dose of carboplatin was calculated using the Calvert and Egarin formula.

2.1. Explain the mechanism of action of platinum compounds. (30 marks)

2.2. Briefly describe what is meant by risk benefit assessment using cisplatin and carboplatin as examples. (40 marks)

2.3. Explain the term "AUC" used in the Calvert and Egarin formula. (20 marks)

2.4. Name the dose limiting toxicity seen with carboplatin and how you would monitor the patient for it. (10 marks)

3. Explain the pharmacological basis for the therapeutic use of the following :-

3.1. Controlled release oral morphine in palliative care. (25 marks)

3.2. Co-administration of calcium folinate with methotrexate. (25 marks)

3.3. Co-administration fo mesna with cyclophosphamide. (25 marks)

3.4. Ondansetron in chemotherapy induced nausea and vomiting.(25 marks)

SECTION D – CANCER BIOLOGY

Answer <u>two questions</u> of the three questions given below.
Each question carries 100 marks.
Each question to be answered in a separate book.

1. Write notes on :-

   1.1. Graft Vs Host disease. (40 marks)

   1.2. Tumour antigens. (20 marks)

   1.3. Cytotoxic lymphocytes (40 marks)

2. The chromosome culture and karyotyping of a man with chronic myeloid leukaemia shows the presence of the following clonal abnormality. 46, XY,t (9 :22)

   2.1. Describe briefly how this abnormality produces the condition. (50 marks)

   2.2. Discuss the sensitivity of different types of genetic tests in detecting this condition. (20 marks)

   2.3. What genetic test would you use to follow up treatment for this condition. (10 marks)

   2.4. Why do you want to use the test named in 3 above?

3.

   3.1. Write a brief account on molecular basis of cancer. (40 marks)

   3.2. Briefly describe the fundamental changes in all physiology that determine the malignant phenotype. (60 marks)

POSTGRADUATE INSTITUTE OF MEDICINE
UNIVERSITY OF COLOMBO

MD (CLINICAL ONCOLOGY) PART I EXAMINATION
AUGUST 2010

Date : 2nd August 2010 **Time : 2.00 p.m. – 5.00 p.m.**

PAPER 1

Parts A and B must be answered.

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

PART A - 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 question Nos. 2 to 7.

1.

1.1. Define the term " "Effective Dose" and state what is expected to be achieved by limiting the Effective Dose to an individual. (20 marks)

1.2. What are the SI units for
(i) absorbed dose ?
(ii) effective dose ? (10 marks)

1.3. A male worker receives 25 mSv whilst working in a radiation controlled area. Is this acceptable in relation to dose limitation criteria and why ? (10 marks)

1.4. List three (3) deterministic effects if the foetus is exposed to ionizing radiation of 200 mSv during the period from 3 weeks after conception until the end of pregnancy.
What are the most probable deterministic effects after exposure to 100 - 200 mSv during weeks 3 to 8, (15 marks)

1.5. Give two (2) additional Stochastic Effects which may occur. (10 marks)

1.6. Whal do you understand by a passive dosimeter used in personal dosimetry. (15 marks)

1.7. Give two (2) examples of passive dosimeters with a brief explanation of their advantages and disadvantages. (20 marks)

2.

2.1. Define linear stopping power for an electron beam. (10 marks)

2..2. Explain why charged particles such as MeV electrons have relatively short ranges, compared with photons of similar energy, when they Interact with tissue. (20 marks)

2.3. List two main interaction processes in tissue for each of the following beams.

(i) 6 MV x-rays (10 marks)
(ii) 6MeV electrons (10 marks)

2.4. Give a brief description of each of the above mentioned (in 2.3) interaction processes. (30 marks)

2.5. Give typical depths in water for 10 x 10 cm^2 fields at 100 cm SSD for ;

(i) 100% and 50% isodoses for 6 MV x-rays. (10 marks)
(ii) 80% and 50% isodoses for 6 MeV electrons. (10 marks)

3.

3.1. define the following terms with reference to ICRU reports 50 and 62

(i) Internal Target Volume (ITV) (20 marks)
(ii) Organs at Risk (OAR) (15 marks)

3.2. What is meant by serial OAR, parallel OAR and serial- parallel OAR as applied to the ICRU reports. (15 marks)

3.3. Give an example in each case for part 3.2. (10 marks)

3.4. What is meant by non-coplanar and non-coaxial beams. (10 marks)

3.5. State the target dose uniformity recommended in the ICRU report No.50 for photon and electron beams. (10 marks)

3.6. Give the ICRU reference point locations for

(i) Direct 6 MeV electron beam.
(ii) Direct 6 MV photon beam.
(iii) Anterior and posterior parallel opposed 6 MV photon beams.
(iv) Three field coplanar photon beams.

(20 marks)

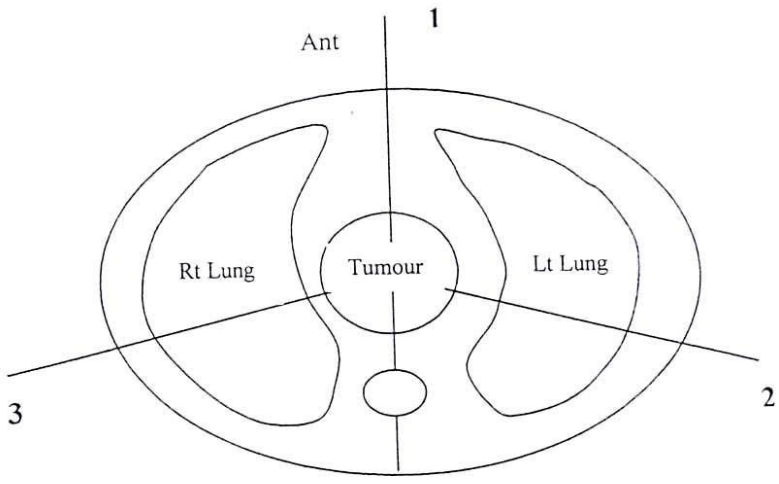
4.

4.1. Define the Percentage Depth Dose (PDD) for MV radiation using a relevant diagram. (20 marks)

4.2. How does PDD vary with field size ? (10 marks)

4.3. A patient with an oesophageal tumour is to be treated using a 10MV photon beam from a linear accelerator and the prescribed tumour dose is 54 Gy in 27 fractions over 5½ weeks.

Machine Calibration conditions:
Source Chamber Distance = 100 cm, d_{max} = 2.5 cm,
Field size = 10 x 10 cm^2 .
Calibration dose rate = 1 cGy / MU



Description	1. Ant	2. Lt/Lat-oblq	3. Rt/Lat-oblq
Treatment Field size (cm^2)	**8 x 14**	**6 x 14**	**6 x 14**
Gantry angle	**0^0**	**100^0**	**260^0**
Percentage depth dose (PDD) (*without lung correction)	**76.5%**	**60.1%**	**60.1%**
Skin to tumour center depth (cm)	**9**	**14**	**14**
Average Lung depth for relevant Beams (cm)	**0**	**5**	**6.5**
Collimator scatter factor	**1.001**	**0.982**	**0.982**
Phantom scatter factor	**1.002**	**0.990**	**0.990**

Assume 2D-planning with 3 beams, as shown in the figure. Using the data given in the table with a 100 cm SSD treatment technique.

(i) Write the corrected PDD values at the tumour centre from each field after correction for lung inhomogeneity . (10 marks)

(ii) Assuming equal weighting from all beams calculate the applied dose per field per fraction after inhomogeneity correction. (15marks)

(iii) Calculate the monitor units for each beam. (25 marks)

(iv) The collimator angle for beams 2 and 3 may require correction to avoide the spinal cord. How do you find this angle practically ?
(10 marks)

(v) It is planned to treat this tumour using a 100cm isocentric technique (SAD). Assuming a similar dose distribution to the PTV with 3-fields using the same gantry angles, how does the number of MU change ? Briefly explain the reason for this.
(10 marks)

5.

5.1. What is. virtual simulation ? (15 marks)

5.2. Discuss the role of virtual simulation in the treatment planning Process. (20 marks)

5.3. What is 3D conformal radiotherapy (3DCRT) ? (10 marks)

(i) Give three (3) limitations of 3DCRT ? (15 marks)

(ii) Give two (2) practical examples where these limitations are clinically important. (10 marks)

(iii) Give two (2) techniques which would overcome these limitations. (10 marks)

5.4. Give two (2) differences between forward planned and inverse planned IMRT. (20 marks)

6.

6.1. What is meant by the therapeutic range for electron therapy ? (10 marks)

6.2. Sketch the depth dose curves for 6 & 15 MeV electron beams on the same graph and clearly specify the therapeutic and practical ranges. (20 marks)

6.3. Stare two (2) advantages and two (2) disadvantages of MeV electrons against kV X-rays used in external beam radiotherapy. (20 mark)

6.4. When planning for MeV electron beams, what are the problems associated with

(i) Oblique incidence of the electron beam. (15 marks)

(ii) Using bolus material. (15 marks)

6.5. What would be the usual electron beam energy to treat recurrent chest wall lesions for a patient who has undergo previous total mastectomy ? (05 marks)

Give three (3) considerations when choosing this energy. (15 marks)

7.

7.1. Write down the source distribution rules for the Paris system for volume implants. (20 marks)

7.2. How are the Basal Dose Rates and Reference Dose Rates defined for Volume implants ? (20 marks)

7.3. Illustrate the source distribution for a single plane interstitial implant using the Paris system with Ir-192 hair pins for a 4 cm x 4 cm tumour and mark the basal dose points. (20 marks)

7.4. One of the treatment techniques for prostate cancer is use of brachytherapy with Iodine-125 seeds.

(i) Give three (3) physical characteristics of the source used. (15 marks)

(iii) Explain why it is double encapsulated. (05 marks)

7.5. Last two (2) advantages and two (2) disadvantages of using iodine - 125 seeds in prostate brachytherapy. (20 marks)

PART B – MEDICAL STATISTICS

Each question carries 100 marks.
Each question to be answered in a separate book.
Answer <u>two questions</u> of the three questions given below.

1. A case control study was conducted to assess the association of circulating high-sensitivity C-reactive protein (CPR) and lung cancer. Cases were individually matched to controls on age at enrollment, sex and smoking status at enrollment. The following table shows the results of the study.

Table – Association of lung cancer with CRP levels

CRP levels (mg/dl)	OR	95% Cl	Adjusted OR	95% CI
< 1.0	1.00	Reference	1.00	Reference
1.1 – 2.7	1.26	0.88 to 1.80	1.22	0.83 to 1.78
2.8 – 5.5	1.41	1.00 to 1.98	1.54	1.08 to 2.21
>5.6	1.95	1.38 to 2.75	1.98	1.36 to 2.89

OR : odds ratio, 95% Cl : 95% confidence interval

1.1. State the null hypothesis. (10 marks)

1.2. Describe how would you define the control group ? (20 marks)

1.3. State the reasons for matching. (10 marks)

1.4. Briefly explain the biases that could occur when assessing CRP levels In blood. (20 marks)

1.5. Interpret the result of the study ? (30 marks)

1.6. What is your conclusion ? (10 marks)

2. A non-randomized trial was conducted to assess the effect of statin use for improving clinical outcome in patients treated with radiotherapy (RT) for prostate cancer. Six hundred (600) eligible patients were invited to participate. Two hundred (200) were given statin during the RT and the other 400 were given only RT. The primary end point was freedom from bio chemical failure (FFBF). At the end of the 5 year follow up period outcome data were available for only 170 statin and 320 control group participants. Men using statin had a 5 year FFBF of 93% compared with 80%; for men not taking statin (p value <0.001 by log rank test). Multivariate analysis was performed and for statin use the Hazard Ratio was 0.43 (95% confidence interval 0.25 to 0.73) controlling for stage of cancer and prostate specific antigen.

2.1. Define the clinical question which was investigated by the above study. (10 marks)

2.2. Briefly explain the problems encountered from non-randomization of the participants. (20 marks)

2.3. Calculate the loss to follow up rate. (10 marks)

2.4. How would you incorporate the loss to follow up data in the analysis ? (10 marks)

2.5. Briefly explain the Log Rank test. (20 marks)

2.6. What was the purpose of applying a multivariate method for the above study ? (10 marks)

2.7. Interpret the results of the above study. (20 marks)

3. Write notes on the following :

3.1. Cross-over trial (25 marks)

3.2. Incidence density (25 marks)

3.3. Lead time bias (25 marks)

3.4. Standardised mortality ratio (25 marks)

POSTGRADUATE INSTITUTE OF MEDICINE
UNIVERSITY OF COLOMBO

MD (CLINICAL ONCOLOGY) PART I EXAMINATION
AUGUST 2010

Date : 3rd August 2010 Time : 9.00 a.m. -12.00 noon

PAPER II

Sections A, B, C and D must be answered.

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

SECTION A – PATHOLOGY

Answer two questions of the three questions given below.
Each question carries 100 marks.
Each question to be answered in a separate book.

1 What histological criteria, including where relevant, Immunohistochemistry, differentiate the following tumours.

1.1. Neuroblastoma and embryonal rhabdomyosarcoma (25 marks)

1.2. Adrenal cortical adenoma and adrenal cortical carcinoma. (25 marks)

1.3. Mucinous cystadenoma and cystadenocarcinoma of ovary. (25 marks)

1.4. Adinocarcinoma and carcinoid tumour of the lung. (25 marks)

2. A 23 year old female presents to you with enlarged cervical lymphadenoopathy of two months duration.

2.1. What are the malignant neoplasms you would consider ? (15 marks)

2.2. Describe the histological and immunohistochemical features of two (2) of the neoplasms you have mentioned. (60 marks)

2.3. Mention two (2) benign conditions you would consider in this Patient. (10 marks)

2.4. Mention three (3) important histological features that would help to differentiate benign and malignant neoplasms. (15 marks)

3.

3.1. A 45 year old man presents with frank haematuria. What are the possible malignant tumours which could account for this ? (30 marks)

3.2. Describe briefly the clinical and histological features of a malignant renal neoplasm seen in

(i) an adult (35 marks)

(ii) a child (35 marks)

SECTION B – RADIOBIOLOGY

Answer <u>two questions</u> of the three questions given below.
Each question carries 100 marks.
Each question to be answered in a separate book.

1..

1.1. When considering the influence of irradiated volume on normal tissue tolerance it is important to discriminate between structural tissue tolerance and functional tolerance.
What are the factors on which structural tissue tolerance and functional tolerance depend. (20 marks)

1.2. Give an example for parallel and serial tissue organizations and show how they differ with respect to reserve capacity, effect on volume irradiated and risk to develop a complication ? (5 x 8 marks)

1.3. Complete the following chart on clinical and biological characteristics of early and late radiation reactions.

	Early reactions	**Late reactions**
Latency		
Fractionation sensitivity		
Influence of overall treatment time		
Clinical course		

(5 x 8 marks)

2.

2.1. In one or two sentences state your answers to the following considering time, dose and fractionation.

(i) What are the consequences if the interval between fractions is decreased to less than 6 hours.

(ii) What would you expect if you prolong the overall time within the normal radiotherapy range in terms of sparing effect.

(2 x 10 marks)

2.2. What is the main reason to use hypofractionation ? (20 marks)

2.3. What does a survival curve characterized by a low œ/ß ratio suggest ? (20 marks)

2.4. What does a breaking survival curve where the slope abruptly decreases indicate ? (20 marks)

2.5, What would the œ/ß ratio be for an exponential survival curve ? (20 marks)

3. Repopulation of cancer cells after exposure to multiple doses of photons has been of considerable interest in radiotherapy.

3.1. What is repopulation and what is its outcome ? (20 marks)

3,2. Write briefly on an approach that has been used to overcome repopulation in the clinic. (30 marks)

3.3. What is the limiting factor in this treatment ? (10 marks)

3.4. Name a clinical trial carried out to address 3.2. What else did this trial aim at ? (20 marks)

3.5. What s the basis of conventional fractionation ? (20 marks)

SECTION C - CHEMOTHERAPY (PHAMACOLOGY)

Answer <u>two quesstions</u> of the three questions given below.
Each question carries 100 marks.
Each question to be answered in a separate book.

1.

1.1. A 35 year old lady with breast cancer was given treatment with fluorouracil, epirubicin and cyclophosphamide (FEC). Explain brief1y the mechanisms of action of each of the 3 drugs mentioned above in treating breast cancer. (60 marks)

1.2. Explain the pharmacological basis for the use of the following drugs in patients with breast cancer.

(i) Anastrazole (20 marks)

(ii) Trastuzumab (20 marks)

2.

2.1. Explain the term "steady state concentration of a drug" and describe two factors that could influence "steady state concentration of a drug" (40 marks)

2.2. Briefly describe the important pharmacological principles to be considered when designing a dosage regimen in oncology in relation to

(i) the patient (20 marks)

(ii) the drug (20 marks)

(ii) the disease (20 marks)

3. You have been nominated to represent the Oncologists at the National Pharmacovigilance Committee.

3.1. Define the term Pharmacovigilance (10 marks)

3.2. Give four potential harmful effects of cytotoxic drug use. (20 marks)

3.3. Explain the term "autonomy" with respect to patient care and describe the main method of ensuring autonomy. (20 marks)

It has been brought to the notice of the Committee that there is a recent increase in the incidence of serious adverse events at the National Cancer Hospital. The committee nominates you to head the three member team appointed to investigate this recent increase.

3.4. List four objectives of this investigation (20 marks)

3.5. Outline five components of your investigation (30 marks)

SECTION D – CANCER BIOLOGY

Answer <u>two questions</u> of the three questions given below.
Each question carries 100 marks.
Each question ,to be answered in a separate book.

1. Explain the role of the following cells and molecules in the immune response against tumour antigens.

1.1. B lymphocytes (25 marks)

1.2. T lymphocytes (25 marks)

1.3. Antigen presenting cells (25 marks)

1.4. Cytokines (25 marks)

2. A 60 year old man with polycythaemia is being investigated.

2.1. What genetic test would you order to arrive at a diagnosis ? (10 marks)

2.2. Is this mutation inherited or acquired ? (10 marks0

2.3. How does this mutation contribute to the development of polycythaemia ? (30 marks)

2.4. Give three (3) methods that can be used to detect the mutation in 2.1. ? (30 marks)

2.5. What method can be used to quantify the load of malignant clones before and after treatment ? (10 marks)

2.6. You suspect a malignant transformation. What other genetic tests would be useful to confim or exclude your suspicions ? (10 marks)

3.

3.1. Define

(i) an oncogene (10 marks)

(ii') a proto-oncogene (10 marks)

3.2. List four (4) proto-oncogenes and give the cancers commonly associated with each one (20 marks)

3.3 Briefly describe four (4) different mechanisms, by which a proto-oncogene can induce malignant change in a cell. (60 marks)

POSTGRADUATE INSTITUTE OF MEDICINE
UNIVERSITY OF COLOMBO

MD (CLINICAL ONCOLOGY) PART I (REPEAT) EXAMINATION
DECEMBER 2010

Date : 13th December 2010 Time : 2.00 p.m. – 5.00 p.m.

PAPER 1

Parts A and B must be answered.

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

PART A - 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 given from question Nos. 2 to 7.

1.

(a) Define the term "Equivalent Dose" (H_T) in a tissue and give the SI unit of (H_T). (20 marks)

(b) Output of aCobalt-60 teletherapy unit at the time of source installation is 250 RMM (Roentgen per minute at 1 metre).
What is the equivalence of above output in cGy/min at 1 meter ? (10 marks)

(c) What is the occupational exposure ? (10 marks)

(d) List dose limits recommenced by Sri Lankan /IAEA regulations for
(i) workers (10 marks)

(ii) pregnant women (5 marks)

(e) Briefly explain Stochastic effect and Deterministic effect and give two examples for Deterministic effects. (25 marks)

(f) List two radionuclides used in imaging or therapy as unseal sources and give two radiation protection problems envisaged in using these sources. (20 marks)

2.

(a) Define
  (i) Absorbed dose (D) (15 marks)
  (ii) Air KERMA (K) (20 marks)

(b) Give SI units for D and K (10 marks)

(c) For orthovoltage and megavoltage photon beams,
  (i) Sketch the graphs to show D and K with depth in tissue (20 marks)
  (ii) Write the relationship between D and K (10 marks)

(d) What is a delta ray ? (15 marks)

(e) How much energy (in joules) expended per ion pair in air (W_{air}) (10 marks)

3.

(a)
  (i) Describe Internal Margin (IM) and Set-up Margin (SM) according to ICRU report 62. (40 marks)
  (ii) How does it relate to Planning Target Volume(PTV) ?(10 marks)

(b) Give two advantages of using immobilization devices in radiotherapy. (10 marks)

(c) Define Relative Dose Factor (RDF). (15 marks)

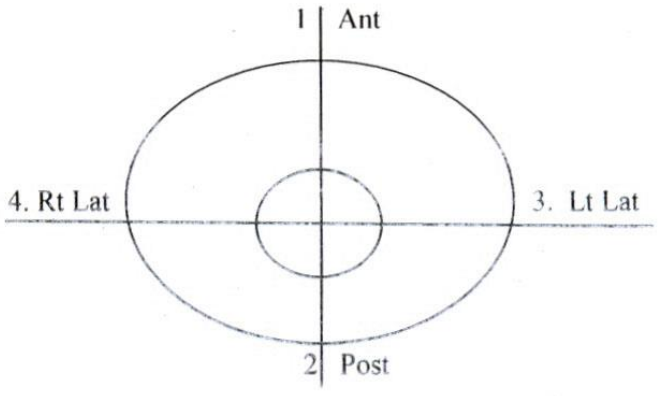
(d) Explain why the RDF in phantom changes with field size for high energy photon beams. (10 marks)

(e) Sketch the graph of RDF vs. field size for Co-60 gamma rays. (15 marks)

4.

(a) Define Tissue Maximum Ratio (TMR) using a suitable diagram. (20 marks)

(b) A patient with a carcinoma of cervix has been planned to give 46 Gy in 23 fractions from a linear accelerator machine during phase 1 of the treatment. In 2D manual planning four open beams are used on SAD technique as shown in figure with 10 MV photons.



Mechine Calibration conditions:
Source Chamber Distance =100 cm, d_{max} =2.5 cm,
Field size =10 x 10 cm^2.
Calibration dose rate = 1cGy / MU

Description	Beam 1 Ant	Beam 2 Post	Beam 3 Lt Lat	Beam 4 Rt Lat
Tissue depth to beam isocenter (cm)	16.0	10.5	17.0	17.0
Gantry angle	0^0	180^0	90^0	270^0
Treatment Field size (cm^2)	15 x16	15x16	11x16	11x16
Tissue maximum ratio	0.723	0.840	0.692	0.692
Collimator scatter factor		1.024	1.015	1.015
Phantom scatter factor	1.016	1.016	1.010	1.010

(i) Find the dose rate in water at d_{max} for beam 1 and beam 3 (10 marks)

(ii) Assuming equal dose to the tumour center from all beams, calculate the number of monitor units (MUs) for each beam. (40 marks)

(c) Give reasons why the above calculated MUs are slightly changed when compared with 3D CRT data sheet of the same patient. (15 marks)

(d) Compare the above treatment plan with a plan giving an equal weighting from all beams with a similar set up. (Calculations are not required)

5.

(a) In external beam therapy, define

(i) Wedge angle (20 marks)

(ii) Wedge Transmission Factor (20 marks)

(b) Sketch isodose curves in water for 8W x I5 cm^2 field size with a 30° wedge for Co-60 gamma rays. (20 marks)

(c)

(i) What is hinge angle ? (15 marks)

(ii) Write the equation to select wedge angle from hinge angle ? (10 marks)

(d) Briefly explain the importance of dose monitoring ionization chambers used in the head of a Linear accelerator ? (15 marks)

6.

(a) What mechanical changes need to take place in a Clinical Linear Accelerator when switching from photon to electron mode ? (20 marks)

(b) Briefly explain the physical importance of above components. (40 marks)

(c) List the central axis beam characteristics in electron beam therapy. (20 marks)

(d) Briefly explain the change of above beam characteristics on field size. (20 marks)

7. With regards to HRD gynaecological Brachytherapy,

(a) Write down two radionuclides commonly used in HDR remote after loading units. (10 marks)

(b) Briefly compare the physical properties of the above radionuciides. (30 marks)

(c) Give the typical initial activities of the respective sources.(10 marks)

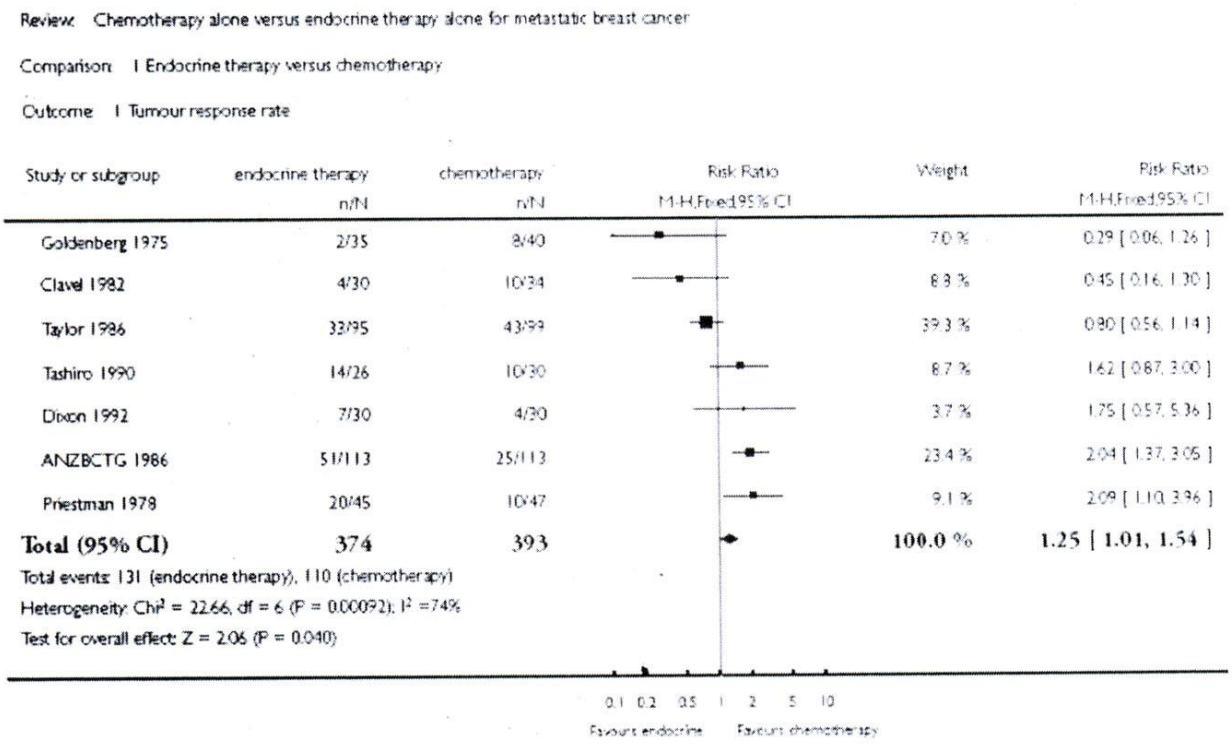
(d) Define point A and point B of the Manchester system. (25 marks)

(e) Briefly explain the radiation safety measures that should be considered daily for a remote after loading HDR Brachytherapy machine. (25 marks)

PART B - MEDICAL STATISTICS

Each question carries 100 marks.
Each question to be answered in a separate book.
Answer <u>two questions</u> of the three questions given below.

1. A systematic review was conducted to determine whether starting treatment with chemotherapy or endocrine therapy has the more beneficial effect on tumour response. The following forest plot shows the results.



(a) List two (2) advantages of systematic reviews. (10 marks)

(b) List the steps in conducting a systematic review. (30 marks)

(c) Describe and interpret the results of the forest plot. (40 marks)

(d) What is your conclusion ? (10 marks)

(e) List two (2) biases that could occur while conducting a review. (10 marks)

2. A study was conducted to assess the validity of a new screening test for detecting cervical intraepithelial neoplasia (CIN2+). A total of 2400 women were invited to participate for the study. Cutoff point was determined using receiver operating characteristic curve as >0.6 Units to define positive findings of the new test. The gold standard method detected 70 women with CIN2+.

New test	**Sensitivity % (95% confidence interval)**	**Specificity % (95% confidence interval)**
>0.6 Units	84 (76 – 93)	88 (86 – 89)

(a) What is meant by 'Gold standard' ? (10 marks)

(b) Briefly explain how the investigators decided the cutoff level for the above study ? (25 marks)

(c) Briefly describe the method of conducting the study. (25 marks)

(d) Interpret the above results. (20 marks)

(e) Calculate and interpret the positive predictive value for the new test. (20 arks)

3. Write notes on the following

(a) Confounding factors (25 marks)

(b) Cluter randomisation (25 marks)

(c) Paired t-test (25 marks)

(d) Kaplan-Meier survival curve (25 marks)

POSTGRADUATE INSTITUTE OF MEDICINE
UNIVERSITY OF COLOMBO

MD (CLINICAL ONCOLOGY) PART I (REPEAT) EXAMINATION
DECEMBER 2010

Date : 14th December 2010 Time : 9.00 a.m. – 12.00 noon

PAPER II

Parts A, B, C and D must be answered.

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

SECTION A - PATHOLOGY

Answer two questions of the three questions given below.
Each question carries 100 marks.
Each question to be answered in a separate book.

1.

1.1 Mention the malignant neoplasms that may be seen in the uterus in a 60 year old lady. (35 marks)

1.2 Describe briefly the histological features of anyone neoplasm you have mentioned in 1.1. (30 marks)

1.3 What histological features are valuable in predicting the prognosis and further management of a uterine carcinoma ? (35 marks)

2. A 25 year old female is found to have a anterior mediastinal mass.

2.1 What are the possible malignant neoplasms you would expect to see in this patient ? (30 marks)

2.2 What laboratory investigations would help in arriving at a diagnosis ? (30 marks)

2.3 Describe briefly the histological and immunohistochemical features of two common tumours mentioned in 2.1 (40 marks)

3.

3.1. Innumerate the primary malignant bone tumours. (30 marks)

3.2. What information would you like to provide to the pathologist to facilitate the diagnosis. (30 marks)

3.3 Describe briefly the histological features and useful immuno-histochemical markers of a primary bone tumour affecting a

(a) 30 year old male.

(b) 60 year old female (40 marks)

SECTION B - RADIOBIOLOGY

Answer <u>two questions</u> of the three questions given below.
Each question carries 100 marks.
Each question to be answered in a separate book.

1.

1.1 Name the most important mode of cell death following irradiation. (10 marks)

1.2 Name a type of cell different from the above and state the mode of death. (20 marks)

1.3 The time of appearance and dose dependence of radiation damage in a normal tissue depends upon its proliferative organization. Comment on this with the help of rapid renewing and slowly renewing normal tissues. (30 marks)

1.4 What is consequential late effects? When does this arise ? (20 +20 marks)

2.

2.1 lrradiation of an exponentially-growing population of cells in culture with a dose that kills 90% of cells tends to select surviving cells that are initially in which phase of the cell cycle. . (10 marks)

2.2. Giving your reason state how you would draw a tumour growth curve. (10 marks)

2.3. State the factors that determine the volume doubling time of a tumour. (15marks)

2.4 What is the main reason for slow growth of many human tumours ? (10 marks)

2.5 Two patients are diagnosed on the same day with tumours of approximately the same size. However, the T_{por} for patient A's tumour was determined to be 5d while the T_{por} for patient B' s tumour was calculated as 20 d. Assuming that there was no cell loss taking place and the tumour's growth fraction did not change, if treatment had been initiated 20 d earlier, determine the ratio of the number of cells in the tumours of patient A to B. (35 marks)

2.6 Draw the volume response of an uncontrolled tumour and state in the graph the processes that contribute to the response. (20 marks)

3.

3.1. State the advantages of fractionation in radiotherapy. (25 marks)

3.2 What is hyper fractionation and give the rationale for this method ? (25 marks)

3.3 What does the α/β ratio describe ? What does a low and high α/β ratio indicate ? (10 +40 marks)

SECTION C – CHEMOTHERAPY (PHARMACOLOGY)

Answer <u>two questions</u> of the three questions given below.
Each question carries 100 marks. .
Each question to be answered in a separate book.

1.

1.1 Explain the term post marketing pharmacovigilance and list the reasons for the need to have post marketing pharmacovigilance. (40 marks)

1.2 Explain the term Type A Adverse drug reaction and indicate what measures you will take to prevent Type A Adverse drug reactions in Oncology practice. (30 marks)

1.3 Explain the term "bioavailability" and give examples of drug interactions affecting the bioavailability of a drug. (30 marks)

2. Explain the mode of action of the following drug classes in relation to cancer treatment.

2.1 Folate antagonists (25 marks)

2.2. Selective oestrogen receptor modulators (SERMs) (25 marks)

2.3. Gonadorelin analogues (25 marks)

2.4. Spindle inhibitors (25 marks)

3. You are a consultant in an oncology unit in Sri Lanka. A Clinical research organization contacts you regarding participation as a principal investigator for an international multi-center phase III clinical trial to find out the efficacy and safety of a new Epidermal Growth Factor Receptor (EGFR) inhibitor for advanced colorectal cancer not responding to standard therapy.

3.1 Name four (04) bodies from which you need to obtain the approvals/registrations to conduct this clinical trial in your hospital. (20 marks)

3.2 Name the guideline ,according to which you will be expected to conduct this clinical trial and explain the reasons for complying with the guidelines. (20 marks)

3.3 Explain the importance and process by which informed consent will be obtained from participants for this clinical trial. (30 marks)

3.4 Discuss the requirements you need to have and responsibilities that you would have as the principal investigator of this clinical trial. (30 marks)

PART D - CANCER BIOLOGY

Answer <u>two questi</u>ons of the three questions given below.
Each question carries 100 marks.
Each question to be answered in a separate book.

1. A woman with breast cancer is heterozygous for the 5804delG mutation on the BRCA 1 gene. This is a nonsense mutation.

1.1. Describe what is meant by a nonsense mutation. (20 marks)

1.2 Describe the methods that can be used to detect the presence of this mutation in other members of her family giving reasons. (20 marks)

1.3 Mutations in BRC Al gene are said to act in a recessive fashion. Describe this statement. (20 marks)

1.4 Discuss briefly the role of family history assessment and pre-symptomatic testing in the prevention of breast cancer. (20 marks)

1.5 Enumerate the features in a family history that would indicate a strong genetic predisposition for breast cancer. (20 marks)

2.

2.1 List three (03) causative agents that give rise to DNA damage. (15 marks)

2.2 Briefly describe the effects of DNA damage. (50 marks)

2.3 Briefly describe the factors that effect the rate of DNA repair (15 marks)

2.4 List three (03) types of endogenous DNA damage mechanisms (20 marks)

3. Explain the role of

3.1 Major Histocompatibility Complex (MHC) in the recognition of tumour Antigens. (40 marks)

3.2 Immunoglobulin G (IgG) in combating haematological malignancies. (30 marks)

3.3 Complement cascade in eliminating cancer cells. (30 marks)

POSTGRADUATE INSTITUTE OF MEDICINE
UNIVERSITY OF COLOMBO

MD (CLINICAL ONCOLOGY) PART I EXAMINATION
AUGUST 2011

Date : 1st August 2011 **Time :** 2.00 p.m. – 5.00 p.m

PAPER I

Part A and B must be answered

If the examiners cannot read your writing you will not be given full credit for your knowledge.

PAT A – PHYSICS

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

1.

1.1 Define the term "Gray (Gy)" and briefly explain why this unit is not used in radiation protection to express dose to the human body. (20 marks)

1.2 Whilst preparing a patient for treatment, a worker is exposed for 20 minutes from a detached ^{60}Co Brachytherapy source at 2 m distance from the source, without knowing that it was detached. The dose rate at 1 m from this source is 480 m Sv/h.

(a) Calculate the dose to the body. (20 marks)

(b) Is this dose acceptable in relation to dose limitation criteria, if he has not received an appreciable dose during the last five (05) years ? (20 marks)

1.3

(a) What is meant by a stochastic effect and give two examples. (20 marks)

(b) Briefly explain the probable effects to the human foetus if it is exposed to a dose of 200 mSv during 8-16 weeks of pregnancy (20 marks)

2.

2.1.

(a) Define Half Value Layer (HVL). (15 marks)

(b) Write the relationship between HVL and linear attenuation coefficient for a given material. (10 marks)

(c) Why is the 2^{nd} HVL larger than the 1^{st} HVL for a orthovoltage x-ray beam. (15 marks)

2.2 Briefly discuss the main physical processes involved and the reasons for the use of filters in the following situations.

(a) The added filter in a diagnostic x-ray machine. (20 marks)

(b) The Thoraeus filter in orthovoltage therapy. (20 marks)

(c) The beam flattening filter in a 15 MeV linear accelerator. (20 marks)

3.

3.1. Define the following terms with reference to ICRU Reports 50 and 62

(a) Treated volume (15 marks)

(b) Irradiated volume (15 marks)

3.2 In relation to 3D CRT planning process explain briefly

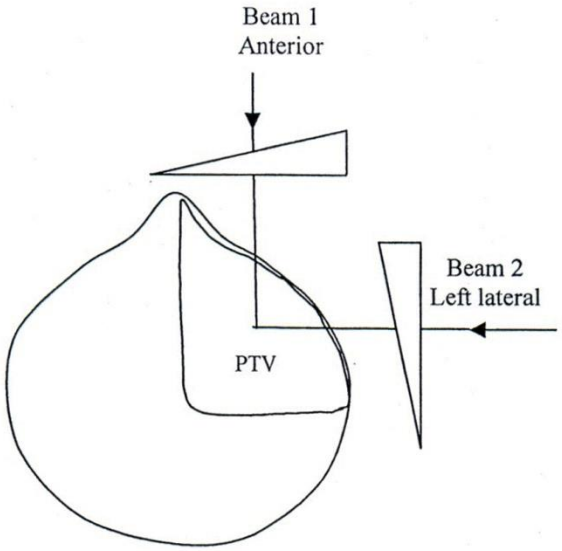
(a) Digitally reconstructed radiographs (DRR) (15 marks)

(b) List two clinical advantages and two disadvantages of using CT based target volume delineation. (20 marks)

3.3. To optimize the CTV delineation process in head and neck cancer list three (03) modern imaging modalities. (15 marks)

3.4. In the expansion of the CTV to PTV for a lung tumour, give two (02) specific uncertainties in PTV delineation. (20 marks)

4 A maxillary antrum tumour is to be treated by 6 MV x-rays at 100 cm Source Axis Distance (SAD) with two beams as shown in the figure below. The prescribed dose to the tumour centre is 66 Gy in 33 fractions over 6 1/2 weeks.



The output of the 6MV machine is measured with an ionization chamber at 1.5 cm depth (d_{max}) in water, Source chamber distance 100 cm, dose rate at D_{max} for 10 cm field size is 1 cGy/MU.

Description	**Beam 1(Anterior)**	**Beam 2 (Left Lateral)**
Gantry angle	0^o	90^o
Tissue depth to beam isocenter (cm)	4.5	3.5
Treatment field size (cm)	X_1= 3.0, X_2= 4.0 Y1= 5.0, Y_2= 4.0	X_1= 6.0, X_2= 4.0 Y1= 5.0, Y_2= 4.0
Tissue maximum ratio	0.950	0.970
Wadge aransmission factor	0.584	0.582
Collimator scatter factor	0.984	0.994
Phantom scatter factor	0.992	0.996

4.1. Calculate the dose rate at d_{max} in water for the above mentioned open and wedge beams. (20 marks)

4.2 Assuming 2D manual planning and considering equal dose to the tumour center from both beams, calculate the number of monitor units per field per fraction. (40 marks)

4.3 Illustrate other possible field arrangements with appropriate wedges to be considered for the above treatment. (20 marks)

4.4 How do you estimate the total dose to the ipsilateral eye ? (20 marks)

5. In external beam photon therapy

5.1 Sketch typical isodose curves for 6 MV photon beam in water at 100 cm SSD for 10 cm x 10cm field size. (20 marks)

5.2 Compare the above isodose distributions with ^{60}Co at 80 cm SSD and 200 KV (HVL 1.5 mm Cu) at 50 cm SSD for 10 cm x 10 cm field size (30 marks)

5.3 List five (05) beam parameters that affect isodose distributions.

(20 marks)

5.4 Briefly explain the use of

(a) Physical wedges. (10 marks)

(b) Motorized wedges. (10 marks)

(c) Tissue compensators. (10 marks)

6. In Electron Beam Therapy

6.1. Discuss the advantages and disadvantages compared to ^{60}Co external beam therapy. (20 marks)

6.2. How does the energy and dose deposition of an electron beam vary with depth in tissue and why ? (20 marks)

6.3. List the clinical information and beam parameters which are necessary for energy selection. (20 marks)

6.4.

(a) What is meant by practical range of an electron beam and illustrate this diagrammatically. (20 marks)

(b) Give typical values of practical range for 6 Me V and 20 Me V nominal electron energies. (10 marks)

6.5. What is the role of bolus in electron beam therapy treatment ? (10 marks)

7. A tongue tumour with dimensions of 2 cm x 2 cm x 1 cm is to be treated with a ^{192}Ir implant.

7.1 Give four (04) physical properties of ^{192}Ir. (30 marks)

7.2 List three (03) different forms of ^{192}Ir a available for this treatment. (15 marks)

7.3 Give the dose rate ranges for low (LDR), medium (MDR) and high (HDR) as used in brachytherapy. (15 marks)

7.4 Compare and contrast the Manchester and Paris rules for implant dosimetry. (25 marks)

7.5 What isotope can be used, other than 192Ir, for HDR after-loading brachytherapy. Give the main advantage. (15 marks)

PART B – MEDICAL STATISTICS

Each question carries 100 marks.
Each question to be answered in a separate book.
Answer <u>two questions</u> of the three questions given below.

1. A Prospective cohort study was conducted to assess whether the body mass index (BMI) is associated with colorectal adenoma. Self- administered questionnaire was used to gather the relevant information in addition to record of the anthropometric measurements. Cox regression analysis was performed. The following table shows the results of the study.

BMI kg/m^2	**Median follow-Up time (months)**	**Adjusted HR**	**95% CI**
Women			
Normal weight < 19.0	2,026.2	Reference	
Overweight or obese ≥ 19.0	969.8	0.75	0.20 to 3.0
Men			
Normal weight < 19.0	832.6	Reference	
Overweight or obese ≥ 19.0	864.1	8.70	2.0 to 37.0

HR: Hazards Ratio, 95% CI: 95% Confidence Interval

1.1 Explain how the investigators calculate median follow-up time for this study. (20 marks)

1.2 Explain why the investigators reported median follow up time instead of mean. (10 marks)

1.3 What information would you expect to obtain the questionnaire? (10 marks)

1.4 How would you minimize information bias for this study ? (20 marks)

1.5 Explain why they apply Cox regression. (10 marks)

1.6 Explain why they analyze the date by gender. (10 marks)

1.7 Interpret the result of the study? (20 marks)

2. You are asked to design an experimental study to examine whether zoledronic acid prevents bone loss in pre-menoposal women receiving chemotherapy for early stage breast carcinoma.

2.1 List the steps in designing the above study. (30 marks)

2.2 Describe, giving reasons, three (03) steps to improve the quality of the study. (30 marks)

2.3 Briefly describe the plan for data analysis including statistical procedure. (20 marks)

2.4 Briefly describe the ethical considerations relevant to the above study. (20 marks)

3. Write notes on the following-

3.1 Interim analysis (25 marks)

3.2 Censored data (25 marks)

3.3 Volunteer bias (25 marks)

3.4 Non-parametric tests (25 marks)

POSTGRADUATE INSTITUTE OF MEDICINE
UNIVERSITY OF COLOMBO

MD (CLINICAL ONCOLOGY) PART I EXAMINATION - AUGUST 2011

Date : 2nd August 2011 **Time :** 9.00 a.m. – 12.00 noon

PAPER II

Part A,B, C and D must be answered.

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

SECTION A- PATHOLOGY

Answer two questions of the three question given below.
Each question carries 100 marks.
Each question to be answered in a separate book.

1. A 60 year old female presents with an ulcerative growth in the rectum.

   1.1 List five (05) possible malignant lesions that you would consider in your differential diagnosis. (20 marks)

   1.2 Give four (04) clinical investigations which could be used to differentiate them. (20 marks)

   1.3. Give eight (08) immunohistochemical stains with the relevant tumours which would distinguish those you have mentioned in 1.1. (40 marks)

   1.4. Give five (05) premalignant lesions or conditions associated with colorectal carcinoma ? (20 marks)

2. Give five (05) pathological features including immunohistochemistry (where relevant) of each of the following –

2.1. Nodal Follicular lymphoma

2.2. Mucoepidermoid carcinoma of salivary gland

2.3. Papillary carcinoma of thyroid gland

2.4. Phyllodes tumour of breast (25 marks each)

3.

3.1 List five (05) malignant Germ cell tumours of ovary. (25 marks)

3.2 For three of the tumours you have listed in 3.1 give five (05) pathological features for each one. (75 marks)

SECTION B – RADIOBIOLOGY

Answer two questions of the three questions given below.
Each question carries 100 marks.
Each question to be answered in a separate book.

1.

1.1.

(a) What is Repair ?

(b) List factors on which repair is dependent.

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

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

(e) List factors on which regeneration is dependent.

(5 x 10 marks)

1.2. A patient needs to be treated for a type of cancer. The information provided is as follows.
The tumour possesses an α/β ratio of 2 Gy.
Dose limiting normal tissue toxicity has an α/β ratio of 6 Gy

Name the fractionation schedule you would choose and give your reasons
(05 + 20 marks)

1.3.

(a) Maximum cell killing per dose delivered occurs at what LET value ?

(b) At what LET range does RBE change most ?

(c) How does OER change with change in LET ?

(d) Graphically represent (a), (b) and (c)

(e) What happens to RBE when LET is increased above about 100 keV/μm and what is the reason for this ?
(05 x 05 marks)

2.

2.1. To produce a radiation survival curve for a new cell line, four Petri dishes were seeded with 10^2, 10^3 10^4 and 10^5 cells. They were irradiated with 0, 3, 6, and 9 Gy respectively. At the end of a two week incubation period a total of 40 colonies were counted on each dish.

(a) What is the shape of the survival curve? (05 marks)

(b) What are the values for n and Dq ? (10 marks)

(c) What is the surviving fraction after a dose of 3 Gy ?
(10 marks)

2.2. In one or two sentences comment on the following

(a) The β parameter generally increases as the radiation dose rate decreases.

(b) The inverse of the Dq corresponds to the final slope of the survival curve.

(c) Extrapolation number n, of a survival curve increases with increasing LET of the radiation.

(d) D_o is a measure of the incremental increase in cell survival when a dose is fractionated.

(e) When n = 1 $D_{37} = D_o$ (10 x 05 marks)

2.3. An 8 Gy X ray dose delivered at 1 Gy/h is less toxic than the same dose delivered at 1 Gy/min.

State if the following are true or false explanations for this. In a sentence or two give your reasons for the false statements only.
(25 marks)

(a). Fewer free radicals are generated.

(b) Cell division occurs during exposure

(c) Sublethal damage repair occurs during irradiation

(d) free radical scavenging and chemical restitution is permitted

3

3.1 List two (02) micro environment conditions other than hypoxia that can influence cells in a tumour. (10 marks)

3.2 Give two (02) reasons why hypoxia may play an important role in treatment outcome. (10 marks)

3.3. Considering kidney, lung, spinal cord, breast epithelium and bone marrow which tissues would be expected to show the least amount of sparing when irradiated with x-rays at a low versus high dose rate. State your reasons. (40 marks)

3.4 Briefly comment on the following

(a) High tolerance dose when small volumes of skin and spinal cord are irradiated

(b) For < 1 cm lengths of spinal cord an increase in field size is associated with a marked increase in the probability of complications (40 marks)

SECTION C – CHEMOTHERAPY (PHARMACOLOGY)

Answer two questions of the three questions given below.
Each question carries 100 marks.
Each question to be answered in a separate book.

1.

1.1. Write short notes on

(a) Oral bioavailability (30 marks)

(b) Controlled release formulations (20 marks)

1.2

(a) Explain the pharmacokinetics of morphine when given orally. (30 marks)

(c) Give four (04) principles of use when morphine is prescribed for cancer pain. (20 marks)

2.

2.1. In the endocrine therapy of breast cancer

(a) List three (03) drugs in common use and their mode of action (30 marks)

(b) Explain the mechanisms of resistance that may arise to one of these. (40 marks)

(c) Explain the pharmacological basis for the co-administration of an anti-androgen (e.g.; flutamide) and a gonadorelin (gonadotrophin releasing hormone analogue) for the treatment of advanced prostate cancer. (30 marks)

3.

3.1. In developing a new cancer drug what is meant by

(a) Phase I trial (10 marks)

(b) Phase II trial (10 marks)

3.2. What is the difference between phase I trial for a cancer drug and a non-cancer drug. (20 marks)

3.3. Discuss the ethical issues involved in doing phase I clinical trials in Oncology. (20 marks)

3.4. Describe what aspects need to be explained explicitly to the participant during the informed consent process when conducting a phase I clinical trial in oncology. (40 marks)

SECTION D – CANCER BIOLOGY

Answer two questions of the three questions given below.
Each question carries 100 marks.
Each question to be answered in a separate book.

1.

1.1. List five (05) characteristics that a cell acquires in the process of malignant transformation. (25 marks)

1.2. Briefly describe the actions of p53 in cell cycle regulation in DNA Damage. (65 marks)

1.3 List two (02) agents that block the actions of p53. (10 marks)

2.

2.1. Tumours often possess cytogenetically different clones that arise from the initial transformed cell through secondary or tertiary genetic alterations. What is the clinical implication of this heterogeneity ? (10 marks)

2.2 What is the chromosomal abnormality that initiates chronic myelogenous leukemia ? (10 marks)

2.3 What is the effect of this change ? (10 marks)

2.4 Treatment with imatinib induces complete remission of the condition in most patients. What genetic factors contribute to recurrence of the condition in such patients ? (10 marks)

2.5. For each of the following, explain how the test is used for detection, screening and monitoring of genetic abnormalities.

(a) Chromosome culture and karyotyping (20 marks)

(b) Reverse Transcriptase PCR (20 marks)

(c) Real Time PCR (20 marks)

3.

3.1 Define the term “immune surveillance”. (15 marks)

3.2 List three cells and three molecules involved with immune surveillance of cancer cells. (30 marks)

3.3 Explain the mechanism of action of the following in the elimination of cancer cells.

(a) One (01) cell mentioned in 3.2 (30 marks)

(b) One (01) molecule mentioned in 3.2 (25 marks)