

UNIVERSITI SAINS MALAYSIA

Second Semester Examinations
1996/97 Academic Session

April 1997

ZCT 535/4 - Nuclear Medicine and Radiotherapy Physics

Time: [3 hours]

Please make sure that this examination paper consists of THREE printed pages before you commence the examination.

Answer any FIVE questions only.

1. Single Head Digital Gamma Camera System.

- (a) Sketch the basic components of the system. (10/100)
- (b) Explain briefly the physical meaning of peaking the camera, energy resolution and count-rate performance. (30/100)
- (c) Explain briefly important factors that affect the sensitivity of the camera. (20/100)
- (d) Describe important properties of radionuclides used in nuclear imaging. (20/100)
- (e) How is in-vivo activity measured using the system. (20/100)

2. SPECT Procedure.

- (a) Describe the advantages of SPECT over planar imaging. (10/100)
- (b) State 2 unknowns in the projection data. (10/100)
- (c) Describe briefly 2 factors that affect resolution in the final image. (20/100)
- (d) Using a point source explain the principle underlying image reconstruction using filtered backprojection method. (30/100)
- (e) Briefly explain the major factors that limit the accuracy to quantify the activity in the patient using SPECT. (30/100)

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3. (a) In internal dosimetry explain briefly 3 factors that contribute to radiation dose in target organ from radioactivity in the source organ. (30/100)
- (b) For penetrating radiation write down the formula for the mean dose of the target organ and explain the physical meaning of the formula. (10/100)
- (c) 10 millicurie of Tc-99m+DTPA was injected into the patient for kidney study. Over a period of 30 minutes from injection time 5 millicurie of radiopharmaceutical was accumulated in the kidney and was then cleared to the bladder with effective half-life of 30 minutes. Assuming that the uptake in the kidney was linear with time, calculate the mean dose to the kidney. Given that $S(kid-kid) = 0.0046 \text{ rad/microcurie/day}$. (60/100)
5. (a) Define and discuss the following terms:-
- (i) Percentage Depth Dose
 - (ii) Tissue Air Ratio
 - (iii) Tissue Maximum Ratio
- (45/100)
- (b) Discuss factors to be considered in the design of shielding for a treatment room to house a 16 MV linear accelerator. (55/100)
5. (a) Discuss briefly the characteristic features of the central axis depth dose and isodose curves for the following types of radiation
- (i) neutrons
 - (ii) electrons
 - (iii) negative pions
- (60/100)
- (b) Explain briefly the advantages and disadvantages of neutrons, protons, electrons and negative pions in radiotherapy treatments. (40/100)
6. (a) What physical properties are desirable in a gamma emitter which is to be used for brachytherapy? Explain why. (20/100)
- (b) Briefly discuss the procedural precautions taken in brachytherapy wards during mould treatments to limit radiation doses to staff, other patients and visitors. (20/100)

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- (c) What are the main requirements of a remote after loading device. (20/100)
- (d) Describe the main features of either the Manchester or Paris dosimetry system for a single plane brachytherapy implant. (40/100)

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