



NATIONAL UNIVERSITY OF SCIENCE AND TECHNOLOGY
FACULTY OF APPLIED SCIENCES
DEPARTMENT OF RADIOGRAPHY PART 2
PHYSICS OF RADIATION SCIENCE
SRA 2108

Second Semester Examination Paper
March 2025

This examination paper consists of 3 pages

Time Allowed: 3 hours
Total Marks: 100
Special Requirements: None
Examiner's Name: Mr A N Moyo

INSTRUCTIONS

ANSWER ALL PARTS OF QUESTION 1 IN SECTION A AND ANY THREE QUESTIONS FROM SECTION B. SECTION A CARRIES 40 MARKS AND SECTION B CARRIES 60 MARKS

MARK ALLOCATION

QUESTION	MARKS
1.	40
2.	20
3.	20
4.	20
5.	20
6.	20
Maximum possible mark	100

SECTION A

1. (a) Explain the purpose of the MRI safety screening form? [4]

- (b) Differentiate between DICOM and PACS? [4]

- (c) Compare and contrast the spin-echo and gradient-echo sequences? [3]

- (d) Describe how T1 and T2 relaxation times influence MRI images. [4]

- (e) Explain the potential bioeffects of ultrasound on tissues? [3]

- (f) How does the Mechanical Index (MI) relate to ultrasound safety? [2]

- (g) With respect to digital x-ray imaging, describe how the x-ray detector converts x-rays into an image. [4]

- (h) State the difference between a stationery anode and a rotating anode X-ray tube. [4]

- (i) A radio-active substance is identified on the floor in an imaging department. Explain fundamental radiation protection and safety protocols that may be used to mitigate this anomaly. [6]

- (j) Compare and contrast radiation safety between ionising radiation and acoustic radiation [6]

SECTION B

- 2 (a) Discuss how the piezoelectric effect contributes to the functionality of ultrasound transducers? [10]
- (b) Describe the fundamental design considerations of an ultrasound imaging probe. [10]
- 3 (a) Justify the diagnostic value of Radio Nuclide Imaging (RNI) with respect to the following scenarios:
- i. Cancer, [3]
 - ii. Trauma and [3]
 - iii. Infection. [4]
- (b) Describe the role of radiopharmaceuticals in Radionuclide imaging. [5]
- (c) Describe how Positron Emission Tomography (PET) differs from Single Photon Emission Computed Tomography (SPECT). [5]
4. (a) Describe:
- i. The fundamental principle of MRI and [4]
 - ii. How MRI imaging differs from CT imaging. [6]
- (b) Explain how the radiofrequency (RF) pulse interact with the hydrogen nuclei in the body. [5]
- (c) How does the concept of spin relaxation relate to the MRI signal? [5]
5. (a) Differentiate between digital radiography (DR) and Computed radiography (CR). [10]
- (b) Fundamentally, x-ray imaging is about a careful balance among mA, s and kVp. Outline circumstances (and the effect there-off) that may

require the adjustment of each of the aforesaid three parameters one at a time. [10]

6 (a) A radiographer begins his shift and finds images from the previous day yet to be dispatched to the referring doctors. The radiographer notices that the images need post processing and immediately begins post processing the images with respect to collimation and density and then posts them to the referring doctors.

Discuss:

i. The risks associated with this opportunity to post process these digital radiography images. [5]

ii. The benefits associated with this opportunity to post process these digital radiography images [5]

(b) Discuss how:

i. Issues to do with quantity of urine in the bladder impact on the potential of ultrasound imaging. [5]

ii. Issues to do with skull anatomy impact on the potential of ultrasound imaging [5]

END OF EXAMINATION