

OLLSCOIL NA hÉIREANN  
GAILLIMH

NATIONAL UNIVERSITY OF IRELAND  
GALWAY

SEMESTER I (WINTER) EXAMINATIONS 2000/2001

M.Sc. in Biomedical Science

CT512 Medical Imaging.

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Time allowed: **Two** hours.

Answer **three** questions (Marks for each section are shown)

Q.1 Answer all parts:

Outline the properties of alpha, beta and gamma rays listing an example of each. [30]

Show the relative positions of the parent and daughter on the chart of nuclides. [10]

Answer the following: [30]

- (a) define what is meant by the disintegration constant
- (b) define what is meant by the half value layer and tenth value layer for gamma rays
- (c) if the range of beta particles in water is 0.9 cm what would it be in aluminium (density  $2.7 \text{ gcm}^{-3}$ )

Outline some industrial uses of gamma ray sources. [30]

Q.2 Answer all parts

(a) Describe the method whereby we create contrast in medical imaging for the following modalities:

- X-Ray projection Imaging
- Nuclear Medicine
- Computed Tomography
- Ultrasound [60]

(b) Discuss, with the aid of a diagram, factors which determine sharpness and contrast in conventional projection radiography. [20]

(c) Outline the advantages of Computed Tomography over conventional radiography.  
Also give two disadvantages. [20]

**Q.3** Answer all parts:

- (a) In Magnetic Resonance Imaging, describe the concept of precession. [20]
- (b) Describe  $T_1$  and  $T_2$  relaxation. [25]
- (c) Describe, using a diagram, the Spin-Echo Imaging sequence. [30]
- (d) Present a schematic diagram of a modern Magnetic Resonance Imager [25]

**Q.4** Answer all parts

Describe the nature of the waves used in ultrasonic imaging. [10]

If the wave velocity in water is  $1500 \text{ ms}^{-1}$  and the ultrasonic frequency is 2 MHz what is the wavelength? [10]

What is meant by the characteristic impedance ( $\omega$ ) of a medium? Calculate its value for muscle if  $v = 1600 \text{ ms}^{-1}$  and  $\rho = 1000 \text{ kgm}^{-3}$ . [20]

Write down the equation for the fractional energy reflected at the interface between media of impedances  $\omega_a$  and  $\omega_b$ . [20]

What is meant by lateral and longitudinal spatial resolution and say what limits these parameters? [20]

With the aid of a block diagram describe the working of an ultrasonic imaging system as used in medicine. [20]

**Q.5** Write an essay about our ionising radiation environment. Include a pie chart showing from where the contributions arise. Special mention should be made of radon, work at high altitude, internal radioactivity and the contribution from Sellafield. [100]