Eduqas Physics – Component 3

Module B: Medical physics

This topic begins by studying the nature and properties of X-rays and the uses of Xrays in imaging soft tissue. Techniques of radiography are studied together with the use of a rotating beam X-ray computed tomography scanner. The generation and detection of ultrasound, its use for diagnosis and the study of blood flow are introduced. The principles of magnetic resonance are discussed together with the use of MRI in obtaining diagnostic information. The uses of radionuclides as tracers is covered, together with the use of the gamma camera and positron emission tomography scanning.

You should be able to demonstrate and show your understanding of:	**Progress and understanding:**			
	1	**2**	**3**	**4**
The nature and properties of X-rays				
The production of X-ray spectra including methods of controlling the beam intensity and photon energy				
The use of high energy X-rays in the treatment of patients (therapy) and low energy X-rays in diagnosis				
The equation $I = I_0 \exp(-\mu x)$ for the attenuation of X-rays				
The use of X-rays in imaging soft tissue, and fluoroscopy to produce real time X-rays using image intensifiers				
Techniques of radiography including using digital image receptors				
The use of a rotating beam X-ray computed tomography (CT) scanner				
The generation and detection of ultrasound using piezoelectric transducers				
Scanning with ultrasound for diagnosis including A-scans and B-scans incorporating examples and applications				
The significance of acoustic impedance, defined by $Z = c\rho$ for the reflection and transmission of sound waves at tissue boundaries, including the need for a coupling medium				
The use of the Doppler equation $\frac{\Delta f}{f_0} = \frac{2v}{c}\cos\theta$ to study blood flow using an ultrasound probe				
The principles of magnetic resonance with reference to precession nuclei, resonance and relaxation time, and to apply the equation f = 42.6 x $10^6 B$ for the Lamour frequency				

You should be able to demonstrate and show your understanding of:	Progress and understanding:			
	1	2	3	4
The use of MRI in obtaining diagnostic information about internal structures				
The advantages and disadvantages of ultrasound imaging, X-ray imaging and MRI in examining internal structures				
The effects of α, β, and γ radiation on living matter				
The Gray (Gy) as the unit of absorbed dose and the Sievert (Sv) as the unit of equivalent dose and effective dose. Define absorbed dose as energy per kilogram				
The use of the equations • equivalent dose = absorbed dose × (radiation) weighting factor $H=DW_R$ and • effective dose = equivalent dose × tissue weighting factor $E=HW_T$				
The uses of radionuclides as tracers to image body parts with particular reference to technetium-99m (Tc-99m)				
The use of the gamma camera including the principles of the collimator, scintillation counter and photomultiplier / CCD				
Positron emission tomography (PET) scanning and its use in detecting tumours				