THE OPEN UNIVERSITY OF SRI-LANKA

B.Sc DEGREE PROGRAMME-LEVEL - 05

MEDICAL PHYSICS – PHU 3158 / PHE 5158

OPEN BOOK TEST (OBT) - 2010

DURATION: ONE AND HALF HOURS (1 ½ hrs)

Date: 26th of March 2010   **Time: 4.00 pm – 5.30 pm**

Answer <u>ALL</u> questions

(1) a) Explain the term Doppler Effect in Ultrasound and give two uses of this phenomenon in medical diagnosis.

b) Derive expressions for Doppler shift, when

i) The moving source frequency f_s, velocity V_s towards the stationary observer.

ii) The moving observer velocity V_o, source frequency f_s towards the stationary source.

c) Find Doppler shift, when the blood passes through the vessel with velocity V and the transmitter frequency f.

d) Deduce the expression for Doppler shift when the transmitter makes an angle θ with the blood vessel.

e) In a blood flow investigation, when a source of 5 MHz Ultrasound is directed at an angle to produce a Doppler shift of 150 Hz, it is found that the speed of the blood is 45 mm s^{-1}. If the speed of the ultrasound is 1.5 km s^{-1}, what would be the angle that transmitter makes with the blood vessel?

(2) a) Discuss the peripherals of Magnetic Resonance Imaging (MRI) system with the aid of a diagram and give the purpose of using each of them in the system.

b) Describe the terms Precession, T_1 Process and T_2 Process in Magnetic Resonance Imaging (MRI).

c) What is Larmor frequency?

d) A patient of 1.6m is placed horizontally in a uniform magnetic field of flux density 1.55 T directed from his feet to his head. A gradient field of 0.015 T m^{-1} is applied, again from his feet to his head. If $\gamma/2\pi$ is 42.6 MHz T^{-1} (where γ is the gyro magnetic ratio) estimate the frequency of the radio frequency pulse required to produce proton resonance in a slice through his abdomen, located at a distance 0.85 m from his feet.

(3) a) Define the terms Absorbed dose, Equivalent dose and Effective dose.

b) A decayed Co-60 source of activity 2 Ci has to be kept for a long time in storage and dose rate at 1 m from the source should be less than 1 μSv h^{-1}. Design a lead shield to store this source.

Half value thickness (HVT) for Co-60 is 1.2 cm

Tenth value thickness (TVT) for Co-60 is 4 cm

Specific gamma- ray constant of Co-60 is 1.31 R h^{-1} Ci^{-1} m^{-2}

c) What are the radiation protection rules?

d) What do you understand by controlled area and supervised area?

e) Write down the advantages and disadvantages of Thermo luminescent dosimeters.