CHUKA  **UNIVERSITY**

UNIVERSITY EXAMINATIONS

EXAMINATION FOR THE AWARD OF MASTER OF SCIENCE IN MEDICAL PHYSICS

MPHY 817: RADIOLOGY (NON-IONISING RADIATION)

STREAMS: MSC MPHY **TIME :3 HOURS**

DAY/DATE: TUESDAY 17/12/2024 **2.30 P.M-5.30 P.M**

INSTRUCTIONS

Answer question ANY FOUR questions

QUESTION ONE (15 MARKS)

a Discuss three common MRI Artifacts and Troubleshooting Tips to overcome them. (6 marks)

b Describe 3-D imaging in MRI (3 marks)

c Describe the measurement of T_1 in MRI (2 marks)

d Discuss how the following features that contribute to image quality in MRI (4marks)

i) B_0 field strength, homogeneity and shimming

ii) Image acquisition time

iii) Spatial resolution

iv) SNR and contrast to noise ratio

QUESTION TWO (15 MARKS)

a Ultrasound that has a frequency of 2.50 MHz is sent toward blood in an artery that is moving toward the source at 20.0 cm/s. Use the speed of sound in human tissue as 1540 m/s. (Assume that the frequency of 2.50 MHz is accurate to seven significant figures.). What frequency does the blood receive? What frequency returns to the source? What beat frequency is produced if the source and returning frequencies are mixed? (6 marks)

b Why is it possible to use ultrasound both to observe a fetus in the womb and also to destroy cancerous tumors in the body? (2 marks)

c Describe three attractive characteristics, of ultrasound that make it one of the most commonly used diagnostic imaging modality. (3 marks)

d Discuss the two most important mechanisms for biological effects of ultrasound (2 marks)

e Acoustic pressure is 10500Nm^2 and characteristic impedance is 30Ω calculate the particle speed.

(2 marks)

QUESTION THREE (15 MARKS)

a Describe Magnetic Resonance Imaging or MRI. (4 Marks)

b Describe the Nuclei used for MRI. (2 Marks)

c Explain gradient echo imaging giving the main components of the gradient echo sequence. (3 marks)

d State three uses of MRI (3 marks)

e Explain why Contrast agents are used in $T_{1 \text{ and }} T_2$ (3 marks)

QUESTION FOUR (15 MARKS)

a Draw a schematic diagram showing the major components of a clinical MRI system utilizing a superconducting magnet. (4 marks)

b Describe the transversal magnetization. (3 Marks)

c Describe spin echo imaging (3 Marks)

d State and describe any three risks associated with use of MRI. (3 Marks)

e Explain the relationship between Field of view and spatial resolution in MRI (2 Marks)

QUESTION FIVE (15 MARKS)

a) Describe ultra sound imaging. (4 Marks)

b) Acoustic energy density is defined by the sum of the kinetic energy density and the potential energy density. Show this by means of suitable equations

(2 marks)

c) Describe the use of quality assurance phantoms in ultra sound imaging

(3 marks)

d) State and explain four modern ultra sound imaging methods. (4 marks)

e) Describe the clinical Significance of ultra sound (2 marks)
