

NATIONAL UNIVERSITY OF SCIENCE AND TECHNOLOGY

APPLIED PHYSICS DEPARTMENT

SRA 3211 – ULTRASOUND IMAGING

BSc HONOURS PART III: MAY 2013

DURATION: 3 HOURS

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

SECTION A

1. (a) *Acoustic shadowing* and *acoustic enhancement* are the two artefacts that provide the most useful diagnostic information.
 - (i) Define the words in italics (*Acoustic shadowing* and *acoustic enhancement*). [2]
 - (ii) Explain, giving examples, how the artefacts in (i) provide diagnostic information in ultrasound imaging. [4]
- (b) The widely used B-mode is a development of A-mode. Explain the principles of B-mode scanning. [4]
- (c) Justify the inclusion of a matching layer in probe design. [3]
- (d) Explain how the piezoelectric effect is made use of in ultrasound imaging. [3]
- (e) Explain any two parameters used in obstetric ultrasound and show how the measurements are obtained. [4]
- (f) Differentiate axial and lateral resolution in ultrasound imaging [4]
- (g) Identify any two complications of early pregnancy and describe the ultrasonic appearances. [4]
- (h) Define focusing in ultrasound and give two main reasons why the ultrasound beam needs to be focused. [3]
- (i) Differentiate between reflection and refraction and explain their significance in ultrasound imaging. [5]
- (j) Identify and justify one quality assurance procedure in ultrasound imaging. [4]

SECTION B

2. (a) Using the Doppler equation explain the principles of Doppler ultrasound. [10]
(b) Find the Doppler shift frequency in soft tissue if the transmitted frequency is 3MHz and the velocity of a reflector is 20cm/s? [5]
(c) Differentiate between pulsed wave Doppler and continuous wave Doppler and justify one application of each in obstetrics ultrasound. [5]

3. A 20 week pregnant woman presents for ultrasound scanning.
(a) Discuss the routine imaging of this patient. [15]
(b) Identify the further role ultrasound may play in the management of this patient. [5]

4. (a) Describe the changes that occur in the uterus with the menstrual cycle. [6]
(b) Compare and contrast the sonographic appearances of the uterus and ovaries between premenarchal, women of reproductive capacity and post-menopausal women. [14]

5. Describe the following functional core modules of ultrasound equipment:
(a) Master control; [5]
(b) Pulse generator; [3]
(c) Transducer; [4]
(d) Signal manipulation and storage [5]
(e) Image display [3]

6. Ultrasound is considered to be a safe imaging modality. Discuss the biological effects of ultrasound and compare these with effects due to conventional x-ray imaging. [20]

END OF EXAMINATION