BAHAGIAN PEPERIKSAAN DAN PENILAIAN
JABATAN PENDIDIKAN POLITEKNIK DAN KOLEJ KOMUNITI
KEMENTERIAN PENGAJIAN TINGGI

JABATAN KEJURUTERAAN ELEKTRIK

PEPERIKSAAN AKHIR

SESI II : 2021/2022

DEU50043: MEDICAL IMAGING

TARIKH   : 02 JULAI 2022
MASA   : 8.30 PAGI – 10.30 PAGI (2 JAM)

Kertas ini mengandungi **LAPAN (8)** halaman bercetak.

Bahagian A: Struktur (2 soalan)

Bahagian B: Esei (2 soalan)
Dokumen sokongan yang disertakan : Kertas graf semi log

JANGAN BUKA KERTAS SOALAN INI SEHINGGA DIARAHKAN

(CLO yang tertera hanya sebagai rujukan)

SECTION A: 60 MARKS
BAHAGIAN A: 60 MARKAH

INSTRUCTION:
This section consists of **TWO (2)** structured questions. Answer **ALL** questions.

ARAHAN:
*Bahagian ini mengandungi **DUA (2)** soalan berstruktur. Jawab **SEMUA** soalan.*

QUESTION 1
SOALAN 1

CLO1
C4

This question refers to the following figure A1 of Ultrasound imaging.
Soalan ini merujuk kepada Rajah A1 Pengimejan ultrabunyi berikut.

The following Figure A1 shows the image of ultrasound A-scan mode through a person's abdomen. Consider the path of the ultrasound wave used to scan an internal organ. Assume that the weaker echoes come from internal organs. A signal received from the transducer is shown below as the ultrasound propagation pathway. The first reflected signals received at the transducer is at 0.08 ms (milliseconds) as shown in the signal plot of Figure A1. The distance from this first signal received to the interface 1, 2 and 3 are also shown in the figure.

Gambar Rajah A1 berikut menunjukkan imej imbasan mod A ultrabunyi menerusi perut seseorang. Pertimbangkan jalur gelombang ultrasound yang digunakan untuk mengimbas organ dalaman. Anggaplah gema yang lebih lemah berasal dari organ dalaman. Isyarat yang diterima dari pemindaharuh ditunjukkan di bawah ini sebagai jalur penyebaran ultrasound. Terdapat isyarat pertama yang diterima pada pemindaharuh pada 0.08 ms (milli saat) seperti ditunjukkan dalam plot isyarat dalam Rajah A1. Jarak dari isyarat pertama yang diterima ini ke antara muka 1, 2 dan 3 juga ditunjukkan dalam rajah.
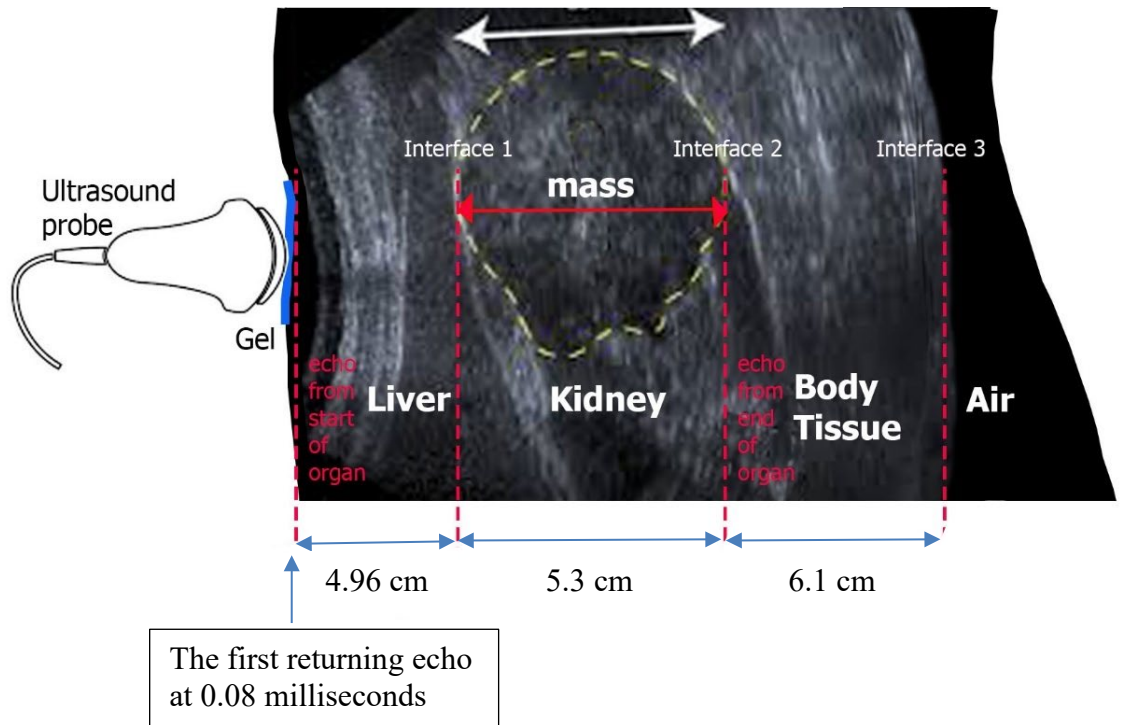
Figure A1: Ultrasound wave used to scan an internal organ in human body
/ *Rajah A1: Gelombang ultrabunyi digunakan untuk mengimbas organ*
dalaman dalam tubuh manusia

(a)   Determine the time of the signal received in milliseconds (ms) at the first (1)
interface of liver/kidney, the second (2) interface of kidney/body tissue and the
last interface (3) of body tissue/air based on the material properties. Plot the
pulse amplitude against time to show your answer.

Tentukan masa isyarat yang diterima dalam milisaat (ms) pada antara muka
pertama (1) hati/buah pinggang, antara muka kedua (2) tisu buah
pinggang/badan dan antara muka terakhir (3) tisu badan/udara berdasarkan
sifat bahan. Plotkan denyutan amplitud melawan masa untuk menunjukkan
jawapan anda.

[10 marks]
[*10 markah*]

(b)   Determine the percentage of relative intensity by using the reflection coefficient
        equation at interface, 1, 2 and 3. The last medium is air with Acoustic impedance
        $= 0.0004 \times 10^6$ kg/m^{2}s. Remember that the wave has to travel to and back from
        each interface.

        *Tentukan peratus intensiti relatif dengan menggunakan persamaan koefisian
        pantulan bagi puncak ultrabunyi yang diterima pada antaramuka 1, 2 dan 3.
        Medium terakhir adalah udara dengan impedans Akustik = 0.0004 × 10^6
        kg/m^{2}s. Perlu diingatkan bahawa gelombang harus bergerak ke depan dan
        belakang dari setiap antaramuka.*

        [10 marks]

        [*10 markah*]

(c)   Illustrate the propagation of a sound wave through the various mediums using
        the calculated value.

        *Gambarkan penyebaran gelombang bunyi melalui pelbagai medium
        menggunakan nilai yang dikira.*

        [10 marks]

        [*10 markah*]

        Given:

        The Percentage of Reflection Coefficient

        $(Peratus\ Pekali\ Pantulan), \alpha_R = \left(\dfrac{Z_2 - Z_1}{Z_2 + Z_1}\right)^2 \times 100\%$

        The fraction of the incident energy that is *transmitted* across an interface is
        described by the transmission coefficient α_T

        $where\ \alpha_T = \dfrac{4Z_1 Z_2}{(Z_1 + Z_2)^2} \times 100\%,\ \alpha_R + \alpha_T = 100\%$

        Z_1 and Z_2 are the acoustic impedances of the two media.

        Distance = Speed x Time

        Distance of ultrasound propagation, d

        $$= \frac{1}{2} \times speed, c\ \times\ time\ duration, \Delta t$$

Acoustic impedance (kg/m^2s) = c, speed(m/s) × ρ, density (kg/m^3)

Density, ρ of a thin layer of gel = 1,004 kg/m^3, and speed, c = 1,555 m/s,

Density, ρ of a liver = 1,065 kg/m^3, and speed, c = 1,550 m/s,

Density, ρ of kidney =1,038 kg/m^3, and speed, c = 1,560 m/s, and

Density, ρ of body tissue = 1,058 kg/m^3, and speed, c = 1,540 m/s.

Acoustic impedance of Air (kg/m^2s) = 0.0004 × 10^6 kg/m^2s

QUESTION 2
SOALAN 2

Table A2 below shows the reading of an isotope material activity of Flourine-18, ^{18}F and Nitrogen-13, ^{13}N which are recorded every 10 minutes in time interval for 100 minutes duration. The following questions refer to this table.

Jadual A2 di bawah menunjukkan bacaan aktiviti bahan isotop Flourine-18, ^{18}F and Nitrogen-13, ^{13}N yang direkodkan setiap 10 minit dalam selang waktu selama 100 minit. Soalan berikut merujuk kepada jadual ini.

Time (Minute)	Fluorine -18, 18F (Ci)	Nitrogen-13, 13N (Ci)
0	40.00	150.00
10	37.55	74.85
20	35.26	37.35
30	33.10	18.64
40	31.08	9.30
50	29.17	4.64
60	27.39	2.32
70	25.72	1.16
80	24.14	0.58
90	22.67	0.29
100	21.28	0.14

Table A2: Radioactive decay of Fluorine-18, ^{18}F and Nitrogen-13, ^{13}N /
Jadual A2: Pereputan radioaktif Fluorine-18, ^{18}F dan Nitrogen-13, ^{13}N

CLO1

C3

(a)   Plot the activity of both isotopes in Curies unit versus Time in minutes on semi-log graph paper.

Plot aktiviti kedua-dua isotop ini dalam unit Curies lawan Masa dalam minit pada kertas graf separa log.

[10 marks]

[*10 markah*]

(b)

CLO1

C3

i.   Using your plotted graph in (a), estimate the half-life of Nitrogen-13, ^{13}N isotope. Sketch the line on the graph (a) to show how you did the estimation. Label your graph properly. Attach this graph as your answer sheet.

Berdasarkan kepada graf yang anda plot di (a), anggarkan separuh hayat (half-life) bagi isotop Nitrogen-13, 13N ini. Lakar garis pada graf yang anda plot di (a) untuk menunjukkan bagaimana anda melakukan anggaran. Lampirkan graf ini sebagai kertas jawapan anda.

ii.   Verify your answer with calculation.

Buktikan bacaan anda dengan pengiraan.

[10 marks]

[*10 markah*]

(c)   Using the calculated half-life of Nitrogen-13, ^{13}N isotope and the half-life of Fluorine-18, ^{18}F isotope is 109.8 minutes, calculate how much time t must elapse before these isotopes possess equal activities.

CLO1

C3

Dengan menggunakan jangka hayat isotop Nitrogen-13, 13N dan separuh hayat isotop Fluorine-18, 18F adalah 109.8 minit, hitung berapa lama masa yang mesti dilalui sebelum isotop ini mempunyai aktiviti yang sama.

[10 marks]

[*10 markah*]

SECTION B: 40 MARKS

BAHAGIAN B: 40 MARKAH

INSTRUCTION:

This section consists of **TWO (2)** essay questions. Answer **ALL** questions.

ARAHAN:

Bahagian ini mengandungi DUA (2) soalan esei. Jawab SEMUA soalan.

QUESTION 1

SOALAN 1

CLO1
C3

Referring to Figure B1, write an essay that clearly discusses the needs for cross sectional image in medical diagnosis.

Merujuk kepada Rajah B1, tulis satu esei yang membincangkan dengan jelas keperluan imej keratan rentas dalam diagnosis perubatan.

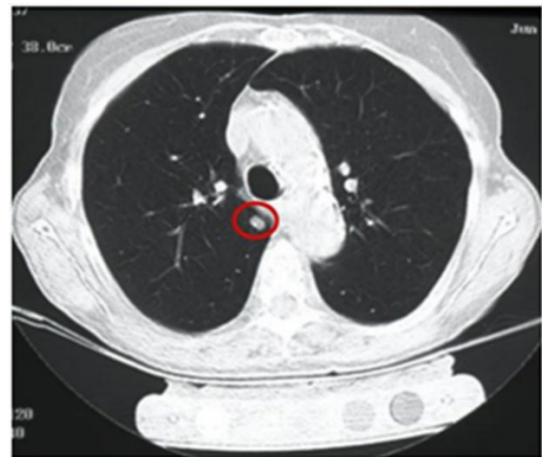Image obtained from conventional
x-ray machine

Image obtained from CT Scan
machine

Figure B1: Lung cancer images / *Rajah B1: Imej kanser paru-paru*

[20 marks]

[*20 markah*]

QUESTION 2
SOALAN 2

CLO1
C3

Write an essay that clearly discusses the Magnetic Resonance Imaging Bioeffects and safety.

Tulis satu esei yang membincangkan dengan jelas Kesan Bio Pengimejan Resonan Magnet dan Keselamatan.

[20 marks]

[*20 markah*]

SOALAN TAMAT

NO. SIRI SKRIP JAWAPAN : _____   KOD KURSUS : _____