
UNIVERSITI MALAYSIA PERLIS

Peperiksaan Pertengahan Semester Kedua
Sidang Akademik 2017/2018

27 Mac 2018

ENT390 – Bioinstrumentation 1
[Bioinstrumentasi 1]

Masa: 1 Jam 30 Minit

Please make sure that this question paper has **SIX (6)** printed pages including this front page before you start the examination.
*[Sila pastikan kertas soalan ini mengandungi **ENAM (6)** muka surat yang bercetak termasuk muka hadapan sebelum anda memulakan peperiksaan ini.]*

This question paper has **TWO (2)** questions. Answer **all** questions. Each question contributes 25 marks.
*[Kertas soalan ini mengandungi **DUA (2)** soalan. Jawab **semua** soalan. Setiap soalan menyumbang 25 markah.]*

Note: This is extra instructions
[Ini adalah arahan tambahan.]

Part A: Answer all questions
[Bahagian A: Jawab semua soalan]

Question 1
[Soalan 1]

(a) Infusion pumps are designed to assist in fluids delivery into a patient's body in controlled amounts. Force and pressure sensors are used to ensure the desired amount of fluid is being delivered to the patient and detect occlusion, if any.
[Pam infusi direka bentuk untuk membantu dalam memasukkan cecair ke dalam badan pesakit dengan jumlah yang terkawal. Penderia daya dan tekanan digunakan untuk memastikan jumlah cecair yang dikehendaki dihantar dan mengesan sekatan, sekiranya ada.]

(i) Suggest a suitable type of sensor to detect force and pressure changes, and justify your suggestion.
[Cadangkan jenis penderia yang sesuai untuk mengesan perubahan daya dan tekanan, dan wajarkan cadangan anda.]

(3 Marks /*Markah*)

(ii) Elaborate **TWO (2)** sensor characteristics that are deemed importance for infusion pump as described in Q1(a)(i)
*[Huraikan **DUA (2)** ciri-ciri penderia yang disifatkan penting untuk pam infusi.]*

(4 Marks /*Markah*)

(b) You are given a task to design a capacitive sensor that is able to pass sound frequencies above 25 Hz. For a 1.5 cm^2 capacitance sensor, R is 10 MΩ. (Relative Permitivity $= 8.8854 \times 10^{-12}$)
[Anda diberikan tugasan untuk mereka bentuk penderia kapasitan yang mampu membenarkan frekuensi bunyi lebih 25 Hz. Untuk 1.5 cm^2 penderia kapasitan, R adalah 10 MΩ*. Ketelusan relatif* $= 8.854 \times 10^{-12}$*,]*

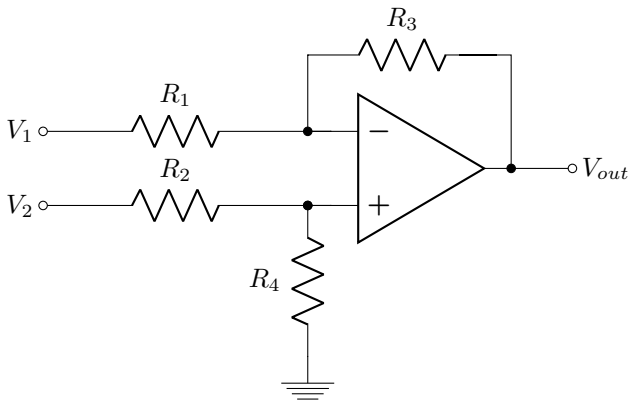

Figure 1.1
[Rajah 1.1]

Question 2

[Soalan 2]

(a) Bioelectric potentials are produced as a result of electrochemical activity of an excitable cell. In resting state where there is no stimulus, the cell is polarized.

[Daya bioelektrik dihasilkan dari kesan aktiviti elektrokimia sesuatu sel peka rangsang. Dalam keadaan rehat di mana tiada rangsangan, sel adalah terkutub.]

(i) What is the typical value of cell membrane potential in resting state, and how it is measured?

[Apakah nilai daya membran sel dalam keadaan rehat, dan bagaimana ianya diukur?]

(2 Marks /*Markah*)

(ii) Elaborate how the cell membrane potential maintained polarized in resting state.

[Huraikan bagaimana daya membran sel kekal terkutub sewaktu keadaan rehat.]

(8 Marks /*Markah*)

(iii) Differentiate between absolute refractory period and relative refractory period, and why the value differs in ventricular cell?

[Bezakan di antara tempoh refraktori mutlak dan tempoh refraktori relatif, dan kenapa nilai ini berbeza untuk sel ventrikular?]

(5 Marks /*Markah*)

(b) The simplest configuration of instrumentation amplifier (INA) is shown in Figure 1.1.

[Tatarajah paling mudah bagi penguat instrumentasi (INA) ditunjukkan dalam Rajah 1.1.]

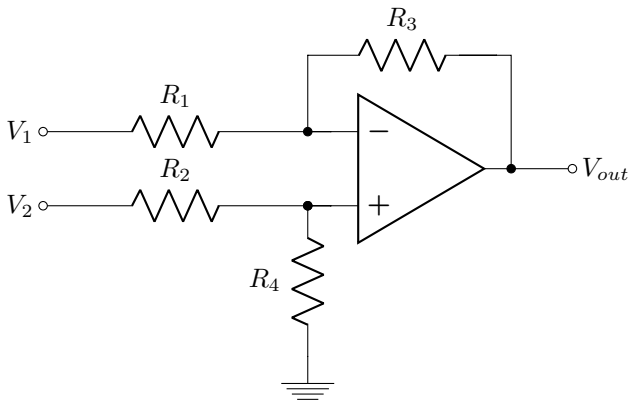

Figure 2.1

[Rajah 2.1]

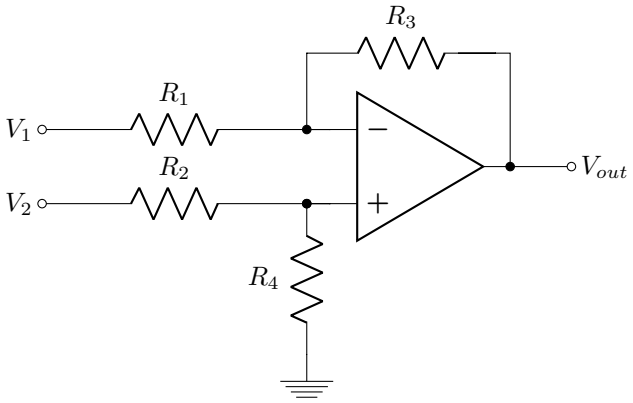

Figure 2.2
[Rajah 2.2]

Table 2.1: Freq. vs Magnitude
[Jadual 2.1: Frekuensi vs Magnitud]

Frequency	**Impedance (Magnitude) (Ω)**
5 Hz	20,000
10 Hz	19,998
⋮	⋮
40 kHz	602
50 kHz	600
100 kHz	600

Table 2.2
[Jadual 2.2]

Frequency	**Impedance (Magnitude) (Ω)**
5 Hz	20,000
10 Hz	19,998
⋮	⋮
40 kHz	602
50 kHz	600
100 kHz	600

(i) Prove that the differential gain, A_d and common-mode gain, A_{cm} of the INA are,
[Buktikan bahawa gandaan kebezaan, A_d dan gandaan ragam sepunya, A_{cm} bagi INA adalah,]

$$A_d = \frac{1}{2}\left[\frac{R_4}{R_2}\left(\frac{1+\frac{R_3}{R_1}}{1+\frac{R_4}{R_2}}\right)+\frac{R_3}{R_1}\right]$$

$$A_{cm} = \left[\frac{R_4}{R_2}\left(\frac{1+\frac{R_3}{R_1}}{1+\frac{R_4}{R_2}}\right)-\frac{R_3}{R_1}\right]$$

(8 Marks /*Markah*)

(ii) What is the expected output voltage if $R_4 = R_3$ and $R_2 = R_1$ where R_2 has 1% tolerance. Justify your answer.
[Apakah voltan keluaran yang dijangka jika $R_4 = R_3$ dan $R_2 = R_1$ dimana R_2 mempunyai 1% had terima. Wajarkan jawapan anda.]

(2 Marks /*Markah*)

Part B: Answer all questions
[Bahagian B: Jawab semua soalan]

Question 3
[Soalan 3]

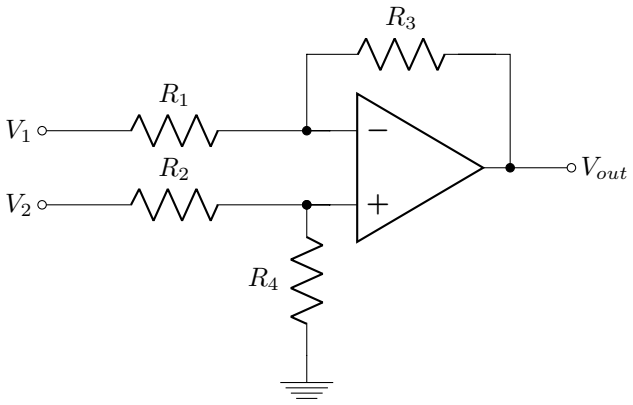

Figure 3.1
[Rajah 3.1]

Table 3.1: Freq. vs Magnitude
*[**Jadual 3.1**: Frekuensi vs Magnitud]*

Frequency	**Impedance (Magnitude) (Ω)**
5 Hz	20,000
10 Hz	19,998
⋮	⋮
40 kHz	602
50 kHz	600
100 kHz	600

-oooOooo-