UTHM
Universiti Tun Hussein Onn Malaysia

UNIVERSITI TUN HUSSEIN ONN MALAYSIA

FINAL EXAMINATION
SEMESTER II
SESSION 2023/2024

COURSE NAME	:	BIOMEDICAL ENGINEERING & APPLICATIONS
COURSE CODE	:	BEJ 45703
PROGRAMME CODE	:	BEJ
EXAMINATION DATE	:	JULY 2024
DURATION	:	3 HOURS
INSTRUCTIONS	:	1. ANSWER ALL QUESTIONS
		2. THIS FINAL EXAMINATION IS CONDUCTED VIA
		☐ Open book
		☒ Closed book
		3. STUDENTS ARE **PROHIBITED** TO CONSULT THEIR OWN MATERIAL OR ANY EXTERNAL RESOURCES DURING THE EXAMINATION CONDUCTED VIA CLOSED BOOK
		4. THE QUESTION PAPER WILL BE COLLECTED AFTER THE EXAM IS DONE

THIS QUESTION PAPER CONSISTS OF **FOUR (4)** PAGES

TERBUKA

Q1 Assistive technology is an umbrella term for assistive products and their related systems and services.

(a) Analyse how the human operator of the assistive technologies model works by giving an appropriate explanation. In your answer, you must include the model sketch and the consequence when something goes wrong in the processing chain.

(13 marks)

(b) You are tasked with designing an assistive technology device for an elderly person with a severe visual impairment.

(i) Recommend a suitable assistive technology device that the elderly person can use.

(2 marks)

(ii) Discuss **THREE (3)** Key Ergonomic Principles that can be implemented based on the recommended solution in **Q1(b)(i)**.

(6 marks)

(ii) Recommend **FOUR (4)** performance specifications for the recommended solution in **Q1(b)(i)**.
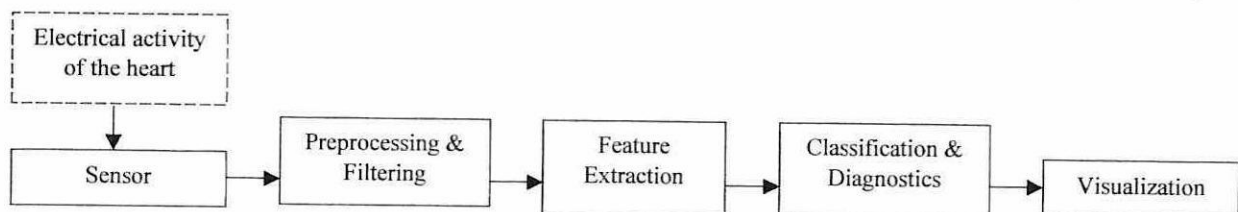
(4 marks)

Q2 There are a variety of techniques that can be used to process biomedical signals, such as point-processing, mask-processing, feature extraction, clustering, and classification.

(a) Discuss **TWO (2)** similarities and **TWO (2)** differences between point-processing and mask-processing techniques.

(8 marks)

(b) Discuss in detail how all components in **Figure Q2.1** can be implemented to detect and display the ECG signal.

(13 marks)

Figure Q2.1 Block diagram of a typical biomedical signal system.

(c) Discuss the difference between clustering and classification techniques when applied to medical image data.

(4 marks)

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Q3   A model is a representation of a natural phenomenon. The rules governing the model can be in the form of differential and difference equations.

   (a)   Discuss the similarities and differences between differential and difference equations.

   (4 marks)

   (b)   Derive and explain a formula for quantifying natural phenomena using the conservation of law.

   (6 marks)

   (c)   Based on **Q3(b)**, sketch the corresponding graphical representation based on the conservation equation.

   (2 marks)

   (d)   **Figure Q3.1** shows a complex state diagram for the Sodium ion channel model. Determine all differential equations related to the diagram using the compartment model definition.

   (13 marks)
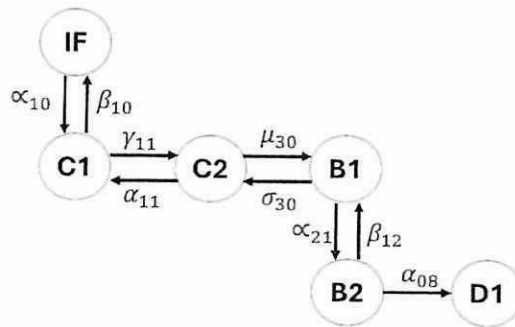
Figure Q3.1 A state diagram for a Sodium ion channel.

Q4   The compartment model, volume balance model, ion channel model, and conservation of law are some of the biosystem model examples.

   (a)   **Figure Q4.1** shows a simple compartment model of fluid flowing from the gut to the blood to the kidney.
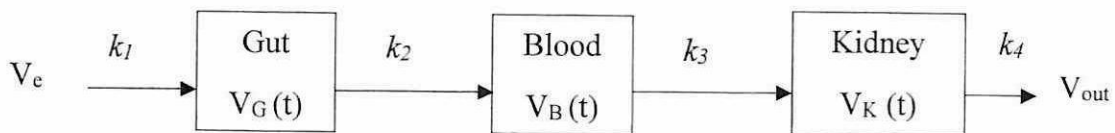
Figure Q4.1 A model of fluid flows from the gut to the kidney.

   (i)   Using the concept of volume balance, analyse and describe how the fluid flows.

   (7 marks)

(ii)   State the possible unit for k_1, k_2, k_3, and k_4.

(1 mark)

(iii)   Determine all possible differential equations associated with this system.

(6 marks)

(b)   Using a sketch of the human body model, compute the related mass equations based on the conservation of law.

(7 marks)

(c)   Discuss **ONE (1)** similarity and **ONE (1)** difference between the volume balance model and the ion channel model.

(4 marks)

- END OF QUESTIONS -

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