



UNIVERSITI TUN HUSSEIN ONN MALAYSIA

**FINAL EXAMINATION
SEMESTER II
SESSION 2017/2018**

COURSE NAME : MEDICAL MEASUREMENT
SYSTEM

COURSE CODE : BEU41003

PROGRAMME CODE : BEJ

EXAMINATION DATE : JUNE/JULY 2018

DURATION : 3 HOURS

INSTRUCTION : ANSWER ALL QUESTIONS

THIS QUESTION PAPER CONSISTS OF SIX (6) PAGES

TERBUKA

Q1 (a) The instrumentation amplifier is a key design component to almost all biopotential measurement.

(i) Discuss the reasonable usage of the amplifier in almost all medical measurement system.

(4 marks)

(ii) Derive the equations for the gain of Op-amp A_3 instrumentation amplifier in **Figure Q1(a)(ii)** and calculate the overall circuit gain. Given that:

$$R_2 = 50\text{k}\Omega, R_1 = 0.5\text{k}\Omega \text{ and } R_3 = R_4 = 50\text{k}\Omega.$$

The output voltage from Op-amp A_1 is V_3 and the output voltage from Op-amp A_2 is V_4 .

(10 marks)

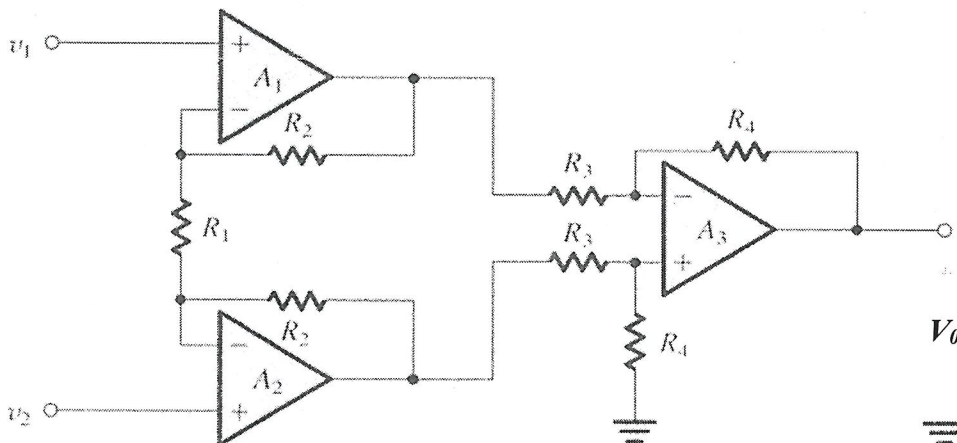


Figure Q1(a)(ii)

(b) (i) Describe the usage of isolation amplifiers in medical measurement system application?

(3 marks)

(ii) Draw and discuss the function of every block diagram an isolation amplifier for medical measurement system application.

(8 marks)

TERBUKA

- Q2**
- (a) Explain the definition of photoplethysmogram (PPG). (7 marks)
 - (b) Discuss the physiological principle of photoplethysmogram (PPG) and illustrate the PPG waveform. (5 marks)
 - (c) Illustrate the block diagram of PPG circuit design for measuring vessel volume and heartbeat with photocoupler. (8 marks)
 - (d) Discover the function of differentiator circuit in photoplethysmogram measurement. (5 marks)

TERBUKA

Q3 (a) **Figure Q3(a)** shows the oscilloscope display of the blood pressure measurement using oscillometric sensor. From the result shown, calculate the diastolic pressure (mmHg) and systolic pressure (mmHg). Given that the VOLT/DIV for both channels (CH1 and CH2) are set at 2 V/div while the TIME/DIV are set at 5 Sec/DIV.

(6 marks)

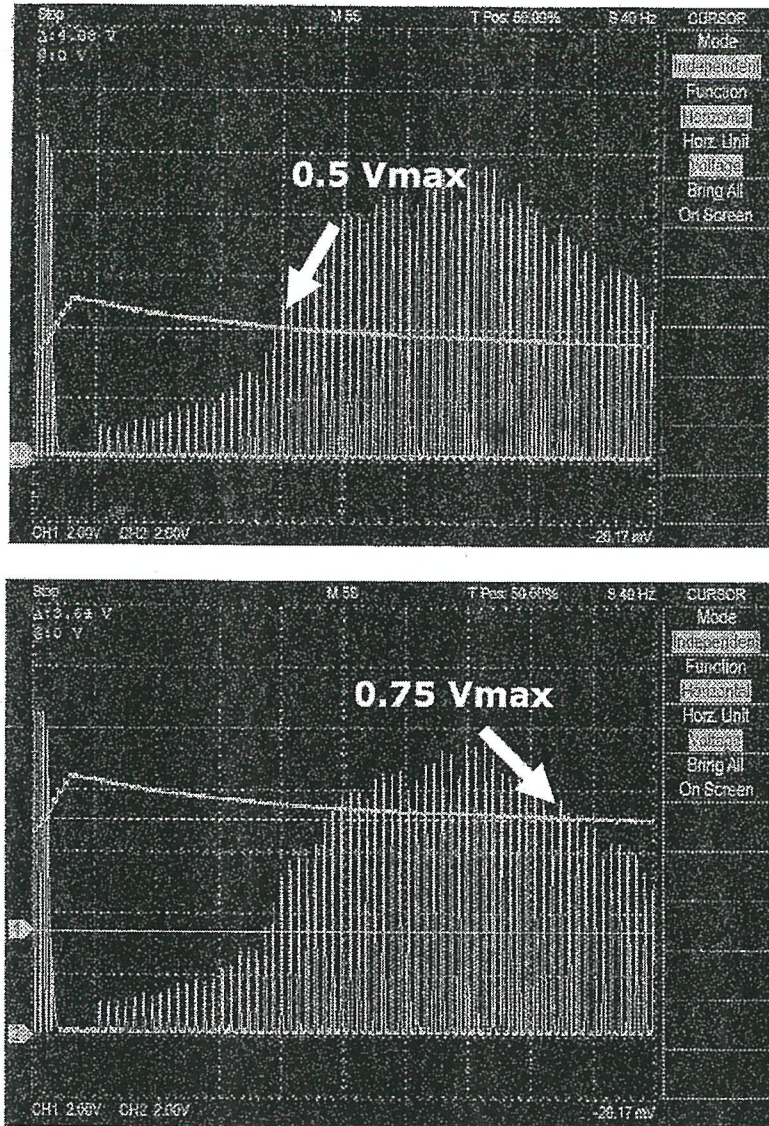


Figure Q3(a)

TERBUKA

(b) Referring diastolic and systolic pressure measured in **Figure Q3(a)**, calculate the mean arterial pressure. (3 marks)

(c) In rehabilitation setting, sometimes it is important to monitor the heart rate of a subject while exercising. Exercise causes three main difficulties for measurement of the Electrocardiogram (ECG).

- The movement of artifacts.
- Sweat on the electrodes.
- Artifacts from the Electromyogram (EMG).

(i) Explain the definition of artifacts. (4 marks)

(d) **Figure Q3(d)** shows an ECG waveform.

- (i) Discuss the type of artifact that affect the ECG waveform.
- (ii) Describe the possible causes that artifact.
- (iii) Recommend the filter that can be used to rectify the signal and why?

(6 marks)

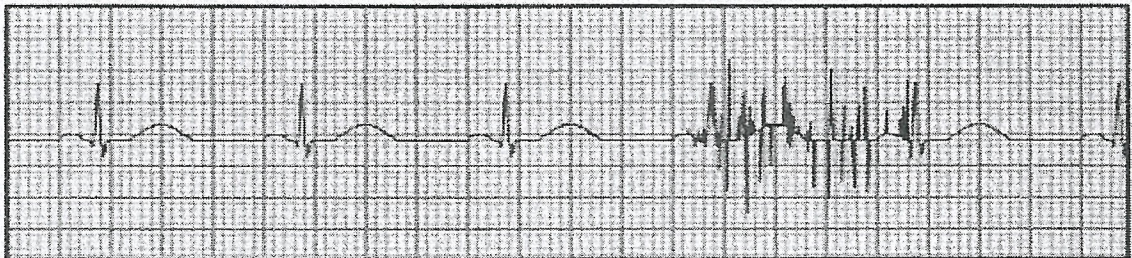


Figure Q3(d)

(e) **Figure Q3(e)** shows an EEG waveform;

- (i) Label the P, Q, R, S, T events in **Figure Q3(e)**
- (ii) Calculate the heart rate (beats/min) based on the QRS complex method.

(6 marks)

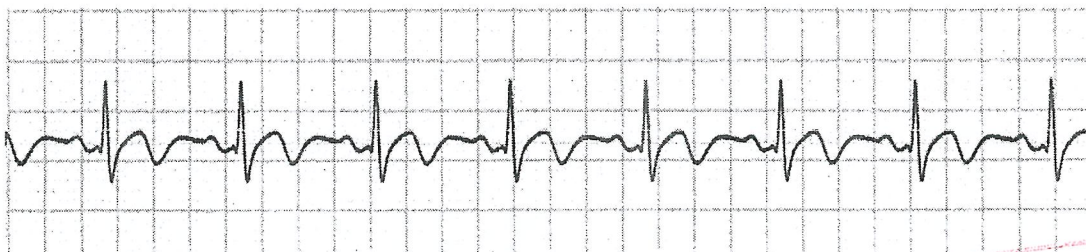


Figure Q3(e)

TERBUKA

- Q4 (a) (i)** Demonstrate and explain the process of respiratory ventilation detection. Use a diagram if necessary. (7 marks)
- (ii) By the aid of illustration, discover the differences of waveform between respiratory while relax and exercise. (10 marks)
- (iii) In the process of your heart pumps blood through your body, you can feel a pulsing in some of the blood vessels close to the skin's surface, such as in your wrist, neck, or upper arm. Construct the procedure for counting your pulse rate when the heart is beating. (8 marks)

TERBUKA

- END OF QUESTION -