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UNIVERSITI TUN HUSSEIN ONN MALAYSIA

**FINAL EXAMINATION
SEMESTER I
SESSION 2013/2014**

COURSE NAME : PRINCIPLE OF PHYSIOLOGICAL DEVICES
COURSE CODE : BEU 30202
PROGRAMME : BEJ
EXAMINATION DATE : JANUARY 2014
DURATION : 2 HOURS
INSTRUCTION : ANSWER ALL QUESTIONS

THIS QUESTION PAPER CONSISTS OF SIX (6) PAGES

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- Q1**
- (a) When dealing with repeated measurement, there are three important statistical quantities; average, standard deviation, and standard error. Define THREE (3) of these terms. (3 marks)
- (b) Draw simple flow chart to show how a medical device is designed and developed until it is in marketing level. (4 marks)
- (c) Explain the benefits of International Organization for Standardization (ISO) that provides a basic for the international comparison of measurement result. (3 marks)
- (d) Figure **Q1 (d)** shows more than a few points data obtain from a measurement. The hollow triangles represent points used to calculate slopes.
- (i) Determine the uncertainty of the measurement by firstly calculate the slope of best, minimum, and maximum. (8 marks)
- (ii) Calculate the final value of slope for the measurement. (2 marks)
- Q2**
- (a) Electrocardiogram (ECG) is an electric activity of several types of tissue in heart during diastole and systole.
- (i) Define the diastole and systole pressure. (2 marks)
- (ii) Draw an ECG wave that mainly consists of P, Q, R, and S waves and point out the representation of P wave, QRS complex, P-R interval, and S-T segment. (10 marks)
- (b) The membrane potential at steady state exists known as equilibrium potential could be calculated from the Nernst equation. Analyze FOUR (4) main factors involved in the movement of ions across the cell membrane in the steady-state condition. (8 marks)

- Q3**
- (a) Figure **Q3(a)** shows the cross-section of a skin-gel-electrode interface. Draw the equivalent circuit for the interface with label of each component in the circuit. (6 marks)
 - (b) The characterization of electrode-electrolyte interface could be modeled as series resistance and capacitance.
 - (i) The series resistance-capacitance circuit could break down at low frequency. Produce a solution to avoid this problem. (2 marks)
 - (ii) Using the solution given in b(i), develop a simplified equivalent circuit of metal microelectrode. (4 marks)
 - (c) A disposable foam-pad electrode is attached to the chest of a patient to measure the electrocardiogram (ECG).
 - (i) Give a factor what could maintain the contact between electrode and skin. (2 marks)
 - (ii) List TWO (2) advantages of this type of electrode. (2 marks)
 - (d) Thermistor is used to measure small temperature changes. Give the difference between Negative Temperature Coefficient (NTC) and Positive Temperature Coefficient (PTC) in terms of the temperature-resistance relationship. (4 marks)
- Q4**
- (a) Sketch a typical zero-power resistance versus temperature characteristic for the negative temperature coefficient. (2 marks)
 - (b) Explain the NTC reflects with the temperature, and with the appropriate equations. (6 marks)
 - (c) Piezoelectric sensor could be operated in ultrasound transducer. Explain the effects when electric current is applied to the piezoelectric in ultrasound transducer. (8 marks)

- (d) Ultrasound commonly takes advantage of Doppler technique in medical field. Give TWO (2) purposes of using Doppler Ultrasound in diagnosis diseases. (4 marks)

Q5 (a) A pulsed Doppler flowmeter has $f_0 = 10\text{M Hz}$, speed of blood flow = 150 cm/s, speed of sound in blood = 1500 m/s and $\theta = 45^\circ$, calculate the Doppler shift for this Doppler flowmeter. (4 marks)

(b) Plethsmography is a method for recording volume changes of an organ or a body part, example a leg.

(i) Draw the Swanson's model that showing a model for impedance plethysmography. (3 marks)

(ii) Using the model drawn in b(i), derive volume changes equation if the assumptions require for this model are valid. (5 marks)

(c) If you are given a resonant frequency of 300Hz and a bandwidth of 50Hz, design a new narrowband bandpass filter. Let $C = 0.01\mu\text{F}$. (8 marks)

-END OF QUESTIONS-

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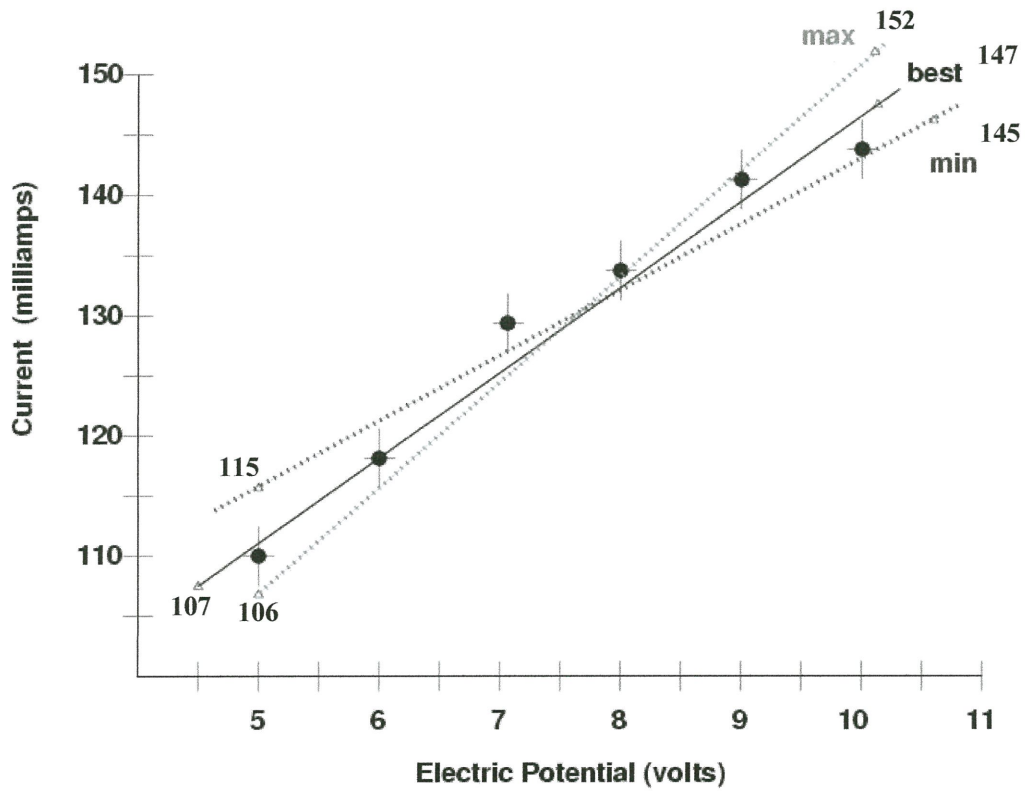


FIGURE Q1(d)

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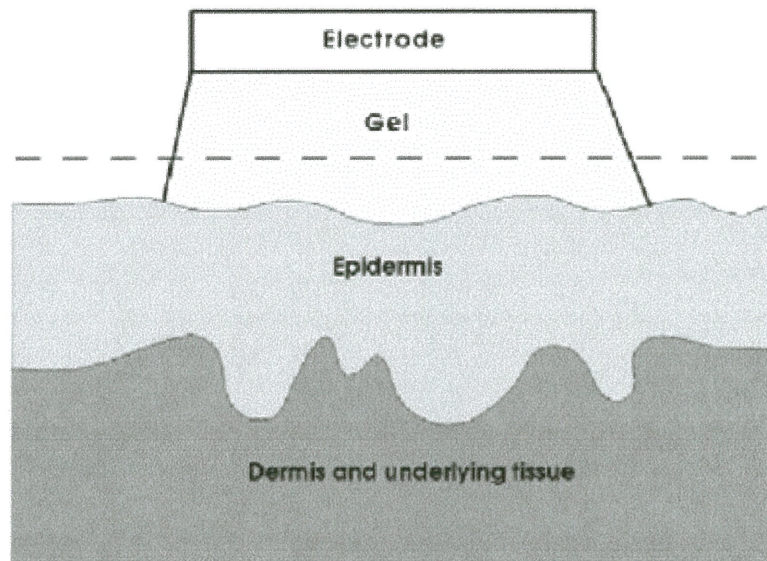


FIGURE Q3(a)