Universiti Tun Hussein Onn Malaysia

UNIVERSITI TUN HUSSEIN ONN MALAYSIA

FINAL EXAMINATION
(TAKE HOME)
SEMESTER II
SESSION 2020/2021

COURSE NAME	:	PRINCIPLE OF PHYSIOLOGICAL DEVICES
COURSE CODE	:	BEU 30203 / BEJ 45203
PROGRAMME CODE	:	BEJ
EXAMINATION DATE	:	JULY 2021
DURATION	:	3 HOURS
INSTRUCTION	:	ANSWER **ALL** QUESTIONS **OPEN BOOK EXAMINATION**

THIS QUESTION PAPER CONSISTS OF **FIVE (5)** PAGES

Q1 (a) Biopotential electrode is the interface between the body and electronic measuring apparatus to measure and records potentials.

(i) Classify **THREE (3)** types of body surface electrodes with their applications.

(6 marks)

(ii) Based on **Table 1**, propose a suitable material to be used as an electrode for measuring ECG signal. Justify your answer.

(4 marks)

(b) Electromyography (EMG) is a technique for evaluating and recording the activity produced by skeletal muscles.

(i) Draw a typical EMG waveform recorded from a contracting muscle over time using surface EMG electrode.

(3 marks)

(ii) Propose an acquisition system setup to record EMG signal on the forearm.

(6 marks)

(iii) With the help of a diagram, find the relationship between the action potential and muscle contraction.

(6 marks)

Q2 (a) The respiration can also be assessed by lung plethysmography, i.e. measuring the volume change in the lung. Determine the principle of Chamber Plethysmography.

(4 marks)

(b) During a typical day, a person works for 8 hours, rests for 4 hours, walks for 1 hour, eats for 2 hours, and sleeps for 9 hours. Determine the capacity of oxygen that he would consume during the whole day. (During sleep and rest he can be assumed to consume 0.05 pound/hour; during eating, this figure will double; during walking, consumption will triple; and during work, it will quadruple.)

(6 marks)

(c) (i) Give the definition of cardiac output and state the cardiac output value for a normal adult.

(2 marks)

(ii) List **TWO (2)** methods for cardiac output measurement.

(2 marks)

(iii) Given that a heart pumps out 70 ml of blood with each stroke and beats 70 times per minute, calculate the cardiac output.

(2 marks)

(d) Design any respiratory measurement technique that can measure the volume of change in the lung. Sketch and elaborate on the working principle of your design. Label clearly and please include any graph / block diagram in your elaboration.

(8 marks)

Q3 (a) A blood specimen has a hydrogen ion concentration of 40 nmol / liter and a P_{CO2} of 60 mmHg. Calculate the hydrogen ion concentration. Discuss the type of acid-base abnormality that the patient exhibits.

(5 marks)

(b) An electronic biosensor can be used to measure the glucose concentration in a drop of blood. Suggest **TWO (2)** advantages of using a biosensor over a dipstick to measure glucose concentration.

(2 marks)

(c) Design an amplifier for use with the pH electrode. Output in the range of 1 to 2 mV is desired for the normal pH variation of blood. (Note: The internal impedance of the pH electrode is in the 10 to 100 MΩ).

(6 marks)

(d) Propose **TWO (2)** commercially successful types of biosensors and discuss their importance to society. Briefly outline a business plan for commercializing the biosensors and discuss the role of intellectual property in achieving commercial success.

(13 marks)

Q4 Transducers are defined as a device which when actuated, transforms energy from one form to another.

(a) Point out **THREE (3)** differences between active and passive transducer.

(6 marks)

(b) Draw a schematic diagram for temperature measurement using active and passive transducers.

(8 marks)

(c) Physiological signals are generated by the body during the functioning of various physiological systems. Propose a method for physiological signal monitoring using a strain gauge transducer. Please include a schematic diagram and describe the details on the working principles of the proposed method.

(11 marks)

-END OF QUESTIONS-

FINAL EXAMINATION

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Table I: Half-Cell Potentials of Common Metals at 25 °C

Metal and Reaction	Half-cell Potential, V
$Al \rightarrow Al^{3+} + 3e^-$	–1.706
$Ni \rightarrow Ni^{2+} + 2e^-$	–0.230
$H_2 \rightarrow 2H^+ + 2e^-$	0.000 (by definition)
$Ag + Cl^- \rightarrow AgCl + e^-$	+0.223
$Ag \rightarrow Ag^+ + e^-$	+0.799
$Au \rightarrow Au^+ + e^-$	+1.680