Universiti Tun Hussein Onn Malaysia

UNIVERSITI TUN HUSSEIN ONN MALAYSIA

FINAL EXAMINATION
SEMESTER I
SESSION 2013/2014

COURSE NAME	:	INSTRUMENTATION & MEASUREMENT
COURSE CODE	:	BEH 20403 / BEX 20703
PROGRAMME	:	BEJ / BEE
EXAMINATION DATE	:	DECEMBER 2013
DURATION	:	3 HOURS
INSTRUCTION	:	ANSWER **ALL** QUESTIONS

THIS QUESTION PAPER CONSISTS OF **EIGHT (8)** PAGES

Q1 (a) In an experiment being conducted by a group of students, they are given three sets of data reading of load weight. They need to determine which set of data has the most precision reading between these three data. If the data are:

A = {50.30, 49.75, 49.60, 50.45, 50.00, 51.05, 49.85},
B = {50.20, 50.15, 49.90, 49.85, 49.95, 50.00, 50.95}, and
C = {50.05, 50.10, 49.65, 50.30, 52.05, 48.85, 50.00}.

(i) Determine the arithmetic mean of all data in set A, set B and set C.

(3 marks)

(ii) Calculate the average deviation of all sets of data.

(3 marks)

(iii) Obtain the standard deviation of all sets of data.

(3 marks)

(iv) Identify which set of data has the most precision reading and give a reason.

(1 mark)

(b) List two (2) advantages of a dual slope integrating type (DVM) over single slope Ramp integrating type (DVM).

(2 marks)

(c) Figure **Q1(c)** shows a block diagram of Dual Slope DVM. Briefly explain the principle of Dual Slope DVM.

(8 marks)

Q2 (a) A basic D'Arsonval movement with a full scale deflection of 50 μA and an internal resistance of 500 Ω is shown in Figure **Q2(a)**. It is to be converted into a 0 – 10 V, 0 - 25V and 0 - 50V multi-range DC voltmeter using individual multipliers for each range. Calculate the value of R_1, R_2 and R_3.

(10 marks)

(b) Figure **Q2(b)** shows a (Permanent Magnet Moving Coil) PMMC instrument with internal resistance of 500 Ω and full scale deflection current of 50 μA. Identify the value of R_1 and R_2 for a multi-range DC ammeter with current ranges of 0 - 50mA and 0 - 100mA.

(10 marks)

Q3 Figure **Q3** shows a commercial AC voltmeter using a PMMC instrument. The PMMC instrument has 100 Ω coil resistance and an FSD of 1 mA. Shunt resistor is given as 200 Ω, while forward-bias resistance of each diode is 200 Ω.

(a) Briefly explain the function of shunt resistor, R_s and diode D_2.

(2 marks)

(b) Calculate the values of R_1, R_2 and R_3 for measurement ranges of 10 V, 50 V and 100 V.

(15 marks)

(c) Determine the AC sensitivity of the voltmeter.

(3 marks)

Q4 Figure **Q4** shows an AC bridge that balanced at a frequency of 1 kHz and has the following constants:

Arm AB : 1 kΩ Resistor,
Arm BC : 2 kΩ Resistor in parallel with 0.25 μF Capacitor,
Arm CD : 500 kΩ Resistor
Arm AD : unknown R_x, Resistor and L_x, Inductor.

(a) Derive the AC bridge balance condition and find the unknown impedance of arm AD.

(14 marks)

(b) Briefly explain the type of AC-Bridge and its advantages.

(4 marks)

(c) Derive and find the Q factor of this AC-bridge.

(2 marks)

Q5 (a) Signal A and B from one system were displayed through an oscilloscope as illustrated in Figure **Q5(a)**. Determine:

(i) The amplitudes or peak voltage

(2 marks)

(ii) Peak-to-peak voltage

(2 marks)

(iii) Period

(2 marks)

(iv) Frequency

(2 marks)

(v) Phase difference of two signals

(2 marks)

(b) Explain the differences between sensor and transducer.

(5 marks)

(c) Figure **Q5(c)** shows a displacement transducer with a shaft stroke of 3.0 inch is applied in the circuit. The total resistance of the potentiometer is 5 kΩ and the applied voltage, V_T is 5.0 V. Determine the value of output voltage, V_o when the wiper is 0.9 inch from B.

(5 marks)

- END OF QUESTION –

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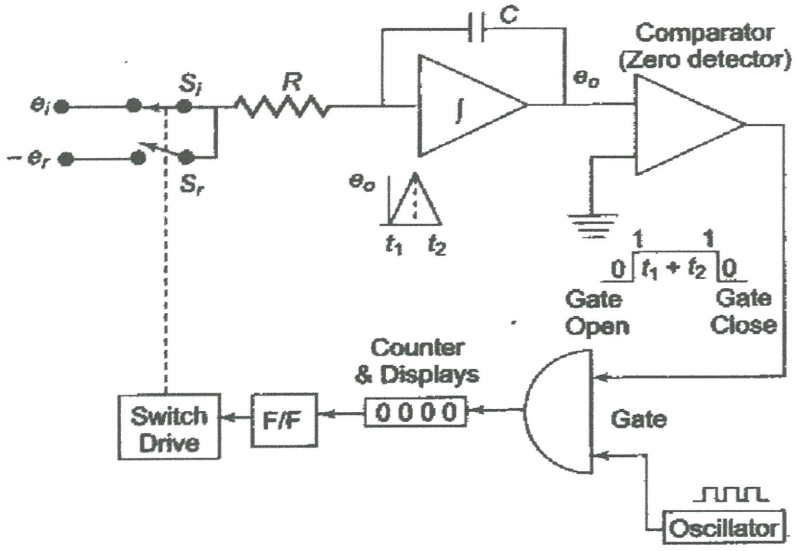

FIGURE Q1(c)

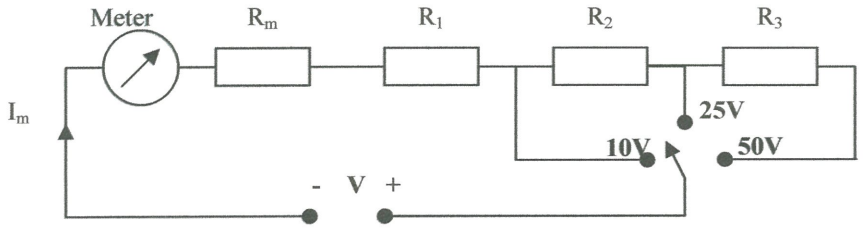

FIGURE Q2(a)

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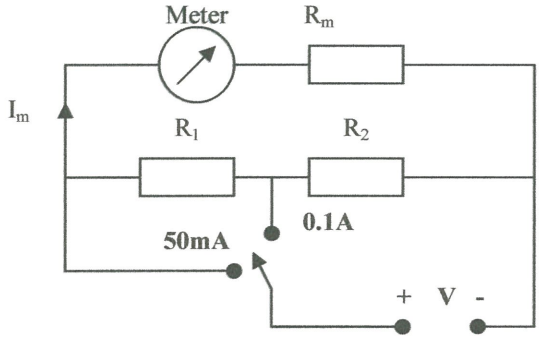

FIGURE Q2(b)

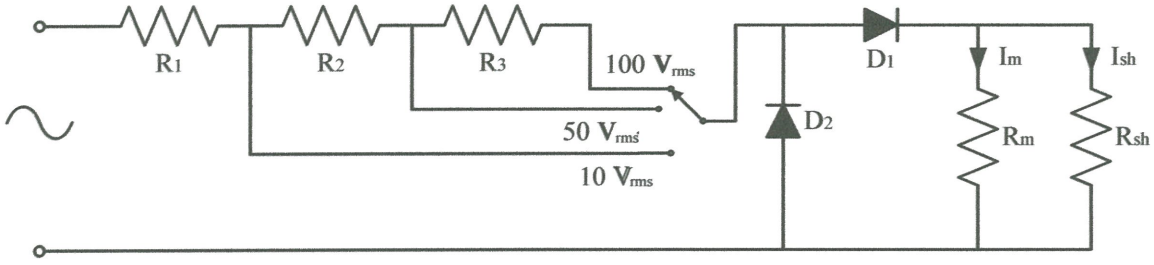

FIGURE Q3

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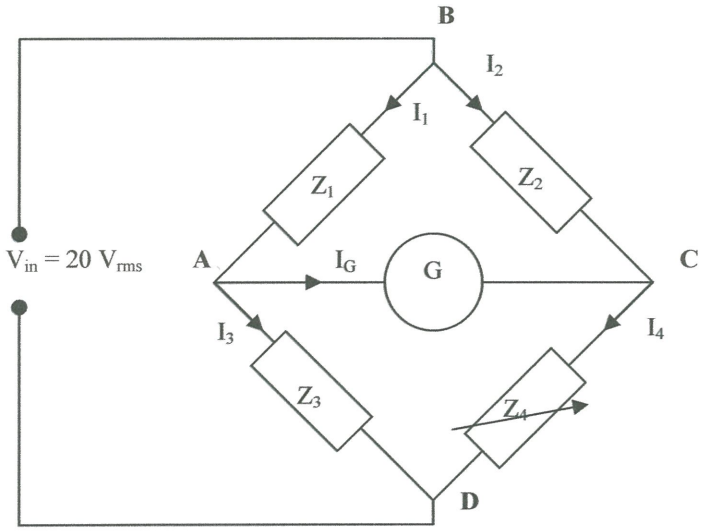
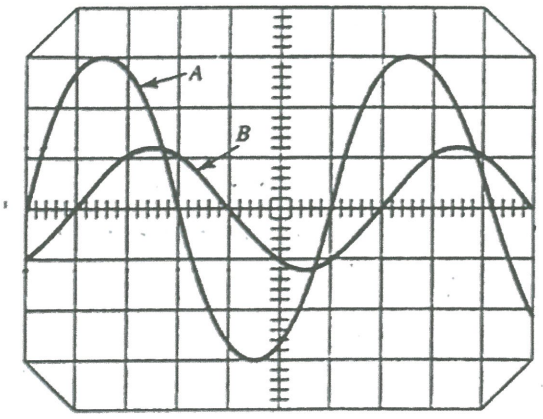


FIGURE Q4



TIME/DIV setting at 0.2 ms, and
VOLTS/DIV setting at 500 mV

FIGURE Q5(a)

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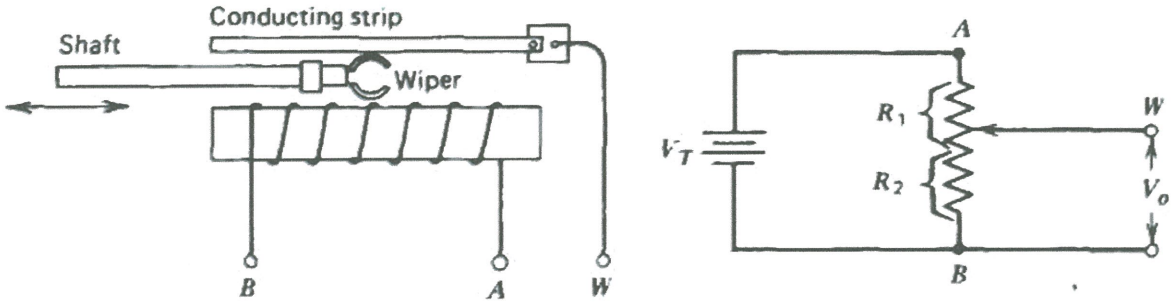

FIGURE Q5(c)