Universiti Tun Hussein Onn Malaysia

UNIVERSITI TUN HUSSEIN ONN MALAYSIA

FINAL EXAMINATION
SEMESTER I
SESSION 2016/2017

COURSE NAME	:	ELECTRICAL INSTRUMENTATION & MEASUREMENTS
COURSE CODE	:	DAE 21402
PROGRAMME CODE	:	2 DAE
EXAMINATION DATE	:	DECEMBER 2016 / JANUARY 2017
DURATION	:	2 HOURS 30 MINUTES
INSTRUCTION	:	ANSWERS **FOUR (4)** QUESTIONS ONLY

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

Q1 (a) There are **four (4)** types of error in measurement. Briefly describe the **four (4)** types of error in measurement.

(8 marks)

(b) The expected value of the voltage across a resistor is 9.0V. However, measurement yields a value of 8.6V. Calculate:

(i) The absolute error

(ii) The percentage (%) error

(iii) The relative accuracy

(iv) The percentage (%) accuracy

(4 marks)

(c) A 500V voltmeter is specified to be accurate within ± 3 % at full scale . Solve the limiting error when the instrument is used to measure 80 V of the voltage sources:

(3 marks)

(d) Statistical analysis have been commonly used in error measurement. The following **table Q1(d)** shown the set of 10 measurement recorded during the experiment. Based upon the data, compute the following;

(i) The arithmetic mean , $\overline{X}$

(ii) The deviation of each value ,d

(iii) The average deviation, D

(iv) The standard deviation ,S

(8 marks)

(e) Define the calibration process

(2 marks)

Q2 (a) State **five (5)** differences between analog and digital multimeters.

(5 marks)

(b) The permanent magnet moving coil instrument **or** PMMC type instrument uses two permanent magnets in order to create stationary magnetic field. These types of instruments are only used for measuring the DC quantities . Based upon the above statements;

(i) Sketch the basic construction of the Permenant-Movement Moving Coil Instrument (PMMC) with complete labelling

(2 marks)

(ii) Briefly describe the basic PMMC operation

(3 marks)

(c) A basic d'Arsonval movement with an internal resistance of 200 Ω, and full-scale deflection current of 5 mA, is to be converted into a multirange DC voltmeter with voltage ranges of 0-10 V, 0-100 V, 0-500 V and 0-1000 V.

(i) Construct the circuit diagram of the multirange DC voltmeter described above with complete labeling

(3 marks)

(ii) Calculate the values of R_1, R_2, R_3 and R_4 required for the above mentioned circuit.

(12 marks)

Q3 (a) Two voltmeters with different sensitivity are used to measure the voltage across a 15 kΩ resistor as shown in **Figure Q3 (a).** Both meters are used on their 0 - 100 V range. Redraw the circuit showing where both of the voltmeters should be connected.

(4 marks)

(b) Find the percentage (%) error due to voltmeter loading effect if the following meters are used.

(i) Voltmeter (range 0 – 10 V) with sensitivity of 10 kΩ/V

(4 marks)

(ii) Voltmeter (range 0 – 10 V) with sensitivity of 5 kΩ/V

(4 marks)

(c) Compare the two results gained from **Q3(b)(i)** and **Q3(b)(ii).**

(1 mark)

(d) Consider the following circuit configuration of The Aryton shunt in **Figure Q3 (d).** Calculate the value of Ra, Rb and Rc by applying the concept of Aryton shunt resistance by considering at the following current range, $I_1 = 2A$, $I_2 = 50mA$, and $I_3 = 20mA$

(12 marks)

Q4 (a) **Figure Q4 (a)** shows the schematic diagram of a Wheatstone bridge with values of the bridge elements. The battery voltage is 20 V and its internal resistance negligible. The galvanometer has a current sensitivity of 40 mm/mA an internal resistance of 500 Ω.

(i) Calculate the deflection of galvanometer.

(8 marks)

(ii) Determine the value of R_4 required to balance the bridge circuit.

(4 marks)

(b) The Wien Bridge is a type of AC bridge circuit as shown in **Figure Q4(b)**. Demonstrate the equation $f = \frac{1}{2\pi\sqrt{C_1 C_3 R_1 R_3}}$ for balance condition where $Z_2Z_3 = Z_1Z_4$.

(13 marks)

Q5 (a) Describe the **four (4)** basic control functions of an oscilloscope.

(8 marks)

(b) Name **two (2)** types of signal generator and describe its difference.

(6 marks)

(c) Draw the block diagram of Analog Oscilloscope and Digital Oscilloscope. Label all the systems in the block diagram.

(11 marks)

Q6 (a) Define the following;

(i) Sensors
(ii) Transducers

(4 marks)

(b) Draw the graph resistance against temperature for the following temperature sensors;

(i) RTD
(ii) Thermistor

(6 marks)

(c) From the graph in **Q6 (b) (i)** and **Q6 (b) (ii)**, state the relationship between resistance and temperature for both of the sensors.

(4 marks)

(d) Briefly explain the principle of the thermocouple sensor operation.
(5 marks)

(e) Give **three (3)** comparisons between RTD's and Thermocouple's sensors.
(6 marks)

-END OF QUESTIONS –

FINAL EXAMINATION

SEMESTER / SESSION : SEM I / 2016/2017 PROGRAMME CODE : 2 DAE
COURSE NAME : ELECTRICAL INSTRUMENTATIONS & MEASUREMENTS
COURSE CODE : DAE 21402

Table : Q1(d)

Number of Measurements	Recorded values, Xn (volts)
1	36.5
2	35.5
3	39.0
4	32.6
5	35.9
6	33.4
7	33.8
8	30.4
9	39.4
10	40.1

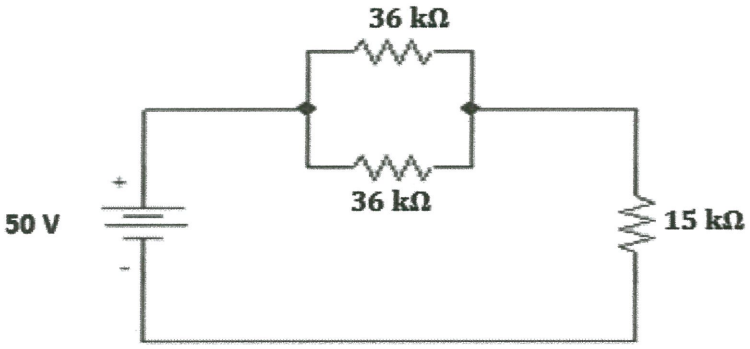

Figure Q3(a)

FINAL EXAMINATION

SEMESTER / SESSION : SEM I / 2016/2017 PROGRAMME CODE : 2 DAE
COURSE NAME : ELECTRICAL INSTRUMENTATIONS & MEASUREMENTS
COURSE CODE : DAE 21402

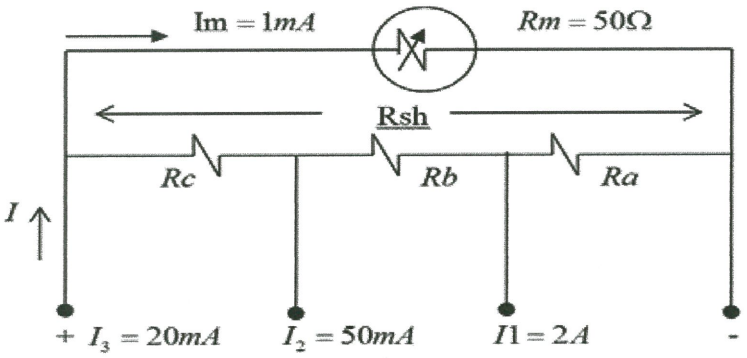

Figure Q3 (d)

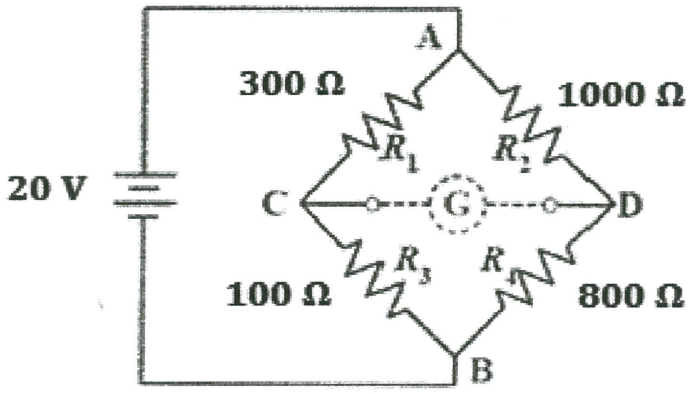

Figure Q4(a)

FINAL EXAMINATION

SEMESTER / SESSION : SEM I / 2016/2017 PROGRAMME CODE : 2 DAE
COURSE NAME : ELECTRICAL INSTRUMENTATIONS & MEASUREMENTS
COURSE CODE : DAE 21402

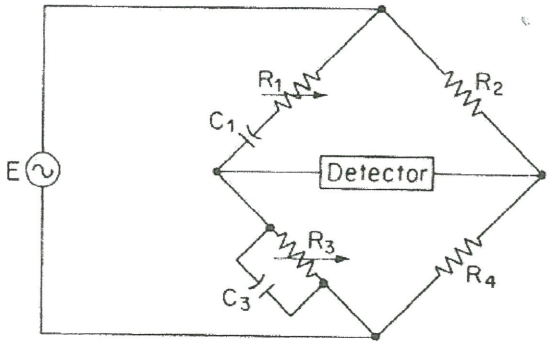

Figure Q4(b)