Universiti Tun Hussein Onn Malaysia

UNIVERSITI TUN HUSSEIN ONN MALAYSIA

FINAL EXAMINATION
SEMESTER I
SESSION 2019/2020

COURSE NAME	:	ELECTRICAL MEASUREMENT AND INSTRUMENTATION
COURSE CODE	:	DAE 21402
PROGRAMME CODE	:	DAE
EXAMINATION DATE	:	DECEMBER 2019/JANUARY 2020
DURATION	:	2 HOURS 30 MINUTES
INSTRUCTION	:	ANSWERS **FOUR (4)** QUESTIONS ONLY

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

Q1 (a) State the type of errors for each of the following statements:-

(i) Ageing components of the measuring activities
(ii) V = 150 Ω ± 5 %
(iii) Misrecording the data of the measurement instruments
(iv) An instrument using low quality of components

(4 marks)

(b) Give **two (2)** reasons why there are differences between calculated and measured values.

(2 marks)

(c) Explain the difference between resolution and sensitivity. (4 marks)

(d) State the relationship between accuracy, quality and cost. (3 marks)

(e) Identify **two (2)** reasons why an accuracy is very important for the automatic weapon systems in military operation.

(4 marks)

(f) The value of resistance is 5.7 kΩ, while measurements yield a value of 5.65 kΩ. Calculate:

(i) The relative accuracy of the measurement.
(ii) Percentage of accuracy

(3 marks)

(g) The output voltage of an amplifier was measured at ten different intervals using the same digital voltmeter with the following results stated in the **Table 1**. Calculate:

(i) The arithmetic mean.
(ii) The precision of the sixth measurement.

(5 marks)

Q2 (a) Describe with the aid of an appropriate diagram **three (3)** types of torque (forces) that involved for the satisfactory operation of deflecting PMMC.

(6 marks)

(b) A PMMC instrument with a coil of 100 turns has a magnetic flux density in its air gaps of 0.2 T. The coil dimensions are 1 cm x 1.5 cm. Calculate the deflecting torque on the coil if the current is 1 mA.

(3 marks)

(c) Decribe **three (3)** precautions during handling and taking measurement of a multimeter.

(3 marks)

(d) A multi-range ammeter Ayrton shunt type is shown in **Figure Q2(d).** The D' Arsonval meter used has a resistance of 1 kΩ and a full-scale deflection current of 50 μA. The Ayrton shunt consists of four resistors connected in series with the value of $R_1 = 1\ \Omega$, $R_2 = 9\ \Omega$, $R_3 = 90\ \Omega$ and $R_4 = 900\ \Omega$. Calculate the ampere meter range of A_1 to A_4 formed.

(13 marks)

Q3 (a) **Figure Q3 (a)** shows a simple series circuit of R_1 and R_2 connected to a 250 V DC source. If the voltage across R_2 is to be measured by voltmeters having:

- A sensitivity of 500 Ω/V , range = 150 V and
- A sensitivity of 10000 Ω/V, range = 150 V

Determine:

(i) Voltage across R_2 without any meter connected across it. (2 marks)

(ii) Voltage across R_2 when a sensitivity of 500 Ω/V. (4 marks)

(iii) Voltage across R_2 when a sensitivity of 10000 Ω/V. (4 marks)

(iv) Which voltmeter will read more accurately. (2 marks)

(b) The half wave rectifier circuit shown in **Figure 3(b)** has an a average forward resistance diode of 50 Ω and is assumed to have an infinite resistance diode in the reverse direction. Based upon the given statement, calculate the following:

(i) The value of the multiplier. (7 marks)
(ii) The ac sensitivity. (3 marks)
(iii) The equivalent dc sensitivity. (3 marks)

Q4 (a) From the circuit shown in **Figure Q4 (a)**, analyze the circuit mathematically to produce an equation of unknown resistance, R_4, when the bridge is balance. (7 marks)

(b) Based on the Wheatstone bridge circuit given in **Figure Q4 (b)**, the resistive components have following nominal values:
$V = 4$ V, $R_1 = 100\ \Omega$, $R_2 = 1$ kΩ, $R_3 = 50.5\ \Omega$ and $R_4 = 500\ \Omega$.
The galvanometer has an internal resistance of 75 Ω.

(i) Calculate V_{TH} and R_{TH} (7 marks)
(ii) Draw the thevenin equivalent circuit. (3 marks)
(iii) Calculate the current flowing through the galvanometer. (3 marks)
(iv) The Galvanometer has a current sensitivity of 2 mm/μA and internal resistance of 75 Ω. Calculate the deflection of the Galvanometer. (2 marks)

(c) State **two (2)** conditions that must be met simultaneously when balancing an AC bridge.

(3 marks)

Q5 (a) List **four (4)** measurements that can be performed using an oscilloscope.

(4 marks)

(b) Describe **three (3)** basic control functions of an oscilloscope.

(6 marks)

(c) The waveform shown in **Figure Q5 (c)** is trace on the screen of an oscilloscope. If the Volt/Div is set at 5.0 V per division and the time base is set at 0.50 ms per division, determine:

(i) The maximum positive value of potential difference.
(ii) The maximum negative value of potential difference.
(iii) Peak-to-peak voltage amplitude, Vp-p.
(iv) The frequency of the signal.

(8 marks)

(d) Based on **Figure Q5 (d)**, if y_o =4.0 cm and y_{max}= 6.4 cm, calculate the phase angle.

(3 marks)

(e) Name **two (2)** types of signal generator and describe the difference between the two signals.

(4 marks)

Q6 (a) Name **four (4)** types of microphones.

(4 marks)

(b) State the basic concept of the capacitor microphone.

(2 marks)

(c) Briefly explain the operating principle of the capacitor microphone.

(5 marks)

(d) State **two (2)** examples of applications for each of the following sensors and transducer:

(i) Sound transducer
(ii) Light sensor
(iii) Speed sensor
(iv) Ultrasonic sensor

(8 marks)

(e) State **two (2)** reasons why sensory system is very useful and helpful for the aircraft pilot. (3 marks)

(f) State **three (3)** opinions why sensors technology is very important in Industrial sectors.

(3 marks)

-END OF QUESTIONS –

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Table 1

Measurement number	1	2	3	4	5	6	7	8	9	10
Measured value of X_n, (Volts)	99	101	102	98	100	104	99	107	108	99

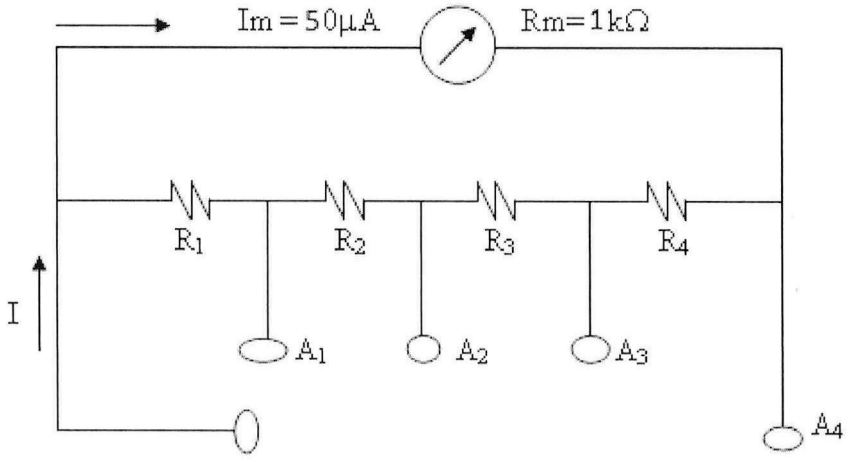

Figure Q2 (d)

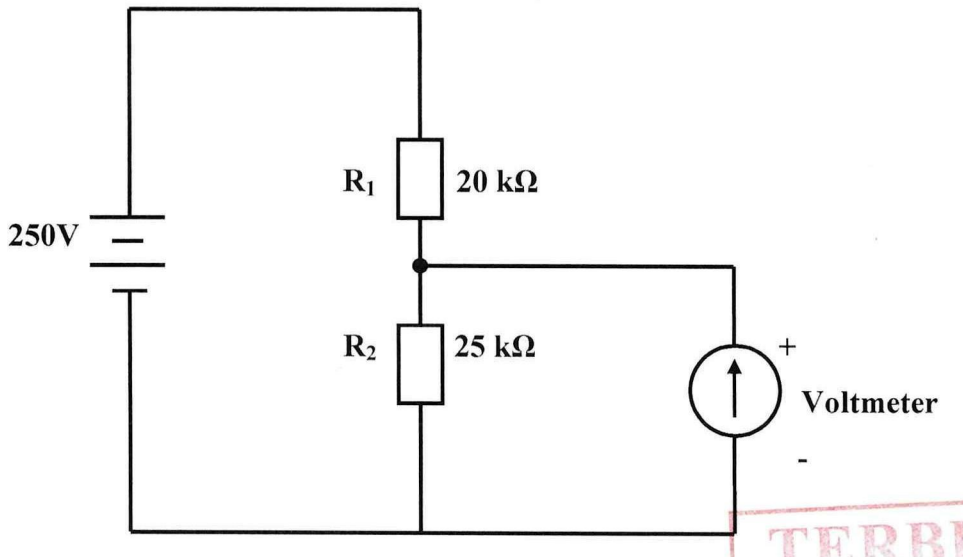

Figure Q3 (a)

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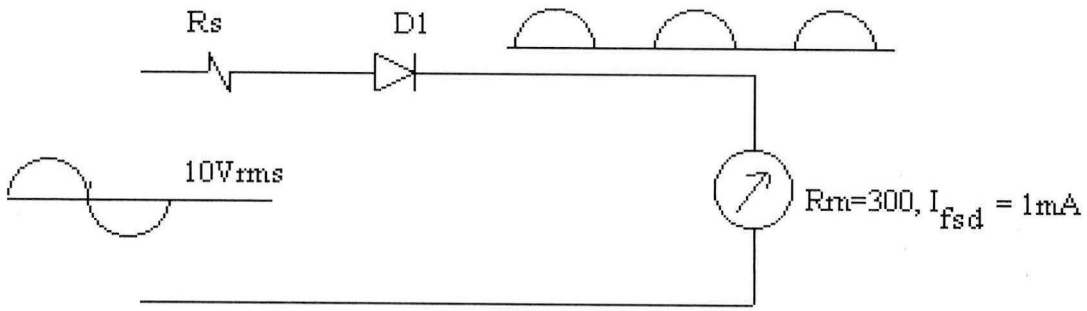

Figure Q3 (b)

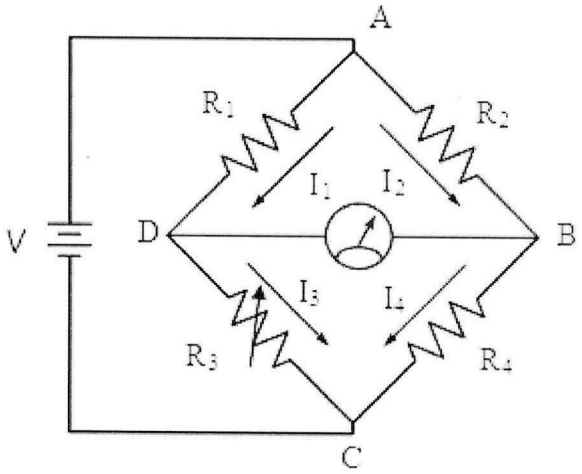

Figure Q4 (a)

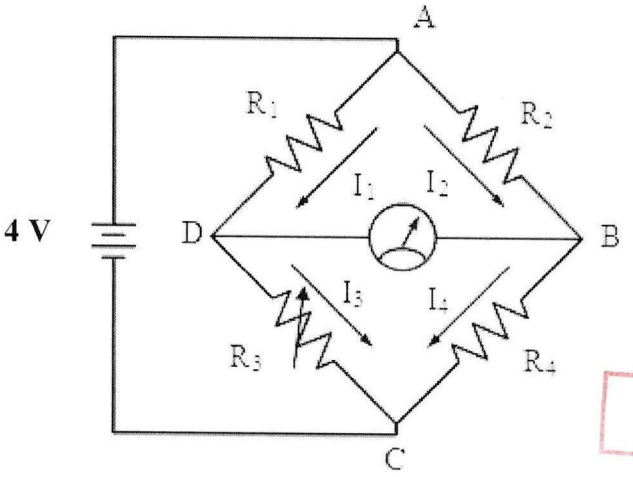

Figure Q4 (b)

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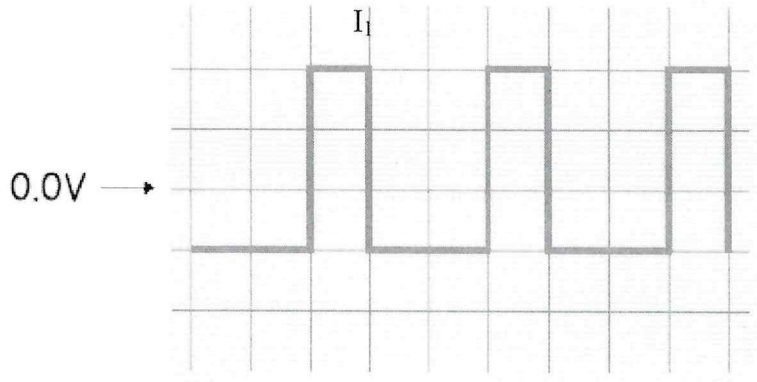

Figure Q5 (c)

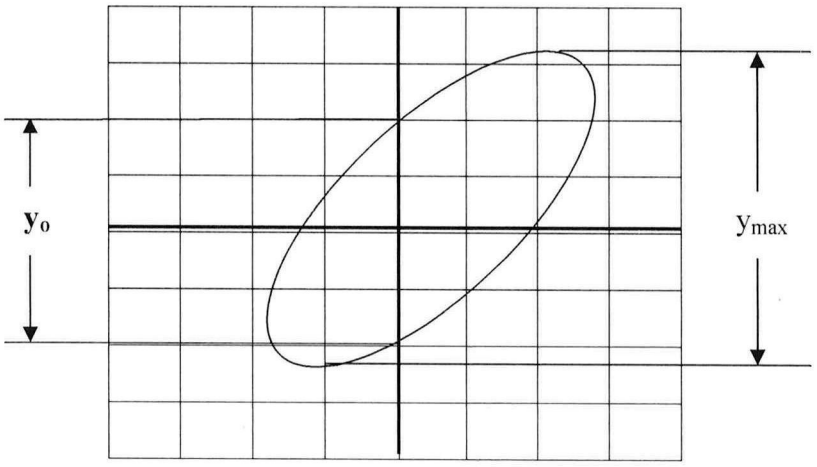

Figure Q5 (d)