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UNIVERSITI TUN HUSSEIN ONN MALAYSIA

**FINAL EXAMINATION
SEMESTER I
SESSION 2021/2022**

COURSE NAME : ELECTRICAL INSTRUMENTATION AND MEASUREMENT
COURSE CODE : DAE 21403
PROGRAMME CODE : DAE
EXAMINATION DATE : JANUARY / FEBRUARY 2022
DURATION : 4 HOURS
INSTRUCTION : 1. ANSWER **ALL** QUESTIONS.
2. THIS FINAL EXAMINATION IS AN **ONLINE ASSESSMENT** AND CONDUCTED VIA **OPEN BOOK**.

THIS QUESTION PAPER CONSISTS OF **SEVEN (7)** PAGES

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- Q1**
- (a) Differentiate the terminology of accuracy and precision in measurement. (4 marks)
- (b) State **two (2)** reasons why accuracy is more important for the radar system onboard a naval ship during military operation at sea. (4 marks)
- (c) Explain the **two (2)** reasons why Working Standards is used as the main reference in controlling the quality of manufacturing goods for the industry compared to other standards. (4 marks)
- (d) State the main purpose of determining mean value for multiple measurements data when using an old instrument. (2 marks)
- (e) Given a four-band resistor with the colour coded Red, Violet, Orange and Gold. Eight measurements of such resistor were measured and found to have the following values as in **Table Q1(e)**. Determine:
- (i) The accepted value of resistor. (1 mark)
- (ii) The arithmetic mean. (2 marks)
- (iii) The deviation of each value. (2 marks)
- (iv) The average deviation. (2 marks)
- (v) The standard deviation. (2 marks)
- (vi) The precision of the 5th measurement. (2 marks)

- Q2**
- (a) State the main reason why Permanent Magnet Moving Coil (PMMC) instruments is classified as deflection instrument. (3 marks)
- (b) List **four (4)** precaution procedures of handling and taking measurement from a multirange voltmeter. (4 marks)
- (c) A PMMC instruments with $I_{FSD} = 50 \mu A$ and $R_m = 1700 \Omega$ is to be employed as a voltmeter with ranges of $1.0 V$, $2.5 V$ and $5.0 V$.
- (i) Calculate the required values of multiplier resistors for the given circuit configuration in **Figure Q2(c)(i)**. (6 marks)
- (ii) Determine which selector position is to be placed for each voltmeter range. (3 marks)
- (iii) Discuss the reason for your answer in **Q2(c)(ii)**. (3 marks)
- (d) Explain the importance of conducting a zero-ohm (0Ω) adjustment in each resistance range of ohmmeter during resistance measurement. (2 marks)
- (e) A series ohmmeter is made up of supply voltage $E_b = 3 V$, series resistor $R_1 = 27 k\Omega$, meter shunt resistor $R_2 = 50 \Omega$, meter $FSD = 50 \mu A$ and meter resistance $R_m = 50 \Omega$. Determine the new resistance to which R_2 must be adjusted when E_b falls to $2.5 V$. (4 marks)

- Q3**
- (a) Differentiate the function and application of Maxwell and Wheatstone bridge. (2 marks)
- (b) With the aid of a diagram, define the expression of bridge null or balance in a Wheatstone bridge. (3 marks)
- (c) State **two (2)** conditions that must be met simultaneously when balancing an AC bridge. (2 marks)
- (d) Based on Wheatstone bridge in **Figure Q3(d)**, the resistive components have following nominal values:
 $E = 5\text{ V}$, $R_1 = 1\text{ k}\Omega$, $R_2 = 1\text{ k}\Omega$, $R_3 = 5\text{ k}\Omega$ and $R_g = 100\ \Omega$
- (i) Calculate the value of R_X when $V_{IH} = 24\text{ mV}$ and $I_g = 13.6\ \mu\text{A}$. (6 marks)
- (ii) The galvanometer has a sensitivity of $20\text{ mm}/\mu\text{A}$. Determine the galvanometer deflection for the condition in **Q3(d)(i)**. (2 marks)
- (e) Maxwell bridge as illustrated in **Figure Q3(e)** has the value of $R_1 = 600\ \Omega$, $C_1 = 1\ \mu\text{F}$, $R_2 = 100\ \Omega$, $R_3 = 1\text{ k}\Omega$ and supply voltage at 6 V with 1 kHz frequency.
- (i) Derive the expression of R_X and L_X as follows:
- $$R_X = \frac{R_2 R_3}{R_1}, \text{ and } L_X = C_1 R_2 R_3$$
- (4 marks)
- (ii) Calculate R_X and L_X . (4 marks)
- (iii) Calculate the Q-factor of the inductor. (2 marks)

- Q4**
- (a) State the importance of calibrating the probe of an oscilloscope. (3 marks)
- (b) Sketch and label the waveform completely:
- (i) **Two (2)** cycles of pulse waveform with 20% duty cycle, $V_p = 5 V$ and $T = 10 ms$. (4 marks)
- (ii) $1\frac{2}{3}$ cycles of triangle wave with $V_{p-p} = 200 V$ and $f = 50 Hz$. (4 marks)
- (c) Explain **two (2)** application of Lissajou pattern in measurement. (4 marks)
- (d) A transducer needs to be with a high reliability and stability. Discuss why this criterion is important in a transducer. (4 marks)
- (e) Explain **two (2)** significant difference between thermocouple and thermistor as a heat sensor. (4 marks)
- (f) Explain the main difference between actuators and sensors. (2 marks)

-END OF QUESTIONS -

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Table Q1(e)

Resistor No	Value (kΩ)
1	27.2
2	26.8
3	25.9
4	28.0
5	27.5
6	26.8
7	28.2
8	25.7

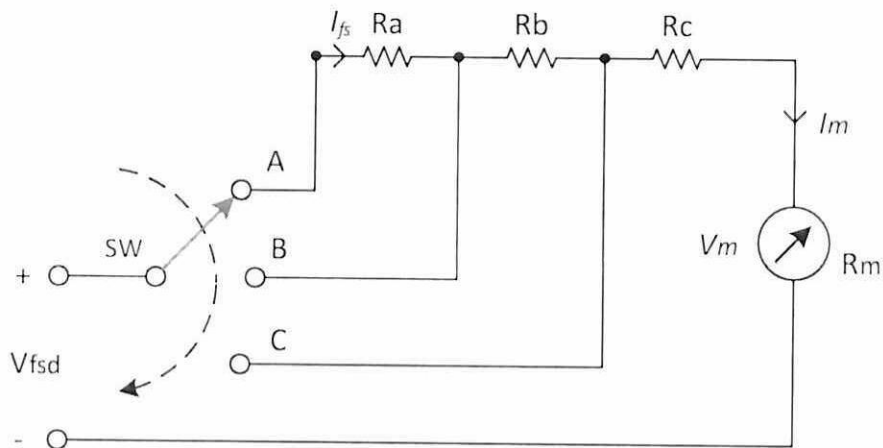


Figure Q2(c)(i)

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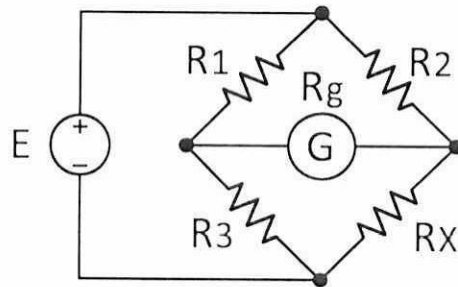


Figure Q3(d)

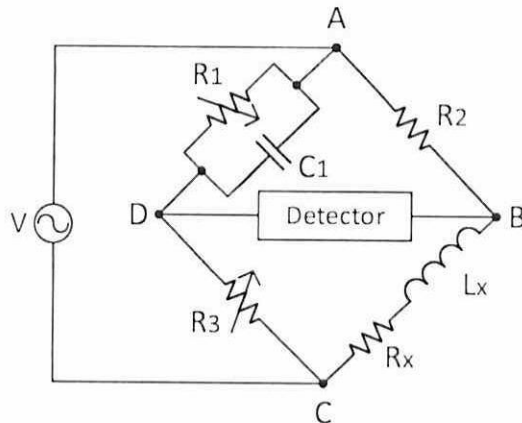


Figure Q3(e)

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