Universiti Tun Hussein Onn Malaysia

# UNIVERSITI TUN HUSSEIN ONN MALAYSIA

## FINAL EXAMINATION
## (TAKE-HOME)
## SEMESTER I
## SESSION 2020/2021

| | | |
|---|---|---|
| COURSE NAME | : | ELECTRICAL INSTRUMENTATION AND MEASUREMENT |
| COURSE CODE | : | DAE 21403 |
| PROGRAMME CODE | : | DAE |
| EXAMINATION DATE | : | JANUARY/FEBRUARY 2021 |
| DURATION | : | 6 HOURS |
| INSTRUCTION | : | ANSWER **ALL** QUESTIONS<br>**OPEN BOOK EXAMINATION** |

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

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**Q1**

(a) State the main difference between accuracy and precision.

(2 marks)

(b) List **five (5)** reasons why there are differences between practical values and theoretical values.

(5 marks)

(c) Explain the reasons in determining the mean value of measurement when taking readings from an old instrument

(3 marks)

(d) Given a four band resistor with the colour coded Red, Black, Orange and Gold.

(i) Determine the resistance value and expressed the tolerance in relative error.
(ii) Calculate an error if the value of the resistor is maximum.
(iii) Calculate an error if the value of the resistor is minimum.

(6 marks)

(e) State the relationship between quality of instrument, accuracy, cost and quality of results.

(3 marks)

(f) Sketch the construction of a permanent Magnet Moving Coil (PMMC) meter movement. Label your sketching that indicate Permanent Magnet, Scale, Control Spring, Pointer and Moving Coil. Briefly explain the function of each components.

(6 marks)

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**Q2**

(a) Based on the **Figure Q2(a)**, a PMMC instruments has three Ayrton shunt resistors connected across it to make an ammeter. The meter has $R_m = 700\ \Omega$, $FSD = 50\ \mu A$ and ammeter ranges of $1\ A$, $50\ mA$ and $25\ uA$.

(i) Calculate the required values of multiplier resistors for the given circuit configuration.

(6 marks)

(ii) Determine which selector position is to be place for each ammeter range.

(3 marks)

(iii) Discuss the reason why the selector is placed as such condition in **Q2(a)(ii)**.

(3 marks)

(b) List **four (4)** precaution during handling and taking measurement of a multirange DC ammeter.

(4 marks)

(c) Define ohmmeter accuracy and explain which part of the scale gives the most accurate resistance measurement.

(3 marks)

(d) Explain the importance of conducting a zero ohm ($0\ \Omega$) 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 $R_1 = 30\ k\Omega$, 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 $2.4\ V$.

(4 marks)

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**Q3**

(a) Differentiate the function and application of Wheatstone and Maxwell bridge.

(3 marks)

(b) A Maxwell bridge is designed to measure the unknown impedance ($R_x$ , $L_x$) of a coil, is shown in **Figure Q3(b)**.

(i) Derive an expression for $R_x$ and $L_x$ under balance condition

(3 marks)

(ii) If the fixed bridge component values are $R_2 = 100\ \Omega$ and $C_1 = 20\ \mu F$, calculate the value of the unknown impedance, $R_x$ and $L_x$ if $R_1 = 3183\ \Omega$ and $R_3 = 50\ \Omega$ at balance.

(5 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:
$V = 5\ V$, $R_1 = 1\ k\Omega$, $R_2 = 1.5\ k\Omega$, $R_3 = 3.9\ k\Omega$ and $R_4 = 7.5\ k\Omega$,

(i) Calculate $V_{TH}$ and $R_{TH}$.
(ii) Draw the Thevenin equivalent circuit.
(iii) The Galvanometer has a current sensitivity of $25\ mm/\mu A$ and internal resistance of $75\ \Omega$. Calculate the deflection of the Galvanometer.

(12 marks)

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**Q4**

(a) State the importance of calibrating an oscilloscope.

(2 marks)

(b) Sketch and label the waveform completely:

(i) **Two (2)** cycles of pulse waveform with 10% duty cycle, $V_P = 5\ V$ and $T = 10\ ms$.

(ii) 1⅔ cycles of triangle wave with $V_{P\text{-}P} = 200\ V$ and $f = 50\ Hz$.

(4 marks)

(c) Two sine waves of the same phase and amplitude are applied to the input terminals of an oscilloscope operating in the X-Y mode. If the signal applied to the horizontal input is *5 kHz* and the frequency of the vertical input signal is *2 kHz*, sketch the waveform that will be observed on the oscilloscope screen.

(2 marks)

(d) Name **two (2)** types of signal generator commonly used in audio manufacturing and describe it differences.

(4 marks)

(e) State **two (2)** reasons why the sensory system is very useful and helpful in petrochemical industries.

(4 marks)

(f) Give **two (2)** examples of applications for each of the following sensor or transducer:

(i) light sensor,

(ii) velocity sensor,

(iii) pressure transducer.

(6 marks)

(g) State the main difference between sensor and transducer.

(3 marks)

**END OF QUESTIONS**

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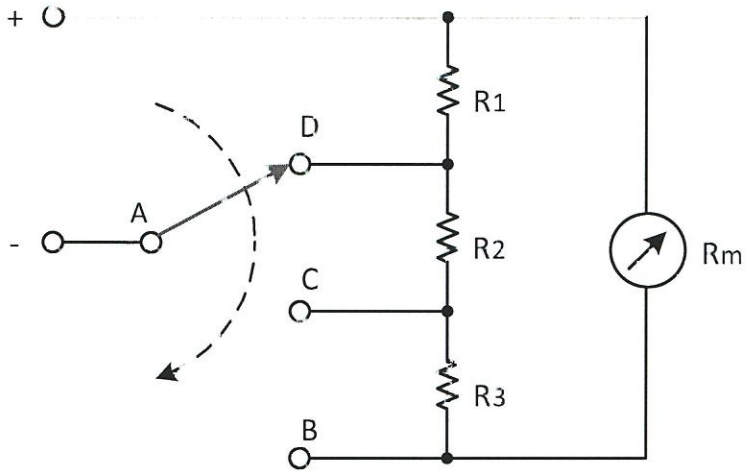


**Figure Q2(a)**

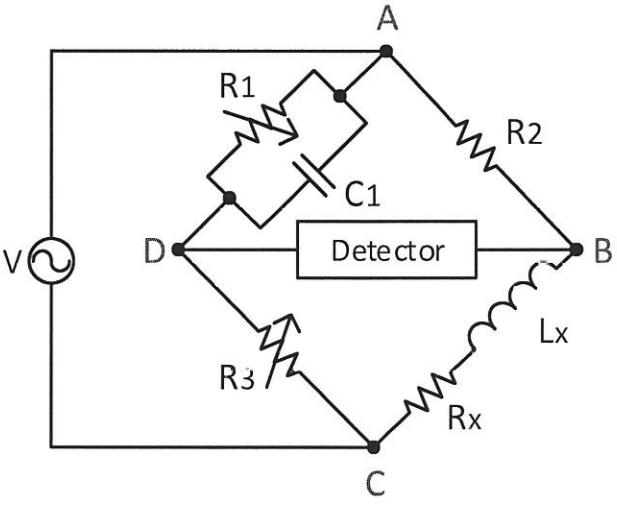


**Figure Q3(b)**

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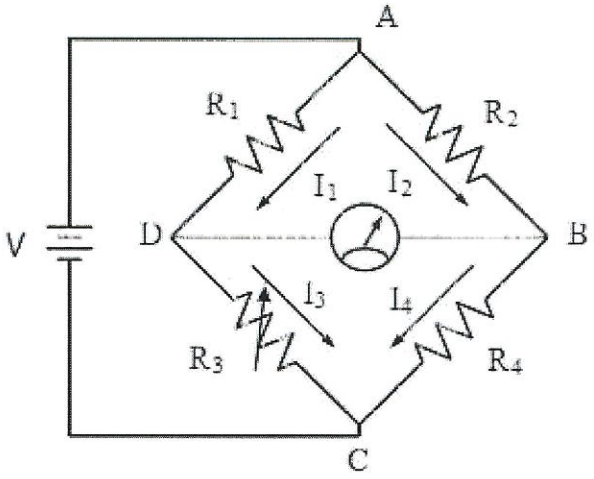


**Figure Q3(d)**