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UNIVERSITI TUN HUSSEIN ONN MALAYSIA

**FINAL EXAMINATION
SEMESTER II
SESSION 2010/2011**

COURSE NAME : ELECTRICAL MEASUREMENT
AND INSTRUMENTATION

COURSE CODE : DEE 2142

PROGRAMME : 3 DEE/DEX/DET

EXAMINATION DATE : APRIL / MAY 2011

DURATION : 2 ^{1/2} HOURS

INSTRUCTION : ANSWER **FOUR (5)** QUESTIONS
ONLY

THIS PAPER CONSISTS OF NINE (9) PAGES

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- Q1** (a) All measurements are subject to error which contributes to the uncertainty in data collecting. In fact, by “error”, we usually mean just outright mistakes, such as incorrect use of an instrument and failure to read a scale properly. Based upon this situation, there are four (4) sources of error in measurement.
- (i) Identify the four (4) sources of error in measurement. (4 marks)
 - (ii) Briefly explain each of the errors (4 marks)
- (b) Describe the differences between precision and accuracy (4 marks)
- (c) A 500-V voltmeter is specified to be accurate within $\pm 3\%$ at full scale. Calculate the limiting error when the instrument is used to measure the following voltage sources
- (i) 50V
 - (ii) 40V
 - (iii) 80V
- (6 marks)
- (d) State a conclusion based on your finding in Q1(c). (2 marks)
- Q2** (a) The expected value of the voltage across a resistor is 8.0V. However, measurement yields a value of 7.5V. Calculate:
- (i) Absolute error
 - (ii) Percentage of error
 - (iii) Relative accuracy
 - (iv) Percentage of accuracy
- (8 marks)

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(b) Statistical Analysis have been commonly used in error measurement. Given below in Table 1 are the set of 10 measurement recorded during an experiment. For the following data, compute;

- (i) The arithmetic mean
- (ii) The deviation of each value
- (iii) The algebraic sum of the deviation
- (iv) The average deviation
- (v) The standard deviation

(10 marks)

(c) Define calibration process.

(2 marks)

Q3 (a) Sketch the basic construction of modern Permanent Magnet Moving Coil (PMMC) and state its two (2) main features.

(4marks)

(b) A multi-range ammeter Ayrton shunt type is shown in Figure Q3(b). The D'Arsonval meter used has a resistance of $1k\Omega$ and a full-scale deflection current $50\mu A$. 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.

(10 marks)

(c) (i) A basic D'Arsonval movement with a full-scale deflection of $50\mu A$ and internal resistance of 500Ω is used as a DC voltmeter. Determine the value of the multiplier resistance needed to measure a voltage range of 0-10V

(4 marks)

(ii) Sensitivity and voltmeter range can be used to calculate the multiplier resistance, R_s of a DC voltmeter.

(2 marks)

- Q4** (a) There are many special forms of the bridge circuit. With the aid of simple bridge diagram, identify at least five (5) commonly used bridges. (10 marks)
- (b) The unknown resistor R_X is connected in Figure Q4(b), and R_3 is adjusted so that the bridge will be in balanced condition. Calculate the value of R_X if R_3 is 576Ω . (4 marks)
- (c) Given the following Maxwell-Wein Bridge diagram in Figure Q4(c). Show that the following formula comply;

$$(R_2 \times R_4) + (j\omega L_1 R_2) = (R_1 \times R_3) + (j\omega C R_1 R_2 R_3)$$
 (6 marks)
- Q5** (a) Figure Q5(a) is the basic circuit of ohmmeter.
- (i) Show that the relationship of the meter deflection percentage can be written as the following formula.

$$\% \text{ Deflection} = \frac{R_Z + R_m}{R_Z + R_m + R_X}$$
 (4 marks)
- (ii) Show that any resistance measured by the ohm meter is equal to the resistance of the ohm meter itself if the deflection of the indicator is 50% of full scale deflection. (4 marks)
- (b) A multi-range meter ampere Ayrton shunt type is shown in Figure Q5(b). D'Arsonval meter used has a resistance of $R_m = 2k\Omega$ and a full-scale deflection current, I_{FS} deflection = $100\mu A$. The Ayrton shunt consists of three resistors connected in series. Calculate all the resistor values if the meter has a range of $1mA$, $10mA$ and $100mA$. (12 marks)

- Q6** (a) D'Arsonval meter movement with I_{FS} deflection = 1 mA and $R_m = 250$ Ohm used in full wave rectifier circuit ac voltmeter, such as shown in Figure Q6(a). All diodes have a forward biased resistance of 300 Ohm and an infinite values of reverse biased resistance. Calculate the resistance coefficient of R_S .
(8 marks)
- (b) A $R_{sh} = 250$ Ohm resistor is connected at point A and B which is consistent with the d'Arsonval meter. Calculate the new values of the resistance R_S .
(12 marks)
- Q7** (a) State five (5) functions available in an Oscilloscope
(5 marks)
- (b) By referring to figure Q7(b) :
- (i) Label the parts of the Cathode Ray Tube
(4 marks)
- (ii) Explain its operation.
(5 marks)
- (c) Define the following terms below and sketch each waveform for further explanation.
- (i) Rise Time
(ii) Fall Time
(iii) Delay Time
(6 marks)

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TABLE 1: Q2(b) Data gained during an experiment

Number of Measurement	Recorded values, Xn (volt)
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

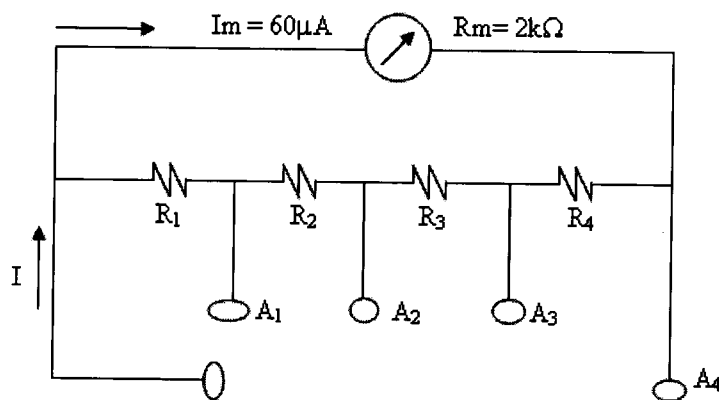


FIGURE Q3(b)

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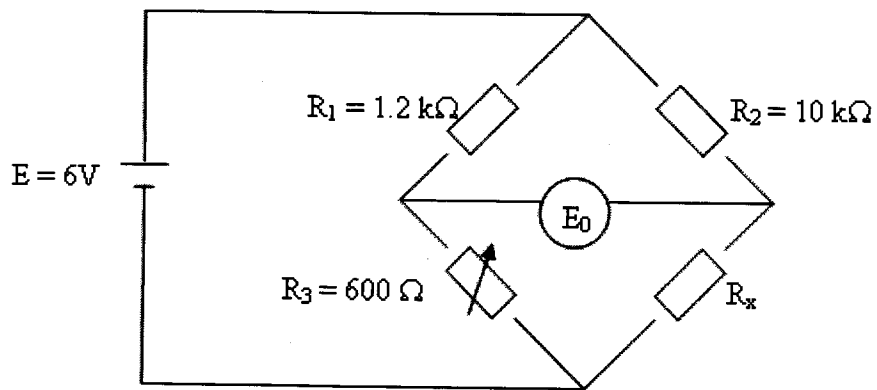


FIGURE Q4(b)

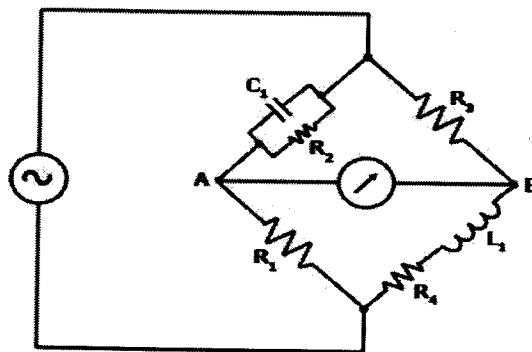


FIGURE Q4(c)

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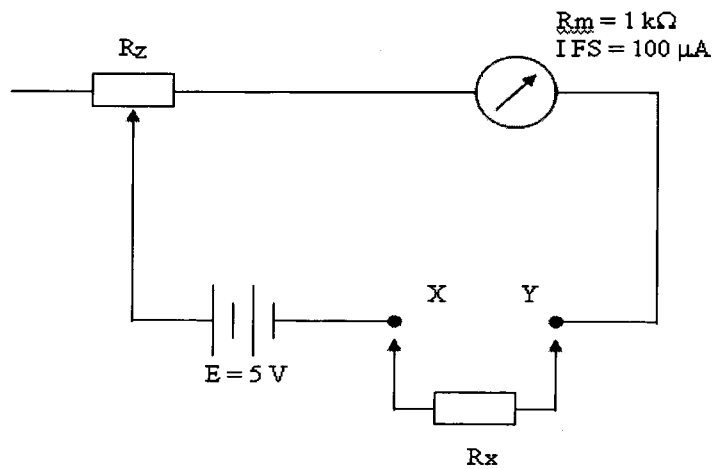


FIGURE Q5(a)

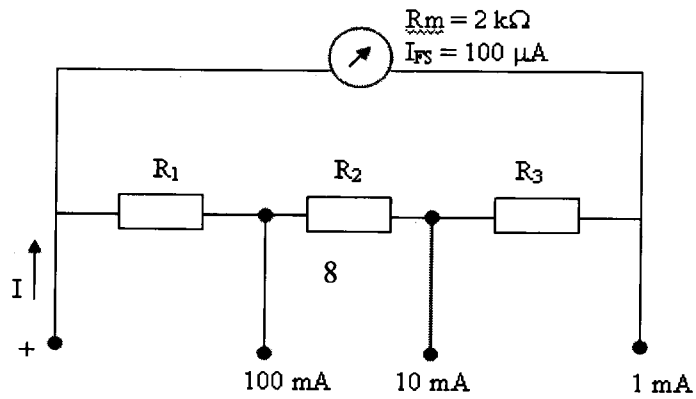


FIGURE Q5(b)

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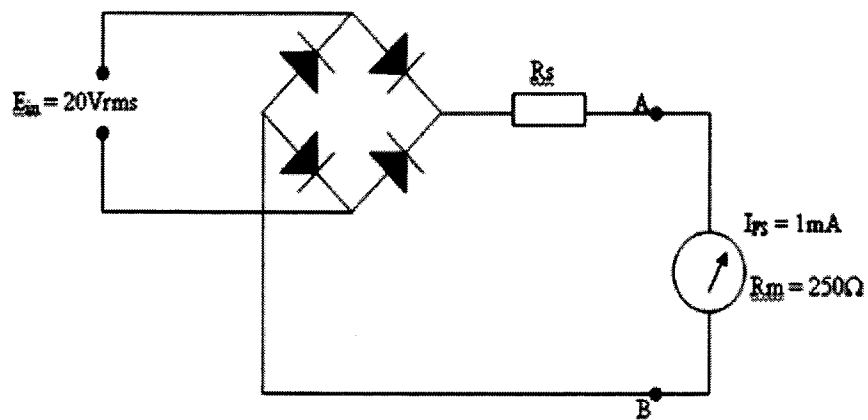


FIGURE Q6(a)

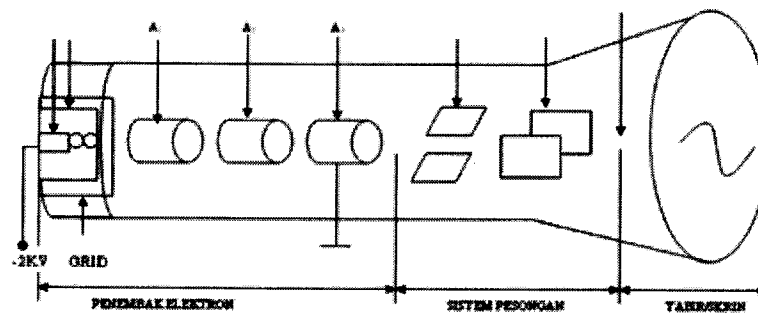


FIGURE Q7(b)