UNIVERSITI TUN HUSSEIN ONN MALAYSIA

FINAL EXAMINATION
SEMESTER I
SESSION 2012/2013

COURSE NAME	:	ELECTRICAL INSTRUMENTATION AND MEASUREMENT
COURSE CODE	:	DAE 21402
PROGRAMME	:	2 DAE
EXAMINATION DATE	:	OCTOBER 2012
DURATION	:	2 ½ HOURS
INSTRUCTIONS	:	ANSWER **FOUR (4)** QUESTIONS ONLY

THIS QUESTION PAPER CONSISTS OF SEVEN (7) PAGES

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;

(i) Identify the **four** (4) sources of error in measurement.

(4 marks)

(ii) Briefly explain any **two** (2) of the errors.

(4 marks)

(b) A 500-V voltmeter is specified to be accurate within ±3% at full scale. Calculate the limiting error when the instrument is used to measure the following voltage sources

(i) 40V
(ii) 50V
(iii) 80V

(6 marks)

(c) The expected value of the voltage across a resistor is 8.0V. However, measurement yields a value of 7.5V. Calculate:

(i) The absolute error
(ii) The relative accuracy

(4 marks)

(d) Statistical analysis have been commonly used in error measurement. By referring to Table Q1(d), there are a set of 10 measurement data recorded during an experiment. Compute;

(i) The arithmetic mean
(ii) The deviation of each value
(iii) The standard deviation

TABLE Q1(d)

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

(6 marks)

(e) Define calibration process

(1 mark)

Q2 (a) Sketch the basic construction of modern Permanent – Magnet Moving Coil (PMMC) and state its **two** (2) main features .

(6marks)

(b) A multi-range ammeter Ayrton shunt type is shown in Figure Q2(b). The D' Arsonval meter used has a resistance of 2 kΩ and a full-scale deflection current 60 μA. The Ayrton shunt consists of four resistors connected in series with the value of R1= 1 Ω, R2 = 9 Ω, R3 = 90 Ω and R4= 900 Ω. Calculate the ampere meter range of A1 to A4 formed.

(12 marks)

(c) (i) Construct a basic multi-range ammeter circuit with an appropriate labeling.

(3 marks)

(ii) A basic D' Arsonval movement with a full-scale deflection of 50 μA 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)

Q3 (a) Describe **three** (3) precautions that should be observed when using a multirange voltmeter.

(3 marks)

(b) A basic d'Arsonval meter movement with internal resistance, R_m= 100 ohms, and full-scale current, I_{fsd} = 1 mA, is to be converted into a multirange d.c. voltmeter with voltage ranges of 0-10 V, 0-50 V, 0 - 250 V, and 0 – 500 V.

(i) Draw the circuit diagram of the mutirange dc voltmeter and label it.
(ii) Calculate the values of R_1, R_2, R_3 and R_4.

(10 marks)

(c) A voltmeter having a sensitivity of 1000 ohms/volt, reads 100V on its 150V scale when connected across an unknown resistor in series with a milliammeter. When the milliammeter reads 5mA, calculate:-

(i) the apparent resistance of the unknown resistor
(ii) the actual resistance of the unknown resistor
(iii) the error due to the loading effect of the voltmeter

(12 marks)

Q4 (a) List **four** (4) measurements that can be performed using an oscilloscope.

(4 marks)

(b) Draw the block diagram of a cathode-ray oscilloscope. Label all the blocks and mark X-position, Y-position, Time/Div. and Volt/Div. controls.

(10 marks)

(c) The waveform shown in Figure Q4(c) is observed on the CRT screen. If the Time/Div switch is set to 5 µsec and the Volts/Div switch is set to 0.1 V, determine ,

(i) Peak-to-peak voltage amplitude, V_{pp}
(ii) Period for one cycle, T
(iii) Frequency, f

(4 marks)

(d) 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 vertical input is twice the frequency of the horizontal input signal, sketch the waveform that will be observed on the oscilloscope screen.

(3 marks)

(e) What is the difference between a signal generator and a function generator in electronics?

(4 marks)

Q5 (a) State the purpose of the Wheatstone bridge.

(2 marks)

(b) State the function of adjustable precision resistor in Wheatstone bridge.

(2 marks)

(c) Draw and label completely the basic circuit of the Wheatstone bridge.

(4 marks)

(d) Name all the components of the circuit in Q5 (c).

(4 marks)

(e) From the circuit in Q5 (c) also, analyze the circuit mathematically to produce an equation of unknown resistance when the bridge is balance.

(6 marks)

(f) State **three** (3) examples of applications of the wheatstone bridge in commercial circuits.

(3 marks)

(g) Give a reason why there is no current flow through the Galvanometer when the bridge is balance.
Prove your answer mathematically.

(4 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

(3 marks)

(c) From the graphs in Q6 (b) (i) and (ii), briefly describe the relationship between resistance and temperature for both of the sensors.

(3 marks)

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

(5 marks)

(e) Give **four** (4) examples of applications for each of the following sensors in industrial or commercial sectors.

(i) thermocouple
(ii) pressure

(4 marks)

(f) Give **three** (3) comparisons between RTD's and Thermistor sensors.

(6 marks)

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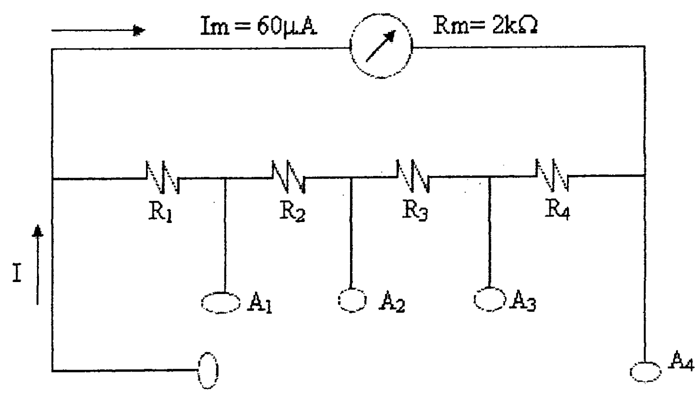

FIGURE Q2(b)

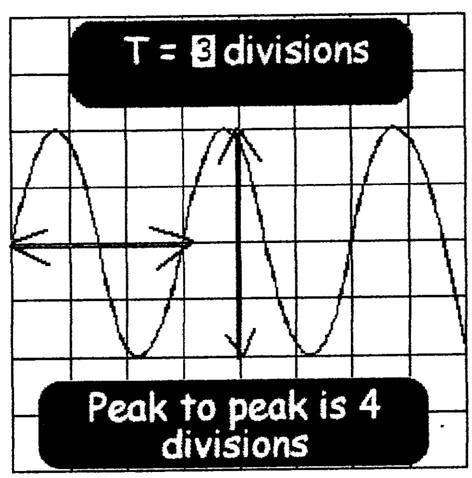

FIGURE Q4(c)