Universiti Tun Hussein Onn Malaysia

UNIVERSITI TUN HUSSEIN ONN MALAYSIA

FINAL EXAMINATION
SEMESTER II
SESSION 2014/2015

COURSE NAME	:	ELECTRICAL MEASUREMENTS
COURSE CODE	:	BEF 20903 / BEF 23903
PROGRAMME	:	BACHELOR OF ELECTRICAL ENGINEERING WITH HONOURS
EXAMINATION DATE	:	JUNE 2015 / JULY 2015
DURATION	:	3 HOURS
INSTRUCTION	:	ANSWER **ALL** QUESTIONS

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

Q1 (a) Measurement is the act or the results of a quatitative comparison between a predetermined standard and unknown maginitude. Explain the basic requirements for getting the meaningful results of the measurement.

(4 marks)

(b) The **three (3)** resistors of R_1, R_2 and R_3 have the following rating:

$$R_1 = 50\ \Omega \pm 2\ \%, \quad R_2 = 55\ \Omega \pm 2\ \%, \quad R_3 = 60\ \Omega \pm 4\ \%$$

Calculate the limiting value and percentage limiting error of series combination of resistance.

(6 marks)

(c) The voltmeter and ammeter can be developed by using D'Arsoval meter movement.

(i) Design the voltmeter and ammeter for extending the range of voltage and current respectively.

(4 marks)

(ii) A voltmeter with a 50 V range and 30 kΩ/V sensitivity is used to measure the voltage accros R_2 in **Figure Q1(c)**. Analyze the voltage reading and the percentage error of reading.

(6 marks)

Q2 (a) Wheastone bridge is the most accurate method available for measuring medium resistance.

(i) Describe the basic operation of wheastone bridge for measuring resistance.

(4 marks)

(ii) **Figure Q2(a)** shows a circuit diagram of the wheastone bridge. Apply the thevenin theorem for obtaining the current through the galvanometer.
(Given V=10 V, R_1=10 k Ω, R_2=10 kΩ, R_3=1 kΩ, R_4=1.3 kΩ and R_G=150 Ω)

(6 marks)

(b) The Schering Bridge is one of the most important A.C bridges that widely used in the measurement of unknown capacitors and insulating properties.

(i) Prove that the unknown capacitor and resistance of the tested material in **Figure Q2(b)** as follows:
(*Hint: the general equation for balance condition is* $Z_1Z_x=Z_2Z_3$)

$$R_x = \frac{R_2C_1}{C_3}; \quad C_x = \frac{R_1C_3}{R_2}$$

(4 marks)

(ii) The balance condition of the Schering bridge is obtained when the value of R_1=2.5 kΩ, C_1=0.5 μF, R_2=1.5 kΩ and C_3=0.6 μF. Calculate the unknown capacitor (C_x) and resistor (R_x).

(2 marks)

(iii) Criticize the limitation of Shering bridge and choose the appropriate bridge for measuring the unknown capacitor with great accuracy.

(4 marks)

Q3 (a) (i) List **three (3)** advantages of using the instrument transformers for extension of range with reference to shunts and multipliers.

(3 marks)

(ii) Referring to **Figure Q3(a),** the current transformer of 1000A/5A, 50 Hz has secondary burden 1.5 Ω. If iron loss in the core is 1.5 W, calculate the maximum flux in the core.

(4 marks)

(b) (i) Investigate **four (4)** ratios parameter for Potential Transformer (PT).

(8 marks)

(ii) With the help of a diagram, explain the principle operation of an electrostatic voltmeter.

(5 marks)

Q4 (a) (i) Name a meter that is used to measure the average power in a circuit.

(1 mark)

(ii) Investigate various factors that are responsible for introducing errors in wattmeter.

(6 marks)

(b) The power in a single circuit can be measured using three voltmeters and three ammeters. Sketch the circuit diagram for both methods.

(4 marks)

(c) Power of a single phase 6.6 kV load drawing a current of 50 A is required to be measured by means of a wattmeter having a volt terminals marked as 110 V and current terminals of 5 A.

(i) Draw the circuit diagram showing the connection of the wattmeter using the instrument transformers.

(5 marks)

(ii) Calculate suitable transformation ratios of Potential transformer (PT) and Current Transformer (CT).

(4 marks)

Q5 (a) Differentiate the **three (3)** type of resistances in point of view of measurement.

(6 marks)

(b) The insulation resistance of a metal-sheath electrical cable shown in **Figure Q5(b)** is tested using 20 kV supply and a micro ammeter. A current of 4.5 μA is measured when the components are connected without guard wire. When the circuit is connected with a guard wire, the current is 1.2 μA.

(i) Explain the important of guard wire in **Figure Q5(b)**.

(2 marks)

(ii) Calculate the volume resistance of the cable insulation.

(2 marks)

(iii) Calculate the surface leakage resistance.

(4 marks)

(c) There are several possible sources of measurement error associated with low resistance measurements.

(i) List the **two (2)** possible sources that contribute to the error in low resistance measurements.

(2 marks)

(ii) Suggest the possible solution to reduce error in measurement of low resistance.

(4 marks)

- END OF QUESTIONS -

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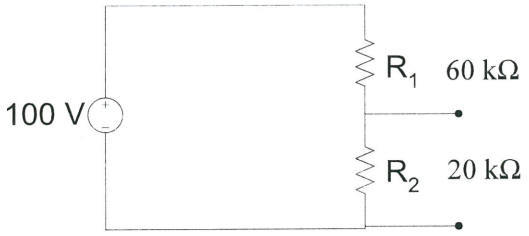
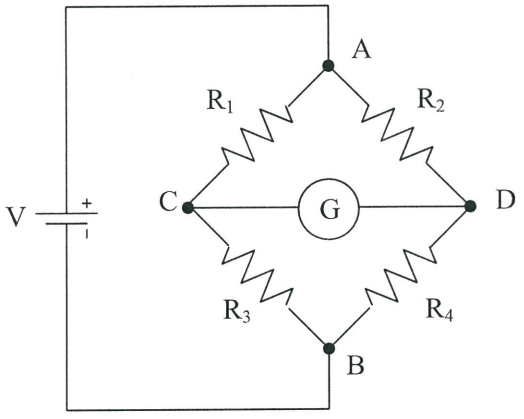


FIGURE Q1(c)



$V = 10\ V$
$R_1 = 10\ k\Omega$
$R_2 = 10\ k\Omega$
$R_3 = 1\ k\Omega$
$R_4 = 1.3\ k\Omega$
$R_G = 150\ \Omega$

FIGURE Q2(a)

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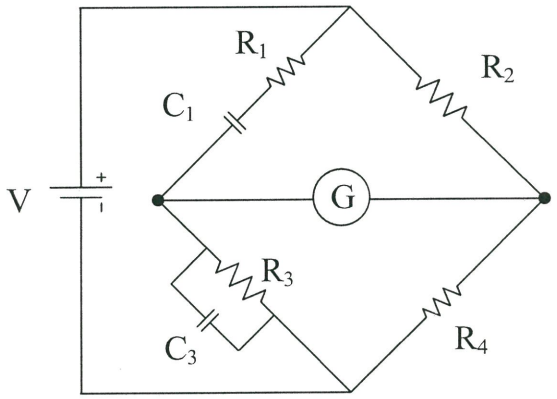

FIGURE Q2(b)

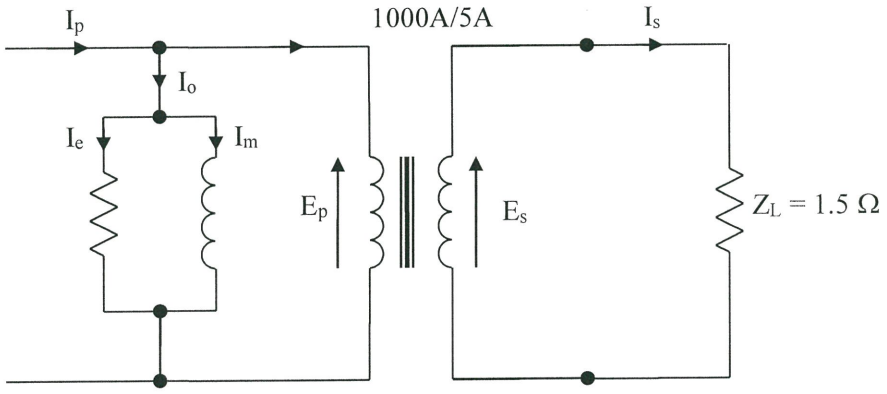

FIGURE Q3(a)

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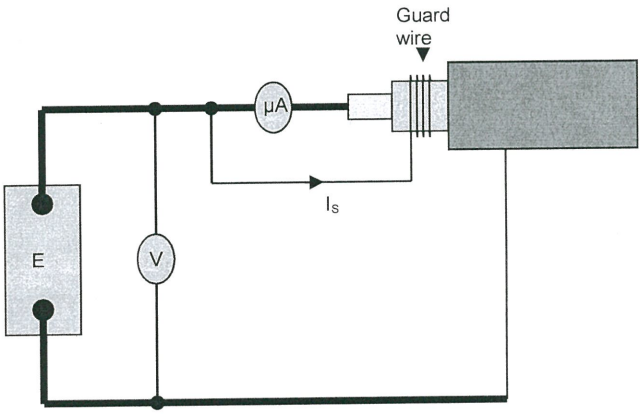

FIGURE Q5(b)