UNIVERSITI TUN HUSSEIN ONN MALAYSIA

FINAL EXAMINATION
SEMESTER II
SESSION 2011/2012

COURSE NAME	:	ELECTRICAL MEASUREMENTS
COURSE CODE	:	BEF 20903
PROGRAMME	:	BEE
EXAMINATION DATE	:	JUNE 2012
DURATION	:	3 HOURS
INSTRUCTION	:	ANSWER **FOUR (4)** QUESTIONS ONLY

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

Q1 (a) Sketch a D'Arsonval meter and briefly explain how it works.

(6 marks)

(b) For the circuit shown in Figure Q1(b), given that V_{in} = 20Vrms, R_m=500Ω, I_{fsd} = 1mA, R_{sh}=500Ω, average forward resistance of 50Ω and infinite reverse resistance of each diode, calculate the following:

(i) the multiplier, R_s
(ii) the ac sensitivity, S_{ac}
(iii) the dc sensitivity S_{dc}.

(8 marks)

(c) Compute the value of the shunt resistors for the circuit shown in Figure Q1(c). Given that R_m = 1kΩ, I_{fsd} = 100 mA, and $R_{sh} = R_a + R_b + R_c$

(11 marks)

Q2 (a) Eight resistors with the colour code value of 5.6 kΩ are measured with a newly calibrated ohmmeter and the following kilo-ohm readings were obtained: 5.76, 5.60, 5.65, 5.50, 5.70, 5.55, 5.80, and 5.55. Determine:

(i) The mean value of the resistors
(ii) The deviation of each resistor from the mean value
(iii) The average deviation
(iv) The standard deviation and
(v) The probable error

(10 marks)

(b) The resistance of a resistor is measured by a Wheatstone bridge and its value is given by the expression $R_x = R_2 R_3/R_1$. If R_1 = 220 Ω ± 2%, R_2 = 2755 Ω ± 2.5% and R_3 = 101 Ω ± 0.5%, calculate:

(i) Value of R_x
(ii) Error in ohm for resistor R_x
(iii) Percentage error of R_x

(6 marks)

(c) A voltmeter and an ammeter are to be used to determine the power dissipated in a resistor. Both instruments are guaranteed to be accurate within ±1% at full scale. If the voltmeter reads 80V on its 150-V range and the ammeter reads 70mA on its 100-mA range, calculate the limiting error for the power calculation.

(9 marks)

Q3 (a) A Wheatstone bridge is shown in Figure Q3(a). Show that when the bridge is balanced, the unknown R_x is given by:

$$R_x = R_3 \frac{R_2}{R_1}$$

(6 marks)

(b) Figure Q3(b) shows an AC bridge (Hay bridge) for measuring inductor parameters L_x and R_x.

(i) Show that when the bridge is at null point :

$$R_x = \frac{\omega^2 C_1^2 R_1 R_2 R_3}{1 + \omega^2 C_1^2 R_1^2}$$

$$L_x = \frac{R_2 R_3 C_1}{1 + \omega^2 C_1^2 R_1^2}$$

(10 marks)

(ii) Show that if the Q-value of an unknown inductor is high, the expression for the inductance value is independent of frequency when the bridge is at null point.

(5 marks)

(iii) If the Q value of an inductor is high, obtain the value of R_x and L_x given that $R_2 = R_3 = 1200\Omega$, $C_1 = 0.02\ \mu F$ and $R_1 = 50\Omega$.

(4 marks)

Q4 (a) With reference to Figure Q4(a), derive the expression for R_1 and R_2 that make up the series type ohmmeter in terms of the internal resistance of the D'Arsonval movement and the half scale deflection resistance R_h.

(12 marks)

(b) Sketch a simple 'megger' unit and briefly explain the function of each part. Explain how the unit can be prevented from producing exceedingly high voltage when one tries to crank it at high speed.

(13 marks)

Q5 (a) Draw an electrodynamometer-type wattmeter showing clearly the voltage and current coils. Show how it can be used to measure AC or DC power.

(8 marks)

(b) With the aid of circuit diagram show that the power of a three-phase load could be measured by a two wattmeter method.

(8 marks)

(c) The two-wattmeter method is used to measure a balanced three-phase inductive load with the following readings: $P_1 = 4.9$ kW and $P_2 = -1.37$ kW. Determine:

(i) The total power of the load
(ii) The total reactive load
(iii) The power factor of the load

(9 marks)

Q6 (a) Explain the following:
(i) A transfer instrument
(ii) Insertion error due to the use of moving coil voltmeter
(iii) Human errors in making measurement

(12 marks)

(b) With the aid of diagram(s), explain the working of an induction energy meter. After that answer the following:
(i) Describe the procedure to ensure the accuracy of the meter reading
(ii) Describe what needs to be done to prevent the disc from rotating when there is no energy consumed

(13 marks)

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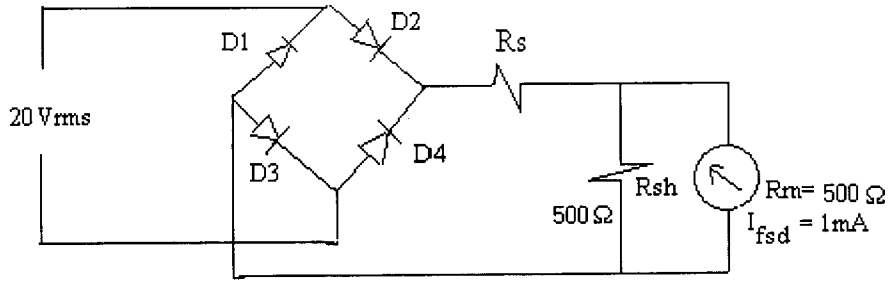

FIGURE Q1(b)

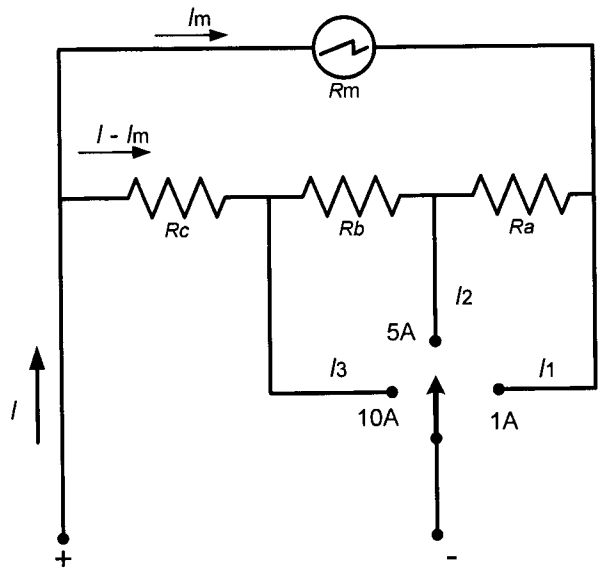

FIGURE Q1(c)

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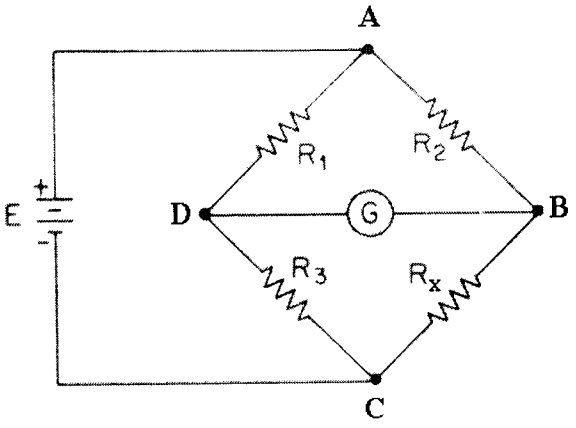

FIGURE Q3(a)

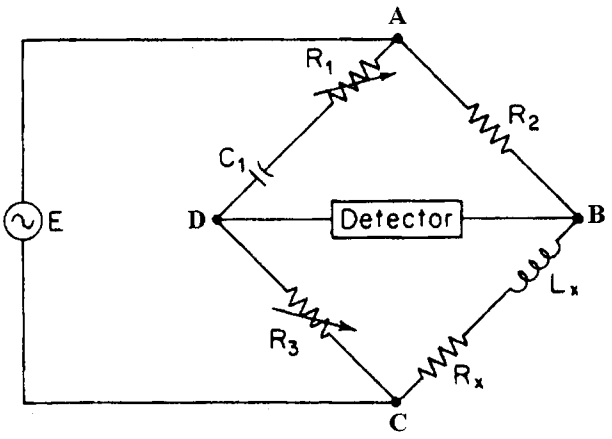

FIGURE Q3(b)

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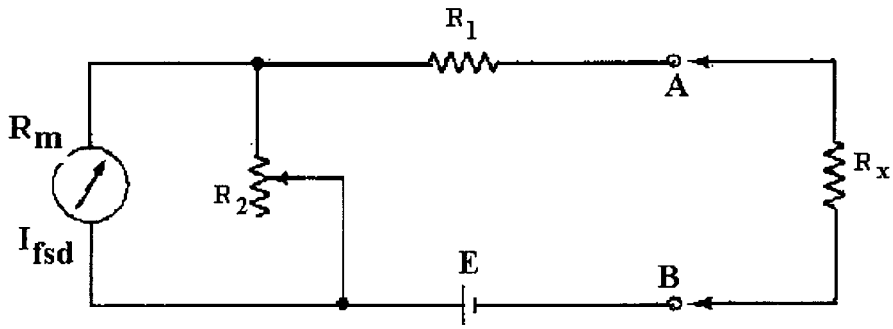

FIGURE Q4(a)