Department of Electrical Engineering
Assignment
Date: 23/06/2020

Course Details

Course Title: Instrumentation and Measurement **Module:** 6th (BE)
Instructor: Engr Waleed Jan **Total Marks:** 50

Student Details

Name: Idress Iqbal **Student ID:** **13171**

Note: Draw neat diagrams where necessary. Assume missing details if required.

Q1.		A student has connected two voltmeters in series and have applied 500V across them. Both voltmeters have the same range of 0-300V. What will be their readings if their internal resistances are 25kΩ and 15 kΩ respectively?	**Marks 10** **CLO 2**
Q2.		A dynamometer type wattmeter has two current coils each having a resistance of 0.5Ω. Both of the coils are connected in parallel. The wattmeter voltage coil is connected to the supply side. The wattmeter shows a reading of 200W while the reading on the ammeter is 4A which is connected in series with the current coil of the wattmeter. Calculate the following parameters: a) Power dissipated in the wattmeter b) True load power c) Percentage error due to the connection of wattmeter	**Marks 10** **CLO 2**
Q3.	**(a)**	What is the difference between Kelvin's bridge and Wheatstone Bridge? Explain briefly.	**Marks 05** **CLO 3**
	(b)	Explain how the potential on the upper (top) node in a DC bridge is equal to the potential on the lower (bottom) node?	**Marks 05** **CLO 3**

Q4.	**(a)**	Why the energy meters designed for DC circuits cannot be used for AC circuits?	**Marks 05** **CLO 03**
	(b)	What will happen if the phase difference between two alternating fluxes in an induction type energy meter is zero degrees?	**Marks 05** **CLO 03**
Q5.	**(c)**	Why the series magnet is wound with a wire of few turns as compared to shunt magnet in an induction type energy meter?	**Marks 05** **CLO 03**
	(d)	What is the significance of meter constant in an energy meter?	**Marks 05** **CLO 03**

Submitted To . Engr Wafeed Jam sir . Paper EMI

(1)

Name Idrees Iqbal (ID) (13171) Semester 8th

Q.No 1:

Ans)

Given data

Two Voltmeter Range = 0 - 300V

$R_1 = 25 K\Omega$

$R_2 = 15 K\Omega$

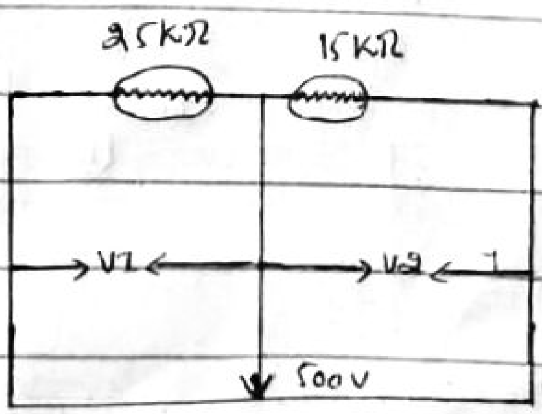
Total Voltage $V_1 = 500V$

Required:

Voltage Reading in 1st Voltmeter = V_1 = ?

Voltage Reading in 2nd Voltmeter V_2 = ?

Diagram:



Solution.

Here we use Voltage divider Rule the reading of the two Voltmeter are.

$$V_1 = \frac{25K\Omega}{25K\Omega + 15K\Omega} \times 500V$$

$$V_1 = 312.5V$$

$$V_2 = \frac{15KV}{15K\Omega + 25K\Omega} \times 500V$$

$$V_2 = 187.5V$$

Q.No 2:

Ans)

Given data:

$R_1 = 0.5\Omega$

$R_2 = 0.5\Omega$

Power $P = 200W$

$I = 4A$

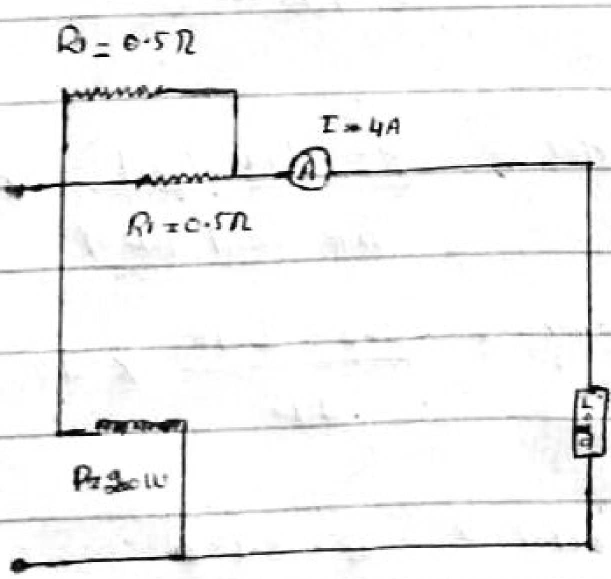
Required:

(a) Power dissipated in the Watt meter =?

(b) True load power =?

(c) Percentage error due to the Connection of Wattmeter =?

Diagram:



Solution

Resistance of Current Coils

$$R_C = \frac{R_1 R_2}{R_1 + R_2}$$

$$R_C = \frac{0.5 \times 0.5}{0.5 + 0.5}$$

$$R_C = \frac{0.25}{1} = 0.25\,\Omega$$

(a) Power dissipated in Wattmeter $= I^2 R_C$

$$I^2 R_C = \left((4)^2 \times 0.25\right)$$

$$I^2 R_C = 16 \times 0.25$$

$$I^2 R_C = 4\,W$$

(b) True Load Power = 200 - 4

= 196 W

(c) % error = $\frac{P - \text{True load}}{\text{True Load Power}} \times 100$

$$\%\ \text{error} = \frac{200 - 196}{196} \times 100$$

% error = 2.0408

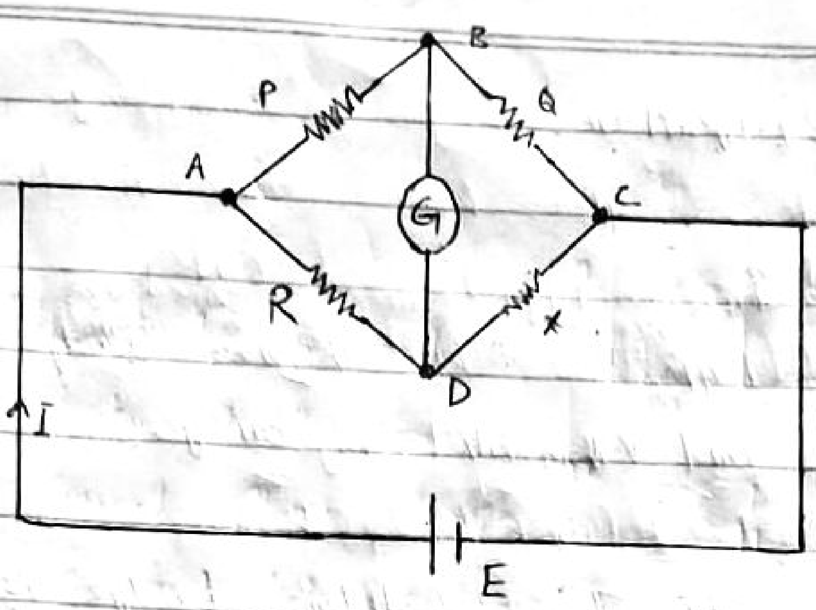
QNo 3 part (c)

Ans)

Differences b/w Kelvin's bridge and Wheatstone bridge

Wheatstone bridges

* The Wheatstone bridge is used to measure an unknown electrical resistance.
* The Wheatstone bridge is the combination of 4 resistance forming a bridge
* The four resistance in the circuit are refered to his arms of bridge
* The unknown resistance is connected with two known resistor and a galvanometer
* To find the value of unknown resistor, the deflection of galvanometer is made zero by adjusting the variable resistor



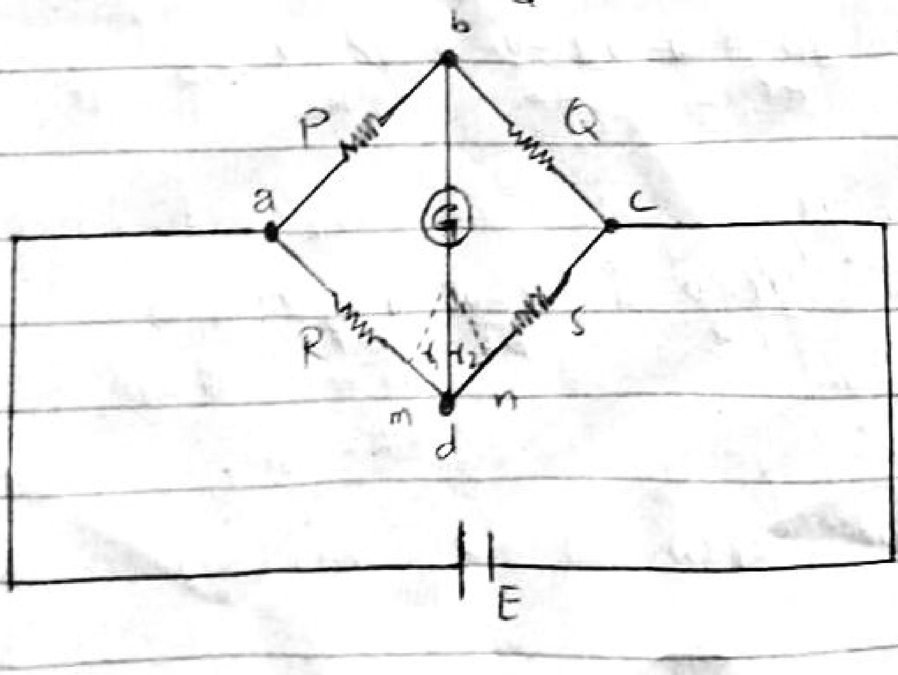
Where P & Q are known resistance
R is a variable resistor
X is unknown resistor
E is dc power supply.

Kelvin bridge:

* This bridge is modification of Wheatstone bridge and is used to measure low resistance very accurately.
* When we are implementing Wheatstone bridge in the laboratory, we connect all the resistances through connection wires.

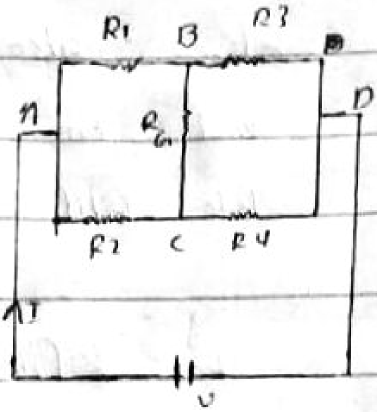
- Hence, there connecting wires also have some resistance and in order to measure it we will use kelvin's bridge
- In kelvin bridge, we have a connecting wire b/w point m & n having a resistance r.
- The galvanometer can connect both to point m & n.
  where G is connected to
  $M \rightarrow s + r$

$$\Rightarrow R = \frac{P}{Q}(s + r)$$



QNo3 Part b:

Ans)



If bridge is not balanced then some current flows through G and let resistance offered be RG

Total current = I

Total voltage = V

Then

$$Req = \frac{V}{I} = \frac{V}{\frac{VB}{R?} + \frac{VC}{R'}}$$

Applying KCL eq^n for VB & VC

for VB

$$\frac{VB-0}{R3} + \frac{VB-VC}{RG} + \frac{VB-V}{R1} = 0 \quad \text{- eq1}$$

for VC

$$\frac{VC-0}{R4} + \frac{VC-VB}{RG} + \frac{VC-V}{R2} = 0 \quad \rightarrow eq(2)$$

Solve eq(1) and (2) we get

| VB & VC |

Q no 4 Part a

Ans)

No it is because AC energy meter works due to the involvement of two alternating magnetic field produced by AC quantities (voltage and current respectively) that interacts with an aluminium disk causing eddy current to ~~inter~~ induced in the disk due to this eddy current and pre-existing magnetic field disk experience a force which causes it to rotate and increment the reading in proportion to the amount of energy consumed (in units or kWh both are same). In DC such induction effect and eddy current are not produced so the same energy meter cannot measure the energy consumed by any DC circuit until unless you convert the DC to AC then put it through the energy meter and gain convert it to DC and then supply to the DC load.

QNo 4 part b)

Ans)

It should be noted that when $\phi = 0°$ (i-e two fluxes are in phase) then deflecting torque is zero or no torque can be produced.

Torque will be maximum when $\phi = 90°$

QNo 5 part a

Ans)

Series magnet :

This Series magnet Consist a number of U-Shaped lamination assemble together to form a Core. A thick Wire of few turns is Wound on both legs of the U-shaped lammated Core. The Wound Coil is Known as Current coil and is Connected in series With the load so that is carried the load. The Series magnet is placed underside the aluminium disc and produced magnet field proportional to and in phase With current

Shunt magnet :

The shunt magnet Consist of a number of M-shaped lamminations assembled together to form a Core. A fine Wire of large turns is Wound on the central limb of this magnet. The wound Coil is known as pressure coil is Connected across the load. So that it Carried Current proportional to supply Voltage. The shunt magnet is In order to obtain deflecting torque Current in the Pressure Coil must lag behind the supply Voltage by 90° This Copper ring as as a short Circuited transformer Secondary. As its inductance is high as Compared with its resistance the Current Circulating in the ring will lag by nearly 90° behind the Voltage Producing it.

QNo 5 part b

Ans) Energy Meter Constant is the amount of KWH used in its low Voltage Circuit for each revolution of the induction disc.

Calculation.

typical industrial 3 phase Energy

Meter which is fed by a suitable current transformer (CT) and potential transformer (PT). To calculate the tmc. if it is given that No. of Revolutions per kWh then MC is inverse of this no. for example let's say for a certain Energy meter no of Rev./kWH is given as 400, then MC = 1/4000. If the No. of Rev. per kWh is given as a very small No like 0.06 or 0.16 etc. then it refers to kWH value in primary circuit. This is 1kWH value passes in HV circuit for giving amount of Rev. To calculate MC in such cases, invert such No & then divide by CT & PT ratio.