**Department of Electrical Engineering**

**Assignment**

**Date: 23/06/2020**

## Course Details

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| **Course Title:** | Instrumentation and Measurement | **Module:** | 6th (BE) |
| **Instructor:** | Eng. Waleed Jan sab | **Total Marks:** | 50 |

## Student Details

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| **Name:** | Muhammad Waqar Hameed | **Student ID:** | 6939 |

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

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| **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**<br>**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:<br>a) Power dissipated in the wattmeter<br>b) True load power<br>c) Percentage error due to the connection of wattmeter | **Marks 10**<br>**CLO 2** |
| **Q3.** | **(a)** | What is the difference between Kelvin's bridge and Wheatstone Bridge? Explain briefly. | **Marks 05**<br>**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**<br>**CLO 3** |

**(a)** Why the energy meters designed for DC circuits cannot be used for AC circuits?

**Q4.**

**(b)** What will happen if the phase difference between two alternating fluxes in an induction type energy meter is zero degrees?

**(c)** Why the series magnet is wound with a wire of few turns as compared to shunt magnet in an induction type energy meter?

**Q5.**

**(d)** What is the significance of meter constant in an energy meter?

Q1:.

A Student has Connected to Voltmeters in Series and have applied 500V across them. Both Voltmeter have the Same range 0–300. What will their reading if their internal resistance are 25KΩ and 15KΩ respectively.

Sol:.

Givend Data:

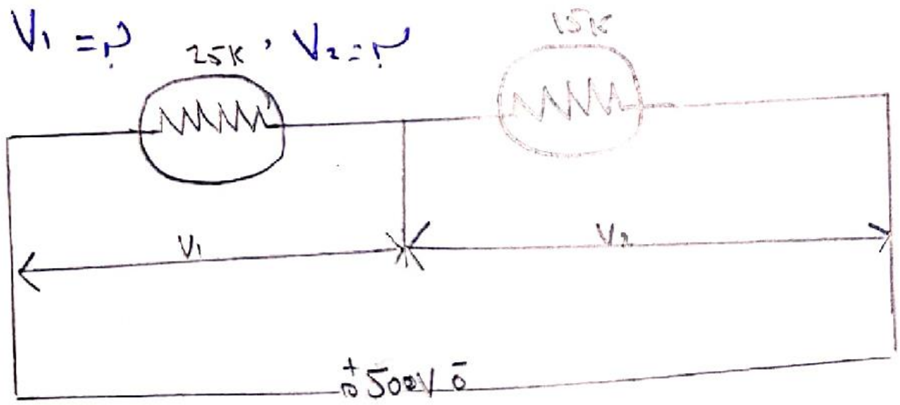
$R_1 = 25 k\Omega$

$R_2 = 15 K\Omega$

$V = 500 V$

Find:.

$V_1 = ?$ , $V_2 = ?$




$V_1 = \frac{25K}{25K + 15K} \times 500 = 0.625 \Omega \times 500 = 312.5 \Omega$

$V_2 = \frac{15K}{15K + 25K} \times 500 = 0.375 \Omega \times 500 = 187.5 \Omega$

Q2:

A dynameter type Wattmeter has two current coil each having a resistance of 0.5Ω Both of the coil are connected in Parallel The Wattmeter Voltage coil is connected to the supply side The Wattmeter Show reading 200 W. While the reading on the ammeter is 4A. Which is connected in Series With the current coil of the Wattmeter Calculate the following:

a) Power dissipated in the Wattmeter

b) True Load Power

c) Percentage error due to the Connection of Wattmeter.

Sol:

Given Data:

$R_1 = 0.5\Omega$

$R_2 = 0.5\Omega$

Power $P = 200W$

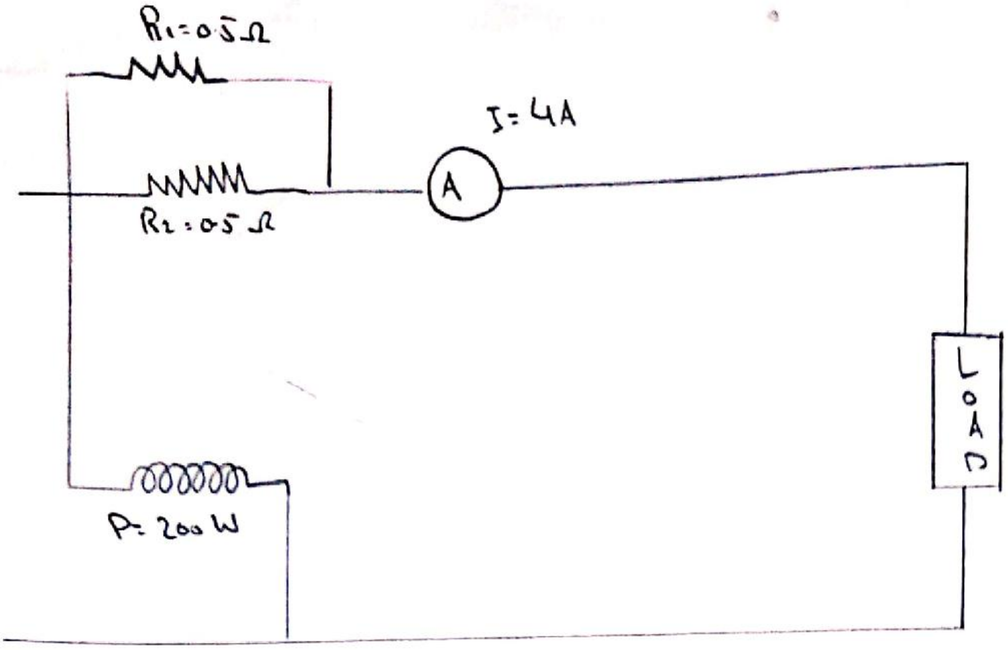
$I = 4A$

Required:

a) Power dissipated in the Wattmeter

b) True Load Power

c) Percentage error due to the Connection of Wattmeter




Resistance of current coil

$$R_c = \frac{R_1 R_2}{R_1 + R_2} = \frac{0.5 \times 0.5}{0.5 + 0.5} = \frac{0.25}{1} =$$

$R_c = 0.25\,\Omega$

a) Power dissipated in Wattmeter $= I^2 R_c$

$= (4)^2 \times 0.25$

$= 4W$

b) True Load Power $= 200 - 4$

$= 196$ W

c) % Error

$$\frac{P - \text{True Load Power}}{\text{True Load Power}} \times 100$$

$$= \frac{200 - 196}{196} \times 100$$

$= 2.04\,\%$

Q3:: Part (a):

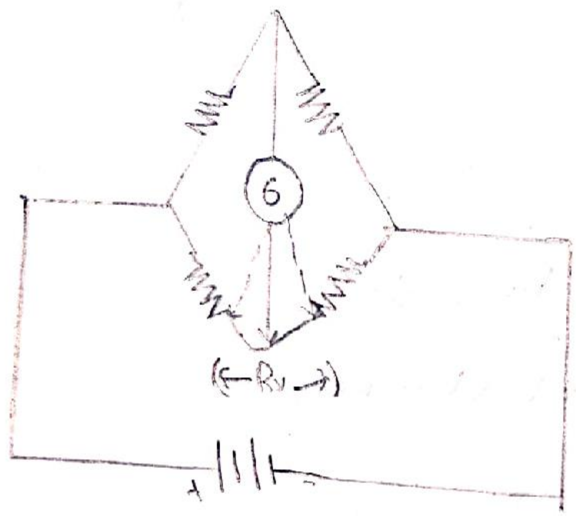
What is the difference b/w Kelvin's bridge and Wheatstone Bridge.

Ans::

Kelvin bridge:

Low resistance can not be accurately measured by the Wheatstone bridge due inaccuracies caused by the lead and contact resistance For low resistance measured (below 1Ω) Kelvin bridge is used.

Kelvin Bridge:




i) Ry Represents the resistance of the connecting leads from R3 to Rx

ii) R1 is the unknown resistance to measured

iii) Galvanometer could be connected either a, b, c position

iv) If the galvanometer is connected to 'a' the lead resistance $R_y$ added to $R_x$. If the galvanometer is connected to C then $R_y$ gets added to $R_3$

The Point b is in b/w the Point a and c in such a way that the ratio of the resistance from c to b and that from a to b is equal to the ratio of $R_1$ and $R_2$

$$\frac{R_{cb}}{R_{ab}} = \frac{R_1}{R_2}$$

Now the bridge balance equation in its standard

$$R_1 R_3 = R_2 R_x$$

But $R_3$ and $R_x$ now are changed to $R_3 + R_{ab}$ and $R_x$ to $R_{cB}$ Respectively due to lead resistance

$$R_1 (R_3 + R_{ab}) = R_2 (R_x + R_{cb})$$

$$(R_x + R_{cb}) = \frac{R_1}{R_2}(R_3 + R_{ab})$$

Now we have

$$\frac{R_{cb}}{R_{ab}} = \frac{R_1}{R_2}$$

$$\frac{R_{cb}}{R_{ab}} + 1 = \frac{R_1}{R_2} + 1$$

## Wheat Stone Bridge:

The Wheat Stone Bridge was invented by Samuel Hunter Christie in 1833 and improved by Sir Charlles Wheatston in 1843.

i) It is used to measure an unknown electrical resistance.

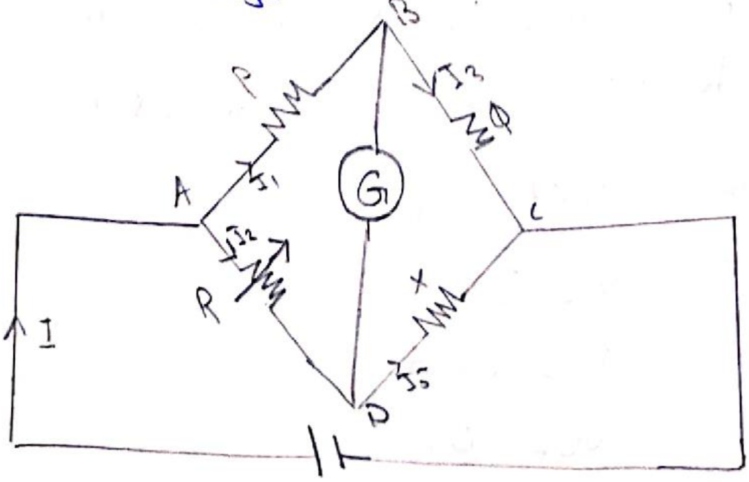
ii) The Wheatstone bridge is the Combination of 4 resistance forming a bridge.

iii) The four resistance in the Circut are refered to as arms of bridge

iv) The unknown resistance is Connected with 2 Known Known resistor and galvanometer

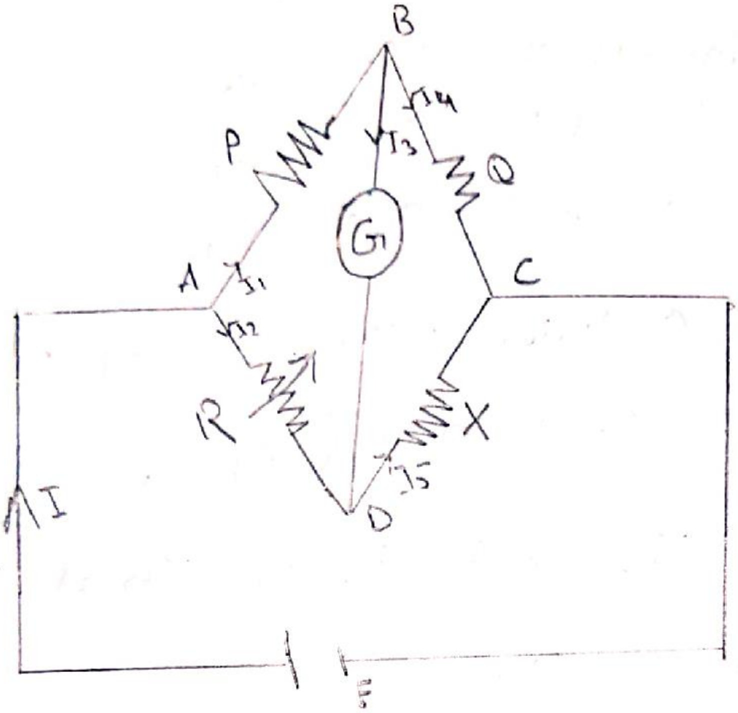
v) To Find the Value of unknown resistor the deflection of galvanometer is made by Zero by adjusting The Variable resistor

This Point is Known as balance Condition of Wheatstone bridge



Q 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?




Where P & Q are Known Resistor

R is Variable Resistor

X is unknown Resistor

E is dc Power Supply

Now in order to find the value of unknown resistor (X) we have to make the deflection of galvanometer equal to zero i.e $I_3 = 0A$

This Condition of bridge

When $I_3 = 0A$

$I_5 = I_2$

$E_{..}$ $I_4 = I_1$

Also $V_{AB} = V_A - V_B = I_1 P \rightarrow (1)$

$V_{BC} = V_B - V_C = I_1 Q \rightarrow (2)$

$V_{AD} = V_A - V_D = I_2 R \rightarrow (3)$

$V_{DC} = V_D - V_C = I_2 X \rightarrow (4)$

at balance condition when $I_3 = 0A$ Potential diffrence b/w Point B And D is Zero i.e $V_B = V_D$ and it is Proved bellow

As we know that

$V_{BD} = V_B - V_D = I_3 G$

So $V_{BD} = I_3 G$

$V_{BD} = (0) G$

$V_{BD} = 0V$

or $V_B - V_D = 0$

or $V_B = V_D$ (Proved)

Q4:. a:

Why the energy meter designed for DC circuit Cannot be used for AC circuit

Ans:.

Energy meter designed for DC circuit not AC because AC energy work due to involvment of two alternating magnetic field. Produced by AC quantities (Voltage and current) that interact with an aluminium disk caussing eddy current to induced in the disk. In DC such induction effect and eddy current no Produced.

Q4: b Part:

What will happen if the Phase diffrence b/w two alternating fluxes in an induction type energy meter is zero degree

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 $\phi = 90°$ When the attrectin flux has a Phase diffrence of 90°

- The deflecting torque is the Same at every instant Since $\phi_m$, $\phi$, m & a are fixed for a given Condition

The direction of deflecting torque depends upon which flux is leading the other.

Q5 (6):

Why the Series magnet is wound with a wire of few turn as compared to Shunt magnet in an induction type energy meter

Ans: The Series magnetic is wound with a wire of few turns axis Connected in Series with load So that it Carries the Load current The Coil of this magnetic is highely non-inductive

Q5 (d) Part

What is the significance of meter Constant in an energy meter

Ans:.

Energy meter Constant is the amount of KWH used in its low voltage circuit for each revolution of the induction disk. The unit of energy meter constant is revolution per Kilo Watt hour (rev/Kwh

It is Constant Value.

If an energy meter has Constant value of 150 rev/Kwh

It will Consume the energy of 1Kwh (1 unit) in every 150 revolation

If it rotates 300 revolation it will Consume 2Kwh energy