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

Course Details

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

Student Details

Name: **M.Kamran** **Student ID:** **13752**

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**

Q#:1.

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 resistance are 25KΩ and 15KΩ respectively.

Data:

Two voltage range = 0-300V

Voltage applied = 500V

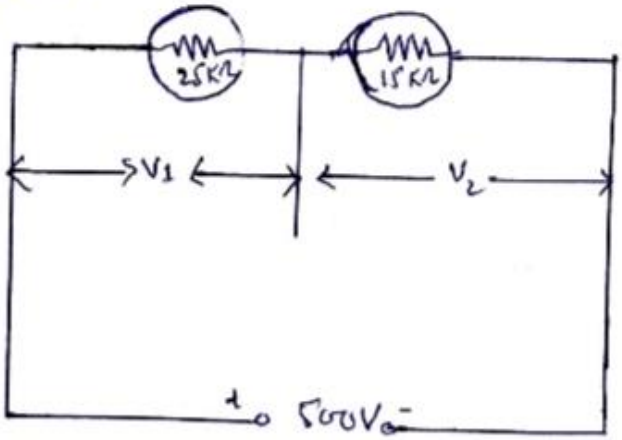
Resistance 1 = 25KΩ

Resistance 2 = 15KΩ

Required:

voltage readings of both the voltmeters V_1 and V_2.

Diagram:



Solution:

Here we use voltage devider rule the reading of the two voltmeter are

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

$$V_1 = \boxed{312.5\,V}$$

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

$$V_2 = \boxed{187.5\,V}$$

Q#2:

A dynamometer type wattmeter has two current coils each having a resistance of 0.5Ω Both of the coils are connected in parrell. 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 parameter.

Given Data:

$R_1 = 0.5\Omega$

$R_2 = 0.5\Omega$

power $= P = 200W$

$I = 4A$

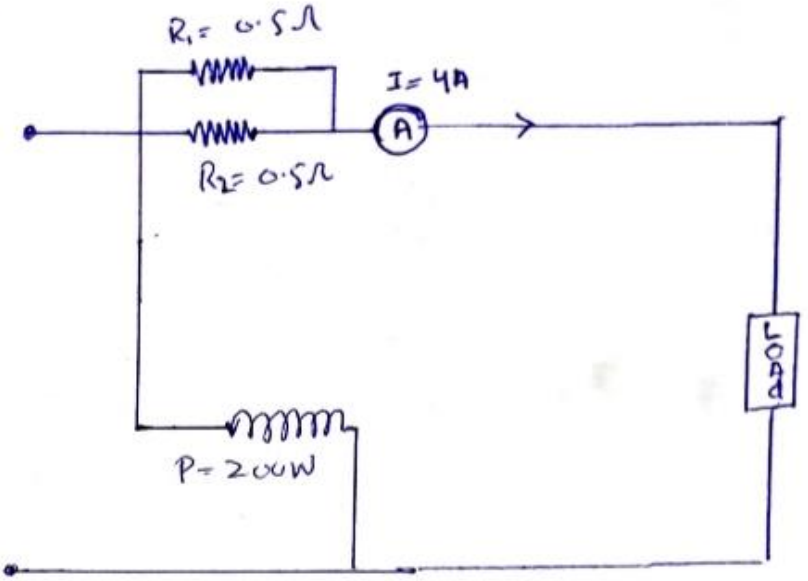
Required:

(a) power dissipated in the wattmeter?

(b) True load power?

(c) percentage error due to the connection of wattmeter?

Diagram:



Solution:

Resistance of the current

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

(a) power dissipated in wattmeter = I^2R_c

$$I^2R_c = (4)^2 \times 0.25 = 16 \times 0.25 = \boxed{4W}$$

(b) True load power = 200 - 4

$$= \boxed{196\,W}$$

(C) % error = $\frac{\text{P - True load}}{\text{True load power}} \times 100$

$$= \frac{200-196}{196} \times 100 = \boxed{2.0408}$$

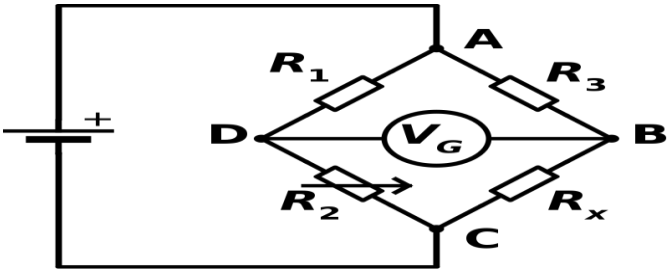
Q#3 (a): What is the difference between Kelvin's bridge and Wheatstone Bridge? Explain briefly.

Wheatstone bridge :

A Wheatstone bridge is an electrical circuit used to measure an unknown electrical resistance by balancing two legs of a bridge circuit, one leg of which includes the unknown component. The primary benefit of the circuit is its ability to provide extremely accurate measurements (in contrast with something like a simple voltage divider). Its operation is similar to the original potentiometer.

The Wheatstone bridge was invented by Samuel Hunter Christie (sometimes spelled "Christy") in 1833 and improved and popularized by Sir Charles Wheatstone in 1843. One of the Wheatstone bridge's initial uses was for soils analysis and comparison..

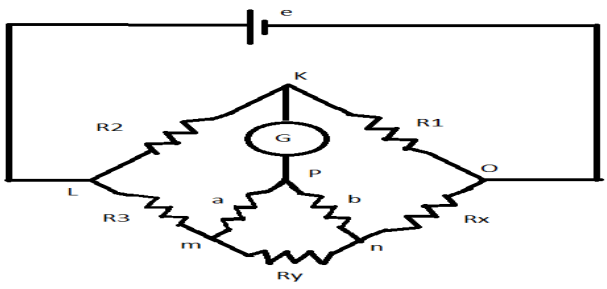
Circuit diagram:



Kelvin's bridge

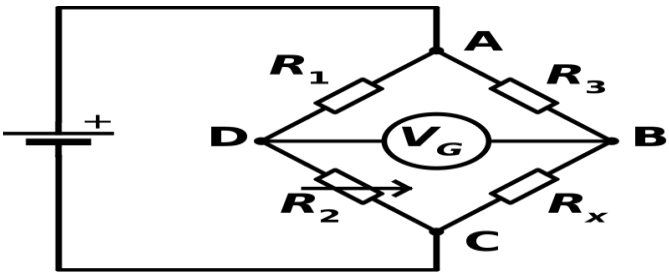
Wheatstone bridge use for measuring the resistance from a few ohms to several kilo-ohms. But error occurs in the result when it is used for measuring the low resistance**.** This is the reason because of which the Wheatstone bridge is modified, and the Kelvin bridge obtains. The Kelvin bridge is suitable for measuring the low resistance.

Circuit diagram:



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?

In DC Bridge circuits the upper and lower resistors are connected in series .R1 is in series with R3 and R2 is in series with R4



So is the resisters are in series the same current flow through both of them so the same current flows in upper resisters same in lower resisters .when this happened ,both sides of the parallel bridge network are said to be balances because the voltage at point C is same as point D.

As we know that voltage is same in parallel so when the network is balanced voltage should be same upper in lower nodes .so that why potential on upper of DC bridge is equal the lower of bottom node

Q#4(a) Why the energy meters designed for DC circuits cannot be used for AC circuits?

Its because AC Energy meter works due to the involvement of two alternating magnetic fields produced by AC quantities (voltage and current respectively) that interacts with an aluminium disk causing eddy current to induced in the disk. Due to this eddy current and pre-existing magnetic field, disk experiences 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 nor 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 again convert it to DC and then supply to the DC load.

Q#4(b)What will happen if the phase difference between two alternating fluxes in an induction type energy meter is zero degrees?

We know that in induction type energy meters, in order to maintain speed of rotation proportional to power “The phase angle between supply voltage and pressure coil flux should be equal to 90º“. However in actual practice, the angle between supply voltage and pressure coil flux is exactly not 90º but few degrees less.

if the phase difference between two alternating fluxes in an induction type energy meter is zero degrees then it results in improper rotation of disc. Improper phase angle is due to improper lag adjustment, variation of resistance with temperature or it may be due to abnormal frequency of supply voltage.

Q#5(c): Why the series magnet is wound with a wire of few turns as compared to shunt magnet in an induction type energy meter?

Series magnet: it consists of a number of U-shaped laminations of silicon steel together to form a core. A coil of thick wire having a few turns is wounded in both legs of U-shaped magnet. The coil is known is current coil which is connected series with load. Produce the magnetic field proportional and in phase with line current I.

Shunt magnet: it consists of number of M-shaped laminations of silicon steel assembled together to form a core. A coil of thin wire having large number of turn in wound on central limb of the magnet. This coil is connected across the load. Thus it is excited by current proportional to the supply voltage and known is potential coil.

Why the series magnet is wound with a wire of few turns as compared to shunt magnet

Because the shunt Magnet is voltage coil has many turns and is arranged to be as highly inductive as possible. In other words, the voltage coil produces a high ratio of inductance to resistance. This causes the current, and therefore the flux, to lag the supply voltage by nearly 0 90. And series magnet which is connected in series with the load so that it carry the load current. The flux produced by this magnet is proportional to, and in phase with the load current.

Q5 (d): What is the significance of meter constant in an energy meter?

In an energy meter the constant is shown on the meter name plate. A (kh=7.2) Constant means that for each revolution of the disk, 7.2 watt-hours has been used (constant will vary with different meters). Energy meters constant is the amount of kWh used in its low voltage circuit for each revolution of the induction disk.