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: Owais Afridi **Student ID:** 13686

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**

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Question # 01

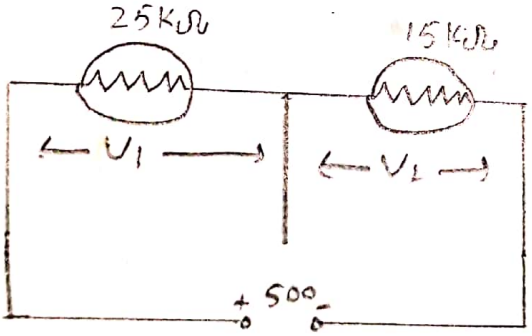
Given Data:

Two Voltmeters in Series range = 0-300V.
applied Voltage across them = 500V
Internal Resistance of V_1 = 25KΩ
Internal Resistance of V_2 = 15KΩ

Required:

We have to find Readings in Both Voltmeters.

Diagram:



Formula:

$$V_1 = \frac{R_1}{R_1 + R_2} \times V$$

(2)

Solution:

$$V_1 = \frac{R_1}{R_1+R_2} \times V$$

$$= \frac{25 \times 10^3}{25 \times 10^3 + 15 \times 10^3} \times 500$$

$$= \frac{25,000}{25,000 + 15,000} \times 500$$

$$= \frac{25,000}{40,000} \times 500$$

$$V_1 = 312.5\,V$$

$$V_2 = \frac{R_2}{R_2+R_1} \times V$$

$$= \frac{15 \times 10^3}{15 \times 10^3 + 25 \times 10^3} \times 500$$

$$= \frac{15,000}{40,000} \times 500$$

$$= 0.375 \times 500$$

$$V_2 = 187.5\,V$$

③

Question # 02

Given Data:

Coils are connected in parallel having resistance = R = 0.5

Power = 200W

Current = I = 4A

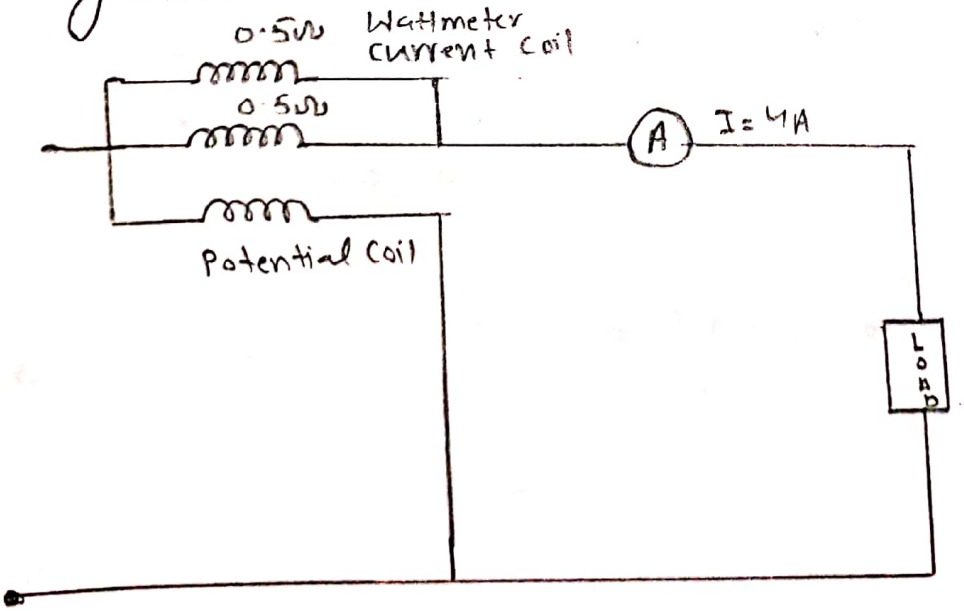
Required:

a- Power dissipated in Wattmeter = ?

b- True load power = ?

c- % error due to Connecting of Wattmeter = ?

Diagram:



(4)

Solution:

$$R_c = \frac{R_1 \times R_2}{R_1 + R_2}$$

$$= \frac{(0.5)(0.5)}{0.5+0.5}$$

$$= \frac{0.25}{1}$$

$$R_c = 0.25\ \Omega$$

a- Power dissipated in Wattmeter:

$$= I^2R$$
$$= (4)^2(0.25)$$
$$= 4W$$

b- True load power

= Power total - Power dissipated

= 200 - 4

= 196 W

c. % Error $= \frac{P_T - \text{load Power}}{\text{load Power}} \times 100$

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

$$= 2.04\ \%$$

Question # 03

Part (a):

Answer:

Kelvin's Bridge:

The Kelvin bridge or thompson Bridge is used for measuring the unknown resistance having a value less than 1Ω. It is the modified form of the Wheatstone Bridge.

Need of Kelvin's Bridge:

Wheatstone bridge use for measuring the resistance from 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.

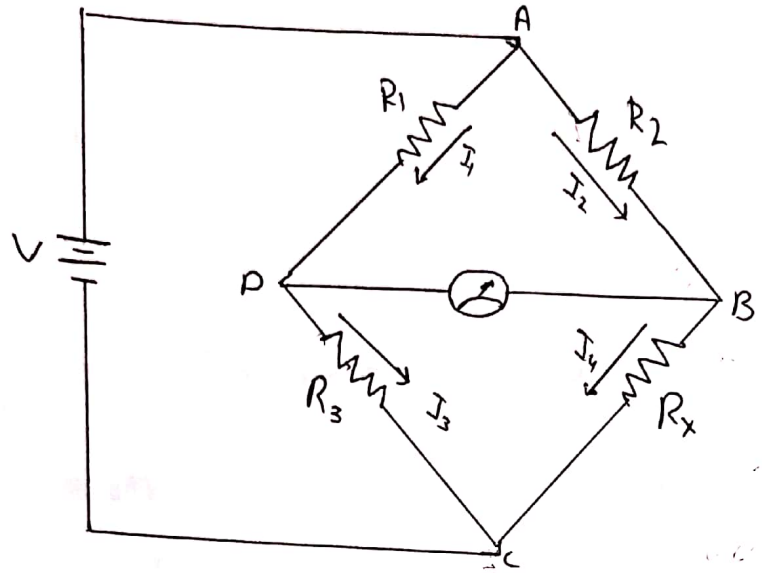
⑥

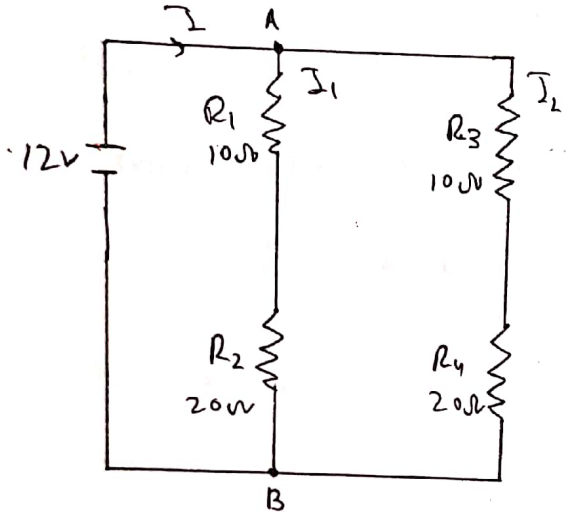
Wheatstone Bridge:

The device uses for the measurement of minimum resistance with the help of Comparison method is known as the Wheatstone bridge. The value of unknown resistance is determined by Comparing it with the known resistance. The Wheatstone bridge works on the principle of null deflection, i-e The ratio of their resistance are equal, and no current flows through the galvanometer. The bridge is very reliable and gives an accurat result except in low resistance measuring.

The working of the bridge is Similar to the potentiometer.

Question # 03
Part (b)





The difference in potential is crucial for current flow. not the value of the potential to ground of end points.

Bridge circuit are particularly useful in connecting resistance changes into voltage bridge that can be input directly into automatic control system.

(8)

$$I_1 = \frac{V}{R}$$

$$= \frac{12}{10+20}$$

$$I = 0.4A$$

$$V_{R2} = I \times R_2$$

$$= 0.4 \times 20.$$

$$= 8V$$

$V_{R1} = 4V$ and $V_{R2} = 8V$

Both points have same values of 8V

C = D = 8 volts.

the difference is 0V.

When this happens, both sides of the parrallel network are said to be balanced Because the voltage at point C is the same value as the voltage at point D.

Question #04

(a)

Energy Meter:

The meter which is used for measuring the energy utilises by the electric load is known as the energy meter.

Energy meter designed for DC circuits not used in AC circuits. 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.

On the other hand in DC circuits such induction effect and eddy current are not produced so Because of this energy meter for DC circuit cannot be used for AC circuits.

(90)

Question#04

Part(b):

When angle ($\theta = 0°$) is equal to zero degree the two fluxes are in phase. and deflecting torque is zero.

When agle is perpendicular to x-axis that is when $\theta = 90°$ the deflecting torque will be maximum and the alternating flux has a phase difference of 90°.

When at every instant Since ϕ_m, ϕ are fixed for a given Condition the deflecting torque is the Same.

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

Question#05

Part(c):

The shunt magnet is wound with a wire of many turns as is connected across the supply so that it carries current proportional to the supply voltage. Due to large no of turns, the coil of shunt meter is highly inductive. Hence the current and the flux passing through it lags the suppling voltage by 90°.

The series magnet is wound with a wire of few turns as is connected is series with the load. so that it carries the load current. The coil of this magnet is highly non-inductive.

Question#05

Part(d):

Energy Meter Constant:

Energy meter constant is the amount of 1KWH used in its low voltage circuit for each revolution of the induction disc.

The constant is shown on the meter nameplate A constant "Kh=7.2" means that for each revolution of the disc, 7.2 watt-hours has been used (Constant will vary with different meters). To determine how much electrical energy is used by counting-meter-disc Revolutions,

The unit of energy meter constant is revolution per kilowatt hour (rev/KWh).

If meter constant of energy meter is 1500 rev/KWh it means that for consumption of 1 KWh the disc will make 1500 revolution.