# 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

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**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** |

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|---|---|---|---|
| **Q4.** | **(a)** | Why the energy meters designed for DC circuits cannot be used for AC circuits? | **Marks 05**<br>**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**<br>**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**<br>**CLO 03** |
| | **(d)** | What is the significance of meter constant in an energy meter? | **Marks 05**<br>**CLO 03** |

Q (1) Sol:-

Given data:-

Two voltmeters range = 0 - 300v

$R_1 = 25\ K\Omega$

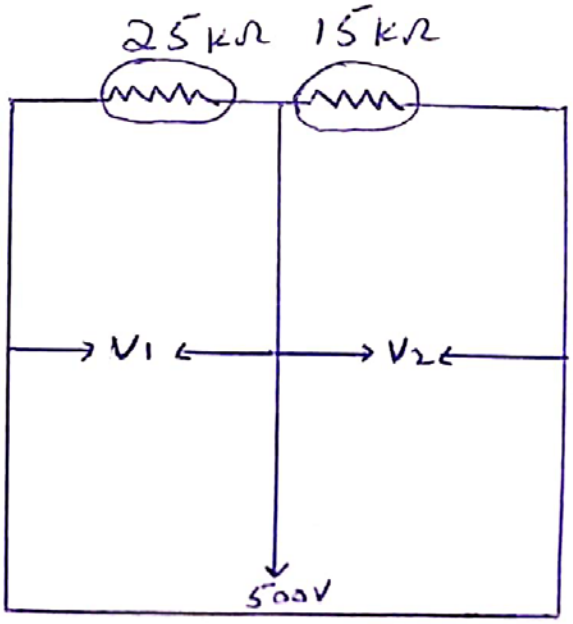
$R_2 = 15\ K\Omega$

Total voltage $V_I = 500v$

Required:- Voltage reading in 1st Voltmeter = $V_1 = ?$

voltage reading in 2nd voltmeter $V_2 = ?$

Diagram:-



Solution:-

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

$$V_1 = 312.5V$$

$$V_2 = \frac{15\,k\Omega}{15\,k\Omega + 25\,k\Omega} \times 500V$$

$$V_2 = 187.5V$$

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Q (2) Given data:-

$R_1 = 0.5\Omega$

$R_2 = 0.5\Omega$

$P = 200W$

$I = 4A$

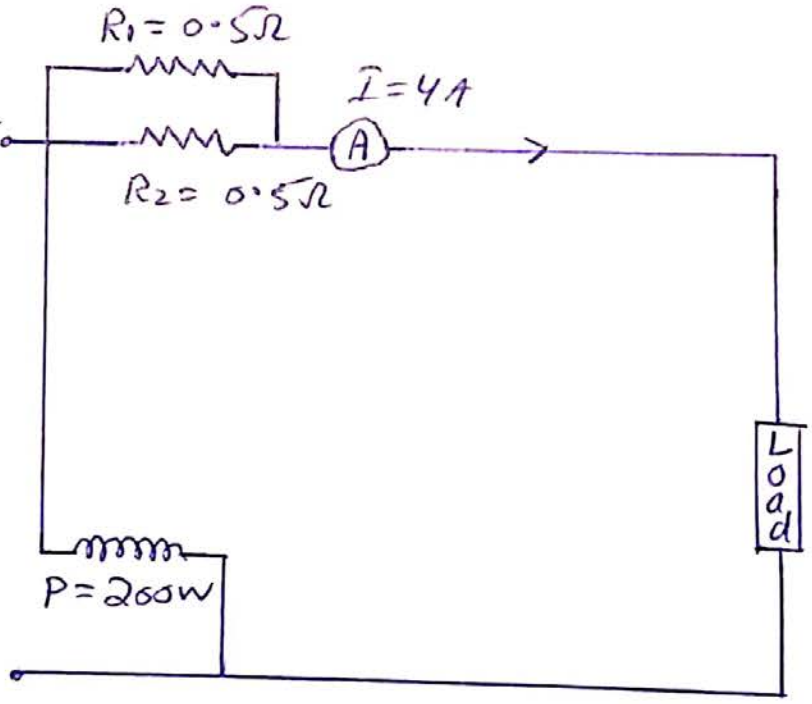
Required:-

(a) Power dissipated in the wattmeter =?

(b) Percentage error due to the connection of wattmeter =?

(c) True load power =?

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 the wattmeter $= I^2 R_c$

$$I^2 R_c = (4)^2 \times 0.25$$

$$= 16 \times 0.25$$

$$I^2 R_c = 4w$$

(b) True load power $= 200 - 4 \Rightarrow 196w$

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

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

% error = 2.0408

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Q(3) Ans:-

wheatstone Bridge :-

A wheatstone Bridge measures electrical resistance by balancing a bridge circuit. The circuit has two legs. of which one contains the unknown resistance of value between 1 ohm to 10 ohms. Apart from resistance,

this setup can also measure impedence, capacitance and inductance.

* Kelvin's bridge:-

The kelvin bridge is more advanced and helps in measuring resistance less than 1 ohm. However, it has two more resistors than the wheatstone bridge.

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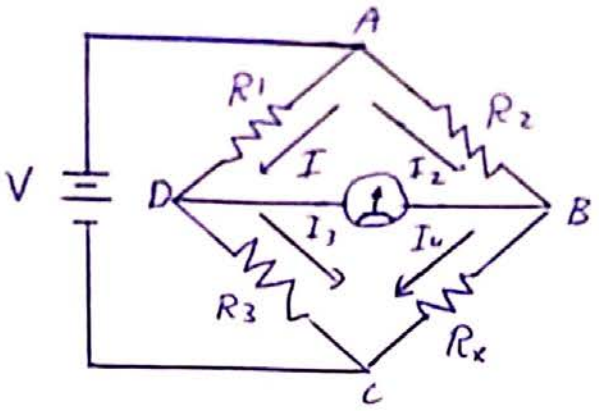
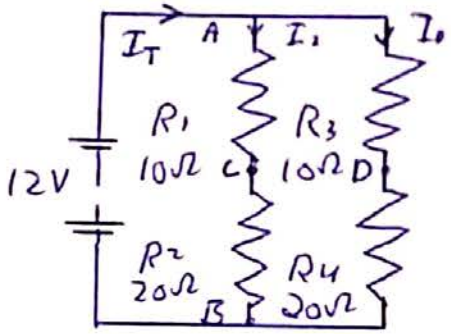
Q(3) (b):-

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




$$I_1 = V \div R = 12V \div (10\Omega + 20\Omega)$$
$$= 0.4A$$

$$V_{R2} = I \times R_2 = 0.4A \times 20\Omega$$
$$= 8 \text{ volts}$$




$V_{R_1} = 4V$ and $V_{R_2} = 8V$

both Points have the same value of 8 volts:

C = D = 8 volts the difference is: 0 volts

when this happens, both sides of the Parallel network are said to be balance because the voltage at point C is the same value as the voltage at Point D.

Q 4. (a)

Ans:- Energy meter designed for DC circuits not AC because AC energy works due to involvement of two alternating magnetic field produced by AC quantities (voltage and current) that interacts ~~win~~ with an aluminium disk causing eddy current to induced in the disk. In DC such induction effect and eddy current not produced.

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Q 4: (b)

Ans:- It should be noted that

when $\theta = 0^\circ$.

i.e (two flures are in phase)

Then deflecting torque is zero or no torque can be produced.

Torque will be maximum when

$$\theta = 90^\circ.$$

i.e when the alternating flux has a phase difference of $90^\circ$.

The deflecting torque is the same at every instant since $\phi_m$, $\phi$, m & $\theta$ are fixed for a given condition.

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

Q 5: (c)

Ans:- 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 logs the suppling voltage by 90°. The series magnet is wound with a wire of few turns is connected is series with the load. So that it carriis the load current the coil of this magnet is highly non-inductive

Q 5: (d)

Ans:- Energy meter constant is the amount of kWH used in its low voltage circuit for each revolation of the induction ~~disc~~. The unit of energy meter constant is rev per kilo wall hour (rev/kwh).

It is constant value. If an energy meter has energy meter constant value of 150 rev / kwh.

It will consume the energy of 1 kwh (1unit) in every 150 revolution.

If it has rotates 300 revolution, it will consume 2 kwh energy.