Course Name:	**Elements of Electrical and Electronics Engineering Laboratory**	**Semester:**	**I**
Date of Performance:	**19/11/2024**	**Batch No:**	**C5-3**
Student Name:	**Rajat Kumar**	**Roll No:**	**16014224054**
Faculty Sign & Date:		**Grade/Marks:**	**/ 20**

Experiment No: 7

Title: Measurement of Power using Two Wattmeter Method

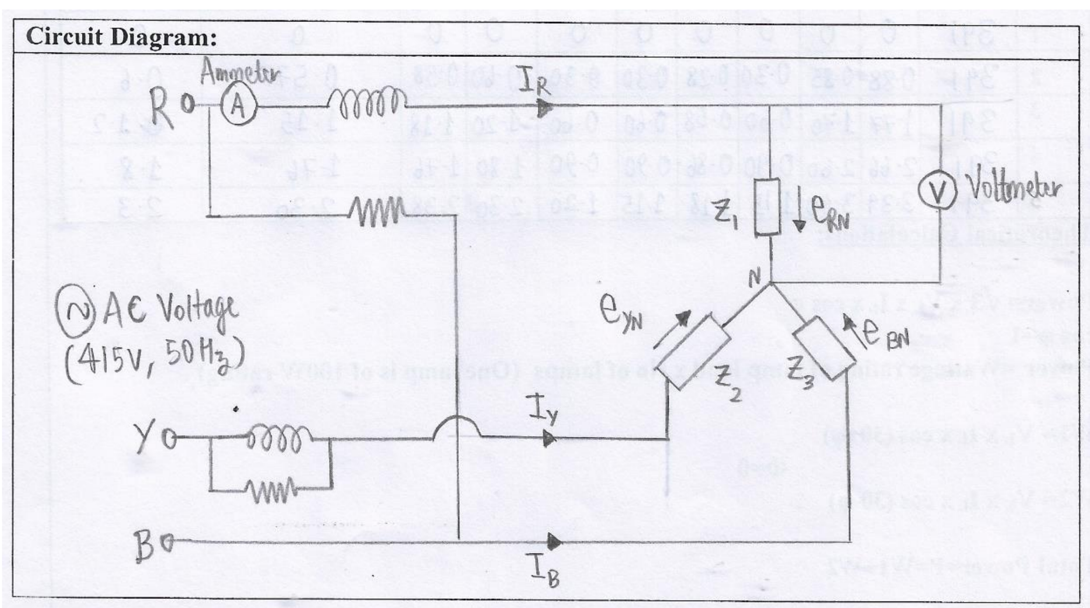
Aim and Objective of the Experiment:

- To measure the power of three phase power using Two Wattmeter Method

COs to be achieved:

CO2: Demonstrate and analyze steady state response of single phase and three phase circuits

Circuit Diagram:



Stepwise-Procedure:

1. Connect the circuit as shown in circuit diagram.
2. Increase the load and note down the reading $\mathbf{V_L}$, $\mathbf{I_L}$, $\mathbf{W_1}$ **and** $\mathbf{W_2}$
3. Practically you will obtain total power $\mathbf{W = W_1 + W_2}$.\
4. Theoretically power is measured by using formula $\mathbf{P = \sqrt{3} V_L I_L \cos\phi}$, using $\mathbf{\cos\phi = 1}$ (unity) for resistive load.

Observation Table:

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Sr.no	V_L (Volts)	I_L (Amp)		W_1 (KW)		W_2 (KW)		= W_1+W_2) KW)		P = $\sqrt{3}V_LI_LCOS\phi$ (KW)	Lamp load given from lamp bank (KW)
		TH	PR	TH	PR	TH	PR	TH	PR		
1	391	0	0	0	0	0	0	0	0	0	0
2	391	0.88	0.85	0.30	0.28	0.30	0.30	0.60	0.58	0.57	0.6
3	391	1.77	1.70	0.60	0.58	0.60	0.60	1.20	1.18	1.15	1.2
4	391	2.66	2.60	0.90	0.86	0.90	0.90	1.80	1.76	1.76	1.8
5	391	3.39	3.40	1.15	1.18	1.15	1.20	2.30	2.38	2.30	2.3

Theoretical Calculations:

Power = $\mathbf{\sqrt{3} \times V_L \times I_L \times \cos\varphi}$ **(where,** $\mathbf{\cos\varphi = 1}$**)**
Power = Wattage rating of lamp load × No of lamps (where, 1 lamp is of 100W rating)

$\mathbf{W_1 = V_L \times I_L \times \cos(30 + \Phi); \Phi=0}$
$\mathbf{W_2 = V_L \times I_L \times \cos(30 - \Phi); \Phi=0}$

Total Power = $\mathbf{P = W_1 + W_2}$

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1 Calculations –

☆ For Calculations of Load Current (Theoretical) –

$\Rightarrow P = \sqrt{3} \cdot V_L \cdot I_L \cdot \cos\phi$

a) for load of 0 Watts –
$P = 0, \therefore I_L = 0A$

b) for load of 600 Watts –
$P = 600, \therefore I_L = \frac{P}{\sqrt{3} \cdot V_L} = \frac{600}{\sqrt{3} \times 391}$

$\left[I_L = 0.886A \right]$

c) for load of 1200 Watts –
$P = 1200, \therefore I_L = \frac{P}{\sqrt{3} \cdot V_L}$

$I_L = \frac{1200}{\sqrt{3} \cdot 391} = 1.77A$

d) for load of 1800 Watts –
$P = 1800, I_L = \frac{P}{\sqrt{3} \cdot V_L}$

$I_L = \frac{1800}{\sqrt{3} \cdot 391} = 2.66A$

e) for load of 2300 Watts –
$P = 2300, \therefore I_L = \frac{P}{\sqrt{3} \cdot V_L}$

$I_L = \frac{2300}{\sqrt{3} \cdot 391} = 3.396A$

☆ For Calculation of W_1 and W_2 (Theoretical) –

$\Rightarrow$ (1) $W_1 = \frac{P}{2}(1 + \sqrt{3} \cdot \tan\phi)$

$\Rightarrow$ (2) $W_2 = \frac{P}{2}(1 - \sqrt{3} \cdot \tan\phi)$

a) for load of 0 Watts –
$W_1 = 0$
$W_2 = 0$

b) for load of 600 Watts –
$W_1 = \frac{600}{2}(1 + \sqrt{3} \times 0) = 300W$

$W_2 = \frac{600}{2}(1 - \sqrt{3} \times 0) = 300W$

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c) for loads of 1200 Watts -

$W_1 = \frac{1200}{2}(1+\sqrt{3}\times 0) = \underline{600\,W}$

$W_2 = \frac{1200}{2}(1-\sqrt{3}\times 0) = \underline{600\,W}$

d) for loads of 1800 Watts -

$W_1 = \frac{1800}{2}(1+\sqrt{3}\times 0) = \underline{900\,W}$

$W_2 = \frac{1800}{2}(1-\sqrt{3}\times 0) = \underline{900\,W}$

e) for loads of 2300 Watts -

$W_1 = \frac{2300}{2}(1+\sqrt{3}\times 0) = \underline{1150\,W}$

$W_2 = \frac{2300}{2}(1-\sqrt{3}\times 0) = \underline{1150\,W}$

* for Calculation of $W = W_1 + W_2$ (Theoretical) -

a) for load of 0 Watts -

$W = W_1 + W_2 = 0 + 0 = \boxed{0W}$

b) for load of 600 Watts -

$W = W_1 + W_2 = 300 + 300 = \boxed{600W}$

c) for load of 1200 Watts -

$W = W_1 + W_2 = 600 + 600 = \boxed{1200\,W}$

d) for load of 1800 Watts -

$W = W_1 + W_2 = 900 + 900 = \boxed{1800\,W}$

e) for load of 2300 Watts -

$W = W_1 + W_2 = 1150 + 1150 = \boxed{2300\,W}$

* for Calculation of Power -

$\Rightarrow P = \sqrt{3} \times V_L \times I_L \times \cos\phi$; $(\cos\phi = 1)$

a) for load of 0 Watts -

$P = \sqrt{3} \times 391 \times 0 \times 1$

$\underline{P = 0W}$

b) for load of 600 Watts -

$P = \sqrt{3} \times 391 \times 0.85 \times 1$

$\underline{P = 0.57\,kW}$

c) for load of 1200 Watts -

$P = \sqrt{3} \times 391 \times (1.7) \times 1$

$\underline{P = 1.15\,kW}$

d) for load of 1800 Watts -

$P = \sqrt{3} \times 391 \times 2.6 \times 1$

$\underline{P = 1.76\,kW}$

e) for 2300 W load -

$P = \sqrt{3} \times 391 \times 3.4 \times 1$

$\underline{P = 2.3\,kW}$

Conclusion:

The two-wattmeter method is used to effectively measure the power in a 3-phase AC circuit, helping us to analyze its steady-state response. In this experiment, the total power was determined both practically and theoretically. Practically, power was calculated by summing the readings from the two wattmeters connected using the circuit diagram using the formula: W=W1+W2.
Theoretically, the power was calculated using the formula $P=\sqrt{3}V_LI_L\cos\phi$ where $\cos\phi=1$ for a purely resistive load. The experimental and theoretical results were consistent, which demonstrated the accuracy of the two-wattmeter method in measuring 3-phase power.
This method also highlights the phase angle's effect on power distribution, because it can measure both active and reactive components.
The experiment helps us to understand the principles of 3- phase power analysis and provides insight into practical applications in electronic systems.

Signature of faculty in-charge with Date: