EXPERIMENT 6

Aim: To study measurement of Power in three phase circuit using Two Wattmeter method.

Apparatus: Wattmeter (600V/5A), Voltmeter(0-600V), Ammeter(0-5A), Auto-transformer, three-phase Induction Motor, connecting wires.

Circuit Diagram:

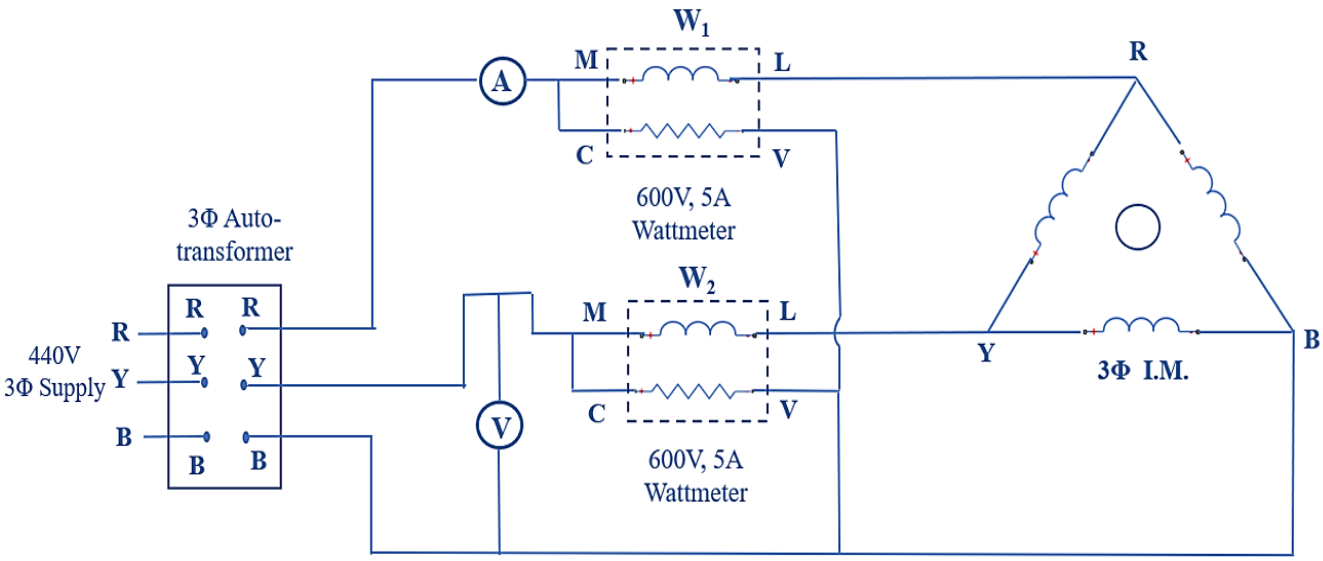

Fig 1. Power Measurement using Two Wattmeter Method

Theory:

Power consumed by a 3-phase balanced or unbalanced load (delta connected) can be measured by using 2-wattmeters properly connected in the circuit. In Two-Wattmeter method, the current coils of the wattmeter are connected with any two lines, say R and Y as shown in Fig.1. While the pressure coil of each wattmeter is connected between these two lines and the third line i.e., B as shown above. Under running conditions, the power consumed by the three-phase system is the sum of the two individual wattmeters.

$$\text{i.e., } P_{Measured} = W_1 + W_2$$

where, W_1 is the power measured by wattmeter 1 and W_2 is the power measured by wattmeter 2.

The total power in circuit can be calculated as follows:

$$P_{Calculated} = \sqrt{3}\, V_L\, I_L\, cos\, \theta$$

where,

V_L is the line voltage,

I_L is the line current

$cos\, \theta$ is the power factor.

The phase angle can be calculated as,

$$\therefore\ \theta\ = \left[tan^{-1}\left\{\sqrt{3}\ \left(\frac{W_2 - W_1}{W_2 + W_1}\right)\right\}\right]$$

The percent error is given by

$$\%\, error\ = \frac{P_{Calculated}\ -\ P_{Measured}}{P_{Measured}} \times 100$$

Multiplying Factor for wattmeter is calculated as follows:

$$Multiplying\ Factor\ = \frac{Voltage\ Rating\ *\ Current\ Rating\ *\ Power\ factor}{Full - scale\ reading}$$

Procedure:

1. Connect the circuit as shown in the Fig.1.
2. Start the 3Φ-ac supply and observe wattmeter readings. If one wattmeter reads negative or gives reverse reading then switch off the supply and reverse the current coil terminals.
3. Now, again start the ac supply and set the voltage to desired value using auto-transformer and then note down the current in ammeter i.e. line current I_L, voltage in voltmeter i.e. line voltage V_L and power rating in both the watt meters i.e. W_1 and W_2.
4. Repeat the procedure for five different voltages.

Observation Table:

Sr. No.	Line Voltage V_L	Line Current I_L	W_1	W_2	$P_{Measured} = W_1 + W_2$	Phase Angle, θ	$P_{Calculated} = \sqrt{3}\, V_L\, I_L \cos\theta$	% error
1	400V	3.6A	220*4	-135*4				
2	360V	3.0A	165*4	-97*4				
3	300V	2.4A	120*4	-60*4				
4	280V	2.2A	100*4	-50*4				
5	240V	2.0A	80*4	-45*4				

Calculations:

Questions:

(1) What are the advantages and disadvantages of two wattmeter method?

Conclusion: