NOTES Class-46

Measurement of Power and Power factor using Two Wattmeter Method:

Wattmeter:

Wattmeter is a power measuring instrument. It consists of a fixed coil called 'Current Coil (CC) and a moving coil called 'Pressure Coil' (PC). Pressure coil is also called 'Voltage coil' (VC).

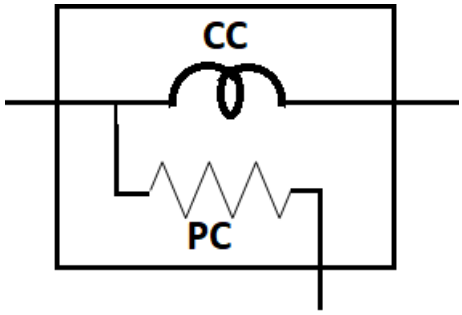


Fig: Wattmeter symbol

PC carries the pointer of the instrument and indicates the average power.

Two Wattmeter Method:

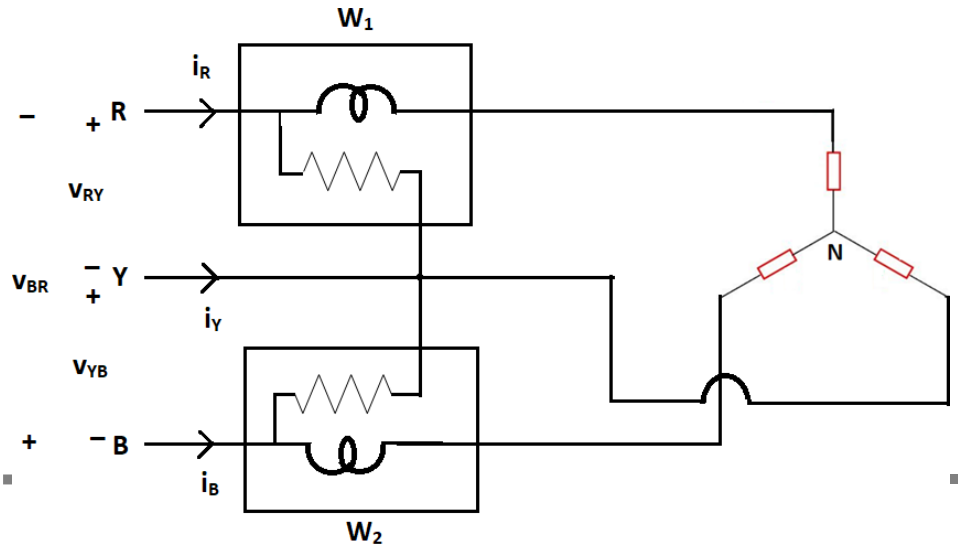


Fig: Two Wattmeter Method circuit diagram

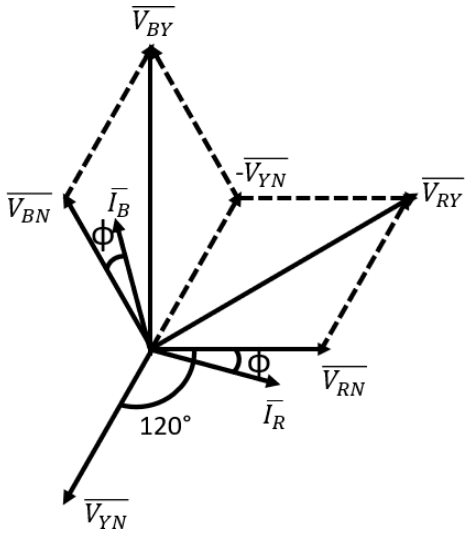
Two wattmeters are sufficient to measure three phase active power irrespective of whether the load is star connected or delta connected and irrespective of whether the load is balanced or unbalanced.

First Wattmeter reading, $W_1 = V_{RY}*I_R*\cos(\angle(V_{RY}, I_R))$

Second Wattmeter reading, $W_2 = V_{BY}*I_B*\cos(\angle(V_{BY}, I_B))$

To obtain the angles, let us draw the phasor diagram.

Consider inductive load. Then, phase current lags phase voltage.



Therefore, $W_1 = V_{RY}*I_R*\cos(30+\phi)$

$W_2 = V_{BY}*I_B*\cos(30-\phi)$

Hence, $W_1 = V_L * I_L * \cos(30+\phi)$ & $W_2 = V_L * I_L * \cos(30-\phi)$

Therefore, $W_1 + W_2 = \sqrt{3} * V_L * I_L * \cos\phi = P_{3-phase}$ --- (1)

Similarly, $\sqrt{3}*(W_2 - W_1) = \sqrt{3} * V_L * I_L * \sin\phi = Q_{3-phase}$ --- (2)

Therefore, $\frac{(2)}{(1)}$ gives,

$$\frac{Q_{3-phase}}{P_{3-phase}} = \frac{\sqrt{3}*(W_2 - W_1)}{W_1 + W_2} = \text{Tan}\phi$$

Hence, power factor of the system is,

$$\cos\phi = \cos\left(Tan^{-1}\left(\frac{\sqrt{3}*(W_2 - W_1)}{W_1 + W_2}\right)\right)$$