ELEMENTS OF ELECTRICAL ENGINEERING
Course Code : UE25EE141A/B

PES UNIVERSITY

FACULTY CONTRIBUTED:

Department of EEE, RR Campus

Prof . Jyothi T N
Prof. Vadhiraj K P P
Prof. Kruthika N
Prof. Suma S
Prof. Pushpa K R
Prof. Sangeeta Modi

Department of ECE, EC Campus

Prof. Lokesh L
Prof. Dhanashree G Bhate
Dr. Renuka R Kajur
Prof. Rajesh Chandrashekar
Prof. Sangam Kumar G H

Measurement of Power and Power factor using Two Wattmeter Method

Jyothi T.N
Department of Electrical & Electronics Engineering

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).

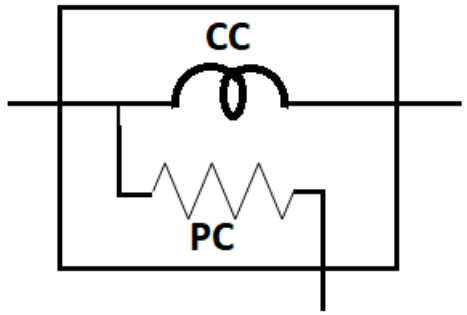


Fig: Wattmeter symbol

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

Two Wattmeter Method

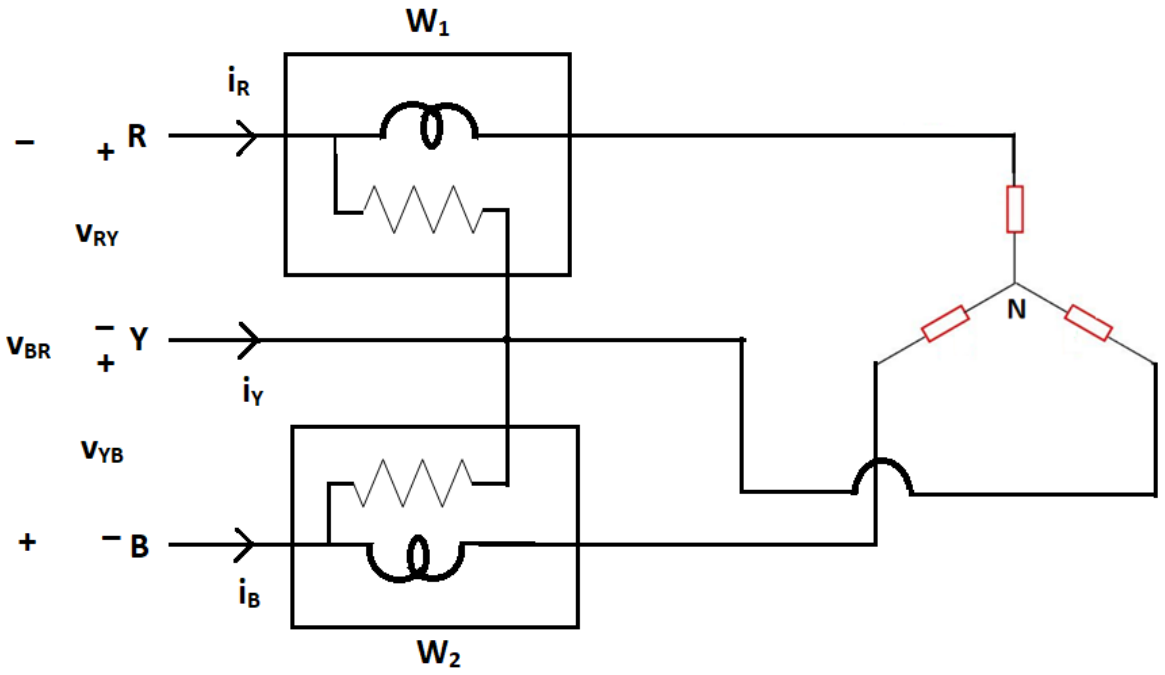
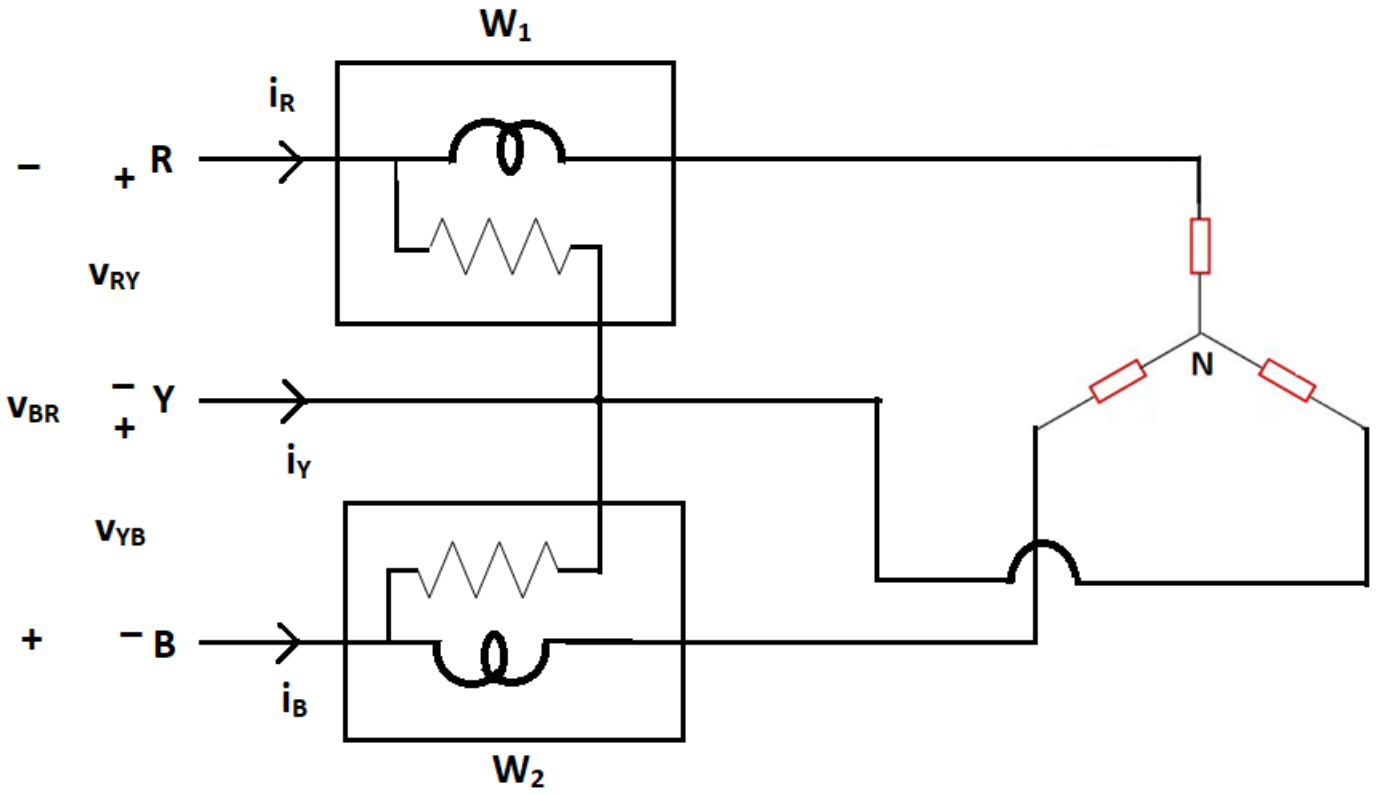


Fig: Two Wattmeter Method circuit diagram

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.

Two Wattmeter Method (contd..)

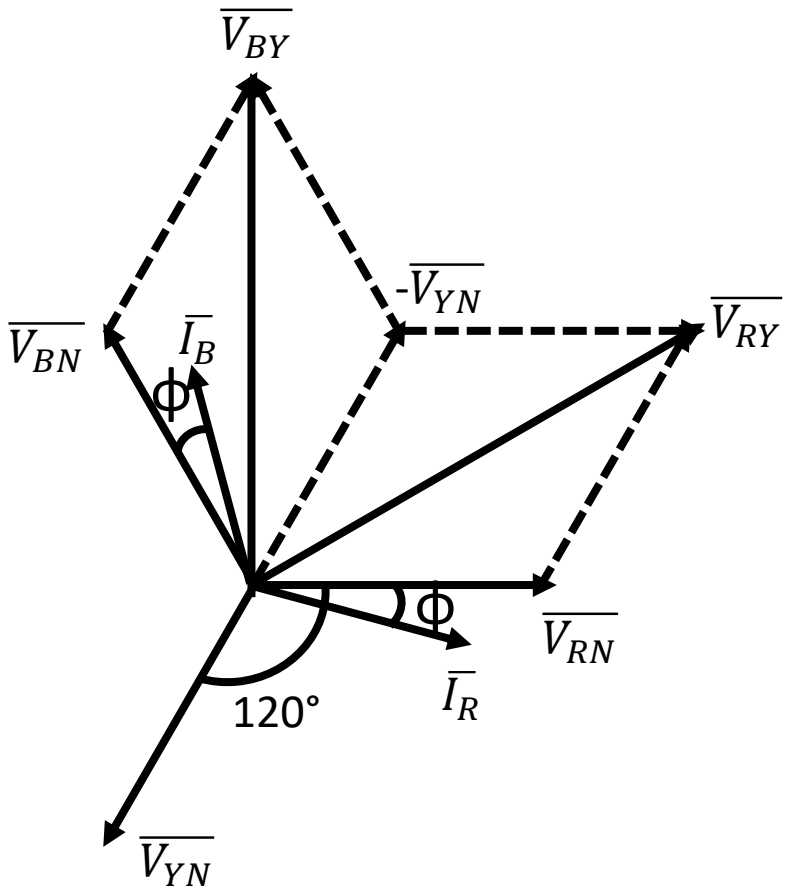


$W_1 = V_{RY} * I_R * \cos(\angle(V_{RY}, I_R))$

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

ELEMENTS OF ELECTRICAL ENGINEERING

Two Wattmeter Method – Phasor Diagram



$$\overline{V_{RY}} = \overline{V_{RN}} - \overline{V_{YN}}$$

$$\overline{V_{BY}} = \overline{V_{BN}} - \overline{V_{YN}}$$

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

$W_1 = V_{RY} * I_R * \cos(30+\phi)$ & $W_2 = V_{BY} * I_B * \cos(30-\phi)$

Two Wattmeter Method – calculations

$W_1 = V_{RY} * I_R * \cos(30+\phi)$ & $W_2 = V_{BY} * I_B * \cos(30-\phi)$

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

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)

$$\frac{(2)}{(1)} \Rightarrow \frac{Q_{3-phase}}{P_{3-phase}} = \frac{\sqrt{3}*(W_2 - W_1)}{W_1 + W_2} = \text{Tan}\phi$$

Hence, power factor of the system is,

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

ELEMENTS OF ELECTRICAL ENGINEERING

Text Book & References

Text Book:

1. "Basic Electrical Engineering" S.K Bhattacharya, 1st Edition Pearson India Education Services Pvt. Ltd., 2017
2. "Basic Electrical Engineering", D. C. Kulshreshta, 2nd Edition, McGraw-Hill. 2019
3. "Special Electrical Machines" E G Janardanan, PHI Learning Pvt. Ltd., 2014

Reference Books:

1. "Engineering Circuit Analysis" William Hayt, Jack Kemmerly, Jamie Phillips and Steven Durbin, 10th Edition McGraw Hill, 2023
2. "Electrical and Electronic Technology" E. Hughes (Revised by J. Hiley, K. Brown & I.M Smith), 12th Edition, Pearson Education, 2016.

THANK YOU

Jyothi T N

Department of Electrical & Electronics Engineering

jyothitn@pes.edu