Rajshahi University of Engineering and Technology

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Experiment Name: Power measurement of a balanced three phase system using two wattmeter method.

Objectives: To measure three phase power using two wattmeter process.

Theory: Wattmeter is an instrument for measuring the real power of single-phase circuits. A single wattmeter can also measure the average power in a three phase circuits which is balanced. Because P1=p2=P3. The total power is three times of one value. But for three phase power measurements we need three or two wattmeter processes.

The two-wattmeter process is the most used method for measuring the power of three phase power measurements. The two wattmeter's must be properly connected to any two phases. The current coil of each wattmeter measures the current of line, while the respective voltage measures the voltage of two line. Current coil is connected to series and voltage coil is connected between two phases. Although, the individual wattmeter no longer read the power taken by any phase, the algebraic sum of two wattmeter equal to the total power, regardless of whether it is delta or wye connected, balanced or unbalanced. The real power is equal to the algebraic sum of the two wattmeter readings.

$$P_1 = V_{ab} I_a \cos(\Theta + 30)$$
$$P_2 = V_{cb} I_c \cos(\Theta - 30)$$
$$P = P_1 + P_2 = \sqrt{3}\, I_L V_L cos\Theta$$

Required Apparatus:

- Three-phase AC power supply
- Resistive load
- Clamp on ammeter
- Connecting wires
- Multimeter

Circuit Diagram:

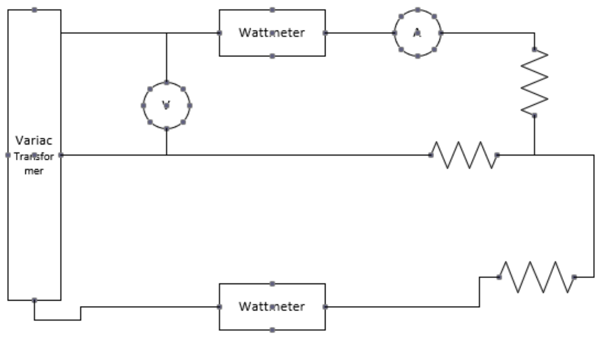


Fig. Three phase power measurement using two wattmeter methods.

Data Table:

SI No	P_1 (w)	P_2 (w)	$P_{T(m)}$ (w)	$P_{T(c)}$ (w)	% Error
1	22	23	45	58.97	23.69%
2	30	28	58	40.47	43.32%
3	36	35	71	90.416	21.47%
4	42	42	84	103.86	19.12%

Calculation:

For 1st calculation,

$\mathbf{P_{T(m)} = 22 + 23 = 45}$ **w,** $\mathbf{P_{T(c)} = 58.97}$ **W, Error** $= \left|\frac{P_{T(theoritically)} - P_{T(measured)}}{P_{T(Theoritically)}}\right| = \left|\frac{58.97-45}{58.97}\right| = \mathbf{23.69\%}$

For 2nd calculation,

$\mathbf{P_{T(m)} = 30 + 28 = 58}$ **w,** $\mathbf{P_{T(c)} =} 40.47$ **W, Error** $= \left|\frac{P_{T(theoritically)} - P_{T(measured)}}{P_{T(Theoritically)}}\right| = \left|\frac{40.47-58}{58}\right| = 43.32\%\%$

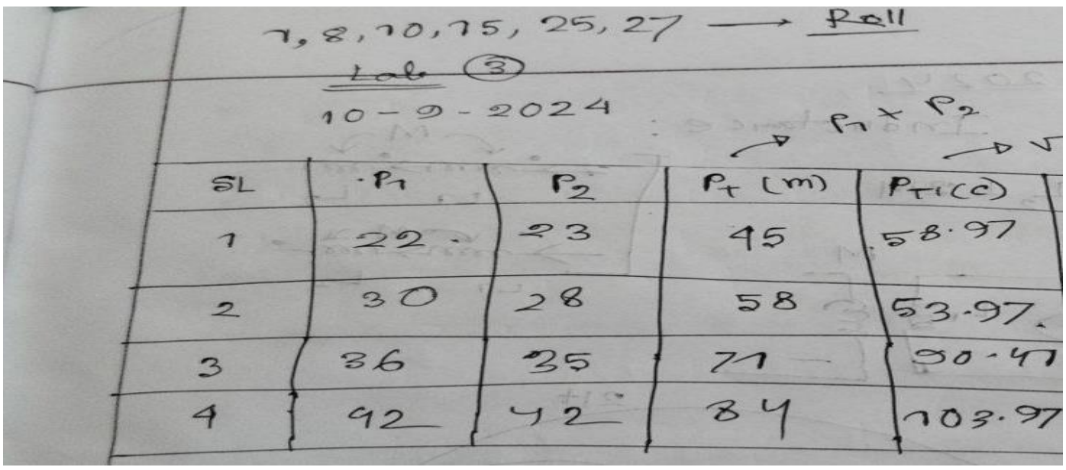
For 3rd calculation,

$\mathbf{P_{T(m)} = 36 + 35 = 71}$ **w,** $\mathbf{P_{T(c)} = 90.416}$ **W, Error** $= \left|\frac{P_{T(theoritically)} - P_{T(measured)}}{P_{T(Theoritically)}}\right| = \left|\frac{71-90.416}{90.416}\right| = \mathbf{23.69\%}$

For 4th calculation,

$\mathbf{P_{T(m)} = 42 + 42 = 84}$ **w,** $\mathbf{P_{T(c)} = 103.86}$ **W, Error** $= \left|\frac{P_{T(theoritically)} - P_{T(measured)}}{P_{T(Theoritically)}}\right| = \left|\frac{103.86-84}{103.86}\right| = \mathbf{19.12\%}$

Data Table from Lab Experiment:


1, 8, 10, 15, 25, 27 → Roll

Lab 3

10 - 9 - 2024

$P_1 + P_2$

SL	P_1	P_2	P_T (m)	P_T (c)
1	22	23	45	58.97
2	30	28	58	53.97
3	36	35	71	90.47
4	42	42	84	103.97

Discussion: In this experiment, we measured the line currents and line voltage. Then we used the formula of power for measuring power theoretically. It is P= $\sqrt{3}\, I_L V_L cos\Theta$. We measured power from the summation of power from the two wattmeter's. Then we compared the theoretical value with measured value. They are all almost equal. We have made an error. It may be for not measuring the value correctly. So, from this experiment we have been able to prove that we can measure the three-phase power using two wattmeter methods instead of the three wattmeter methods.

References

Christopher, K., & Sadiku, M. N. (n.d.). *Fundamentals of Electric Circuits.* New York: McGraw-Hill Education International.