KING FAHD UNIVERSITY OF PETROLEUM & MINERALS

Electrical Engineering Department

EE 360   **Electric Energy Engineering**   -   **Experiment # 2**

THREE PHASE POWER MEASUREMENT

Objectives:

1. Measure power in balanced **Y** and **Δ** systems.
2. Determine power factor of 3Φ systems.

Apparatus:

2 Wattmeters
1 Voltmeter
1 3Φ load
1 Ammeter
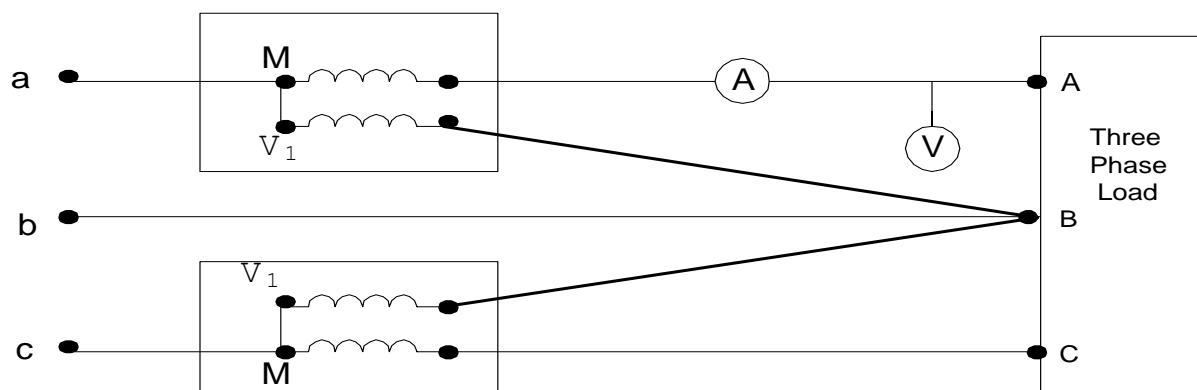1 3Φ variable AC power supply (Variac)

Theory:

Fig.1: Two Wattmeter Connection

If two wattmeters are connected to measure the power of any 3Φ load, it can be shown that the wattmeters will read V_1

$$P_1 = V_L I_L \cos(30 - \theta) \qquad\qquad (1)$$
$$P_2 = V_L I_L \cos(30 + \theta) \qquad\qquad (2)$$

Where θ the power factor angle of the load. From (1) and (2) we can show that the total power

$$P_T = P_1 + P_2 = \sqrt{3}\ V_L I_L \cos\theta \qquad\qquad (3)$$

$$\tan\theta = \sqrt{3}\,(P_1 - P_2)\,/\,(P_1 + P_2) \qquad\qquad (4)$$

Procedure

1. Connect the circuit as shown in fig 1. Connect the 3Φ load in **Y**.
2. Before you switch on, have your connections cheeked by the instructor.
3. Set the supply voltage to 200 V from a variac
4. Select the load power factor to be unity
5. On a separate sheet of paper make a table with 11 columns as shown in table.1.

Pf	P_1 (Watt)	P_2 (Watt)	P_T (Watt)	V_{AB} (Volt)	V_{CB} (Volt)	I_A (amp)	Pf calc.	Pf Error (%)	P_T Calc.	Power Error calc.

Table.1: Results for Y connection

6. Take three sets of readings, <u>one for the rated load <u>8 A</u></u>, one for ½ rated and one for ¼ rated loads.
7. Repeat step 6 for 0.8 lagging as well as leading power factor conditions.
8. Connect the three phase load in **Δ**.
9. Set the supply voltage to 100 volts ($V_L = V_P$ for **Δ**).
10. Repeat step 6 for unity, 0.8 lagging and 0.8 leading power factor conditions. Enter the results in a table similar to table 1. call table 2.

Note: At a certain power factor, one of the wattmeters may try to read backwards. Switch the supply off, reverse the voltage OR the current coil connection. Mark the reading as negative.

Report

1. Using the wattmeter readings, compute the power factor from equation (4). Enter it as pf (calculated) in tables.1 and 2. Calculate the percent error between the calculated and the recorded power factors.
2. Use equations (1) and (2) to calculate the total power. Compare it to the measured total power and enter the percent error in the tables.
3. Comment on the levels of error between the computed and measured values. State any sources of error.
4. Draw a phasor diagram and show why equations (1) and (2) can be used to calculate the total power.