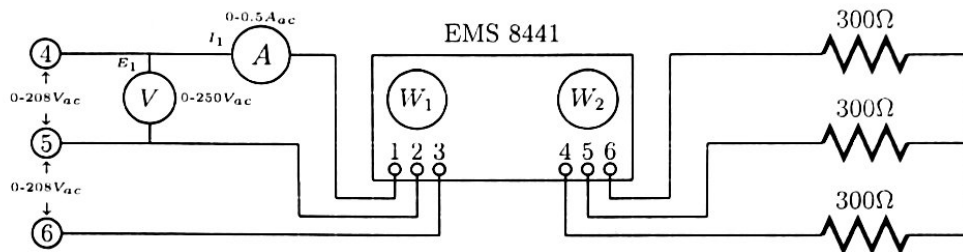


Objective

To measure power in a 3-phase circuit using 2 wattmeters and to determine the phase sequence of a 3-phase line.

Part 1

1. Connect the following circuit using the 3-phase wattmeter.



2. Turn on the power supply and adjust the line voltage to 208 VAC as indicated by E_1
3. Record the line current I_1 and the power indicated by W_1 and W_2 .

Current (A)	Power (W)	Power(W)
$I_1 = 0.46$	$W_1 = 688$	$W_2 = 70$

4. From the results of #3 calculate the 3-phase apparent power, real power, reactive power and power factor:

$S_{3\phi}$ (VA)	$P_{3\phi}$ (W)	$Q_{3\phi}$ (var)	$pf_{3\phi}$
$S_{3\phi} =$	$P_{3\phi} =$	$Q_{3\phi} =$	$pf_{3\phi} =$

5. Replace the resistance with the capacitance module. Set each capacitance to 8.8 micro Farad.
6. Repeat #2, #3 and #4.

Current (A)	Power (W)	Power(W)
$I_1 = 0.42$	$W_1 = 40$	$W_2 = 38$

- +

S. Q. A. S. N.

$S_{3\phi}$ (VA)	$P_{3\phi}$ (W)	$Q_{3\phi}$ (var)	$pf_{3\phi}$
$S_{3\phi} =$	$P_{3\phi} =$	$Q_{3\phi} =$	$pf_{3\phi} =$

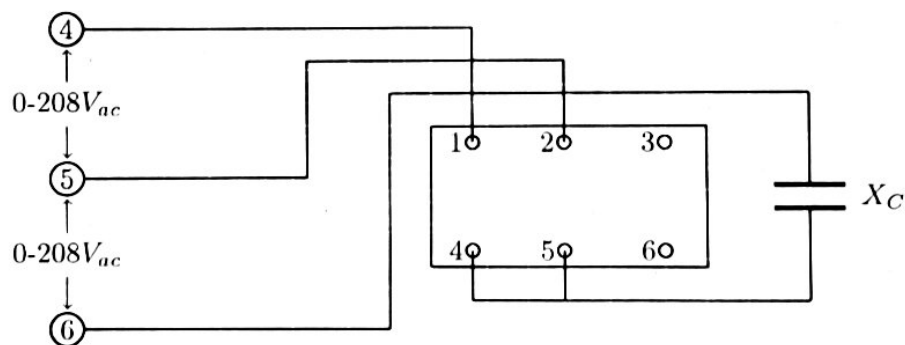
- Replace the capacitance with the inductance module. Set each inductance to 0.8 H.
- Repeat #2, #3 and #4.

Current (A)	Power (W)	Power(W)
$I_1 = 0.46$	$W_1 = 47$	$W_2 = 26$

$S_{3\phi}$ (VA)	$P_{3\phi}$ (W)	$Q_{3\phi}$ (var)	$pf_{3\phi}$
$S_{3\phi} =$	$P_{3\phi} =$	$Q_{3\phi} =$	$pf_{3\phi} =$

Part 2

- Connect the circuit shown below using the synchronizing switch and capacitance modules.



- Set the capacitance to 2.2 μ F.
- Place the synchronizing switch in its open position (to the right).
- Before turning on the power supply make sure the synchronizing switch is open!**
- Determine the phase sequence from the relative lamp brightness. *5, 4, 6*
- Shut off the power supply and interchange any 2 lines. *swap 4 and 5*
- Turn on the power supply and adjust to 50 VAC. *456*

8. Determine the phase sequence.
9. Replace the capacitance with the inductance module set for 3.2 H. *leaving setup*
10. Repeat #5 and #6. *546, swap +5, 456*
11. Write a 1 page discussion of results.

Questions

1. Could 1 wattmeter be used to measure total 3-phase power on a balanced 3-phase, 4-wire system?
2. Can a wattmeter that has I through and V across it, indicate 0 watts? Explain.
3. Could a 3-phase induction motor be used to establish the phase sequence of a 3 phase line?
4. Line voltages are 120 degrees out of phase with each other. Are the phase voltages also 120 degrees out of phase with each other? Explain.

Objective

The objective of this lab was to measure power in a 3-phase circuit using wattmeters and to determine the phase sequence of a 3-phase line.

Procedure

For part 1, we connected the power source to a wye resistive, inductive, and capacitive load through a wattmeter, with a voltmeter measuring the line voltage and an ammeter measuring one of the line currents.

For part 2, we connected the power source to a singular capacitor, by way of a synchronizing switch, as shown in figure 2.

Results and Conclusions

All of our results were within error. They weren't exactly the same, because of tolerances and impurities.

For part 1 of the lab, we had a three phase power of $138.5VA$ at $pf \approx 1$ for the resistive load, $78VA$ at $pf \approx 0.02$ for the capacitive load, and $76VA$ at $pf \approx 0.28$. For part 2,

Questions

1. Could 1 wattmeter be used to measure the total 3-phase power on a balanced 3-phase, 4-wire system?

One wattmeter system (consisting of 2 individual wattmeters) would be enough to measure the total power of a 3-phase, 4-wire system.

2. Can a Wattmeter that has I through and V across it indicate $0W$? Explain.

The wattmeter cannot indicate $0W$. Although they are standard wattmeters, they are still used to calculate the complex power output, which means that one of them will register the power if there is any current and voltage through and across them.

3. Could a 3-phase induction motor be used to establish the phase sequence of a 3 phase line?

Yes. The direction of spin of the induction motor will show you where the phases are in reference to each other.

4. Line voltages are 120° out of phase with each other. Are the phase voltages also 120° out of phase with each other? Explain.

Yes, they are.

Wiring Diagrams

Part 1

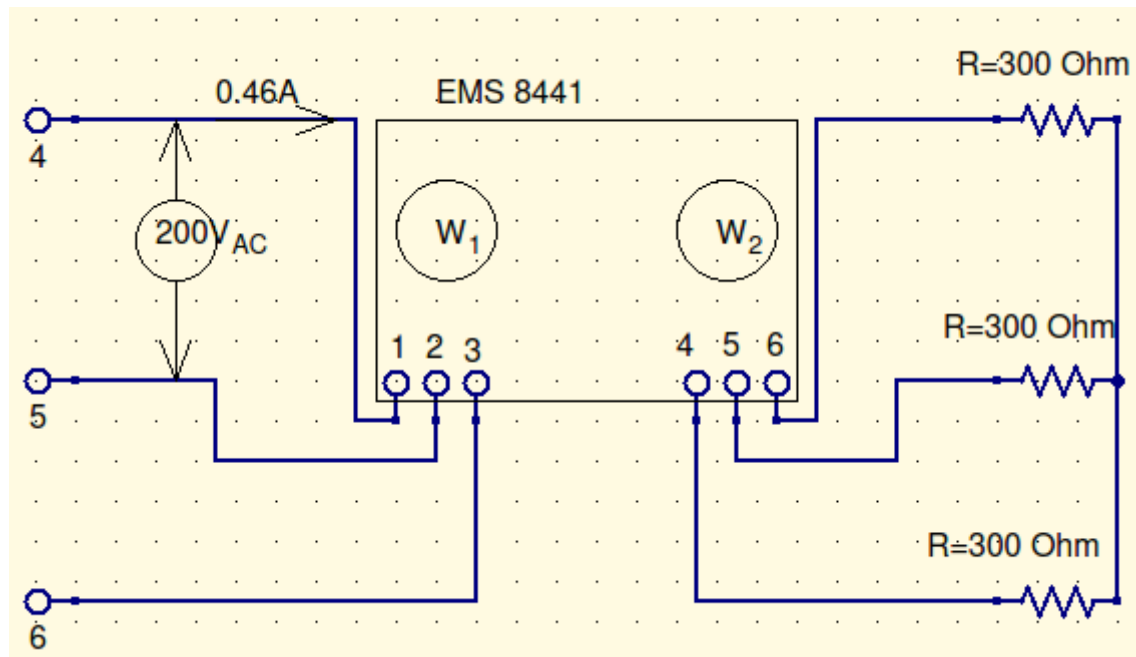


Figure 1: Resistive circuit

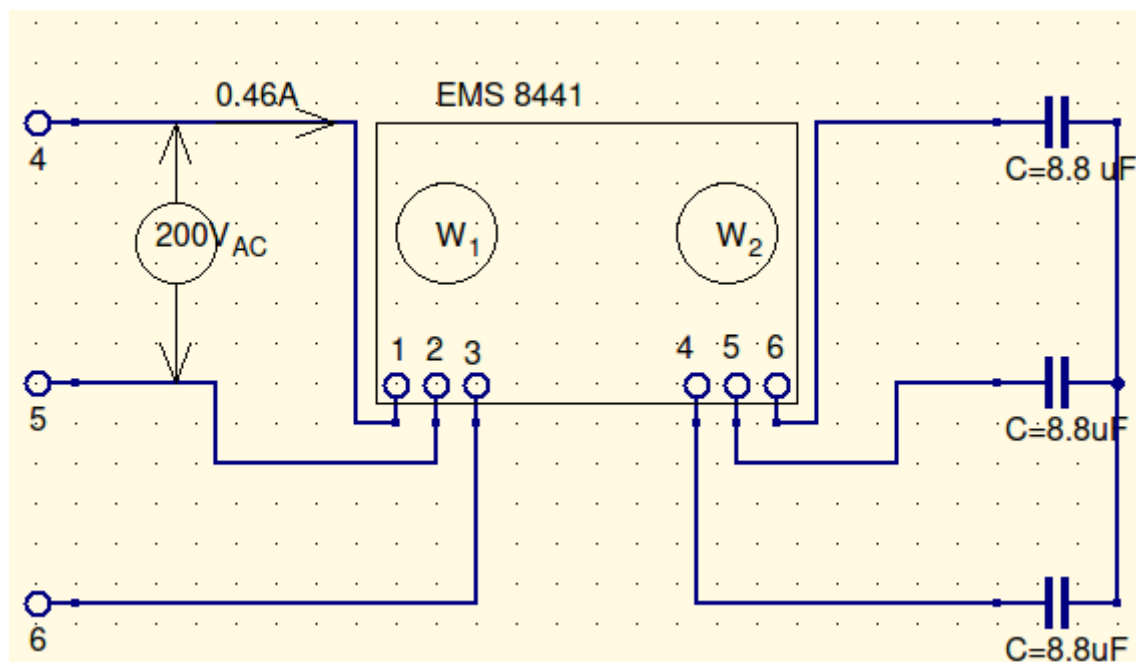


Figure 2: Capacitive Circuit

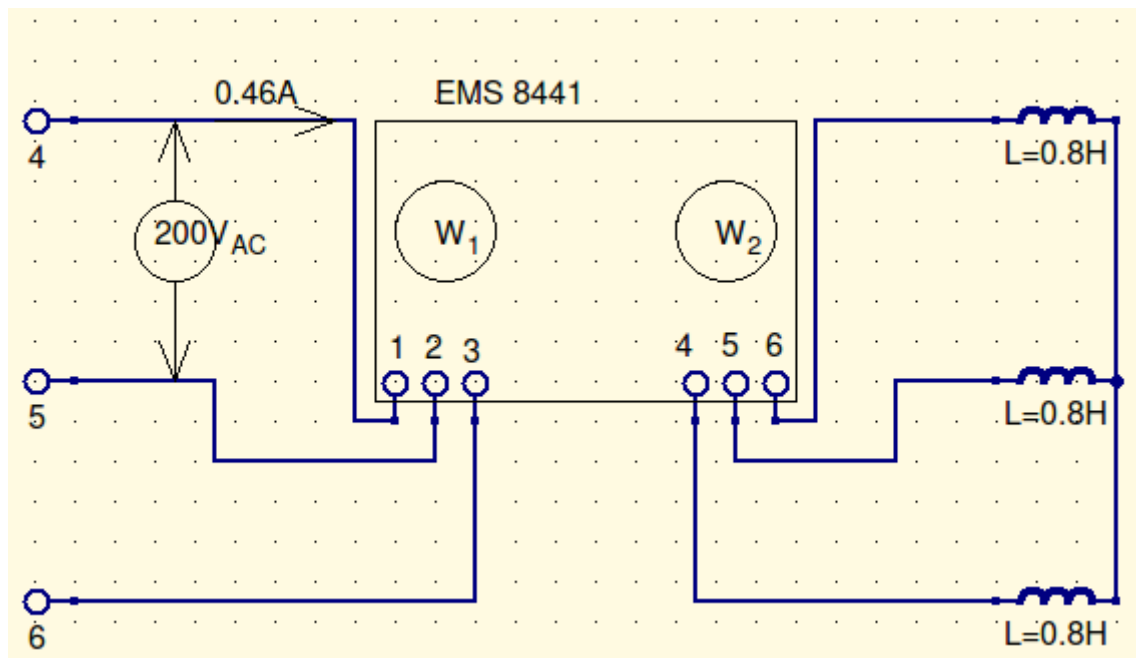


Figure 3: Inductive Circuit

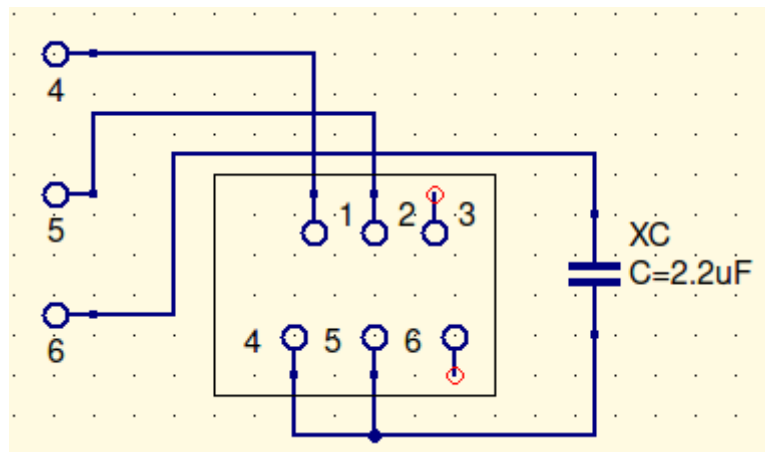


Figure 4: Capacitive Circuit

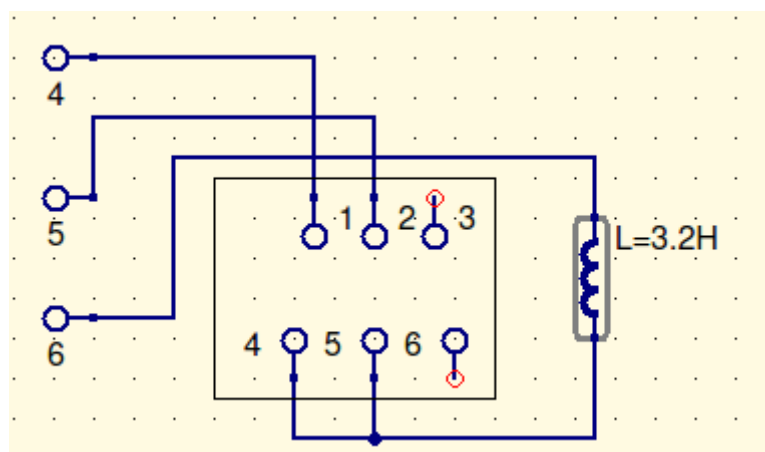


Figure 5: Inductive Circuit

Experimental Data

Part 1

Type	Current (A)	Power (W_1)	Power (W_2)	$S_{3\phi}$ (VA)	$P_{3\phi}$ (W)	$Q_{3\phi}$ (VAR)	$pf_{3\phi}$
Ω_{meas}	0.46	+68.5	+70	138.5	138.5	-1.5	≈ 1
$X_{C_{meas}}$	0.42	-40	+38	78	-2	-78	0.02
$X_{L_{meas}}$	0.46	+47	-26	76	21	73	0.28

$$P_{3\phi} = W_1 + W_2 = 68.5W + 70W \quad (1)$$

$$\underline{|P_{3\phi} = 138.5W|}$$

$$Q_{3\phi} = W_1 - W_2 = 68.5VAR - 70VAR$$

$$\underline{|Q_{3\phi} \approx -1.5VAR|}$$

$$S = \sqrt{P^2 + Q^2}$$

$$S = \sqrt{(138.5W)^2 + (-1.5VAR)^2}$$

$$\underline{|S_{3\phi} \approx 138.5VA|}$$

$$pf = \frac{P}{S} = \frac{138.5W}{138.5VA}$$

$$\underline{|pf_{3\phi} \approx 1|}$$

Part 2

Upon reading the synchronization unit.

The voltage phasor system rotates 45° clockwise from expected, due to the cap. When you swap the lines, it swaps the lamp locations. the voltage phasor system rotates 90° counterclockwise from the cap's location. When you swap lines, it swaps the lamp locations.