

EELE 354 LAB ASSIGNMENT 10:  
THREE-PHASE WYE AND DELTA CIRCUITS

## LAB OVERVIEW:

In this experiment you will work with a 120/208 V three-phase wye-connected supply feeding a three-phase resistive load. Usually, residential homes do not have three-phase service. However, this type of service is used in most industrial facilities with three-phase loads. Some commercial buildings, construction sites and ranches with high power equipment also have three-phase power. The reason is economical. More power can be transferred in a three-phase configuration than single-phase and for a lower cost. In general, heavy electrical devices operating with AC voltage (e.g., large electrical motors) operate with three-phase power.

## OBJECTIVES:

The objectives of this laboratory assignment are:

- Become familiar with both wye and delta-connected three-phase circuits.
- Reinforce lecture learning on three-phase circuit analysis.

## PRE-LAB ASSIGNMENT:

**Read through the entire lab assignment.**

There is no additional pre-lab work.



3. Calculate the expected source current, voltage, and power quantities shown in the table below for both circuits. Recall from lecture, that for a wye-connected source (or load), the phase / line voltage and current relationships are given by:

$$V_{line} = \sqrt{3}V_{phase}$$

$$I_{line} = I_{phase}$$

For a delta-connected load (or source), the phase / line voltage and current relationships are given by:

$$V_{line} = V_{phase}$$

$$I_{line} = \sqrt{3}I_{phase}$$

The phase current in each load (regardless of configuration) is calculated using Ohm's Law:

$$V_{phase} = I_{phase}Z_{phase}$$

Recall from lecture that for a purely resistive load,  $Z = R$ . There is no reactive component to the load ( $jX$ ). Thus, we will have NO reactive power delivered to the load; Only real power. For a resistive load, the power factor,  $PF$  is 1. Thus, real power,  $P$  is equal to apparent power,  $S$ . If we had a load with reactive components (inductors or capacitors), the above would not be true!

The power delivered to the load can be calculated using either phase voltage and current or line voltage and current through the equations:

$$P = 3V_{phase}I_{phase}PF$$

$$P = \sqrt{3}V_{line}I_{line}PF$$

	Load Configuration	Supply Phase Current $I_{phase}$	Supply Line Current $I_{line}$	Supply Phase Voltage $V_{phase}$	Supply Line Voltage $V_{line}$	Supply Power (using phase) $P$	Supply Power (using line) $P$
Calc.	Wye						
Meas.	Wye						
Calc.	Delta						
Meas.	Delta						

4. **Have your instructor check your schematics and calculations.**
5. Wire your three banks of resistors in a wye-connected configuration. Connect this load to the 120/208 V three-phase power supply source and the two power analyzers as dictated by your approved schematic diagram from Step 1. Notice that the available power supply is a three-phase, four-wire system. The red, yellow, and blue terminals are your three lines, while the white is a grounded neutral. The source is protected by a 25 A circuit breaker.
6. **Have your instructor check your circuit wiring. Energize your circuit.**
7. Measure and record the phase voltage and phase current (if wired correctly,  $V_a$  and  $I_a$  are representative of the balanced-source phase voltage and current) from the first power analyzer, and measure and record the line voltage and line current (if wired correctly,  $V_{a-b}$  and  $I_b$  are representative of the balanced-source line voltage and current) from the second power analyzer. Multiply the power reading on the first power analyzer by 3 (to get three phase power) and record it in the first power column. Multiply the power reading on the second power analyzer by  $\sqrt{3}$  (to get total three phase power) and record it in the second power column.
8. De-energize your circuit.
9. Repeat Steps 5 - 7 for a delta-connected load.
10. De-energize your circuit and clean-up your lab station.

Name and initial of lab partners:

Lab Partner 1: \_\_\_\_\_

Lab Partner 2: \_\_\_\_\_

Lab Partner 3: \_\_\_\_\_