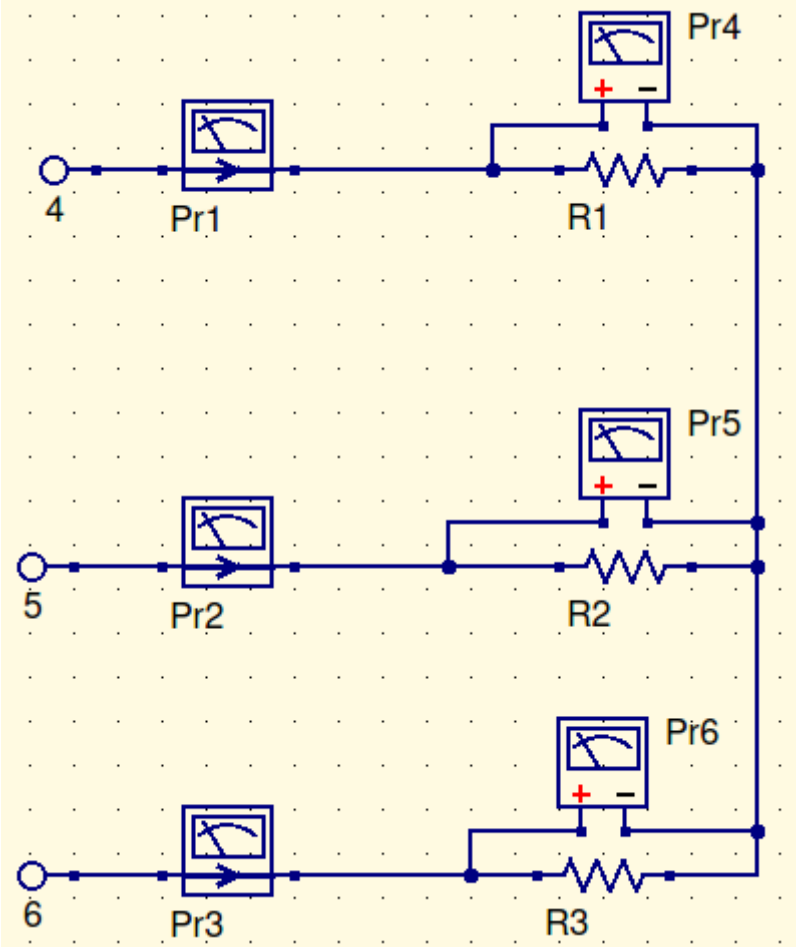
Objective

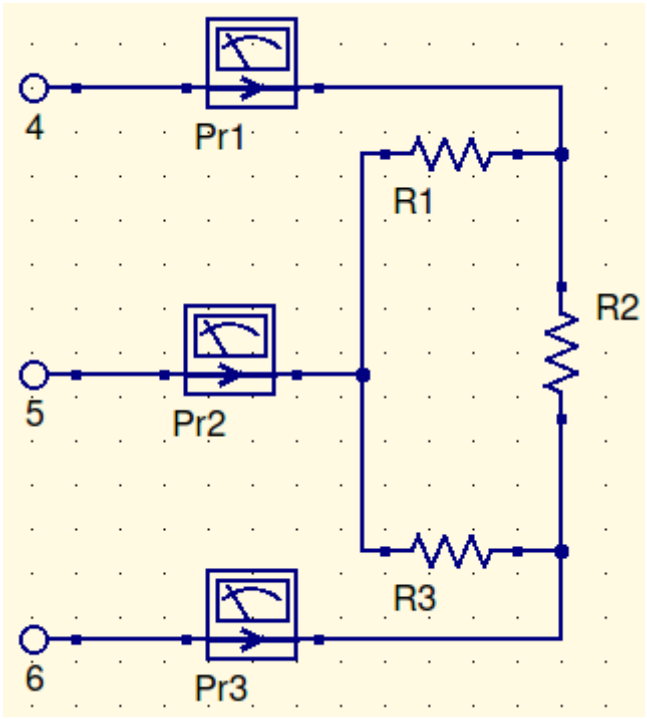
The objective of this lab was to study the relationship between voltage and current in wye and delta 3-phase circuits, as well as to determine the real, apparent, and reactive power in said circuits.

Wiring Diagram

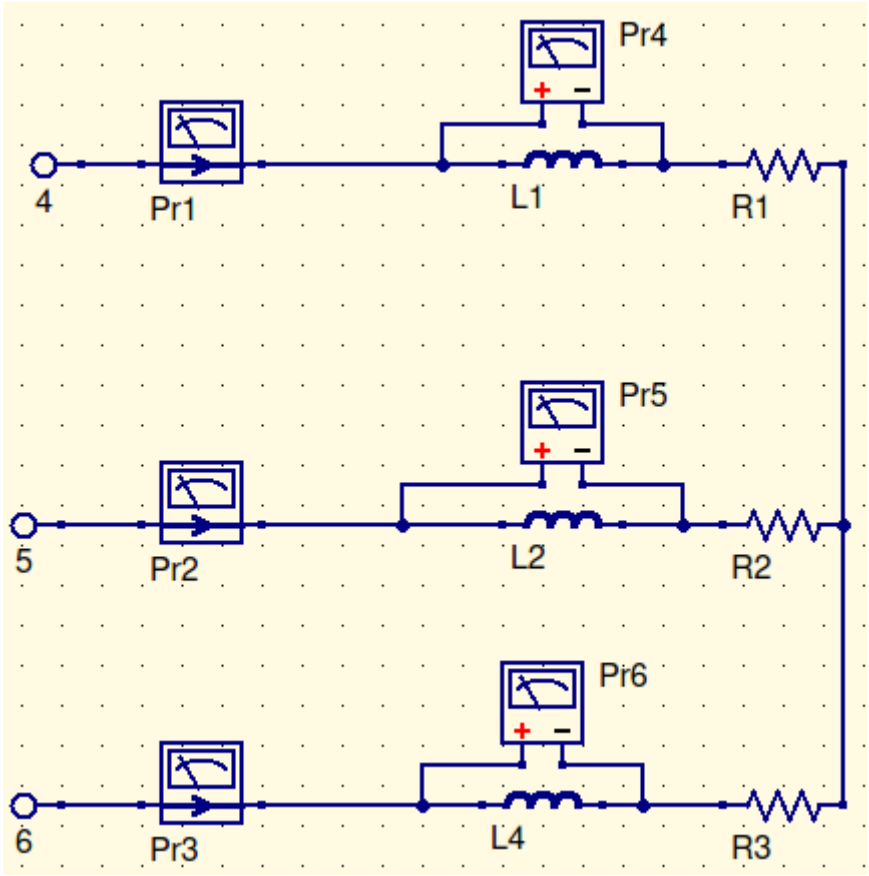
Part 1



Part 2


4
Pr1
R1
R2
5
Pr2
R3
6
Pr3

Part 3


Pr4
4
Pr1
L1
R1
Pr5
5
Pr2
L2
R2
Pr6
6
Pr3
L4
R3

Procedure

Part 1

1. Connect the above wye circuit using the resistance and meter modules. **DO NOT** connect to the neutral.
2. Set each resistance to 400Ω per phase. Use ohmmeter to measure the phase resistance (including the connecting cables).
3. Turn on the power supply and adjust for $208V_{AC}$ line voltage.
4. Measure and record the voltages across the current through the 3 load resistors.
5. Calculate the total power delivered to the three loads.

Part 2

1. Connect the delta circuit shown above.
2. Set each resistance to 400Ω. Before turning on the power suppluy, call the instructor or the TA to inspect your connections.
3. Turn on the power supply and adjust for $120V_{AC}$ line voltage.
4. Measure and record the line voltages.
5. Calculate, using measured data, the total 3-phase power.

Part 3

1. Connect the above wye circuit shown below. **DO NOT** connect the neutral.
2. Set each resistance to 400Ω and each inductance to $0.8H$.
3. Turn the power supply on and adjust for $208V_{AC}$.
4. Measure and record the line currents and the voltages across each inductive load.
5. Measure and record the voltages across each resistor.
6. Using measured date, calculate the real power on each load.
7. Calculate the total 3-phase real power, the reactive power in each load, the total 3-phase reactive power, the total 3-phase apparent power and the power factor.

Experimental Data

Part 1

Phase	Measured Resistance (Ω)	Line Currents (A)	Load Voltage (V)	Per ϕ Power (W)
1	415	0.34	120	40.8
2	413	0.35	120	42.0
3	414	0.34	120	40.8

Total Three-phase power: $123.6W$

Part 2

Phase	Resistance (Ω)	Currents (A)	Per ϕ Power (W)
1	400	0.5	100
2	400	0.6	144
3	400	0.55	121

Total three-phase power: $365W$

Part 3

Phase	Measured Current(A)	Inductive Voltage(V)	Resistive Voltage(V)
1	0.25	67.5	89
2	0.26	67.5	89
3	0.25	67.5	89

Phase	Real Power (W)	Reactive Power (VAR)	Apparent Power(VA)	Power Factor
1	22.25	16.875	27.9	0.80
2	23.14	17.550	29.0	0.80
3	22.00	16.875	27.7	0.79

Three Phase Real Power: $67.39W$

Three Phase Reactive Power:$51.625VAR$

Three Phase Apparent Power:$84.6VA$

Power Factor: 0.80

Calculations and Analysis

Power Calculation: Part 1

$$R_{theory} = 400\Omega; I_{in} = 0.34\bar{3}A \quad (1)$$
$$P = I^2R = (0.34\bar{3}A)^2(400\Omega)$$
$$P = 47W$$
$$P_{total} = 141W$$

Power Calculation: Part 2

$$P = I^2R; R = 400\Omega; I = 0.5A; \quad (2)$$
$$P = (0.5A)^2 \times 400\Omega$$
$$P = 100W$$

Power Calculation: Part 3

$$P = IV;\ Q = IV_{reactive} I = 0.25A;\ V_1 = 67.5V\angle 90^\circ;\ V_2 = 89V\angle 0^\circ \quad (3)$$
$$Q_1 = 0.25A \times 67.5V_{reactive}; P_1 = 0.25A \times 89V$$
$$Q_1 = 16.875VAR; P_1 = 22.25W$$
$$S = \sqrt{P^2 + Q^2}$$
$$S = \sqrt{(22.25W)^2 + (16.875VAR)^2}$$
$$S \approx 27.9VA$$
$$pf = \frac{P}{S} = \frac{22.25W}{27.9VA}$$
$$pf = 0.80$$

Questions

1. Redo the calculations in part 1 with the ideal resistances of 400Ω. How do these results compare to the actual? If the values are different, explain the differences.

$$R_{avg_{meas}} = 414\Omega \quad (4)$$
$$I_{avg_{meas}} = 0.34\overline{3}A$$
$$P_{avg_{meas}} = 44.8W$$
$$P_{total_{meas}} = 146W$$

These numbers are within error of the measured values.

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 $123.6W$. For part 2 of the lab, we had a three phase power of $365W$. For part 3 of the lab, we had $84.6VA\ at\ 0.80pf$.