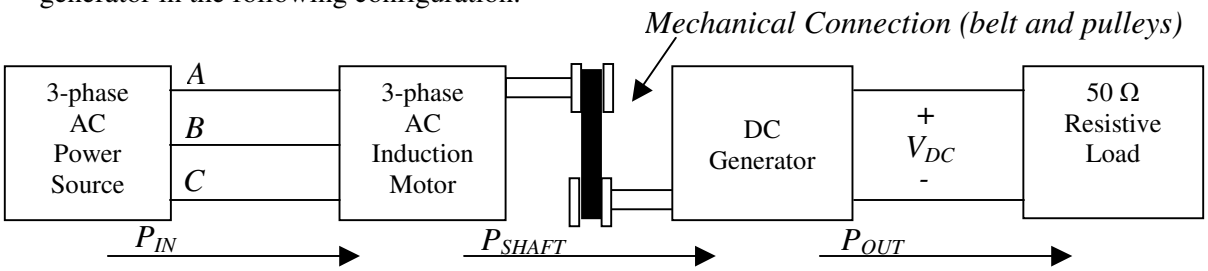
Basic Measurements -- Lab Review Sheet

Objectives:

The main objective of this lab will be to introduce the lab bench and measurement equipment you will be working with for the rest of the semester. You should become familiar with the equipment we use in this course as well as investigating the power flows in a simple system.

Setup:

The system for this experiment consists of a 3-phase AC induction motor and a DC generator in the following configuration.



In general a motor is a device that converts electrical energy to mechanical energy and a generator converts mechanical energy to electrical energy.

In the above diagram we have electrical energy following into the motor from the source. The motor converts this energy into mechanical energy and puts it out to the belt and pulley system. The energy then flows into the DC generator where it is converted back to electrical energy (although it is now DC instead of AC). The load resistor then dissipates the energy leaving the generator.

If your torque meter is reading a negative value it is because the motor is spinning in the opposite direction from what is expected. To reverse the spin of the motor swap any 2 of the 3 phases. This needs to be done because the torque meter is less accurate in the negative range.

The equations for power losses and efficiency of this system are as follows.

$P_{IN} = P_{3\phi} = 3 * P_{1\phi}$	Converts single-phase wattmeter measurement to 3 phase
$P_{OUT} = P_{DC} = V_{DC} * I_{DC}$	DC power loss in load
$P_{LOSS} = P_{IN} - P_{OUT}$	Power lost from input to output
$\eta = \frac{P_{OUT}}{P_{IN}}$	System efficiency
$\omega = \frac{2\pi}{60} N$	Conversion from RPM to rad/sec
$P_{SHAFT} = \tau * \omega$	Mechanical power in belt and pulley system
$\lvert S_{1\phi} \rvert = \lvert V \rvert * \lvert I \rvert = V_{AC} * I_{AC}$	Single phase AC apparent power
$\lvert Q_{1\phi} \rvert = \sqrt{\lvert S_{1\phi} \rvert^2 - \lvert P_{1\phi} \rvert^2}$	Single phase AC reactive power
$\theta = 2\pi * t * f$	Power angle in rad, f = 60 Hz, t = delay from V to I in sec
$pf_{DISP} = \cos(\theta)$	Displacement power factor
$pf = \frac{P_{1\phi}}{S_{1\phi}}$	Power factor
$V_{LL} = \sqrt{3} * V_{LN}$	Line-Neutral to Line-Line Voltage conversion