Experiment #8: Single Phase Induction Motor
(Using the Three Phase Induction Motor)

The single phase induction motor (IM) is the most commonly used motor in major home appliances. It is very rugged, cheap to make, and hardly ever breaks down! It is however, much noisier than its big brother the three phase induction motor. It also has problems getting started. It has no starting torque without special means of getting it started.

In this experiment we use the three phase induction motor to perform two tasks: 1) to explore the speed-torque characteristic to negative speeds, and 2) to excite only one phase and see how a single phase motor would behave with no devices to get it started. The purpose of the experiment is to derive the torque-speed curves of the single phase IM. Since you are already experienced in connecting the machines in this experiment, the description will be very brief. You will also need results from your previous experiments on the three phase IM. Your notes from the material covered in the lecture will be very helpful, and so will be the books on reserve in the library. In a future experiment you will study a self-starting single phase IM.

Experiment Outline:

**Negative Speed Torque-Speed Characteristic:**

1. Mechanically connect the three phase IM to the DC dynamometer. Make sure to connect the arm of the dynamometer as explained in class so that the dynamometer can read both positive and negative torque. Connect the IM to a three phase power supply and measure power, voltage and current. Connect the DC machine to a DC supply so it runs as a separately excited motor and measure its voltage (field and armature). TURN ALL VOLTAGE SOURCES TO ZERO.
2. Apply three phase power to the IM and check its direction of rotation. Turn the AC power down and OFF.
3. Apply DC power to the DC dynamometer so it runs as a DC motor. **Check the direction of rotation, make sure to change connections as necessary so it rotates in the opposite direction to that found in step 2.** Turn all power down to zero volts.
4. Make sure the AC power is down to zero, and excite the DC motor up to the synchronous speed of the IM (1800 rpm). The speed of the motor can be varied by changing the field voltage while keeping the armature voltage constant. **DO NOT FORGET ABOUT THE RUNAWAY SPEED CONDITION WHICH MUST BE AVOIDED BY PROPER OPERATING PROCEDURES AS DISCUSSED IN THE LECTURE.**
5. Slowly apply AC power to the IM till full voltage is applied (same value as in your previous experiment on the IM). Take readings of power, speed, current and voltage to the IM.
6. Gradually reduce the speed, and take more readings as in step 5. Be careful as you get close to zero speed: observe and do not exceed rated current to the IM by more than 25%.
7. Power down (BE CAREFUL TO AVOID RUNAWAY SPEED CONDITIONS).

**Running on only one phase:**

1. Connect single phase AC power source (set at zero volts) to any two terminals of the IM. ASK PERMISSION OF THE INSTRUCTOR TO GO TO THE NEXT STEP.
2. Apply AC power to the IM. What happens? Make sure not to exceed machine ratings.
3. Power down, turn power off.
4. Connect the dynamometer to DC sources so that it can be operated as a motor (as was done previously). Make sure the AC power is OFF. CHECK WITH THE INSTRUCTOR BEFORE GOING TO THE NEXT STEP.
5. Apply DC voltage so that the DC motor is going at the AC synchronous speed (1800 rpm) and note the direction of rotation. Now apply AC voltage to the IM to a level close to its operating value. Note the voltage, current and power to the IM and do not exceed any of its rating AT ALL TIMES. Read the torque value.
6. Reduce the power to the DC motor, and power it down properly. Apply a suitable resistive load to the DCD armature, and power its field. Slowly increase the field current in order to load the AC motor. Repeat for several values of load going down in speed from near synchronous speed.
7. Continue to reduce the speed (by increasing the load) in small steps. How far could you go?
8. Power down and turn power off.
9. Now connect the DCD as a DC motor so it will turn in the direction opposite to that in step 5.
10. Apply DC power and verify that the DC motor is turning in the opposite direction from that in step 5.
11. Repeat the data collection (steps 5, 6, 7, and 8) for this direction of rotation.
12. Power down in a proper manner.