

ECE 3354 – Power Systems Laboratory

<p>Experiment MATLAB Induction motor: Three Phase Induction Machines</p>

Date of Experiment

Month/Day/Year

Prepared By:

Author's Name

Partner's Name

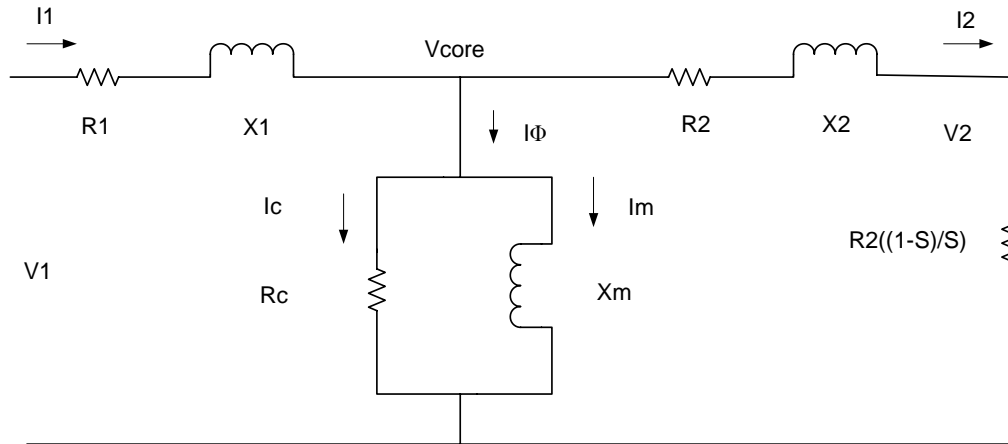
Prepared For:

Instructor's Name

Objective

State what the purpose of the experiment is. Brief, and don't copy manual's words.

1. Derive an equivalent circuit like Figure 5 for the tested machine. Assume a NEMA "D" motor. $X1 = X2'$ in the equivalent circuit.



Remember $SLIP = (SPEED_{syn} - SPEED_m) / SPEED_{syn}$

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

$$T_{dev} = \frac{1}{\omega} I_2^2 \frac{r'_2}{slip} (1 - slip) \text{ for one phase}$$

$$R_{sc} = P_{sc} / I_{sc}^2$$

$$X_{sc} = Q_{sc} / I_{sc}^2$$

$$R_1 = 2.3\Omega$$

$$R_2 = R_{sc} - R_1$$

$$X_1 = X_2 = X_{sc} / 2$$

$$pf = P/S$$

$$Z_1 = R_1 + j X_1$$

$$V_{core} = V_{oc} - (I_{oc})(Z_1)$$

$$P_{core} = P_{oc} - R_1(I_{oc}^2)$$

$$Q_{core} = Q_{oc} - X_1(I_{oc}^2)$$

$$R_c = (V_{core})^2 / P_{core}$$

$$X_m = (V_{core})^2 / Q_{core}$$

Calculate all values and show work.

2. Plot the output torque vs. speed and current I_1 vs. speed from the experiment data.
Note: Plot the three different voltage cases for torque on the same plot. Plot the three different voltage cases for current I_1 on the same plot. **Include plots.**

3. Write a matlab program using the equivalent circuit. You must use the equivalent circuit in figure 5(b) include all branches and components R_1 , R_2 , R_C , X_m , X_1 , and X_2 . Plot torque vs. speed in RPM curves and current vs. speed in RPM for 80%, 90% and 100% of rated voltage as speed varies from 1 to 1800 RPM. **Note:** Plot the three different voltage cases for output torque on the same plot. **Hint** use **figure** command to plot the three curves on the same plot. Plot the three different voltage cases for current on the same plot. Compare the calculated data with the measured data include MATLAB program listing and plot output. **Hint** the fluke meters in the lab measure the magnitude of voltage and current.

Include all plot output and program listing.

4. Change the equivalent circuit by Increasing the resistor R_2 in the rotor by 1Ω , then 2Ω of the equivalent circuit and recalculate the curves as above. This new set of curves is equivalent to adding resistance to the rotor of the machine. **Note:** **Plots** : Plot at 100% rated voltage the three different R_2 cases for output torque on the same plot. Plot at 100% rated voltage the three different R_2 cases for the I_1 current on the same plot. **Hint** let $R_2 = R_2 : R_2 + 1 : R_2 + 2$.

Include all plot output and program listing unless the program above produced these plots.

5. Comment on the differences noted between using stator voltage control and adding rotor resistance, to control the speed of the motor. **Keep your answers short 5 lines or less.**

6. Explain why the induction motor slows down as the load is increased.
Keep your answers short 5 lines or less.

7. Explain how the three-phase induction motor develops starting torque.
Keep your answers short 5 lines or less.