ECE 500-02 **NAME: _____**
ELECTRIC MACHINES AND DRIVES

FINAL EXAM

DUE: BLACKBOARD FOR DUE DATE AND TIME.

SHOW ALL YOUR WORK IN A NEAT AND CLEAR MANNER TO GET MAXIMUM POINTS.
USE ONLY THE FRONT SIDE OF EACH SHEET OF PAPER.
WRITE YOUR NAME ON EACH PAGE, AND NUMBER YOUR PAGES.

I, _____ (PRINT) HAVE COMPLETED THE FOLLOWING TASKS ON MY OWN, WITHOUT THE ASSISTANCE OR GUIDANCE OF ANYONE ELSE, EITHER IN OR OUTSIDE OF MY CLASS.

SIGNATURE: _____, DATE: _____

PROBLEMS

1.) *WORTH 50 POINTS*

A PMAC motor has the following specifications: 2 pole; Balanced 3 phase; $K_t = K_e = 0.75$ in MKS units; Ls = 25 [mH]; $R_s = 0.25\ \Omega$; $J_m = 0.03$ [kg*m^2].

This motor is driving a load of inertia $J_L = 0.05$ [kg*m^2], and a load torque $T_L = 2$ [Nm] to bring the system from rest to a speed of 2,000 [RPM] in t_1 [sec.]; assume $T_{em} = 7$ [NM].

- Calculate *(by hand)* and plot (*using matlab or equivalent*) the speed $\omega_m(t)$ and position $\theta_{is}(t)$ as functions of time during this interval of $0 < t < t_1$ [sec.].
- Calculate *(by hand)* and plot (*using matlab or equivalent*) the voltage $v_a(t)$ and current $i_a(t)$ as functions of time during this interval of $0 < t < t_1$ [sec.].

2.) *WORTH 40 POINTS*

A permanent-magnet dc motor is to be started under a loaded condition. The load-torque T_L is linearly proportional to the speed and equals 3 [Nm] at a speed of 2850 [RPM] and $J_L = 0.05$ [kg*m^2]. We can neglecting L_a and friction. The motor current must not exceed ±12.5 [A]. Calculate and plot the voltage $v_a(t)$, which is to be applied such the motor follow the following speed profile.

Motor Specifications: $J_m = 0.03$ [kg*m^2]; $K_t = K_e = 0.35$ in MKS units; $R_a = 0.25$ [Ω];

- Interval #1: From rest to 2850 [RPM] as quickly as possible, $0 < t \leq t_1$.
- Interval #2: Maintain the 2850 [RPM] for 5 seconds, $t_1 < t \leq t_1+5$ [sec.].

- Interval #3: From2850 [RPM] back to rest as quickly as possible, $t_1+5 < t \leq t_2$ [sec.]. You do not need to consider $t > t_2$.

3.) *Worth 10 Points*

Validate your results for Problem 2 using Matlab/Simulink, or an equivalent simulation tool. Provide narrative explaining how your results validate your analysis. Include the "code," and plot. Remember that the scopes in Simulink have a history tab, in that tab you should uncheck that box that limits the data to the last 5000 elements.