Fall 2005 EE595S
Homework Assignment Number 5

Note: Since this will not be collected, there is no due date. It is recommended that this be completed before we start the next set of lecture notes.

Problem 1
Be sure to understand the concept of maximum torque per amp control of PMSMs, and how all the operating limits were derived. There will be questions on the exam relating to the derivation of these.

Problem 2
Verify (3.5-15).

Problem 3
Consider an indirect current control as shown in Fig. 3.5-1 and 3.5-2 of [2]. Suppose the switching frequency is 20 kHz, and that the low pass filter has a cut-off frequency of 2 kHz. Further suppose that $r_s = 0.2$ Ohms. Select an appropriate value of K and τ. Plot the magnitude and phase of the transfer function between i_{qs}^{r*} (input) and i_{qs}^{r} (output) as well as Δv_{qs}^{r} (input) and i_{qs}^{r} (output).

Problem 4
Verify (4.5-9) in [1].

Problem 5
If you were an induction machine, what kind of an induction machine would you be and why ?

Problem 6
Starting with (4.6-4) derive (4.9-14) in [1].

Problem 7
Reproduce the results shown on page 35-40 of the induction motor lecture notes.

Problem 8
Consider a squirrel cage induction machine operating in the steady state. Suppose that the a-phase current is i_{dc}, the b-phase current is $-i_{dc}/2$, and the c-phase current is $-i_{dc}/2$. These currents are constant (i.e. dc). Using the q-d model in the stationary reference frame with $\theta = 0$, derive an expression for torque in terms of P, L_M, L_{rr}', r_r', i_{dc}, and ω_r.

Reference

[1] *Analysis of Electric Machinery and Drive Systems*
[2] *Analysis and Design of Permanent Magnet Synchronous Machines*