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Title

EXERCISE 1: DC MACHINE MODELING

Course Name

EE-565 Industrial Electronics II

1 GUIDELINES

Consider the DC machine described in Tab. 1 and answer the following questions:

Table 1 Machine parameters

P_n	2 300 W	$U_{a,n}$	220 V	R_a	1.6 Ω	$U_{f,n}$	110 V	R_f	125 Ω	N_f	5	J	0.05 N m s
$\Omega_{m,n}$	50π rad/s	$I_{a,n}$	13 A	L_a	50 mH	$I_{f,n}$	0.88 A	L_f	37 H	k_e, k_m	0.2365	k_F	0.005 5 N m s

2 TASKS DESCRIPTION

1. Verification of the PLECS model: display here your DC machine 'PLECS Model' (with the 'PWM' block) alongside the 'Mathematical Model'. Your PLECS model should run with the torque, armature and excitation voltage profiles provided in the skeleton. Display scope of the model with the Mathematical Model matching the PLECS Model profiles. How did you model the effect of the converter modulation itself ?
2. Plot the steady state torque/speed characteristic of a generic DC machine. Compute the machine start-up torque and current and compare it with the simulation result. Compute the machine no-load speed and compare it with the model (ignore friction). What is the slope of the steady state torque/speed characteristic? Justify your results.
3. Calculate the maximum torque the machine can generate, without exceeding nominal armature and excitation currents. What is the corresponding speed of the machine under nominal supply and excitation voltage?
4. Calculate the maximum torque the machine can generate without exceeding nominal armature and excitation current, but with half the armature voltage (Ua = 110 V). What is the corresponding speed of the machine? Justify your results.
5. Calculate the maximum torque the machine can generate without exceeding nominal armature current, at nominal armature voltage, but with half the excitation voltage (U_f = 55 V). What is the corresponding speed of the machine? Justify your results.
6. Calculate the steady state speed with a load torque of 8 N m, considering friction and under nominal supply conditions?