

ECE 331 - Homework #11

DC Shunt Motors

DC Shunt Excited Motors:

1) Assume a DC motor with $V_t = 120\text{VDC}$, $R_f = 150\ \Omega$, $R_x = 3\ \Omega$, $N_f = 30$, $N_a = 30$, and a reluctance of 1000. Plot the speed vs. load torque relationship.

Note: The torque constant is related to the current I_f :

$$I_f = \frac{120\text{V}}{200\ \Omega} = 0.6\text{A}$$

$$\Phi_P = \frac{N_f I_f}{Rel} = \frac{(30)(0.6)}{800} = 0.0225\text{Wb}$$

$$K_t = \frac{2N_a \Phi_P}{\pi} = 0.4297 \frac{\text{V}}{\text{rad/sec}}$$

2) For the motor in problem #1, plot

- Speed vs. power out
- Speed vs. efficiency

3) Increase the field current by 3x (reduce R_f to 50 Ω). Plot

- Load torque vs. speed
- Speed vs. power out
- Speed vs. efficiency

4) Design a DC shunt excited motor. The motor is to produce 15kW with $V_t = 120\text{VDC}$ at 3000 rpm. Specify R_f , R_x , K_t .

5) Determine the efficiency of the DC motor you designed for problem #4 at this operating condition.

