ECE 331 - Homework #12

DC Series-Shunt & Series Motors - Due Monday, May 5th, 4PM

Problem 1-3) Assume a DC Series motor. Let Vt = 120VDC, Rf = 150 Ohms, **Rx= 0.3 Ohm**, Nf1= 30, Na = 30, and a reluctance of 1000.

The torque constant is related to the current If:

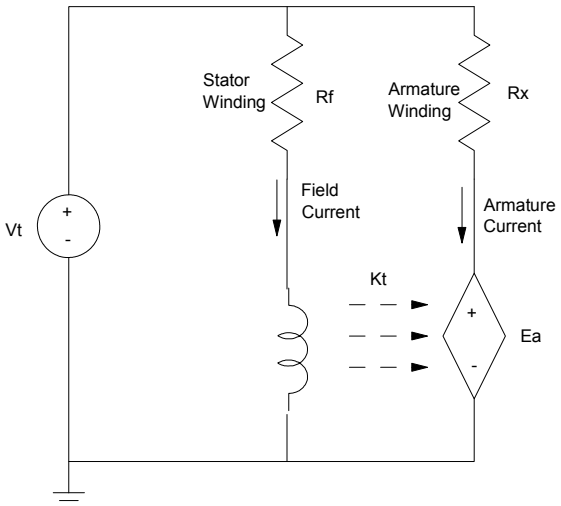
$$I_f = \frac{120V}{150\Omega} = 0.8A$$

The series winding has 1/300 of the number of turns, and likewise has 1/30th of the effect of If. The effecitve field current is then

$$I_f = 0.8A$$

$$\Phi_P = \frac{N_f I_f}{Rel} = \left(\frac{(30)(0.8A)}{1000}\right) = 0.024Wb$$

$$K_t = \frac{2N_a\Phi_p}{\pi} = 0.4584\ \frac{Nm}{A}$$



1) For this motor, assume the load varies from 0 to 20Nm. Compute and plot:

- speed vs. load
- speed vs. power
- power vs. efficiency

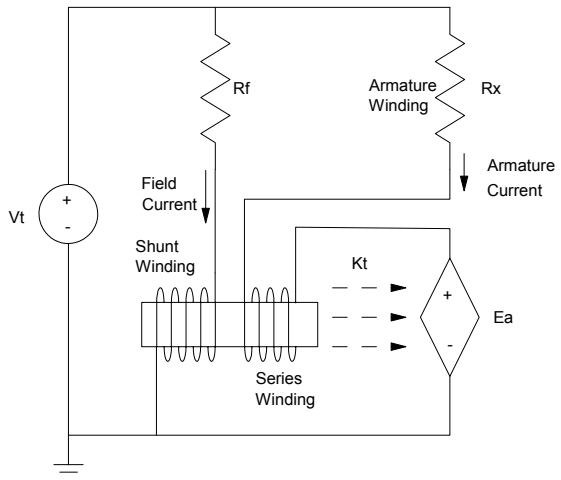
2a) Assume the motor from problem #1 is modified into a series-shunt motor with field weakening so that

$$K_t = \left(0.4584 - \frac{I_a}{1000}\right)\ \frac{Nm}{A}$$

Compute and plot:

- speed vs. load
- speed vs. power
- power vs. efficiency

2b) Assume the load torque is related to speed. Is this a stable solution?



3) If you weaken the field too much, the motor speeds up as you apply more load.

What happens to the motor if you apply a load related to speed (such as friction)?

4) Assume the motor is wound in a series configuration so that

$$K_t = \left(\frac{I_a}{1000}\right) \frac{Nm}{A}$$

Compute and plot:

- speed vs. load
- speed vs. power
- power vs. efficiency

5) What happens to this motor if the load is removed?