ME333 Introduction to Mechatronics
Quiz 8: Brushed DC Motors

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1. Write the motor power equation, derived in terms of V, τ, I, ω, L, and R:

$$IV_{motor} = \tau\omega + I^2R + LI\frac{dI}{dt}$$

transcribed: tau*omega + I^2*R + LI dI/dt

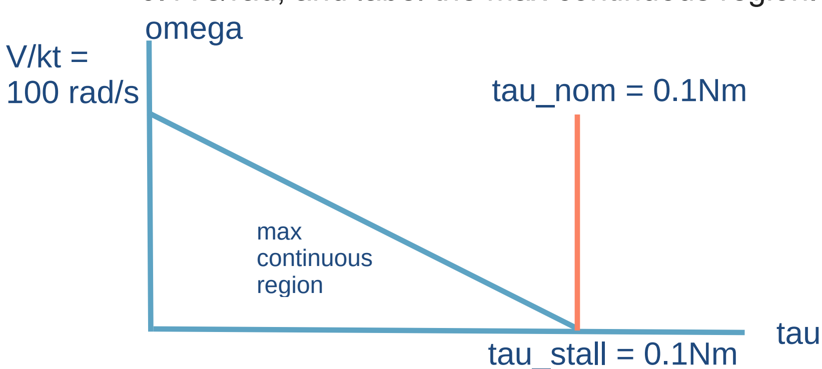
2. Describe what each part of the equation in #1 relates to:

Tau*omega: power used to rotate the motor

I^2*R: power dissipated through heat/resistance

LI dI/dt: power stored in motor inductance--resists instantaneous changes in I

3. Draw the speed-torque curve for a motor at 10V, with R = 10ohm, P = 10W, kt = 0.1Nm/A = 0.1Vs/rad, and label the max continuous region.



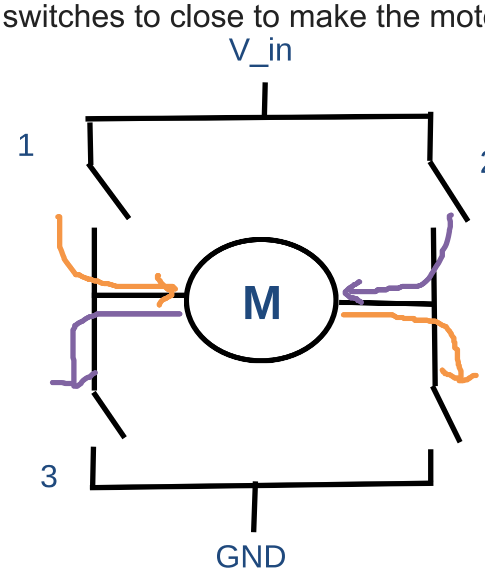
No-load speed:
omega = V/kt - R/kt^2*tau
omega_max = 10V / 0.1Vs/rad
omega_max = 100 rad/s

Stall torque:
0 = V/kt - R/kt^2*tau
tau = kt*V/R
tau_max = 0.1 Nm/A * 10V/10Ohm
tau_max = 0.1Nm

Find current from P_heat:
P=I^2*R
I^2=P/R = 10W / 10Ohms
I = 1A

Nominal torque:
kt = tau/I
tau = kt*I
tau = 0.1Nm * 1A
tau_nom = 0.1Nm

4. Draw a motor connected to four switches, built in an h-bridge configuration. Label the switches that would need to close to make the motor rotate in one direction (either CW or CCW) and the switches to close to make the motor rotate in the other direction.



To make the motor rotate in one direction (ex. CCW):
close switches 1 and 4

To make the motor rotate in the other direction (ex. CW):
close switches 2 and 3