ME729 Advanced Robotics - Homework #5 Solution

3/5/2018

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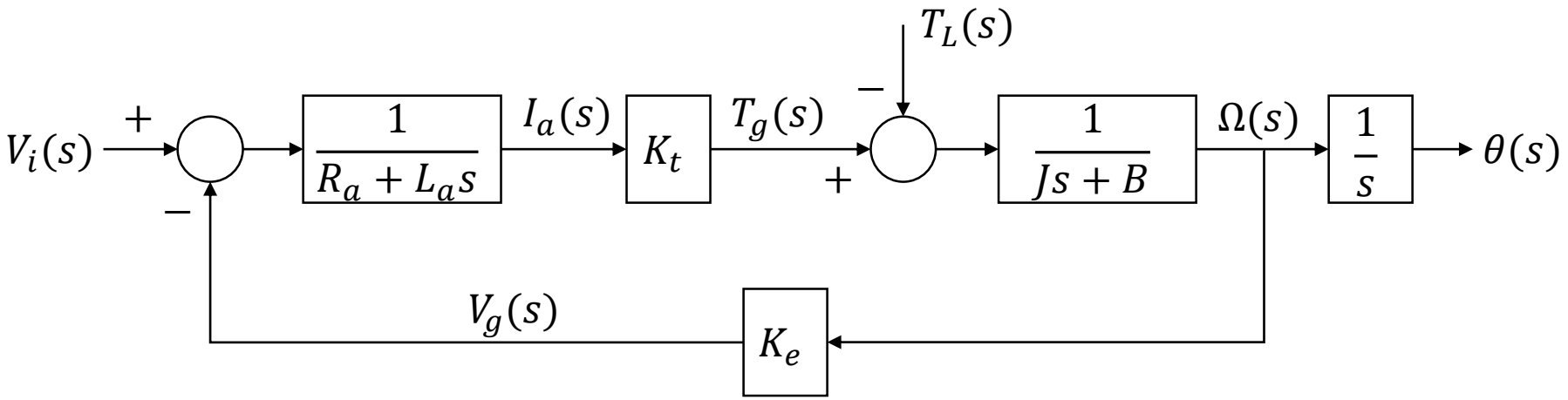
Email me *a pdf file* by next Monday 6 p.m.

1. There is a DC motor's block diagram. V_i, R_a, L_a, K_t, T_L, J, B, and K_e are a input voltage, an armature resistance, an armature inductance, a torque constant, a load torque, a moment of inertia of the rotor, and a back-EMF constant, respectively. In addition, I_a, T_g, Ω, θ, and V_g are an armature current, a generated torque, the shaft angular velocity, the shaft angular position, and a generated voltage, respectively. [5]



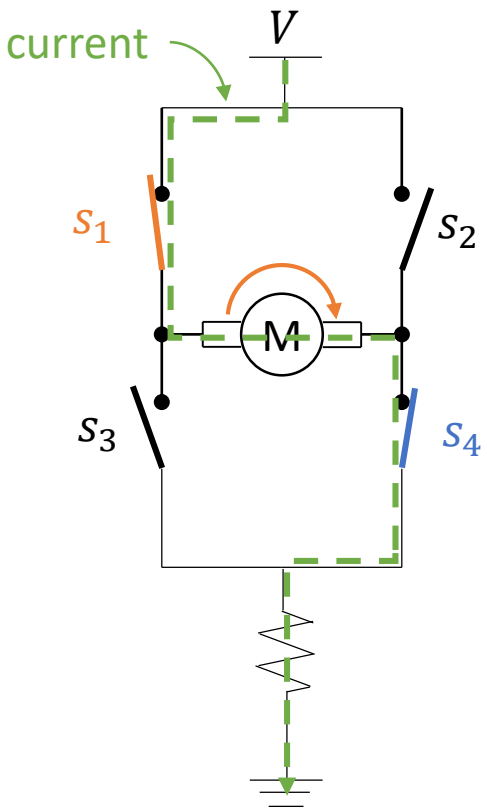
1) Calculate the following transfer function, if $T_L(s) = 0$. [3]

$$\frac{\theta(s)}{V_i(s)} = \frac{K_t}{s\{JL_a s^2 + (JR_a + L_a B)s + R_a B + K_t K_e\}}$$

2) Explain why is the V_g generated while the motor is running. [2]
When the coil of a motor is turned, magnetic flux changes, and the V_g (or an EMF) is induced. The motor thus acts as a generator whenever its coil rotates. That is, when a motor is doing work and its shaft is turning, the V_g is generated.

2. A motor is rotating about clock-wise direction. If you want to stop the motor rotation, there are five combinations of the switches. Find out the combinations. [5]

[Clock-Wise rotation]



s_1	On
s_2	Off
s_3	Off
s_4	On

stop

s_1	Off
s_2	Off
s_3	Off
s_4	Off

s_1	On
s_2	Off
s_3	Off
s_4	Off

s_1	Off
s_2	Off
s_3	Off
s_4	On

s_1	On
s_2	On
s_3	Off
s_4	Off

s_1	Off
s_2	Off
s_3	On
s_4	On