Exercise 3.1

Consider a permanent magnet DC motor; in particular, the DC motor model given in the Simulink model dcMotorSim.slx with parameters given in dcMotorPar.m.

1. Apply a cascade control to the system (DC motor in Simulink) with current, velocity, and position control, where each controller has the form

   $$u_i(s) = K_i e_i(s)$$

   and determine the three gains $K_1, K_2, K_3 \in \mathbb{R}$. Use the procedure from slide 27 to find the gains (just try some different values and observe the changing behavior of the system).

2. Compute the closed loop transfer function (symbolically). Assume that ω does not affect the current control loop.

3. Determine if the system has a steady state error, when applying a constant reference signal?

4. Add a load torque

   $$\tau_l = \frac{1}{2}\cos(\theta)$$

   to the DC motor in Simulink, and simulate the system.

5. Derive a linearized model of the DC motor with the load τ_l (only open-loop system).