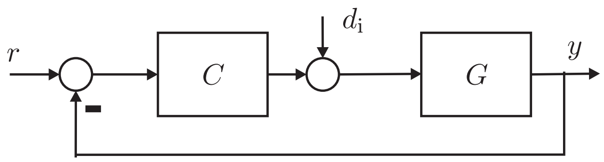
Exercise Sheet 2

Problem 5:

Consider the feedback loop with the reference signal r and the input disturbance signal d_i. The controller and plant transfer functions are

$$C(s) = K\,\frac{s+4}{s+1} \qquad G(s) = \frac{1}{s}$$



a. Is the feedback loop internally stable for $K = 1$ and $K = 14$?

b. Which steady-state output for reference steps do you expect for $K = 1$ and $K = 14$?

c. Which steady-state output for the response to disturbance steps do you expect for $K = 1$ and $K = 14$?

d. Simulate the reference step response and disturbance step response for $K = 1$ and $K = 14$ and verify the results in **a.** to **c.**

e. Now compare the controllers for $K = 1$ and $K = 14$. Which controller achieves better reference tracking/disturbance rejection?

Problem 6:

We perform a speed control experiment with a DC motor.

a. Download the Simulink model of the DC motor from the course webpage. The input signal is the supply voltage u and the output signal is the rotational velocity ω. In addition, there is a disturbance signal T_L which represents a load torque.

b. Perform step responses for u (1 V) and M_L (10^{-3} Nm) and plot the result. Use the parameter values in the following table ($J_a = J_L + J_M$).

J_L	J_M	R_a	L_a	$c\Phi_F$
$2 \cdot 10^{-6}$ kg m^2	$1 \cdot 10^{-6}$ kg m^2	10 Ω	2 mH	$0,05\ \frac{Nm}{A}$

Put the DC motor plant model in a feedback loop. Choose $C(s) = 1781 \cdot \dfrac{8.14 \cdot 10^{-4}\,s + 1}{s}$. Observe the step response to a reference step $r = 20$ rad/sec and a disturbance step of M_L (10^{-3} Nm).

c. Is the feedback loop internally stable?

d. Are the closed-loop poles complex or real? Justify your answer!