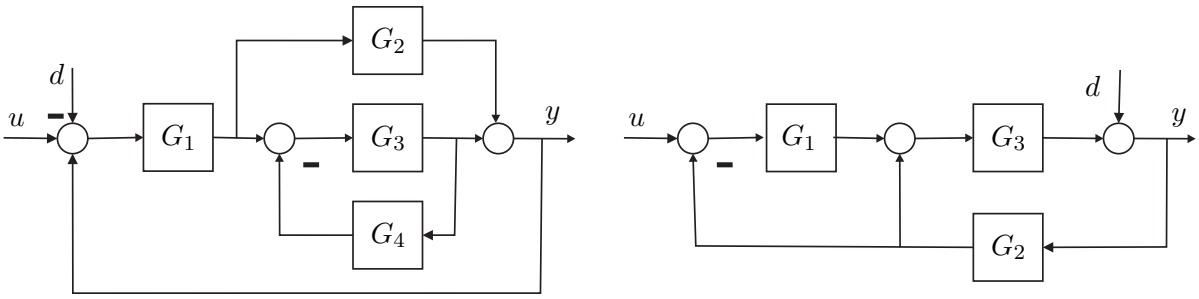
Laboratory 3: Block Diagrams

Problem 7:

The following two block diagrams are given. Compute the transfer functions $T(s) = \dfrac{Y(s)}{U(s)}$ and $S(s) = \dfrac{Y(s)}{D(s)}$ for both block diagrams.

Hint: Use block diagram simplification.



Problem 8:

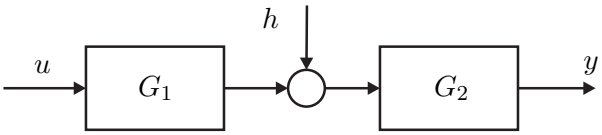
The vehicle suspension system is described by the following differential equation.

$$\ddot{x} = \frac{c}{m}(h - x) + \frac{A_H\, K}{m} u$$

We also recall that x is the displacement signal, u is the input voltage and h describes the street surface.

a. Determine a block diagram of the vehicle suspension system.

b. Simplify the block diagram such that you obtain the form in the following figure.



Write down the transfer functions $G_1(s)$ and $G_2(s)$.

c. Simulate the block diagram in **a.** with an input step of $u = 10\,\sigma(t)$ $(h = 0)$

Hint: Recall the parameters $m = 1000\,\text{kg}$, $c = 10\,000\,\text{N/cm}$, $g = 10\,\text{N/kg}$, $A_H = 15\,\text{cm}^2$, $K = 100\,\text{N/cm}^2/\text{V}$.

d. Simulate the block diagram in **a.** with a step of $h = 5\sigma(t)$ $(u = 0)$.

e. Explain what happens in the real vehicle suspension system when you perform the measurements in **c.** and **d.**

f. Use the simplified block diagram in **b.** to perform the same experiments as in **c.** and **d.**

Extra Problem 1 [Self Study]:

Compute the transfer functions $T(s) = \dfrac{Y(s)}{U(s)}$ and $S(s) = \dfrac{Y(s)}{D(s)}$ for the following block diagrams.