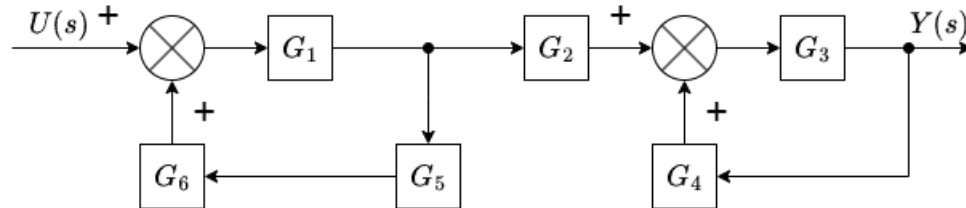


**Control Theory**  
**Assignment #2**

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1. Find a transfer function of the second-order system  $G(s)$  that has damped oscillations and oscillates with a frequency of  $f = 4\text{Hz}$ . Note that  $\omega = 2\pi f$ . In Simulink, check that the response of this transfer function to the unit step meets the requirements.
2. Determine the transfer function  $\frac{Y(s)}{U(s)}$  of the following block diagram.



3. Determine the time delay of the following transfer function:

$$G(s) = e^{-1.7s} \frac{9}{s + 18}$$

Approximate the behavior of the time delay with the second-order Padé approximation.

4. Using both manual and Ziegler-Nichols tuning methods, set up a PID controller that would control a plant with the following transfer function.

$$G(s) = \frac{1}{s^3 + 4.45s^2 + 13.08s + 4.22}$$

Show the resulting control loops in the Simulink environment.