Time and Frequency Domain Characteristics of Automatic Control Systems

Ex. 1.

For the system described by the equation (u – input, x – output)

$$4\frac{dx(t)}{dt} - 2u(t) = -x(t), \qquad x(0) = 0$$

determine and plot the **step** and **impulse** responses (derive the transfer function first).

Ex. 2.

For the system described by the transfer function:

$$G(s) = \frac{2s}{4s+1}$$

determine and draw:

- the **step** and **impulse** responses,
- the **Nyquist** plot (complex frequency response),
- the **Bode** plots (magnitude and phase versus logarithmic frequency).

Ex. 3.

For the systems described by the following transfer functions:

a) $G(s) = \frac{2}{(s+1)(2s+1)}$ b) $G(s) = \frac{2}{s(2s+1)}$

determine and draw the **step** and **impulse** responses (not obligatory for case a), as well as the **Nyquist** plots.

Ex. 4.

Draw the **Bode** magnitude and phase plots of the systems described by the following transfer functions using the graphical method (not obligatory for case a):

a) $G(s) = \frac{0.5}{5s^3 + 6s^2 + s}$ b) $G(s) = \frac{2}{250s^2 + 55s + 1}$

Ex. 5.

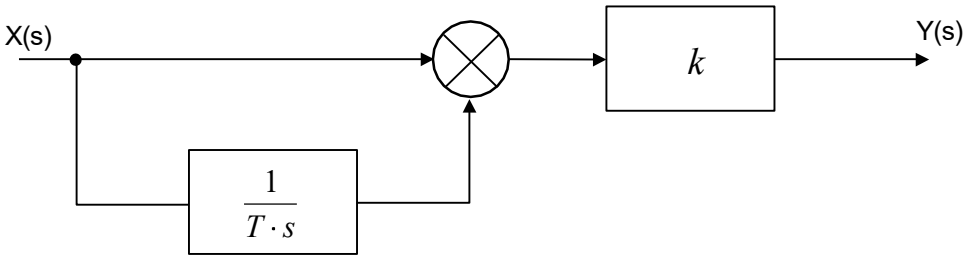
For the system described by the equation (u – input, y – output)

$$2\frac{dy(t)}{dt} - 2u(t) = -y(t)$$

determine and draw the **Nyquist** and **Bode** plots
(derive the transfer function first, assuming $y(0)=0$).

Ex. 6.

Given is a system with the following structure:



Assuming that k = 5 and T = 5, determine and plot:

a) the **step** response of the system,
b) the **Nyquist** plot,
c) the magnitude and phase **Bode** responses.