

Date Due: Azar 20, 391

Homework 7

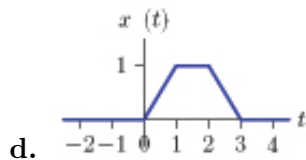
Problems:

1. Determine the Laplace transforms (including the regions of convergence) of each of the following signals.

a. $x(t) = e^{-2(t-3)}u(t-3)$

b. $x(t) = (1 - (1-t)e^{-3t})u(t)$

c. $x(t) = |t|e^{-|t|}$



2. Determine all possible signals with Laplace transforms of the following forms. For each signal, indicate the associated region of convergence.

a. $X(s) = \frac{s+2}{(s+1)^2}$

b. $X(s) = \frac{1}{s^2(s+1)}$

c. $X(s) = \frac{s+1}{s^2+2s+2}$

d. $X(s) = \left(\frac{1-e^{-s}}{s}\right)^2$

3. A system is represented by the following differential equation:

$$\frac{dy(t)}{dt} + y(t) = \frac{dx(t)}{dt} - x(t)$$

- a. Determine the step response of the system with using Laplace transforms.
b. Determine the output $y(t)$ when $x(t) = e^{-t}u(t)$ with using Laplace transforms.
4. Use the initial and final value theorems (where applicable) to find $x(0)$ and $x(\infty)$ for the signals with the following Laplace transforms:

a. $\left(\frac{1}{s}\right)e^{-sT}$

b. $\frac{1}{s(s+1)^2}$

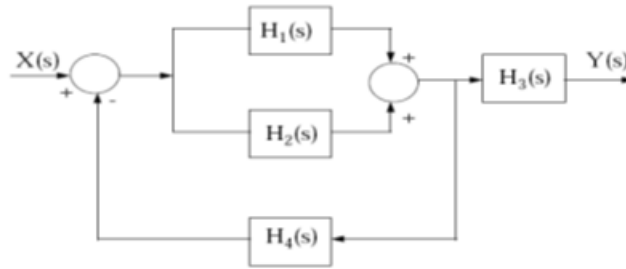
c. $\frac{1}{s^2(s+1)}$

d. $\frac{1}{s^2+1}$

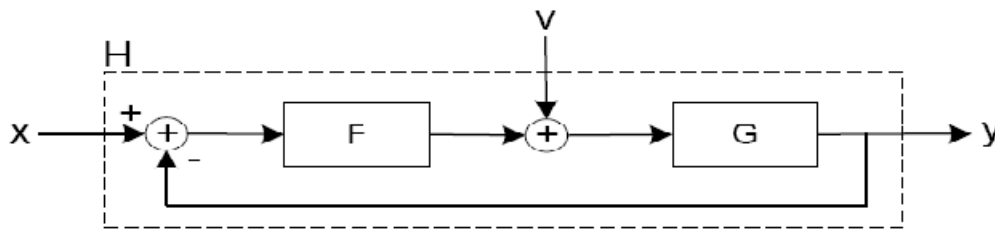
e. $\frac{(s+1)^2-1}{((s+1)^2+1)^2}$

f. $\frac{1-e^{-sT}}{s}$

5. Determine $H(s) = Y(s)/X(s)$ in the following system.



6. Consider a feedback interconnection of two causal, continuous-time LTI systems, as shown in the block diagram below.



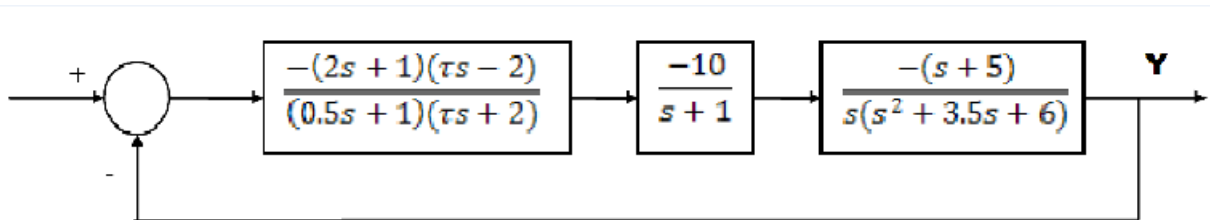
$$F(s) = \frac{K}{s}$$

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

- Determine if any of F or G are stable.
- Determine all values of K for which the closed-loop system is stable.

Practical Assignment:

I. Consider the following feedback system, in which the output is Y.



- If τ in this system becomes 0.25, then how long it takes for the output Y to reach the 90% of its final value. Is the system stable in this manner? sketch Pole zero map and step response of the system.
- Answer part (a) if τ becomes 0.5.
- Determine the maximum value of τ for which the system remains stable.

* **Notice:** For Practical Assignment you have to include your documentation.