EENG307: Intro to Feedback Control

Fall 2020

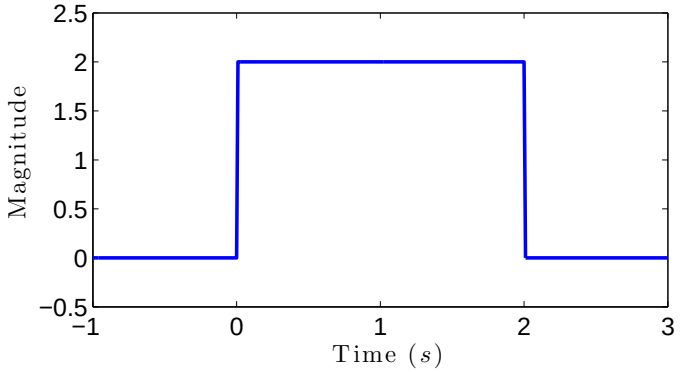
Homework Assignment #2

Due: 11:59pm, Wednesday, Sept 9th, 2020.

1. Find the Laplace Transform of the following function

$$x(t) = tu(t) - tu(t-1)$$

2. Find the Laplace Transform of the following signal:



3. Solve the following differential equation

$$\ddot{x} + 3\dot{x} + 2x = 1 \quad x(0) = 0, \dot{x}(0) = 1$$

4. Find the Inverse Laplace Transform of the following functions

   (a) $F(s) = \frac{4}{s(s^2+2s+2)}$

   (b) $F(s) = \frac{8}{s^2(s^2+2)}$

5. Find the solution to the following differential equations by using Laplace Transforms

   (a)

$$\ddot{x} + 2\dot{x} + 1x = 1 \quad x(0) = 0, \dot{x}(0) = 0$$

   (b)

$$\ddot{x} + 2\dot{x} + 2x = e^{-t} \quad x(0) = 1, \dot{x}(0) = 0$$

6. Quiz Question Monday: Find the Laplace Transform of the function $x(t) = (1 - e^{-t})u(t)$. Simplify to a ratio of polynomials in s.

7. Quiz Question Wednesday: Find the inverse Laplace Transform of the following function

$$F(s) = \frac{s+3}{(s+1)(s+2)}$$

Solutions:

1. $\frac{(1-e^{-s})-e^{-s}s}{s^2}$
2. $F(s) = 2\frac{1}{s} - 2\frac{1}{s}e^{-2s}$
3. $\left(\frac{1}{2} - \frac{1}{2}e^{-2t}\right) u(t)$
4. (a) $f(t) = \left(2 - 2e^{-t}\cos(t) - 2e^{-t}\sin(t)\right) u(t)$
   (b) $f(t) = \left(4t - 2\sqrt{2}\sin(\sqrt{2}t)\right) u(t)$
5. (a) $x(t) = \left(1 - e^{-t} - te^{-t}\right) u(t)$
   (b) $x(t) = \left(e^{-t} + e^{-t}\sin(t)\right) u(t)$