Prof. P. Voulgaris

AAE 353
Homework # 2

Issued: 09/11, 2017
Due: 09/22, 2017

Reading: [redacted] 3.1

1. Consider a system G with input u and output y.

   a) Suppose that G is a time-delay, i.e., the output y is exactly the input u but delayed by T seconds, where T is constant.
   Is this a linear system?
   Is G a time invariant system?

   b) Suppose G is given by the input-output relation $y = mu + b$ where m, b constants.
   Is this a linear system?

2. Verify the following properties of the Laplace Xform

   a. $\mathcal{L}(f(t-T)) = e^{-sT}\mathcal{L}(f(t)) = e^{-sT}F(s)$
   b. $\mathcal{L}(e^{-at}f(t)) = F(s+a)$

3. a) Given that

$$F(s) = \mathcal{L}(f(t)) = \frac{w}{s^2+w^2}, \quad f(t) = \begin{cases} \sin wt, & t \geq 0 \\ 0 & t < 0 \end{cases}$$

   show that

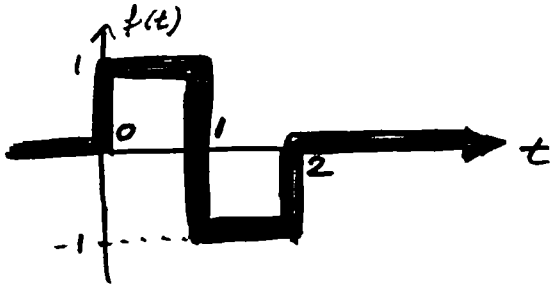
$$G(s) = \mathcal{L}(g(t)) = \frac{s}{s^2+w^2}, \quad g(t) = \begin{cases} \cos wt, & t \geq 0 \\ 0 & t < 0 \end{cases}$$

   by using a suitable property of Laplace transform.

   c) Use (if applicable) the initial value and the final value theorem to obtain

$$f(0^+), \quad f(\infty), \quad g(0^+), \quad g(\infty).$$

4. Find $\mathcal{L}(f(t))$ for the following f *without direct computation.* Rely strictly on the properties of the transform and assume only that $\mathcal{L}(1(t)) = 1/s$ is known (i.e., the Laplace transform of the step function).



Hint: Decompose appropriately f.