

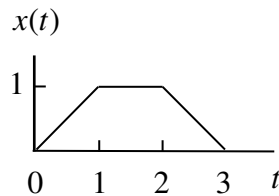
**Concordia University**  
**ELEC372 Fundamentals of Control Systems**

**Homework #4**  
**Amir G. Aghdam**

1. (Partly from G. F. Franklin, J. D. Powell and A. E. Naeini, *Feedback Control of Dynamic Systems*, 6<sup>th</sup> Edition, Prentice Hall, 2010) Consider the standard first order system

$$H(s) = \frac{K}{\tau s + 1}.$$

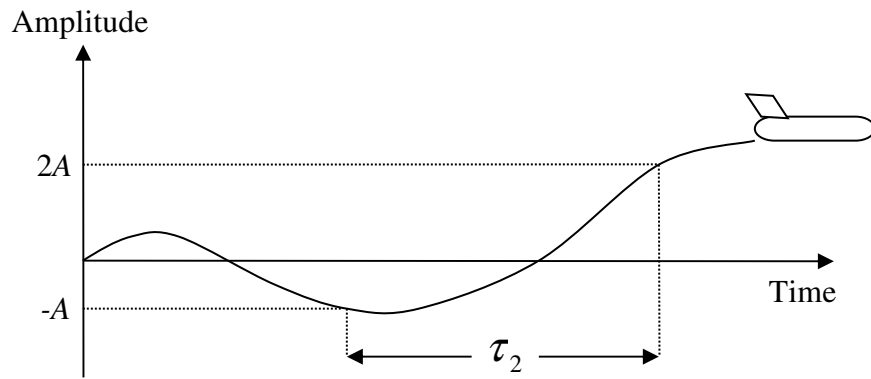
- a) Write the Laplace transform of the signal  $x(t)$  in the following figure.



- b) What is the Laplace transform of the output if this signal is applied to  $H(s)$  ?
- c) Find the output in the time domain.
2. (G. F. Franklin, J. D. Powell and A. E. Naeini, *Feedback Control of Dynamic Systems*, 6<sup>th</sup> Edition, Prentice Hall, 2010) Repeat Problem 1 with the following second-order system

$$H(s) = \frac{\omega_n^2}{s^2 + 2\zeta\omega_n s + \omega_n^2}.$$

3. (G. F. Franklin, J. D. Powell and A. E. Naeini, *Feedback Control of Dynamic Systems*, 6<sup>th</sup> Edition, Prentice Hall, 2010). “A measure of the degree of instability in an unstable aircraft response is the amount of time it takes for the amplitude of the time response to double (see the following figure) given some nonzero initial condition.”



- a) Find the time to double  $\tau_2$  for a first-order system.
- b) Find the time to double  $\tau_2$  for a second-order system.