

HW Assignment 2

Due date: Thursday 17/3/2016

Question 1

Solve the ODE

$$\ddot{y}(t) + 5\dot{y}(t) + 7y(t) = 0$$

with initial conditions: $y(0) = 0$, $\dot{y}(0) = 2$ and $\ddot{y}(0) = 4$ given the fact that one of the roots of the characteristic polynomial is -1 (use polynomial division).

Question 2

What is the impulse response of the system

$$\ddot{y}(t) + 5\dot{y}(t) + 7y(t) = 2\ddot{x}(t) + \dot{x}(t)$$

where $x(t)$ is the input signal and $y(t)$.

Question 3

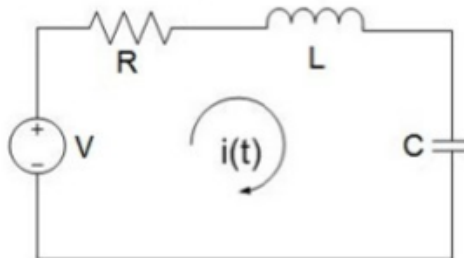
What is the output of the system

$$\ddot{y}(t) + 5\dot{y}(t) + 7y(t) = 2\ddot{x}(t) + \dot{x}(t)$$

for the input $x(t) = 4e^{-3t}u(t)$?

Question 4

The RLC circuit below has a constant voltage source $v(t) = V$



1. Write the differential equation for the current $i(t)$.
2. Calculate the roots of the equation and write the solution for $i(t)$. Note that there are possible phases to the solution, depending on the parameters R, L and C .

Question 5

A first-order all-pass filter is a system with the impulse response $h(t) = -\delta(t) + 2e^{-t}u(t)$ (where $u(t)$ is the step function).

1. What is the ZSR for the input $x(t) = e^t u(-t)$?
2. Sketch the input and the corresponding ZSR.

Question 6

Determine the convolution between

1. $x(t) = e^{-(t-1)}u(t-1)$ and $h(t) = u(t+1)$ where $u(t)$ is the step-function;

2. $x(t) = \begin{cases} t+1 & t \in [-1, 1] \\ -t+3 & t \in [1, 3] \end{cases}$ and $\delta(t-2)$

steps:

- a. plot the input and impulse response.
- b. solve graphically and/or calculate.
- c. plot the output.