

Exercise 4

Convolution

Part 1:

Consider the linear time-invariant system consisting of an RL circuit having an impulse response of $h(t) = \exp(-3t)$. Let the voltage input to this system be once $x_1(t)$ and once $x_2(t)$, as shown in Fig. 1 and Fig. 2. The corresponding output voltages $y_1(t)$ and $y_2(t)$ of this circuit can be found by convolution.

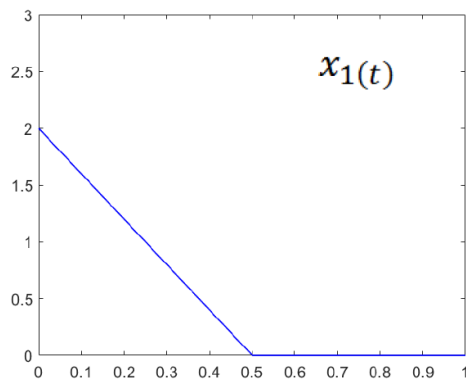


Fig. 1 Linear decreasing voltage

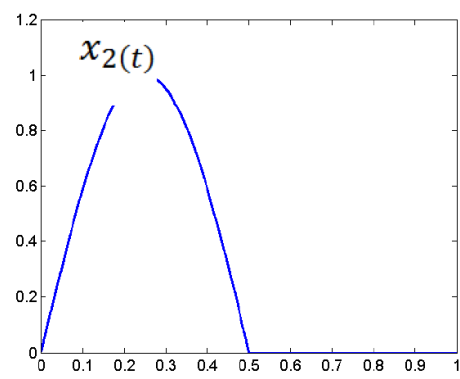


Fig. 2 Half sinusoidal voltage

Write a MATLAB function, named “generation.m” to first generate the input signals and the impulse response, and then to convolve them to get the corresponding output signals $y_1(t)$ and $y_2(t)$. What is the output voltage when the sum of the two input signals is input to the circuit? Your function should only have one input ‘dt’, that is the step size of the signal. There should be 7 outputs from the function: $x_1(t)$, $x_2(t)$, $h(t)$, $y_1(t)$, $y_2(t)$, $x_3(t) = x_1(t) + x_2(t)$ and $y_3(t)$ (output in response to the input $x_3(t)$). Assume that the total time duration for all the input signals and impulse response is 1 sec. Hence, the length of all the outputs after convolution would be 2 seconds.

Part 2:

Write a Matlab test bench script to obtain and plot all the signals.