EE331 Signals & Systems

Lab-1 (PART-1)

1. The signal $x(t)$ is composed of two sinusoids as well as one impulse sequence. Obtain the signal $x(t)$ given in the Figure 1. Note that the signal $x(t)$ is generated by concatenating three signals $x_1(t), x_2(t)$ and $x_3(t)$. The amplitudes of the sinusoidal signals $x_1(t)$ and $x_3(t)$ is 1. Also, the impulse sequence (i.e. $x_2(t)$) is generated by repeating and concatenating the sequence [1 0…0] ten times. As a hint, one copy of the sequence length is 100. Note that the sampling frequency of $x(t)$ is 1kHz. During the generation of signals $x_1(t)$, $x_2(t)$, and $x_3(t)$ and also $x(t)$, **you are not allowed** to use any ***for*** or ***while*** loop structure which means <u>you will not get any grade in case you use any loop structure</u>. Plot the signal $x(t)$ as the first figure.

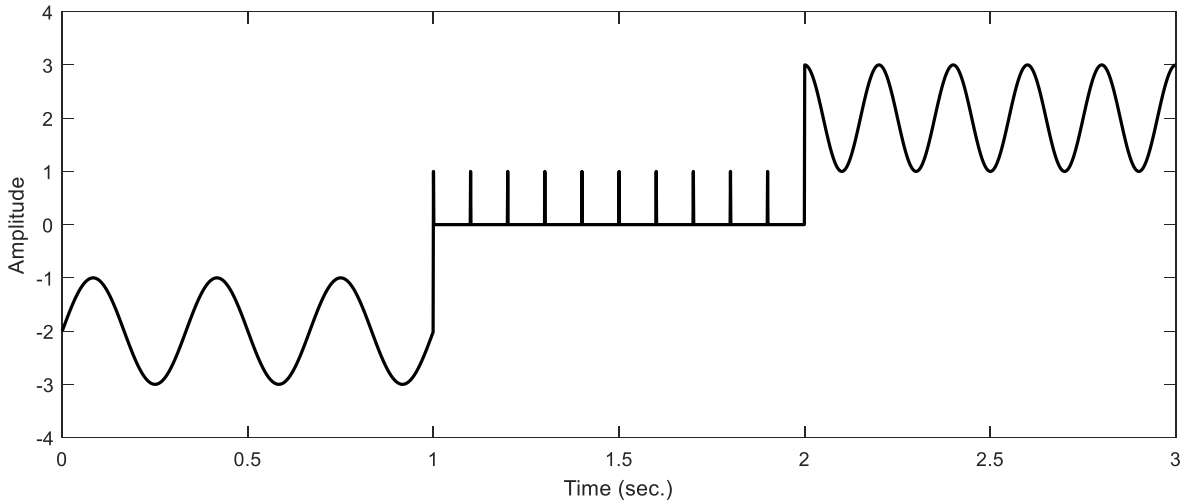

Figure 1. The illustration of the signal $x(t)$ versus time

2. Obtain and plot the signal $x_r(t) = x(-t)$. Plot the signal $x_r(t)$ as the second figure.

3. Calculate and plot the **even** and **odd** parts of the signal $x(t)$. Plot the even and odd parts of $x(t)$ as subplots as the third figure.

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Lab-1 (PART-2)

1. Assume that you have a system *H* that process the given signal $x(n)$ and produces an output $y(n)$. The mathematical expression of the filter *H* is given in Eq. (1).

$$y(n) = h_4x(n) + h_3x(n-1) + h_2x(n-2) + h_1x(n-3) + h_0x(n-4) \qquad (1)$$

Note that the coefficients $\{h_0, h_1, \dots, h_4\}$ are the filter coefficients of the filter system H. Is this system linear/nonlinear ? Show the linearity (or nonlinearity) of the filter system *H* given above by using $x_1(t) = \sin(2\pi 5t)$, $x_2(t) = \cos(2\pi 7t)$ and $x_3(t) = x_1(t) + x_2(t)$. Note that $t \in [0\ 1]$, the sampling frequency is 250 Hz. Note that $h_0 = 1$, $h_1 = 0$, $h_2 = 1$, $h_3 = 0$ and $h_4 = 1$. Now, **you are allowed** to use the loop structures!!

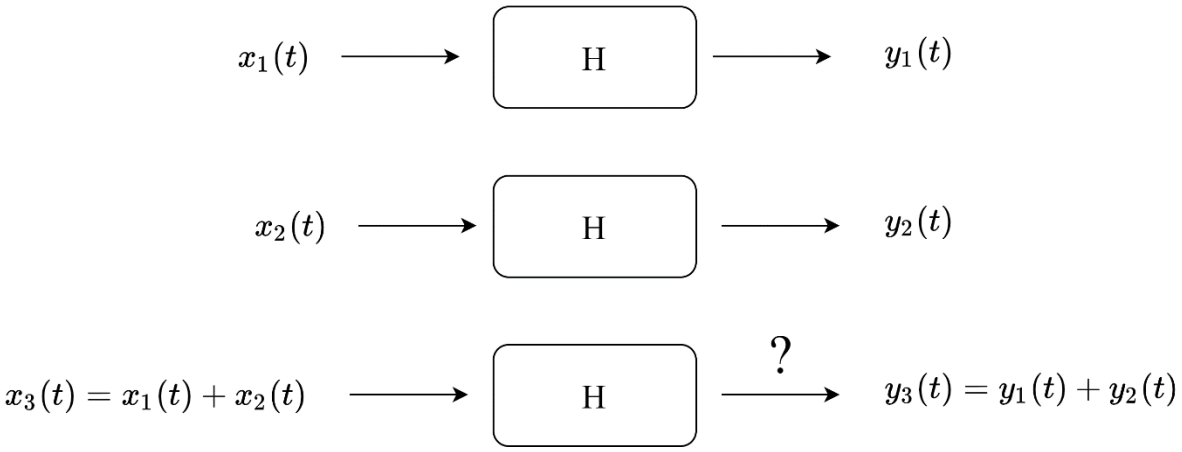

Figure 2. The operation diagram of proving the linearity of system H.

Show the linearity/nonlinearity of the system *H* by using plot command (i.e. plot(y1+y2, y3)).