Lab 3 – LTI systems and Fourier Transform

3.1 LTI systems and periodic signals

An LTI system is given with frequency response $H(j\ \omega)$.

Generate a periodic signal using the matlab function, "partialfouriersum" from previous Lab session. Let T = 2π and the time vector be t = -3T:0.001:3T.

What happens when you pass this signal through the LTI system with given frequency response?

In the same figure, using subplot, plot the input periodic signal in the upper half and the output signal in the lower half for the following cases:

a) The LTI system has frequency response of an ideal low pass filter (LPF) with cut-off frequency $\omega_c = 3.5$.
b) The LTI system has frequency response of an ideal high pass filter (HPF) with cut-off frequency $\omega_c = 3.5$.
c) Let the frequency response be $H(j\ \omega) = \frac{1}{1+j\ \omega}$.

   Repeat the above when
d) A corresponds to $x(t) = \sin(t) + \cos(5t)$.
e) A = ones(1,15).
f) A corresponds to FS coefficients of the periodic square wave.

3.2 Fourier Series to Fourier Transform

Recall the Fourier series coefficients for a periodic square pulse. Let T be the time period of the periodic square wave that has amplitude 1 in [-T1, T1]. It is given that T1 < T/2.

In the same figure, using subplot, plot the periodic square pulse (you can use pulstran() for this) in upper half and its Fourier series coefficients (use stem plot here) in the lower half. Plot the Fourier series coefficients {T a_k } for k = -N:N where N = round(2*T/T1).

By keeping T1 fixed (ex. T1 = 1/4) and gradually increasing T (ex. 1:0.5:20) update your figure in a for-loop (you might want to use the pause(0.5) function to get the changing display).

What is your observation as T is increased?