

Problem 7.19

Using filterdesign GUI to create impulse response of FIR LPF with $M = 37$ and $\hat{\omega}_{co} = 0.3\pi$

(a) When input is $x_1[n] = 10$, the output $y_1[n]$ reaches a steady state value of 10 as seen from the graph.

(b) When the input is $x_2[n] = 10 \cos(0.5\pi n)$, required to find output of the form $y_2[n] = A \cos(\hat{\omega}n + \phi_2)$

Take FFT on the coefficients of $h[n]$ that were exported to the workspace of MATLAB from the GUI and finding the coefficient for $H(e^{j\hat{\omega}})$ corresponding to an angle of 0.5π . This is done by using, $\hat{\omega} = \frac{2\pi k}{N}$, where $N = 37$ and $\hat{\omega} = 0.5\pi$. The value of k is found out to be around 9. Hence, the 9th entry of the FFT values taken as described above will be $H(e^{j0.5\pi})$.

$H(e^{j0.5\pi}) = 0.0192 + 0.0150i$ which in polar coordinates can be expressed as: $0.0243e^{j0.21\pi}$.

$y_2[n]$ can be expressed as: $0.0243(10) \cos(0.5\pi n + 0.21\pi)$

Hence, $y_2[n] = 0.243 \cos(0.5\pi n + 0.21\pi)$.

(c) The plots are:



