

PROBLEM:

The intention of the following MATLAB program is to filter a sinusoid via the `conv` function, but the cosine signal has a starting point at $n = 0$; we assume that it is zero for $n < 0$.

```
omega = pi/2;  
nn = [ 0:4000 ];  
xn = cos(omega*nn - pi/2);  
bb = [ 1 0 0 0 1 ];  
yn = conv( bb, xn );
```

- Determine $\mathcal{H}(\hat{\omega})$ for the FIR filter.
- Make a plot of the magnitude of $\mathcal{H}(\hat{\omega})$ and label *all* the frequencies where $|\mathcal{H}(\hat{\omega})|$ is zero.
- Determine a formula for $y[n]$, the signal contained in the vector `yn`. Give the individual values for $n = 0, 1, 2, 3$, and then provide a general formula for $y[n]$ that is correct for $4 \leq n \leq 4000$. This formula should give numerical values for the amplitude, phase and frequency of $y[n]$.
- Give at least one value of `omega` such that the output is guaranteed to be zero, for $n \geq 4$.