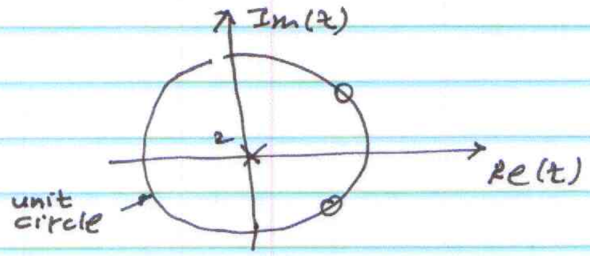
3-30-2014

supplement to Handout #14
Example problems

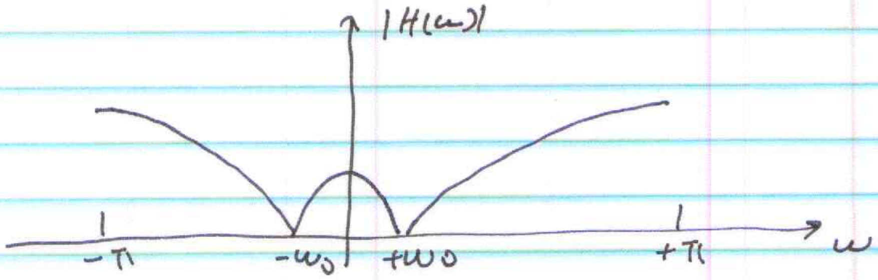
Problem 5.25

Sketch (roughly) the magnitude $|H(\omega)|$ of the Fourier transforms corresponding to the pole-zero patterns below.

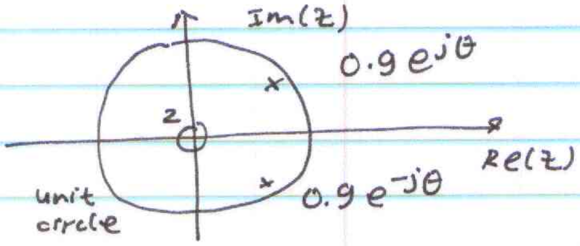
(a)



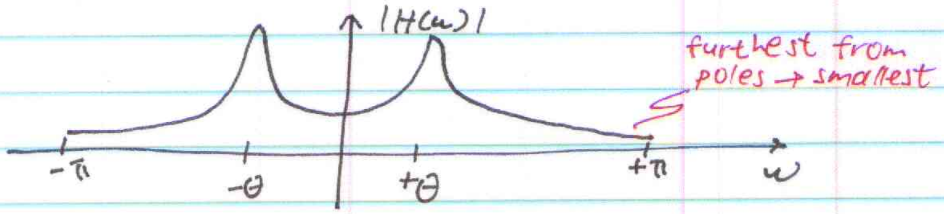
The zeros are on the unit circle at (suppose) $-\omega_0$ and $+\omega_0$. This means that $H(-\omega_0) = H(+\omega_0) = 0$.
The double zero at the origin is equi-distant from the unit circle, and has no effect on the Fourier transform. The magnitude $|H(\omega)|$ relies solely on the distance from the zeros.



(b)

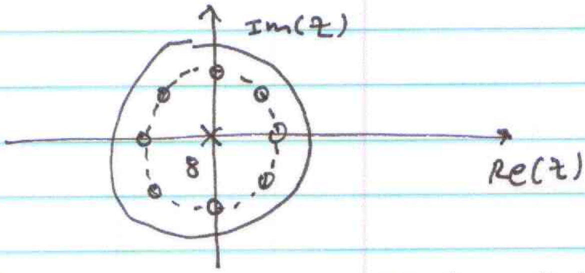


Similar to before, the zeros at the origin have no effect on $|H(\omega)|$. The transfer function is influenced only by the distances from the two complex conjugate poles. The peaks occur at $\pm\theta$.

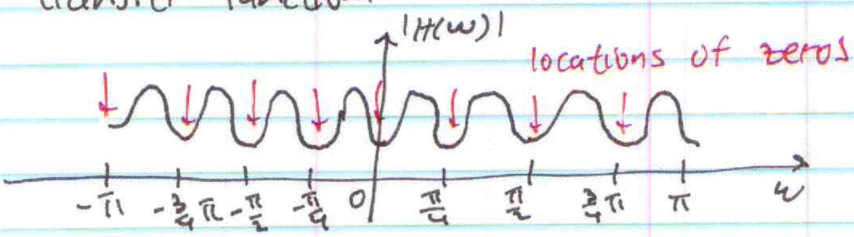


Note that $|H(\omega)|$ is never 0. To be zero, we need a zero on the unit circle.

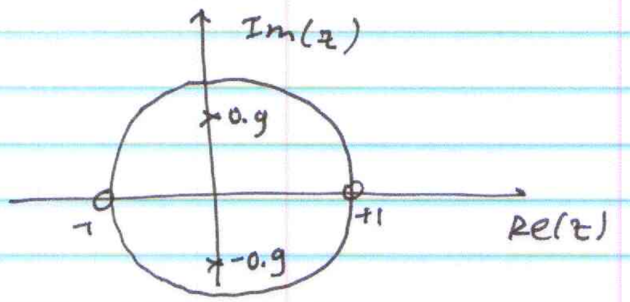
(c)



The eight zeros each slightly reduce the transfer function.



(d)



This is a band pass filter. The zeros at $w=0$ and $w=\pi$ (also $w=-\pi$, due to symmetry) block the signal.
The poles at $w=\pm\frac{\pi}{2}$ let the signal pass through.