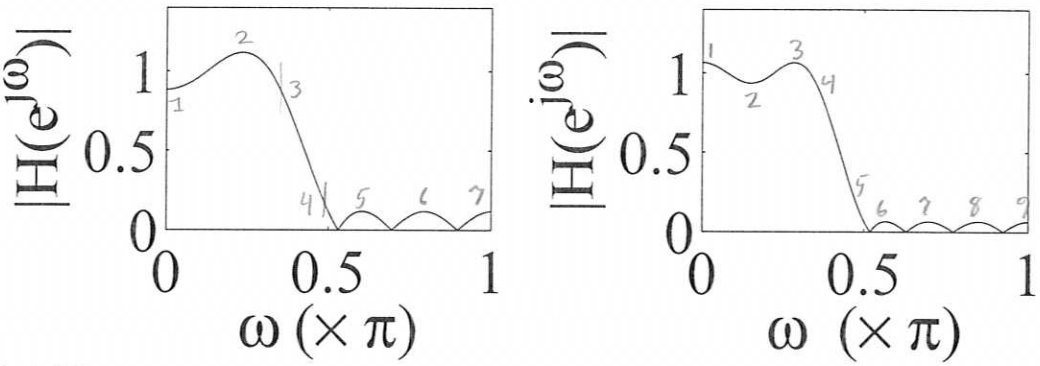
ECEn 487 - Introduction to Digital Signal Processing

Winter 2013

Quiz 10

1. (5 pts) The two following filters were created using the Parks-McClellan algorithm in MATLAB for the same specifications (passband $0 \leq \omega < 0.35\pi$ and stopband $0.5\pi < \omega < \pi$). One, or both, has an impulse response length of 11 samples. From the frequency response, can you tell which one(s) it is? Why?



M = 10

L = M/2 = 5

For this lowpass filter to be optimal, it must have at least L+2 alternations but no more than L+3. So, the filter on the left is the correct one

2. (5 pts) Suppose I have a causal, stable, real signal and I know the DTFT of the real part is

$$X_R\left(e^{j\omega}\right) = 2 + 2\cos 2\omega$$

What is $X_I(e^{j\omega})$?

$\overline{X}_R(e^{j\omega}) = 2 + e^{-j2\omega} + e^{j2\omega}$

$x_e[n] = 2\delta[n] + \delta[n-2] + \delta[n+2]$

$x[n] = 2x_e[n]u[n] - x_e[0]\delta[n]$

$= 2\delta[n] + 2\delta[n-2]$

$\overline{X}(e^{j\omega}) = 2 + 2e^{-j2\omega} = \overline{X}_R(e^{j\omega}) + j\overline{X}_I(e^{j\omega})$

$= 2 + 2\cos(2\omega) - 2j\sin(2\omega)$

$j\overline{X}_I(e^{j\omega}) = -2j\sin(2\omega)$

$\overline{X}_I(e^{j\omega}) = -2\sin(2\omega)$