Key

EE432 In-class exercise

Design an FIR LPF with the following specifications. Your final answer will be the equation for the impulse response of the filter, h[n].

Pass band edge: 20 kHz
Stop band edge: 25 kHz
Stop band attenuation: 70 dB
Sample frequency: 100 kHz

(1) Transition width = 25-20 kHz = 5 kHz

so $f_1 = 20\,kHz + \frac{TW}{2} = 22.5\,kHz$

(2) $\Omega_1 = \frac{2\pi f_1}{f_s} = \frac{2\pi\, 22.5\,kHz}{100\,kHz} = 0.45\pi$

$h_1[n] = \frac{\sin(n\Omega_1)}{n\pi} = \frac{\sin(0.45\pi n)}{n\pi}$

(3) stop band Attenuation = 70 dB so use Blackman Window

$n = 5.98\,\frac{f_s}{TW} = 5.98\,\frac{100{,}000}{5000} = 119.6$

use $119 = N$

(4) $h[n] = h_1[n]\,w[n]$

$= \frac{\sin(0.45\pi n)}{n\pi}\left(0.42 + 0.5\cos\left(\frac{2\pi n}{118}\right) + 0.08\cos\left(\frac{4\pi n}{118}\right)\right)$

for $-\frac{(119-1)}{2} \le n \le \frac{119-1}{2}$

$-59 \le n \le 59$

(5) now shift h[n] right by $\frac{N-1}{2} = 59$ values

$h_{LPF}[n] = h[n-59]$