Exercise 6

Problem 1

a) Use the window method and construct a FIR LP filter of length N = 11, with sampling frequency 1000 Hz and cut-off frequency 250 Hz. Use a rectangular window. Find an expression for the coefficients in the filter.

b) Create a flowchart of the filter.

c) Find a "relatively simple" expression for the magnitude response of the filter.

d) Write the equation for $y(n)$ as a function of the input signal $x(n)$ and the filter coefficients $h(k)$.

e) The signal $x(t) = 2\cos(2\pi 125t) + \cos(2\pi 250t)$ is sampled at the rate 1000samp/sec and sent into the filter. Find an expression for the steady-state output $y(n)$ out of the filter.

f) What is the delay (in ms) and what is the phase shift (in radians) of the two frequency components through the filter?

g) Explain the impact of the use of another window function such as Hamming on the magnitude frequency response.

h) The signal $x(t) = 2\cos(2\pi 100t)$ is sampled with sampling frequency 1000 Hz and sent into the averaging FIR filter that has impulse response $h(n) = \{-1, -1, -1, -1, -1\}$. Find the out of the filter $y(n)$.