Problem 1

(20 points)

a)* Show that Eq.(6.11) can also be obtained by taking the inverse Fourier transform of the following transfer function
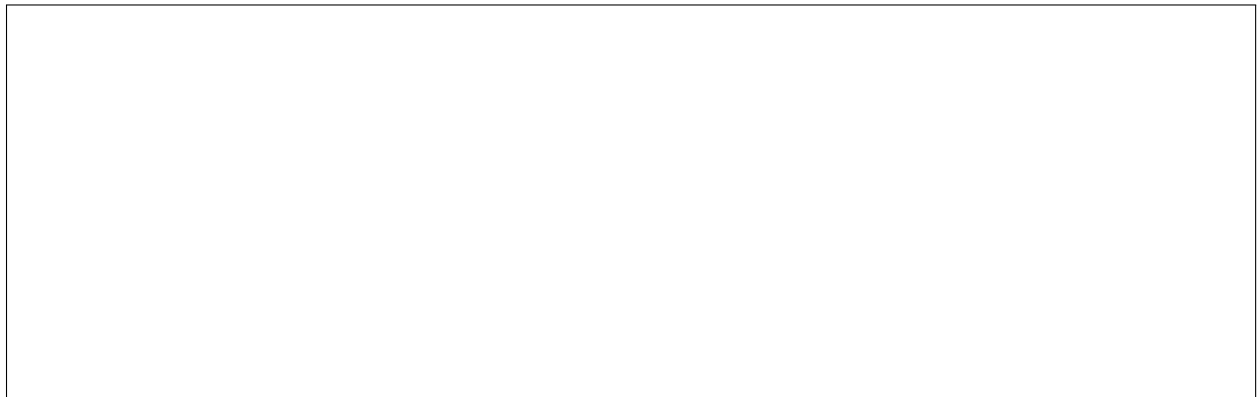
$$H_d(\omega) = \begin{cases} e^{-j\omega M} & |\omega| \leq \omega_c \\ 0 & \omega_c < \omega \leq \pi. \end{cases}$$

Your proof should also contain the new defintion of the support set of a rectangular window.
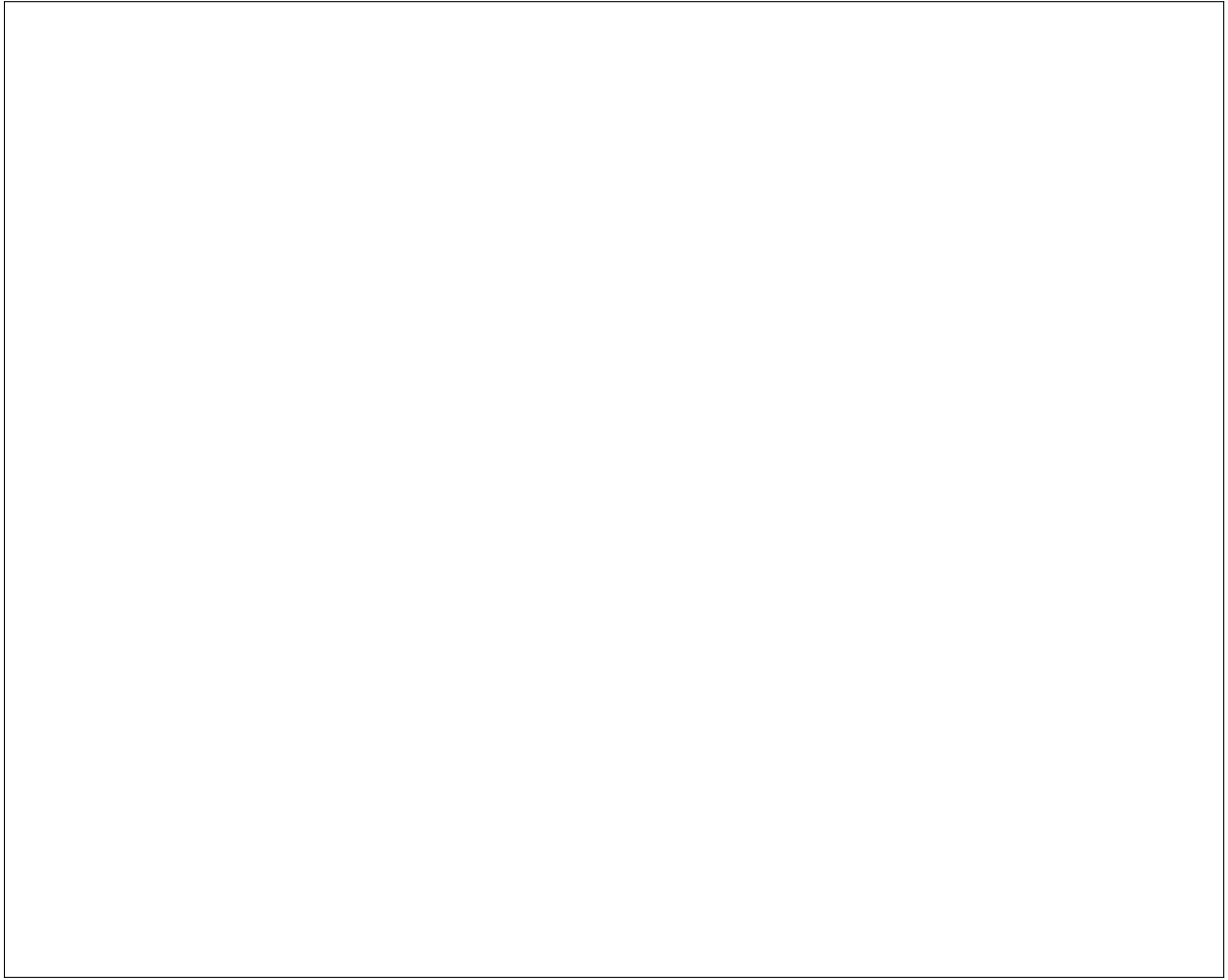
b)* Plot the magnitude and phase plot of $H_d(\omega)$.

c)* Show that the Fourier transform of the rectangular window is given by the following expression

$$W(\omega) = \frac{\sin \omega \frac{2M+1}{2}}{\sin \frac{\omega}{2}}.$$

d)* Plot the time-domain and corresponding magnitude response of the Rectangular, Hamming, Hanning, Bartlett and Tukey windows for $M = 10$.

Hint You can use MATLAB built-in function for such window functions. You may hand in a print out of the plots or draw it by hand. In both cases take care that you label your plot properly.