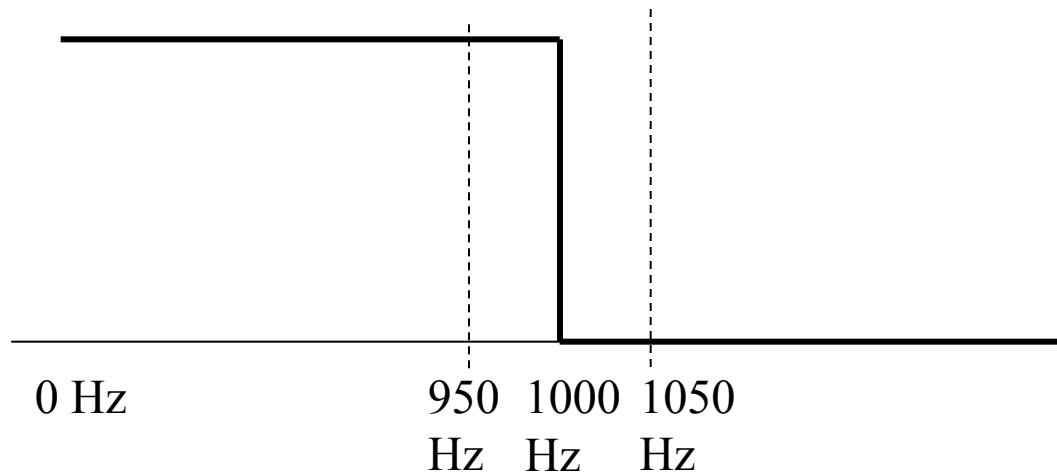## Homework 1 (Due: April 13th)

(1) Design a Mini-max **lowpass** FIR filter such that   (40 scores)

① Filter length = 19, ② Sampling frequency f_s = 2500Hz,

③ Pass Band 0~1000Hz   ④ Transition band: 950~1050 Hz,

⑤ Weighting function: $W(F) = 1$ for passband, $W(F) = 0.6$ for stop band .

⑥ Set $\Delta = 0.0001$ in Step 5.

0 Hz   950 1000 1050
                                        Hz   Hz   Hz

※ Matlab program should be E-mailed to displab531@gmail.com
   E-mail 主旨上註明學號

Show (a) the Matlab program, (b) the frequency response,
       (c) the impulse response $h[n]$, and (d) the maximal error for each iteration.

(2) From the view point of implementation, what are the disadvantages of the discrete Fourier transform? (10 scores)

(3) Why (a) the step invariance method and (b) the bilinear transform can reduce or avoid the aliasing effect in IIR filter design? (10 scores)

(4) Why ① the transition band and ② the weighting function are important in Minimax FIR digital filter design? (10 scores)

(5) Which of the following filters are odd symmetric? (i) Lowpass filter, (ii) matched filter, (iii) the Hilbert transform, (iv) differentiation, (v) the smoother, (vi) the edge detection filter. (10 scores)

(6) Suppose that $x[n] = y(0.0005n)$ and the length of $x[n]$ is 8000. If $X[m]$ is the FFT of $x[n]$, which frequency do (a) $X[600]$ and (b) $X[7000]$ correspond to? (10 scores)

(7) Estimate <u>the length of the digital filter</u> if both the passband ripple and the stopband ripple are smaller than 0.01, the sampling interval $\Delta_t =0.0002$, and the transition band is from 1100Hz to 1200Hz. (10 scores)