EE 424 – Digital Signal Processing

Quiz # 2

Fall 2010

Duration: 45 minutes

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Section: ..2...........

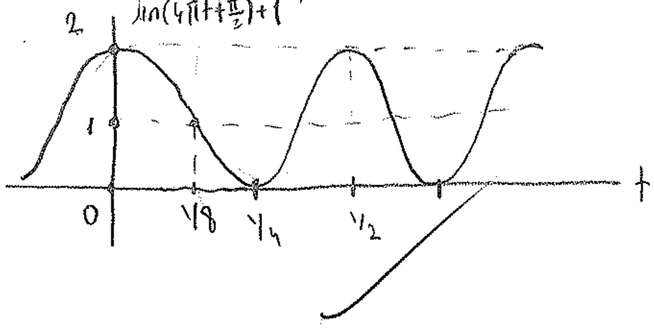
Question-1 (20 pts)	20
Question-2 (40 pts)	40
Question-3 (40 pts)	40
TOTAL (100 pts)	100

Q1) Plot $\sin\left(4\pi t+\frac{\pi}{2}\right)+1$

$4\pi = 2\pi f$ $f=2$ $T=\frac{1}{2}$

frequency

period



Q2) Convolve $x[n]=\{1, 1, \hat{1}, 1, 2, 2, 2, 2, ...\}$ with $h[n]=\left\{-\frac{1}{4}, \frac{1}{2}, -\frac{1}{4}\right\}$ using the I/O relation. Assume that $h[n]$ is the impulse response of an LTI system.
Also assume that $x[-1]=0$.

$n=0$ $n=0$

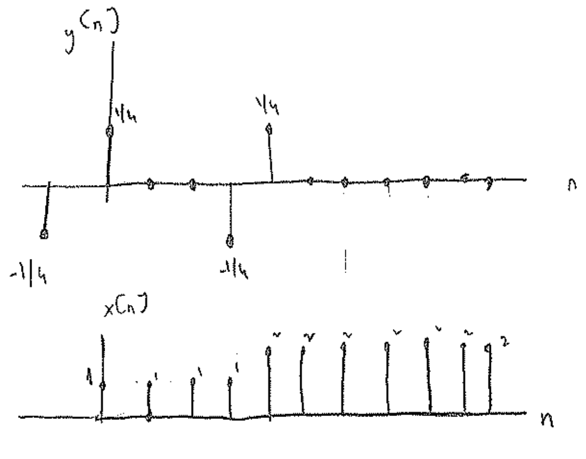
$y[n] = x[n] * h[n]$

$y[n] = -\frac{1}{4}x[n-1] + \frac{1}{2}x[n] - \frac{1}{4}x[n+1]$ Say $x[n]=0$ for $n<0$

$y[n] = \{-\frac{1}{4}, \frac{1}{4}, 0, 0, -\frac{1}{4}, \frac{1}{4}, 0, 0, 0 ...\}$ $y[n]$ is 0 for $n<-1$

$n=-1$ $n=0$

A, this filter is high pass filter the output has non-zero components where there are jumps in $x[n]$. Jums in $x[n]$ means high frequency components. When the input is DC (zero frequency) output is zero.



Q3)

a) Given $x[n]=\{1,\ \underset{\substack{\uparrow \\ n=0}}{2},\ 3,\ 4,\ 5,\ 5,\ 5,\ 5\}$, Decimate $x[n]$ using $h[n]=\left\{\frac{1}{4},\ \underset{\substack{\uparrow \\ n=0}}{\frac{1}{2}},\ \frac{1}{4}\right\}$ by 2.

Assume $x[-1]=x[8]=0$. (20 pts)

$y[n] = \frac{1}{4} \times x[n-1] + \frac{1}{2} \times x[n] + \frac{1}{4} \times x[n+1]$

$y[n] = \{ \frac{1}{4}, \underset{\substack{\uparrow \\ n=0}}{1}, 2, 3, 4, \frac{19}{4}, 5, 5, \frac{15}{4}, \frac{5}{4} \}$

$y_d[n] = y[n/2]$

$\boxed{y_d[n] = \{ 1, 3, \frac{19}{4}, 5, \frac{5}{4} \}}$

b) Write down your Matlab (or Java or C) code for decimation for part (a). (20 pts)

```
x = [ 1 2 3 4 5 5 5 5 ];   % assigning x[n]
h = [ .25 .5 .25 ];        % assigning h[n] (filter)
y = conv(x,h);             % convolving x[n] with h[n] to have the output
yd = y(2:2:end);           % downsampling the output with a factor of 2
                           % we started from y(2) because y(1) is y[-1] where
                           %                              y(2) is y[0]
```