Signal Processing – Örgün – 2015 Midterm Exam Solutions

(1)

a) 15

-5	-4	-3	-2	-1	0	1
-2	1	-1	0	2	-1	3

$x[n+2]$

-2	-1	0
1	0	-1

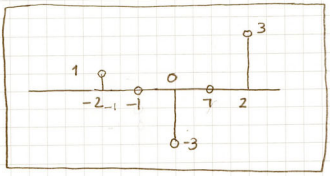
$x[2n+2]$

0	1	2	3	4	5	6
-2	1	-1	0	2	-1	3

$x[n-3]$

0	1	2
-2	0	3

$x[3n-3]$



$x[2n+2] + x[3n-3]$

b) (10) non-periodic

c) (15) Energy $E = 4 + 1 + 1 + 0 + 4 + 1 + 9 = 20$

(2) $y[n] = \cos(2\pi x[n+1]) + x[n]$

i) (3) not-memoryless

ii) (3) $|x[n]| \leq M_x < \infty$

$|\cos(2\pi x[n+1])| < 1$

$|y[n]| \leq 1 + M_x \leq M_y < \infty$

$\therefore$ STABLE

iii) (3) NOT-CAUSAL (Note: causal $\neq$ casual!)

iv) (3) Let's check for homogenity

$H\{a\,x[n]\} = \cos(2\pi a.x[n+1]) + a.x[n]$

$\neq a\,[\cos(2\pi x[n+1])] + x[n])$

$\therefore$ NOT LINEAR

v) $y[n-n_0] = \cos(2\pi\, x[n-n_0]) + x[n-n_0]$

$= \mathcal{H}\{x[n-n_0]\}$

$\therefore$ TIME-INVARIANT

$y(t) = \cos[x(t)]$

i) (3) memoryless

ii) (3) $-1 \leq \cos[|x(t)|] \leq 1$

$|y(t)| \leq 1$ STABLE

iii) (3) causal

iv) (3) Homogenity

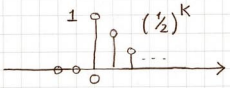
$\cos[a\,x(t)] \neq a\cos[(x(t)]$

$\therefore$ NOT-LINEAR

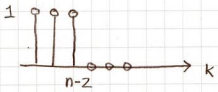
v) (3) $y(t-t_0) = \cos[x(t-t_0)] = \mathcal{H}\{x(t-t_0)\}$

$\therefore$ TIME-INVARIANT

3-30p



$x[k]$



$h[n-k]$

4/4

- $n-2<0 \rightarrow n<2 \rightarrow y[n]=0$

- $n-2\geq 0 \rightarrow n\geq 2$

$$y[n]=\sum_{k=0}^{n-2}\left(\frac{1}{2}\right)^k = \frac{1-(1/2)^{n-1}}{1-1/2} = 2-\left(\frac{1}{2}\right)^{n-2}$$

$$y[n]=\begin{cases} 2-(1/2)^{n-2}, & n\geq 2 \\ 0, & n<2 \end{cases}$$