



Answer the following questions: [15 Marks]

1- Signal Manipulation [6 Marks]

A. Determine whether or not the signal below is periodic and if it is periodic, determine the fundamental period [2 Marks]:

$$x(n) = \cos\left(\frac{n\pi}{6}\right) + \operatorname{Re}\left[e^{\frac{jn\pi}{8}}\right] + \operatorname{Im}\left[e^{\frac{jn\pi}{12}}\right]$$

B. Given the sequence $x(n) = (5-n)[u(n+2) - u(n-3)]$, make a sketch of [4 Marks]:

- $y_1(n) = x(2n-2)$
- $y_2(n) = x(2-2n)$
- Even part and the odd part.

2. Discrete Time Systems [3 Marks]

For the system below:

$$y(n] = x(n) + ([x(n+1) + x(n-1)]/x(n))$$

Determine whether or not the system is:

- Additive.
- Homogeneous.
- Linear.
- Shift invariant.
- Causal.
- LSI.

3. Convolution and DTFT [6 Marks]

Convolve

$$x(n) = \cos(n\pi/2) [u(n) - u(n-4)] \text{ with}$$

$$h(n) = (5-n)[u(n+2) - u(n-3)] \text{ and sketch } x(n), h(n) \text{ and } y(n).$$

Good luck
Dr. Michael Nasief

(2)

①

(A) $X(n) = \cos\left(\frac{n\pi}{6}\right) + \operatorname{Re}\left(e^{j\frac{n\pi}{6}}\right) + \operatorname{Im}\left(e^{j\frac{n\pi}{12}}\right)$

condition

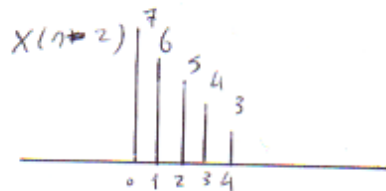
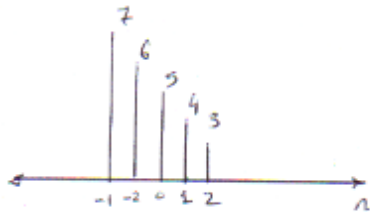
$$\frac{\omega_0}{2\pi} = \frac{M}{N}$$

aperiodic $N_1 = 12$
 $N_2 = 16$
 $N_3 = 24$

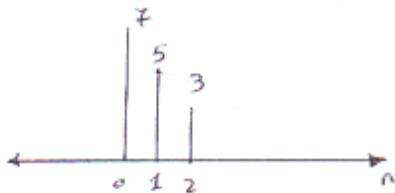
$\Sigma N_T = 48$

(B)

$X(n) = (5-n) [u(n+2) - u(n-3)]$

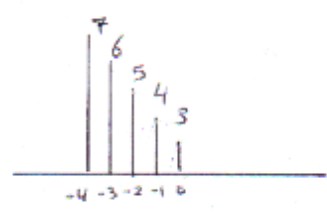


$X(2n-2)$

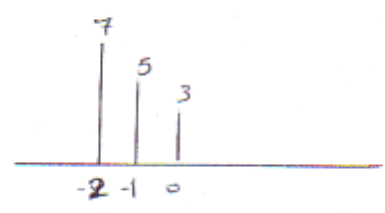


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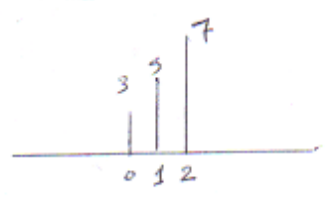
$x(n+2)$



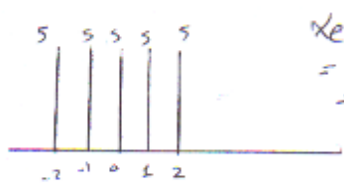
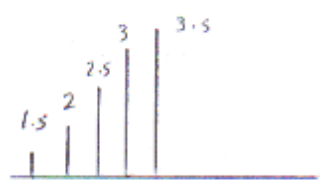
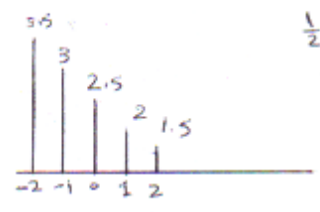
$x(2n+2)$



$x(2-2n)$

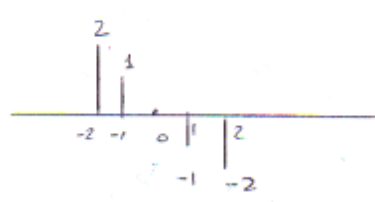


Even part



odd part

$x_o = \frac{1}{2}x(n) - \frac{1}{2}x(-n)$



* not additive

(3)

$$y_1(n) = \left[x_1(n) + \frac{x_1(n+1) + x_1(n-1)}{x_1(n)} \right] + \left[x_2(n) + \frac{x_2(n+1) + x_2(n-1)}{x_2(n)} \right]$$

$$y_2(n) = \left[x_1(n) + x_2(n) + \frac{x_1(n+1) + x_2(n+1) + x_1(n-1) + x_2(n-1)}{x_1(n) + x_2(n)} \right]$$

$y_1(n) \neq y_2(n) \quad \therefore$ not additive

not homogeneous

$$y_1(n) = a \left(x(n) + \frac{x(n+1) + x(n-1)}{x(n)} \right)$$

$$y_2(n) = a x(n) + \frac{a x(n+1) + a x(n-1)}{a x(n)}$$

$y_1(n) \neq y_2(n) \quad \therefore$ not homogeneous

not linear

Shift Invariant

$$y_1(n) = x(n-n_0) + \frac{x(n+1-n_0) + x(n-1-n_0)}{x(n-n_0)}$$

$$y_2(n) = x(n-n_0) + \frac{x(n-n_0+1) + x(n-n_0-1)}{x(n-n_0)}$$

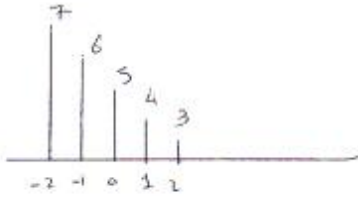
$\therefore y_1(n) = y_2(n) \quad \therefore$ Shift Invariant

not causal \because depends on $x(n+1)$

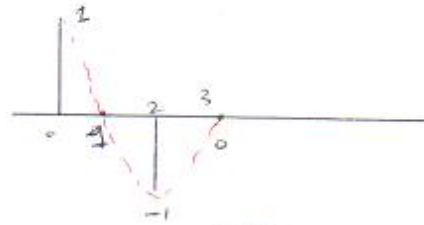
(4)

not LSI since not linear

3 Convolve



$$h(n) = (5-n) [u(n+2) - u(n+3)]$$

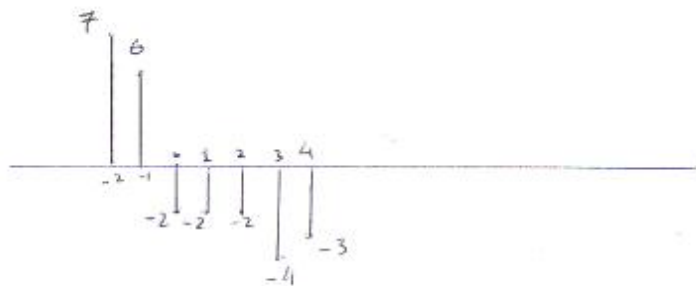


$$x(n) = \cos\left(\frac{n\pi}{2}\right) [u(n) - u(n-4)]$$

$$h(n) = 7\delta(n+2) + 6\delta(n+1) + 5\delta(n) + 4\delta(n-1) + 3\delta(n-2)$$

$$\therefore y(n) = 7x(n+2) + 6x(n+1) + 5x(n) + 4x(n-1) + 3x(n-2)$$

	-2	-1	0	1	2	3	4	
$7x(n+2)$	7	0	-7	0	0	0	0	Range -2 2 0 2 -2 4
$6x(n+1)$	0	6	0	-6	0	0	0	
$5x(n)$	0	0	5	0	-5	0	0	
$4x(n-1)$	0	0	0	4	0	-4	0	
$3x(n-2)$	0	0	0	0	3	0	-3	
	7	6	-2	-2	-2	-4	-3	



```
>> x=[1 0 -1];  
>> dtx=0:2;  
>> y= [7 6 5 4 3];  
>> dty=-2:2;  
>> z=conv(x,y);  
>> dtz=-2:4;  
>> stem(z,dtz)  
>> stem(z,dtz)  
>> z
```

```
z =
```

```
    7    6   -2   -2   -2   -4   -3
```

```
>> stem (z)  
>> stem(z,dtz)  
>> stem (z)  
>>
```

6

