

EE-3220-11 - Dr. Durant - Quiz 2  
Winter 2015-'16, Week 2

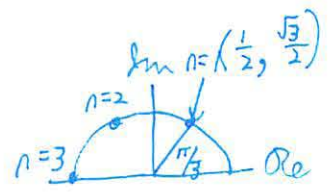
1. (3 points) Indicate whether each of the following systems is linear, time-invariant, and causal. You **do not** need to show your work for this problem.

	$y_1(n) = x(n-3)+2$	$y_2(n) = x^2(n)$	$y_3(n) = nx(n+1)$
Linear?	- $+2$ not linear	- $(a+b)^2 \neq a^2+b^2$	+
Time-invariant?	+	+	- gain of $n$ not constant
Causal?	+	+	- $n+1$ looks in future

2. (2 points) Calculate the non-0 portion of the sequence resulting from  $x(n) = n \cos(n\frac{\pi}{3})(u(n)-u(n-4))$ . Recall that  $u(n)$  is the unit step that becomes 1 when the argument reaches 0. Clearly indicate the  $n=0$  position in your sequence.
3. (1 point) Express your sequence above as a weighted sum of shifted unit samples or deltas ( $\delta(n-k)$ ).

(2)  $u(n)$  turns on at 0,  $u(n-4)$  turns on at 4. So, potentially non-zero only on  $0 \leq n \leq 3$ .  
Multiplier of  $n$  gives 0 @  $n=0 \therefore 1 \leq n \leq 3$ .

$n$	$\frac{n\pi}{3}$	$\cos(\frac{n\pi}{3})$	$x(n)$
1	$\frac{\pi}{3}$	$\frac{\sqrt{3}}{2}$ $\frac{1}{2}$	$\frac{\sqrt{3}}{2}$ $\frac{1}{2}$
2	$\frac{2\pi}{3}$	$-\frac{\sqrt{3}}{2}$ $-\frac{1}{2}$	$-\frac{\sqrt{3}}{2}$ $-1$
3	$\pi$	-1	-3



(3)  $x(n) = \frac{\sqrt{3}}{2} \delta(n-1) - \frac{\sqrt{3}}{2} \delta(n-2) - 3 \delta(n-3)$

4. (1 point) Explain what the term  $h(-2)$  from a system impulse response specifies. That is, what does it say about the relationship between the system input and system output?

(1) right factor, no delay

5. (3 points) Calculate the convolution  $y[n] = x_2[n] * h_2[n] = [5 \ 2 \ -4] * [4 \ 5 \ -3]$ . Show your work (intermediate products; you are not required to show the formula for the convolution sum).

Both sequences start at  $n=0$ .

(4) Amount of output that occurs 2 samples before input per unit of input.  
Non-causal system.

(5)

$k \setminus n$	0	1	2	3	4
0	20	8	-16		
1		25	10	-20	
2			-15	-6	12
$\Sigma$	20	33	-21	-26	12

$x(n-k)h(k)$  (can also do  $x(k)h(n-k)$ )  
"  
"

Checking with MATLAB:

```
>> x=[5 2 -4];
>> h=[4 5 -3];
>> y=conv(x,h)
y =
    20    33   -21   -26    12
```