ISRA UNIVERSITY

Islamabad Campus

MID SEMESTER EXAMINATION – SPRING 2018
Program: BTECH (Electrical)
Solution

Course Title: Signal & Systems
Course Code: ETSS-314
Total Marks: 30
Duration: 1 Hr 30 Min
Day & Date: Fri, May 11, 2018
Start Time: 0530 PST

(Use CAPITAL letters)

Student Name:	Invigilator's Name:
Student Signature:	Invigilator's Signature:
Student Regd. No:	Date:

Attempt all questions. Marks are mentioned against the questions. **Note: Please attach the question paper at the end of the answer sheet.**

PLEASE DO NOT OPEN THE PAPER UNTIL ASKED TO DO SO

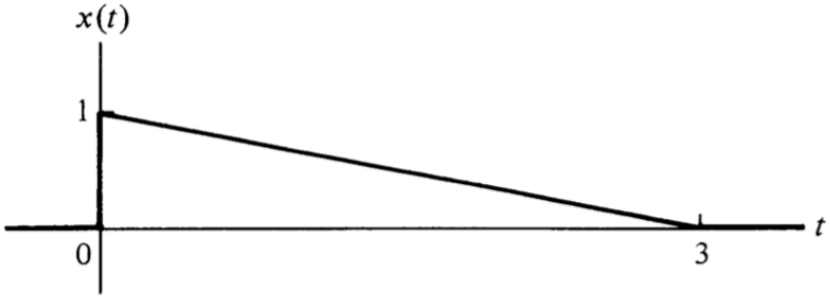
*****************Good Luck*****************

Q1.

a) For x (t) indicated in figure below, sketch the following:

i. $x(1-3t)$

ii. $x(2t+2)$

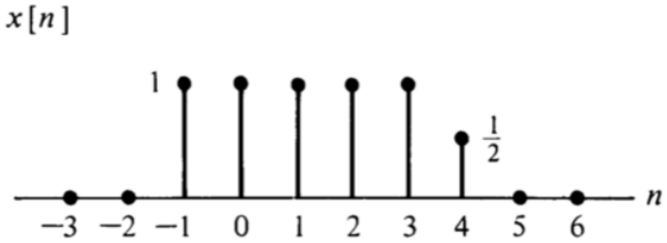


(04 Marks)

b) For x [n] indicated in figure below, sketch the following:

i. $x[n-2]$

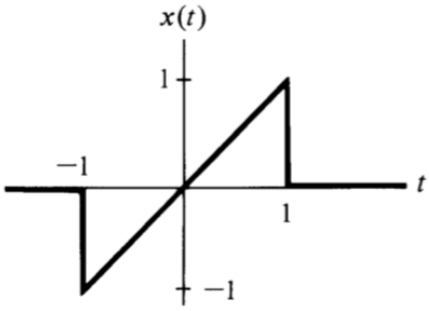
ii. $x[2n]$



(04 Marks)

Q2.

a) For the following signal, determine whether it is even, odd or neither:



(04 Marks)

b) Determine whether or not each of the following signals is periodic. If a signal is periodic, specify its fundamental period:

$$x(t) = 5\cos\pi t \sin 3\pi t$$

(04 Marks)

Solution:

Step #1: Determine fundamental period of individual signals:

$$T_1 = \frac{2\pi}{\omega_1}, \omega_1 = \pi \quad ; T_2 = \frac{2\pi}{\omega_2}, \omega_2 = 3\pi$$

$$T_1 = \frac{2\pi}{\pi} \Longrightarrow 2 \quad ; T_2 = \frac{2\pi}{3\pi} \Longrightarrow \frac{2}{3}$$

Step #2: Find the ratio of fundamental period of 1st signal to fundamental period of every other signal.

$$\frac{T_1}{T_2} = \frac{2}{\frac{2}{3}} = \frac{2}{2} \times 3 \Longrightarrow 3$$

Step #3: If the ratios are Rational, the composite signal is periodic.
Number 3 is rational so x (t) is periodic.

Step #4: T_0 = LCM (T_1 , T_2 ,……)

$$T_0 = LCM\left(2, \frac{2}{3}\right)$$

$$LCM\ of\ fraction = \frac{LCM\ of\ numerators}{HCF\ of\ denominators}$$

$$T_0 = \frac{LCM(2,,2\,)}{HCF(1,3)} = \frac{2}{1} \Longrightarrow 2$$

Hence the fundamental time period of x (t) is 2.

Q3. For the discrete time system given below:

$$y[n] = x[n] + nx[n-2]$$

Check the following:

- **i.** System with/ Without Memory
- **ii.** Causality
- **iii.** Linearity

(04 Marks)

Solution:

- **i.** System with/ Without Memory
  The output y (n) depends on the past value as well so the system is with memory.
- **ii.** Causality
  The output y (n) depends on the present input x(n) and the past input x(n-2).
  Therefore the system is causal.
- **iii.** Linearity
  Let's consider a signal:

$$x(n) = ax_1(n) + bx_2(n)$$

Where $y_1(n) = x_1(n) + nx_1(n-2)$ & $y_2(n) = x_2(n) + nx_2(n-2)$

Then:

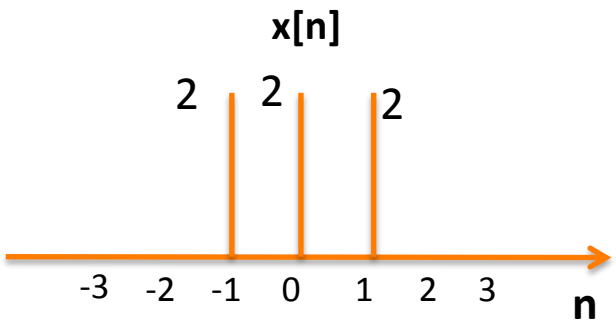
$$ay_1(n) + by_2(n) = ax_1(n) + anx_1(n-2) + bx_1(n) + bnx_1(n-2)$$

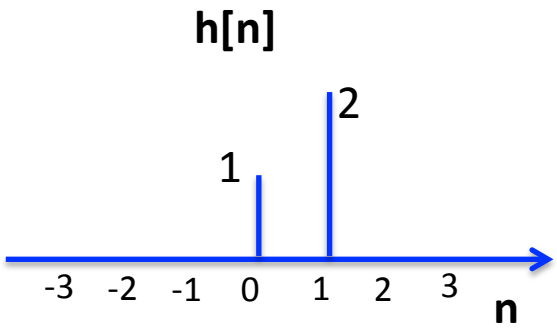
$$ay_1(n) + by_2(n) = a\big(x_1(n) + nx_1(n-2)\big) + b\big(x_1(n) + nx_1(n-2)\big)$$

$$y_3(n) = ay_1(n) + by_2(n)$$

Hence the system is linear.

Q4. Convolve the signals x [n] and h [n], shown below:



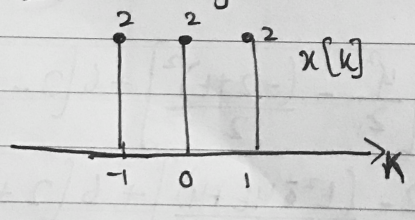


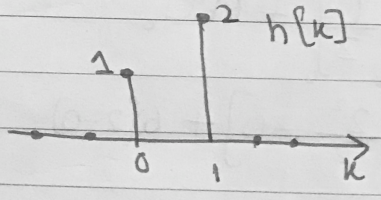
(10 Marks)

Solution:

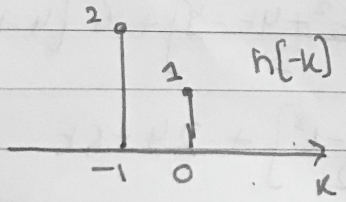
Sol:-

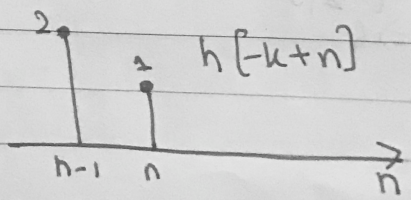
Step 1:- Change $n \to k$





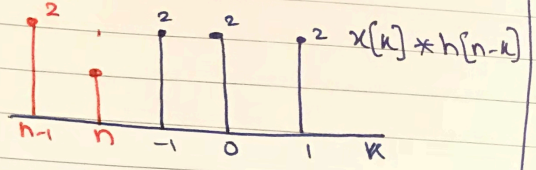
Step 2:- Flip h(k) and ~~as~~ shift





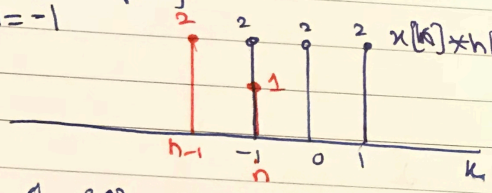
Fair Paper

Step #3:- Now convolve the two signals.



$y[n] = 0$ as there is no overlapping.

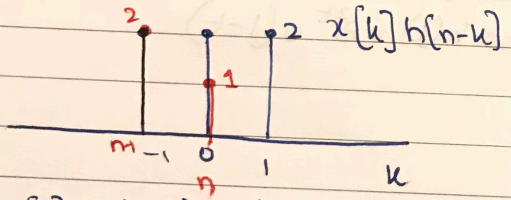
∴ n = -1



$y[-1] = \sum x[k]h[n-k]$

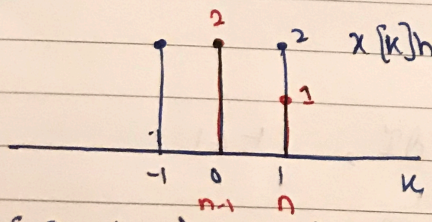
$= (2\times0) + (1\times2) \Rightarrow 2$

∴ n = 0



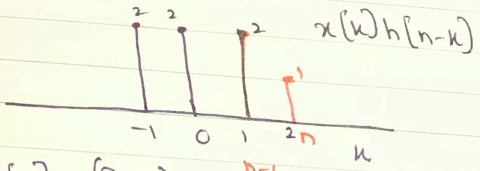
$y[0] = (2\times2) + (1\times2) = 4+2 \Rightarrow 6$

∴ n = 1



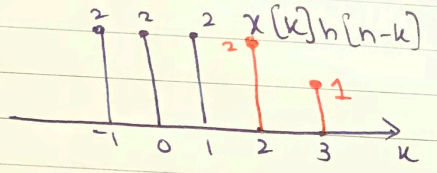
$y[1] = (2\times2) + (1\times2) \Rightarrow 6$

∴ n = 2



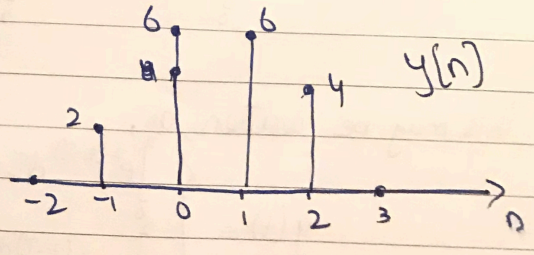
$y[2] = (2\times2) + (1\times0) \Rightarrow 4$

∴ n = 3



$y[3] = 0$ as there is no overlapping

$$y[n] = \begin{cases} 0 & n < -1 \\ 2 & n = -1 \\ 6 & n = 0 \\ 6 & n = 1 \\ 4 & n = 2 \\ 0 & n = 3 \end{cases}$$



**********The End**********