Department of Electrical Engineering
Sessional Assignment
Date: 05/05/2020

Course Details

Course Title: Signals & Systems **Module:** 04
Instructor: Engr- sir mujtaba ihsan **Total Marks:** 20

Student Details

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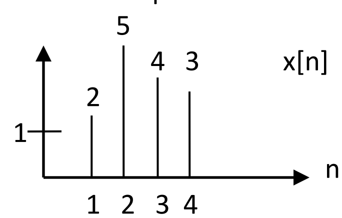
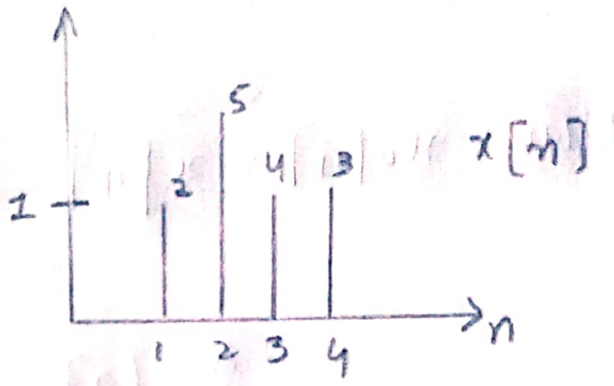
Q1.		**Evaluate** the even and odd components for the given function.  	Marks 05 CLO 1
Q2.		**Calculate** the inverse Laplace transform of the given equation. $$\mathbf{Y(s)} = \frac{\mathbf{s+4}}{\mathbf{s^2 + 4s - 12}}$$	Marks 07 CLO 3
Q3.	i. ii.	**Discuss** the procedure of converting an analog signal into a digital one. Suppose an analog signal has a highest frequency of 60Hz. **Outline** the steps that will ensure that no aliasing occurs.	Marks 02+02 CLO 2
Q4.		**Show** that: $x[n] * [h_1[n] * h_2[n]] = [x[n] * h_1[n]] * h_2[n]$	Marks 04 CLO 2

Q1:- Evaluate the even and odd components for the given function:



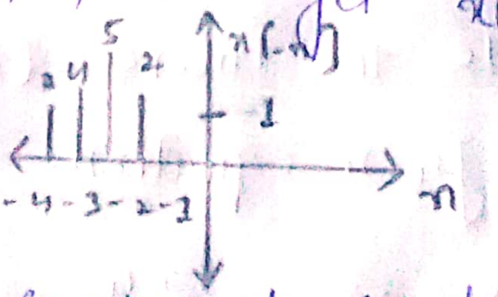
Answer:-

For even component, $x_e(n) = x(n) + x(-n)$

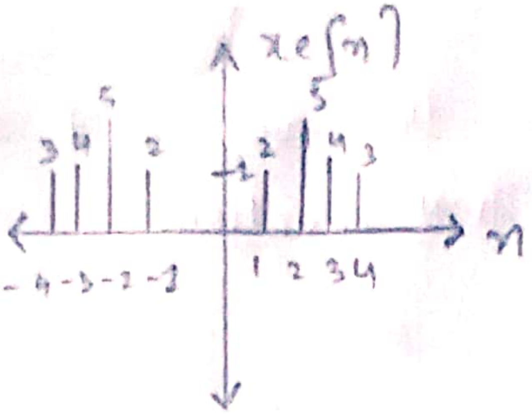
" odd ", $x_o(n) = \frac{x(n) - x(-n)}{2}$

Now we have $x_e[n] = \frac{x[n] + x[-n]}{2}$

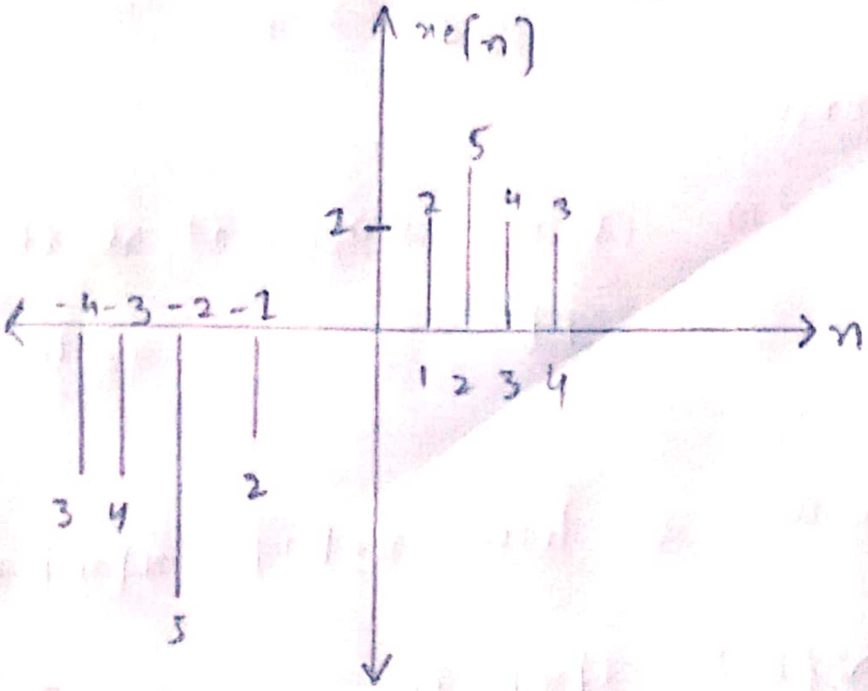
Reflect $x[n]$ to get $x[-n]$



The even component can be drawn By using $x_e[n] = \frac{x[n] + x[-n]}{2}$



Now $x_o[n] = \frac{x[n] - x[-n]}{2}$



Q2:- Calculate the Inverse Laplace transform of the given equation.

$$Y(s) = \frac{s+4}{s^2+4s-12}$$

Solution:-

$$\frac{s+4}{s^2+6s-2s-12}$$

$$= \frac{s+4}{s(s+6)-2(s+6)} = \frac{s+4}{(s+6)(s-2)}$$

$$\frac{s+4}{(s+6)(s-2)} = \frac{A}{s+6} + \frac{B}{s-2}$$

$$s+4 = A(s-2) + B(s+2) \longrightarrow (1)$$

Now

Let $s = 2$ in eq (1)

$$2+4 = A(2-2) + B(2+2)$$

$$2+4 = A(0) + B(4)$$

$$2+4 = B(4)$$

$$\frac{6}{4} = \frac{3}{2} = \frac{B(4)}{4}$$

$$\boxed{B = \frac{3}{2}}$$

Now let $s = -2$

$-2+4 = A(-2-2) + B(-2+2)$

$2 = A(-4) + B(0)$

$\frac{2}{-4} = \frac{A(-4)}{-4}$

$A = \frac{2}{-4} = \frac{1}{-2}$

$$\boxed{A = \frac{1}{-2}}$$

Now putting them back

$= \frac{1}{-2} + \frac{3}{2}$

$H(s) = \frac{1}{-2}\left(-\frac{1}{s+6} + \frac{3}{2}\left(\frac{1}{s-2}\right)\right)$

$= \frac{1}{-2}e^{-6t} + \frac{3}{2}e^{-2t}$

$H(s) = \frac{1}{-2}L^{-1}\frac{1}{s+6} + s+6\ \frac{3}{2}L^{-1}\left(\frac{1}{s-2}\right)(s-2)$

$= \frac{1}{-2}e^{-6t} + \frac{3}{2}e^{-2t}$

Q 3: Part(A)

Discuss the produre of converting an analog signal into a digital one.

Answer:-

Analog signal converted to a digital signal using a two step process

(1) Sampling

(2) Quantization

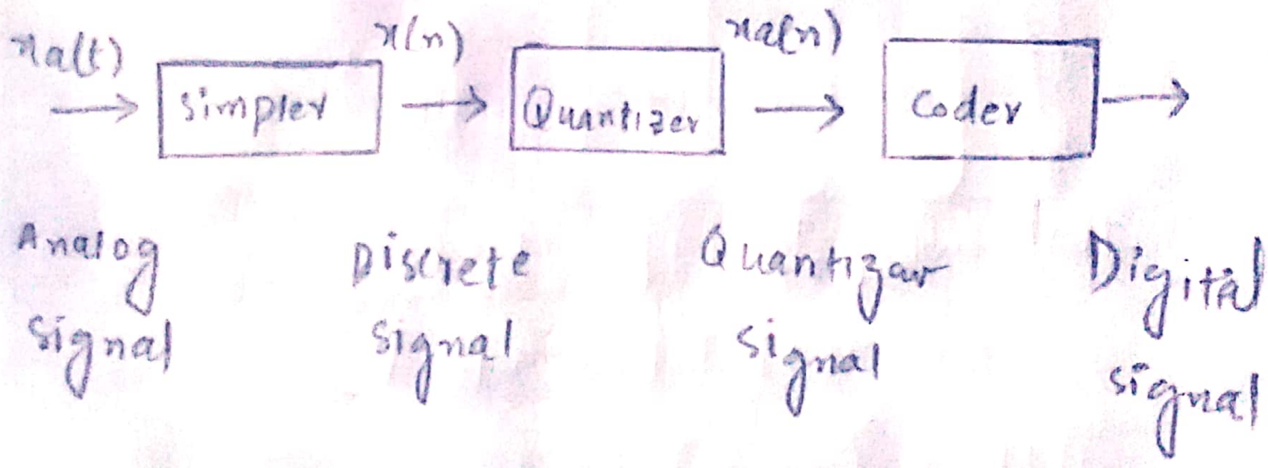
The device used to do this called as ADC (Analog to Digital Converter)

Step 1:-

Samplings converts a continuous time continuous amplitude (real valued) signal to discrete time continuous amplitude (still real valued) signal. Remember only time axis is discretized and not the amplitude axis.

step 2:-

Quantization converts the discrete time continuous amplitude signal to discrete time and discrete valued (from a set of finite values, so that it can be represented by finite bits and can be stored on a computer.



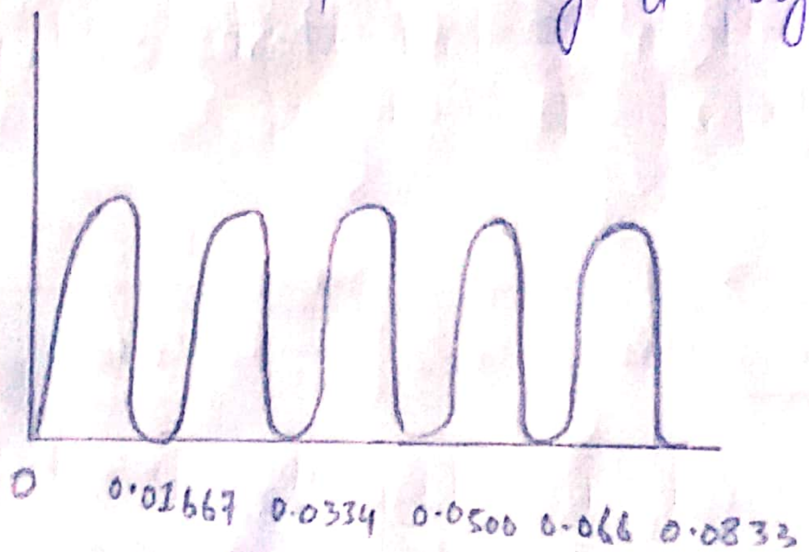
Q3 part B:-

Aliasing:-

The Phenomenon of sinsusoids changing frequency during sampling is called aliasing.

Aliasing always changes a higher frequency into a lower frequency between 0 and 0.5

In addition aliasing may also change the phase of the signal by 180 degrees.



No Aliasing

Q4:

Show that:-

$$x[n] * [h_1[n] * h_2[n]] = [x[n] * h_1[n]] * h_2[n]$$

Solution:-

Proof:

$$x[n]*(h_1[n]+h_2[n]) = \sum_{k=-\infty}^{\infty} x[n-k](h_1[k]+h_2[k])$$

$$= \sum_{k=-\infty}^{\infty} x[n-k]h_1[k] + \sum_{k=-\infty}^{\infty} x[n-k]h_2[k]$$

$$= \boxed{x[n]*h_1[n] + x[n]*h_2[n]}$$

OR

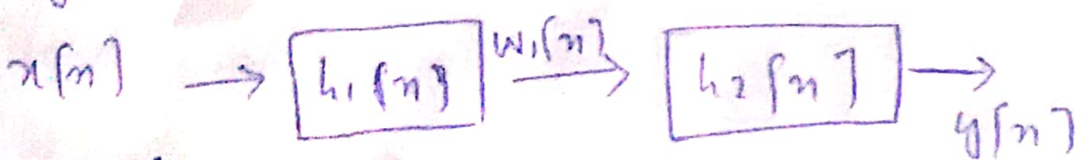
Consider

$$y[n] = x[n]*h_1[n]*h_2[n]$$

let $x[n]*h_1[n] = w_1[n]$

$$y[n] = [x[n]*h_1[n]]*h_2[n] \rightarrow (1)$$

$$y[n] = w_1[n]*h_2 n$$

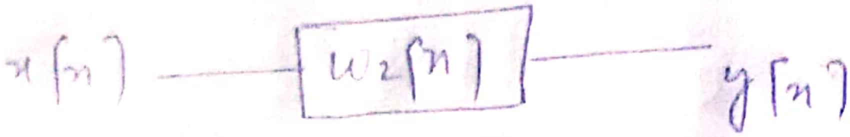


Now consider that

$$w_2[n] = h_1[n]*h_2[n]$$

$$y[n] = x[n]*[h_1[n]*h_2[n]]$$

$$= x[n]*w_2[n]$$



Both block diagrams give the same response

Hence

$$[x[n] * h_1[n]] * h_2[n] = x[n] * [h_1[n] * h_2[n]]$$

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