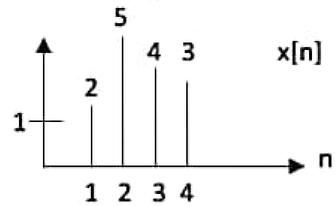
Department of Electrical Engineering
Sessional Assignment
Date: 05/05/2020

Course Details

Course Title: Signals & Systems **Module:** 04
Instructor: ______ **Total Marks:** 20

Student Details

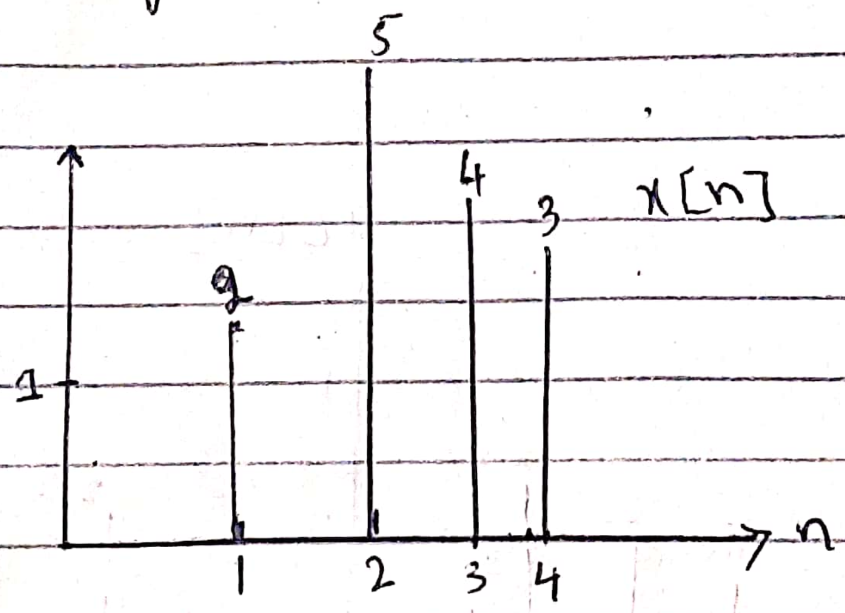
Name: ______ **Student ID:** ______

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.	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

Name: Naveed Ali

ID No. 16753.

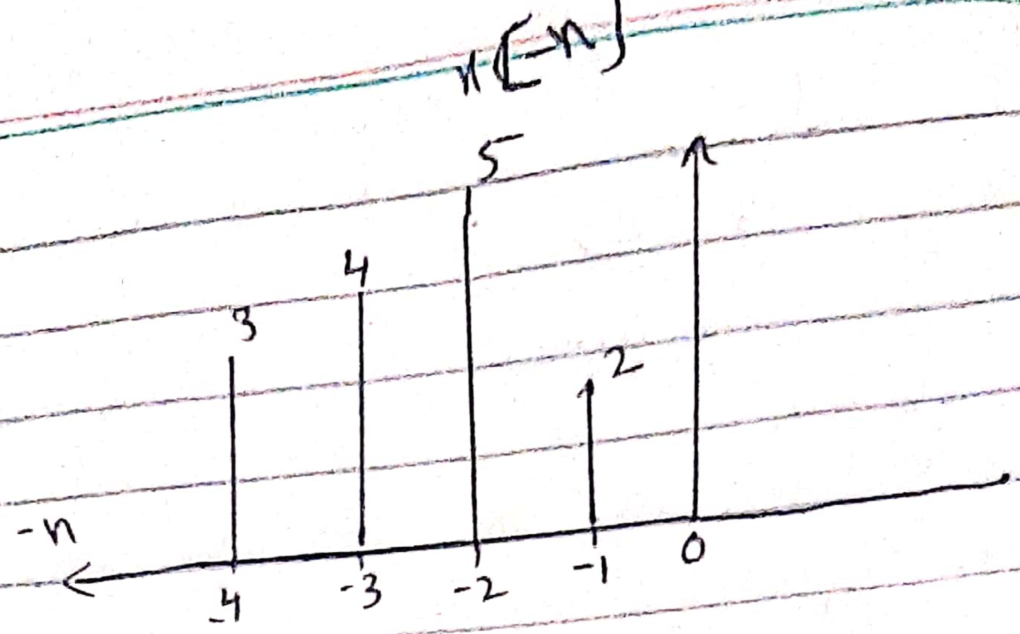
Q1: Evaluate the even and odd ~~no~~ components for the given Function.

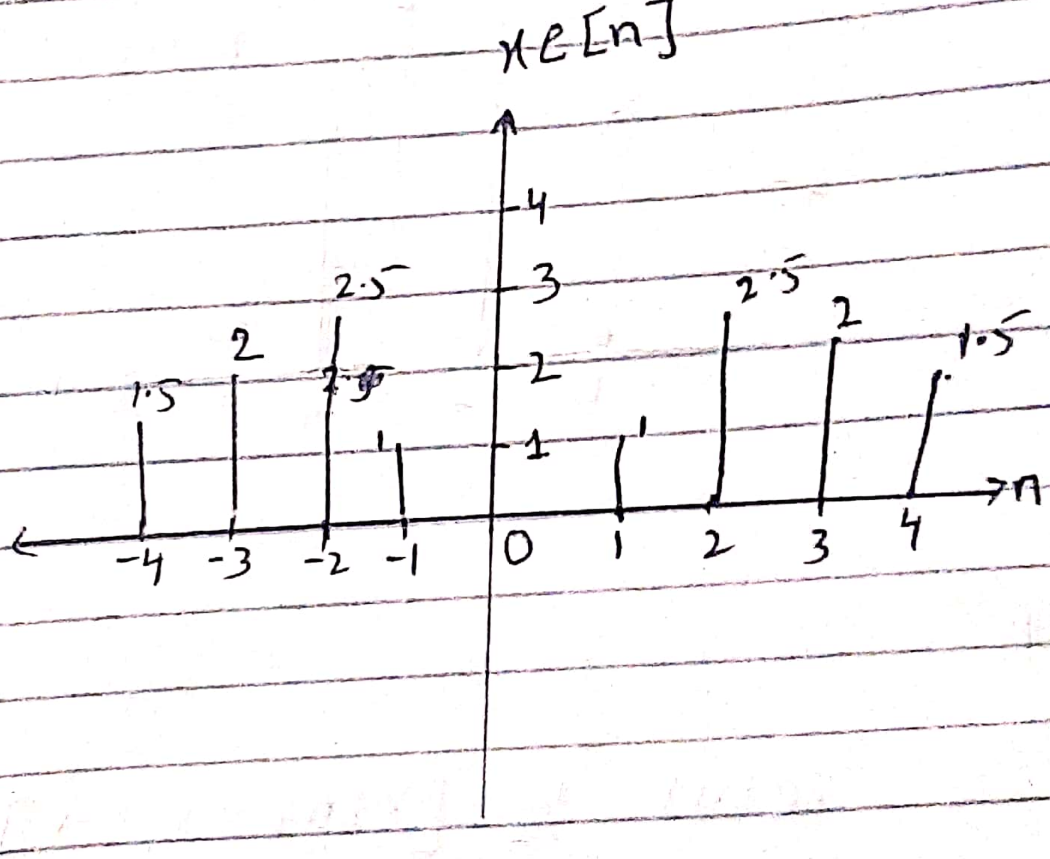


Ans:

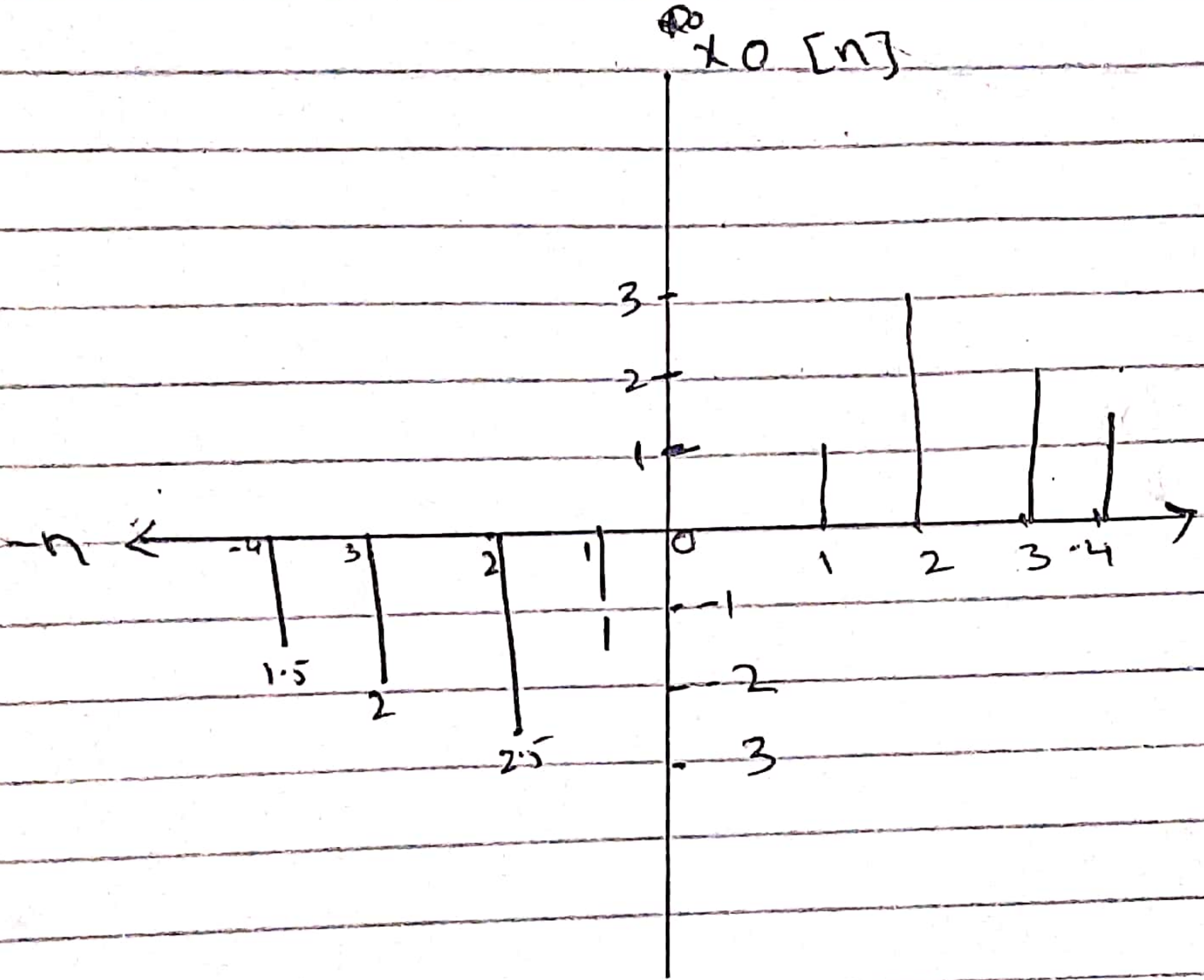
$$x_e[n] = \frac{1}{2}\left[x[n] + x[-n]\right]$$

$$x_o[n] = \frac{1}{2}\left[x[n] - x[-n]\right]$$





even component of the signal.



odd component of the signal.

Q2: Calculate the inverse Laplace transform of a given equation.

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

Sol:

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

$$y : \mathcal{L}^{-1}\left[\frac{s+4}{s^2+4s-12}\right]$$

By partial fraction

$$\mathcal{L}^{-1}\left[\frac{\frac{-2}{-8}}{(s+6)}\right] + \mathcal{L}^{-1}\left[\frac{\frac{6}{8}}{(s-2)}\right]$$

$$= \boxed{\frac{1}{4} e^{-6t} + 3/4\, e^{2t}}$$

3(I) Discuss the procedure of converting an ~~alno~~ analog signal into a digital one

Ans: Analog signal is converted to digital signal using a two step process. The device used to do this is called as ADC (Analog to Digital ~~Conv~~ Converter).

Step 1.

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

Step 2.

Quantization converts the discrete time continuous amplitude (~~still~~ 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(II).

Suppose an alalog signal has highest frequency of 60Hz. outline the steps that will ensure that no aliasing occurs.

Ans. Aliasing.

The sampling rate for an analog singal must be at leest two time as high as the highest frequency in the analog signal in order to avoid aliasing. Conversely for a fixed sampling rate, the highest frequency in the analog signal can be no higher than a half of the sampling rate:

Aliasing is generally avoided by applying low pass filters or Anti-Aliasing filter's (AAF). to the input signal before sampling & when converting a signal from higher to a lower sampling rate.

Q4

Show that:

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

Sol:-

Proof:- Let:

$$a[n] = h_1[n] * h_2[n] = \sum_{k=-\infty}^{\infty} h_1[k] h_2[n-k]$$

$$b[n] = x[n] * h_1[n] = \sum_{l=-\infty}^{\infty} x[l] h_1[n-l]$$

$$x[n] * a[n] = \sum_{l=-\infty}^{\infty} x[l] a[n-l]$$

$$= \sum_{l=-\infty}^{\infty} x[l] \left(\sum_{k=-\infty}^{\infty} h_1[k] h_2[n-l-k] \right)$$

$$b[n] * h_2[n] = \sum_{k=-\infty}^{\infty} b[k] h_2[n-k]$$

$$= \sum_{k=-\infty}^{\infty} \left(\sum_{l=-\infty}^{\infty} x[l] h_1[k-l] \right) h_2[n-k]$$

$$= \sum_{l=-\infty}^{\infty} x[l] \left(\sum_{k=-\infty}^{\infty} h_1[k-l] h_2[n-k] \right)$$

Let, $k' = k-l$. we have $k = l + k'$ and hence

$$b[n] * h_2[n] = \sum_{l=-\infty}^{\infty} x[l] \left(\sum_{k'=-\infty}^{\infty} h_1[k'] h_2[n-l-k'] \right)$$

combining properties 2 & 4 we have.

$(x[n] * h_1[n]) * h_2[n] * h_2(n)$ each.

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

Interpretation:

$x(n] \rightarrow \boxed{h_1[n]} \rightarrow \boxed{h_2[n]} \rightarrow y[n]$

$\updownarrow$

$x[n] \rightarrow \boxed{h_1[n] * h_2[n]} \rightarrow y[n]$

$\updownarrow$

$x(n] \rightarrow \boxed{h_2[n] * h_1[n]} \rightarrow y[n]$

$\updownarrow$

$x(n] \rightarrow \boxed{h_2(n)} \rightarrow \boxed{h_1[n]} \rightarrow y[n]$

& observe that

$x[n] = -\delta(n+2] + \delta[n+1] + \delta[n] + \delta(n-2]$

$h[n] = \delta[n] + \delta[n-1]$.

Thus,

$x[n] * h[n] = (-\delta[n+2] + \delta[n+1] + \delta(n] + \delta(n-2]) * (\delta(n] + \delta[n] + \delta(n-1]$

$= -\delta(n+2] + \delta[n+1] + \delta[n] + \delta[n-2] + (-\delta[n+1] + \delta[n] + \delta[n-1] + \delta(n-3]]$

$= -\delta[n+2] + 2\delta[n] + \delta[n-1] + \delta(n-2] + \delta[n-3]$.