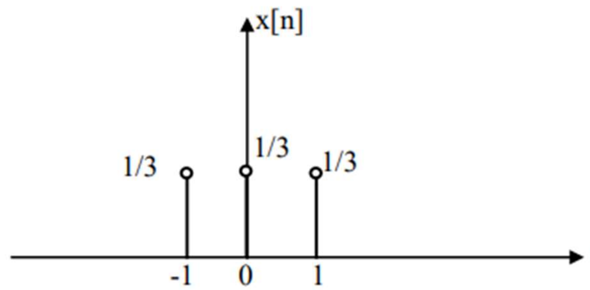
Question no.1:

a. **Find the Z-transform of the signal shown below:**



Solution:

By definition:

$$X(z) = \sum_{n=-\infty}^{\infty} x[n]z^{-n}$$

As we know that, signal exist in between -1 to 1. So, above equation becomes.

$$X(z) = \sum_{n=-1}^{1} x[n]z^{-n}$$

$$= \frac{1}{3}z + \frac{1}{3} + \frac{1}{3}z^{-1}$$

b. **Find the Z-transform of exponentially signal given by:**

$$\boldsymbol{x[n] = a^n u(n)}$$

Solution:

By definition:

$$X(z) = \sum_{n=-\infty}^{\infty} a^n u(n) z^{-n}$$

$$putting\ u(n) = 1, which\ was\ unit\ impulse\ response$$

$$= \sum_{n=0}^{\infty} a^n z^{-n} = \sum_{n=0}^{\infty} (az^{-1})^n$$

$$= \frac{1}{1 - az^{-1}} = \frac{z}{z - a}$$

Question no.2:

Classify the following signal if it is power signal.

a. $\boldsymbol{f(t) = 1 - cost}$

Solution:

$$P = \frac{1}{T}\int_{o}^{T} |f(t)|^2 dt$$

We are taking T in between 0 to 2π

$$P = \frac{1}{2\pi}\int_{0}^{2\pi} \left[\left(\frac{1}{2} - cost\right)\right]^2 dt$$

$$P = \frac{1}{2\pi}\left[\int_{0}^{2\pi} \left(\frac{1}{2}\right)^2 dt - \int_{0}^{2\pi} (cost)^2 dt\right]$$

Solving the integral, respectively.

$$P = \frac{1}{2\pi}\left[\frac{1}{4} \times \int_0^{2\pi} dt - \left[\frac{(sint)^3}{3}\right]_0^{2\pi}\right]$$

Where $\int dt = t, so \int_0^{2\pi} dt = 2\pi - 0$

Power signal becomes,

$$P = \frac{1}{2\pi}\left[\frac{1}{4} \times 2\pi - \frac{\sin(2\pi)^3}{3}\right]$$

Solve it further, we will get

P=0.2499999 this value lies in between $0 < \int_{-\infty}^{\infty} |f(t)|^2 dt < +\infty$, so it is a power signal.

Question no.3:

Use the graphical interpretation of convolution to find the output y[n] for the input x[n] and impulse response h[n].

$$\boldsymbol{x[n] = 0\ 0\ 1\ 1\ 1\ 1\ 1\ 1\ 0\ 0}$$

$$\boldsymbol{h[n] = 1\ 1\ 1\ 0\ 0\ 1\ 0\ 1\ 0\ 1}$$

It is important question!

Question no.4:

Find the linear convolution between

$$\boldsymbol{x(n) = 1, 2, 3, 4\ n \geq 0}$$

$$\boldsymbol{h(n) = 4, 3, 2, 1 \geq 0}$$

Solution:

<u>Example:</u> Find the linear convolution between

$$\mathbf{x(n) = 1, 2, 3, 4 \quad n \geq 0}$$

$$\mathbf{h(n) = 4, 3, 2, 1 \quad n \geq 0}$$

<u>Solution:</u>

$N_1 = 4$, $N_2 = 4$, and $N_1 + N_2 - 1 = 7$ (y(0) to y(7))

$$y(n) = \sum_{m=0}^{7} x(m).h(n-m)$$

$$y(0) = \sum_{m=0}^{7} x(m).h(-m)$$

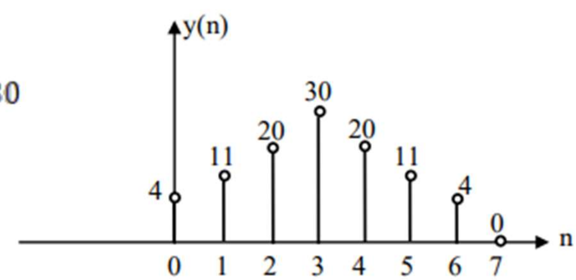
$$= x(0)h(0) + x(1)h(-1) + x(2)h(-2) + x(3)h(-3) + x(4)h(-4)$$
$$+ x(5)h(-5) + x(6)h(-6) + x(7)h(-7) = 1 * 4 + 0 = 4$$

$$y(1) = \sum_{m=0}^{7} x(m).h(1-m)$$

$$= x(0)h(1) + x(1)h(0) + x(2)h(-1) + x(3)h(-2) + x(4)h(-3)$$
$$+ x(5)h(-4) + x(6)h(-5) + x(7)h(-6) = 1 * 3 + 2 * 4 + 0 = 11$$

$$y(2) = \sum_{m=0}^{7} x(m).h(2-m) = 20$$

$$y(3) = \sum_{m=0}^{7} x(m).h(3-m) = 1 + 4 + 9 + 16 = 30$$



$$y(4) = \sum_{m=0}^{7} x(m).h(4-m) = 2 + 6 + 12 = 20$$

$$y(5) = \sum_{m=0}^{7} x(m).h(5-m) = 1 * 0 + 2 * 0 + 3 * 1 + 4 * 2 = 11$$

$$y(6) = \sum_{m=0}^{7} x(m).h(6-m) = 4 * 1 = 4$$

$$y(7) = \sum_{m=0}^{7} x(m).h(7-m) = 0$$

y(n) = 4, 11, 20, 30, 20, 11, 4, 0

Question no.5:

Find the circular convolution between

$$x[n] = 1,2,3,4 \geq 0$$

$$h[n] = 4,3,2,1 \; n \geq 0$$

Solution:

Example: **Find the Circular convolution between**

$$x[n] = 1, 2, 3, 4 \quad n \geq 0$$
$$h[n] = 4, 3, 2, 1 \quad n \geq 0$$

Solution:

N = 4

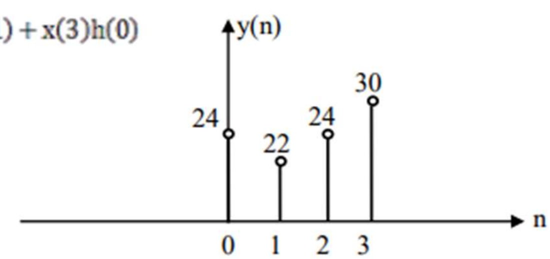
$$y[n] = \sum_{m=0}^{3} h(n-m).x(m)$$

$$y[0] = \sum_{m=0}^{3} h(-m).x(m) = x(0)h(0) + x(1)h(-1) + x(2)h(-2) + x(3)h(-3)$$
$$= 1*4 + 2*1 + 3*2 + 4*3 = 24$$

$$y[1] = \sum_{m=0}^{3} h(1-m).x(m) = x(0)h(1) + x(1)h(0) + x(2)h(-1) + x(3)h(-2)$$
$$= 1*3 + 2*4 + 3*1 + 4*2 = 22$$

$$y[2] = \sum_{m=0}^{3} h(2-m).x(m) = x(0)h(2) + x(1)h(1) + x(2)h(0) + x(3)h(-1)$$
$$= 1*2 + 2*3 + 3*4 + 4*1 = 24$$

$$y[3] = \sum_{m=0}^{3} h(3-m).x(m) = x(0)h(3) + x(1)h(2) + x(2)h(1) + x(3)h(0)$$
$$= 1*1 + 2*2 + 3*3 + 4*4 = 30$$



Question no.6:

Give the classification of discrete time signals?

Solution:

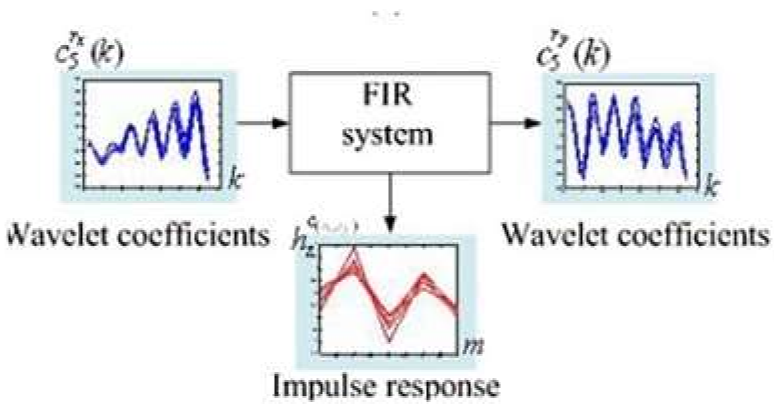
A discrete time signal can be classified as: causal and non – causal, periodic and non – periodic, even and odd, energy and power signals.

Question no.7:

Compare between FIR and IIR systems?

Solution:

If the system's impulse response contains finite number of samples, then the system is a FIR system.



If the system's impulse response contains infinite number of samples, then the system is said to be an IIR system.

Question no.8:

What you know about BIBO stability? Discuss the condition to be satisfied for stability?

Solution:

A system is said to be BIBO stable, if the system's response is bounded (measureable) for bounded excitation. In other words, if the system's output is measurable for the measurable input, the system is said to be BIBO stable. For a system to be stable, the impulse response of the system should be absolutely summable.

Question no.9:

What you understand about time invariant system.

Solution:

For a time invariant system, the system's operation is independent of time. In other words, we can say that if the delayed system response is equal to system's response for delayed input, then the system is known as time invariant system.

Question no.10:

In a flash analog to digital converter. The output of each comparator is connected to an input of a ___?

Solution:

In general, the output of each comparator is connected to an input of a "priority encoder" of a flash ADC.