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Subject : Signal & System Instructor: Mujtaba Ihsan

Module : 4th Semester Summer

Q No. 1

Answer: Periodic signal:

A signal is considered to be periodic signal which repeats itself after specific interval of time.

Example :

Amplifier, amplitude, fourier series etc.

Aperiodic Signal :

A signal is considered to be aperiodic signal which does not repeat itself after regular interval of time

Example :

Fast fourier transform, Discrete time signal, frequamy resolution.

Q No. 2

Answer:

$$f(x) = \begin{cases} 0 & -\pi \le x \le 0 \\ \pi & 0 \le x \le \pi \end{cases}$$

Retaive the fourier series.

Answer :

First we calculate the constant a_0

$$a_0 = 1/\pi \int_{-\pi}^{\pi} f(x)\, dx = \frac{1}{\pi} \int_0^{\pi} \pi\, dx$$

(2)

$= \frac{1}{\pi} \int_0^{\pi} \pi \, dx$

$\frac{1}{\pi} [\pi x|_0^{\pi}]$

$= \frac{1}{\pi} \cdot \pi^2$

$= \pi$ ——— (i)

Find now the fourier co-efficients for $n \neq 0$:

$a_n = \frac{1}{\pi} \int_{-\pi}^{\pi} f(x) \cos nx \, dx$

$= \frac{1}{\pi} \int_0^{\pi} \pi . \cos nx \, dx$

$= \frac{1}{\pi} \left(\frac{\pi . \sin nx}{n} \Big|_0^{\pi} \right)$

$= \frac{1 . \pi}{\pi n} . 0$

$= 0$ ——— (ii)

$b_n = \frac{1}{\pi} \int_{-\pi}^{\pi} f(x) . \sin nx \, dx$

$= \frac{1}{\pi} \int_0^{\pi} \pi . \sin nx \, dx$

$= \frac{1}{\pi} \left[\left(- \pi . \frac{\cos nx}{n} \right) \Big|_0^{\pi} \right]$

$= - \frac{\pi}{\pi n} . (\cos n\pi - \cos 0)$

$= - \frac{1}{n} . (\cos n\pi - 1)$

$= \cancel{1 - \cos n\pi} \quad \frac{1 - \cos n\pi}{n}$

Q No. 3. If $X(z) = \dfrac{2z^2+2z}{z^2+2z-3}$

Retrieve $x[n]$ using inverse z-transform method.

Answer :-

$$X(z) = \frac{2z^2+2z}{z^2+2z-3}$$

$$X(z) = \frac{z(2z+2)}{z^2+2z-3}$$

$$\frac{X(z)}{z} = \frac{2z+2}{z^2+2z-3}$$

$$\frac{2z+2}{z^2+2z-3} = \frac{A}{z-1} + \frac{B}{z+3}$$

$$\frac{2z+2}{(z+3)(z-1)} = \frac{A}{z-1} + \frac{B}{z+3} \quad \text{— (i)}$$

$$2z+2 = A(z+3) + B(z-1)$$

Put $z = -3$

$$2(-3)+2 = A(-3+3) + B(-3-1)$$

$$-6+4 = 0 + B(-4)$$

$$-2 = -B4$$

$$\boxed{B = \frac{2}{4} = \frac{1}{2}} \quad \text{— (ii)}$$

Q No. 4: If

$x[n] = 4\delta[n] - 3\delta[n-1] + 4\delta[n-2]$

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

produce $Y(z)$ and $Y[n]$

Answer :-

First we find $y[n]$

$X(z) = 4 - 3z^{-1} + 4z^{-2}$

$H(z) = 2z^{-1} - 3z^{-2} + 2z^{-3}$

Now

$Y(z) = H(z) * X(z)$

$= (4 - 3z^{-1} + 4z^{-2})(2z^{-1} - 3z^{-2} + 2z^{-3})$

$= 8z^{-1} - 12z^{-2} + 8z^{-3} - 6z^{-2} + 9z^{-3} - 6z^{-4}$

$+ 8z^{-3} - 12z^{-4} + 8z^{-5}$

$= 8z^{-1} - 18z^{-2} + 25z^{-3} - 18z^{-4} + 8z^{-5}$

To find $y[n]$ use the delay property

$y[n] = 8\delta[n-1] - 18\delta[n-2] + 25\delta[n-3]$

$- 18\delta[n-4] + 8\delta[n-5]$

~~Now for~~ $Y(z)$

proved

Step # 3 -:

For the interval.

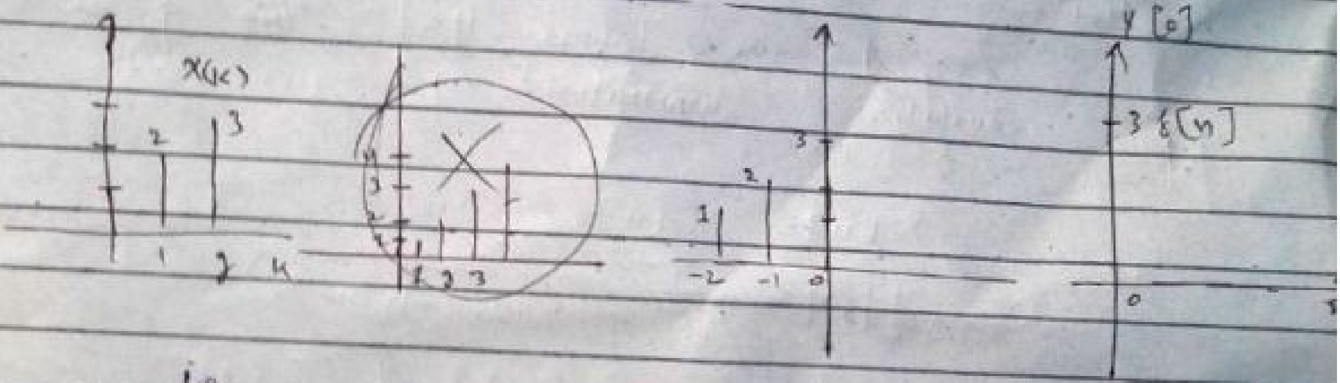
$-\infty < n < 0$

$h(n-k)$ is a value between $-\infty$ and '0'. So when $h(n-k)$ is multiplicative by $x(k)$, the output is zero i.e

$y[n] = 0$

For $n \geq 0$

At $n = 0$



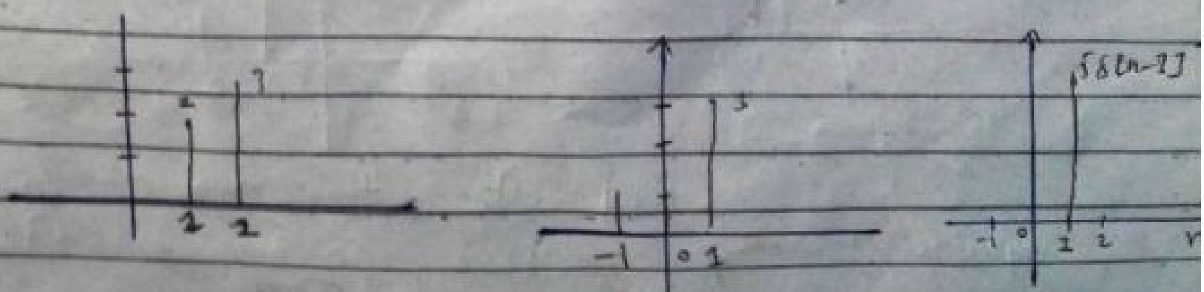
i.e

$$y[0] = \sum_{k=-\infty}^{\infty} x[k]\, h[0-k]$$

$$= (1)(3)$$

$y[0] = 3 \Rightarrow \quad y[0] = 3\delta[n]$. —— (i)

At $n = 1$ $\qquad h[1-k] \qquad y[1]$



i.e

$$y[1] = \sum_{k=-\infty}^{\infty} x[k]\, h[1-k]$$

$$y[1] = (2)(1) + (1)(3) = 5$$