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Q1 :-

Sol :- $y[n] + 0.567\, y[n-2] + 33.3\, y[n-3] + y[n-4] = x[n]$

As we know that we have to find out

* Homogeneous and particular solution

⇒ Homogeneous solution :-

Put λ through out in the above equation in place of y

So:

$\lambda^{n} + 0.567\,\lambda^{n-2} + 33.3\,\lambda^{n-3} + \lambda^{n-4} = 0$

$\lambda^{n-4}(\lambda^{4} + 0.567\,\lambda^{3} + 33.3\,\lambda^{2} + 1) = 0$

We have two roots

$(\lambda^{4} + 0.567\,\lambda^{3} + 33.3\,\lambda^{2} + 1) = 0 \;,\; \lambda^{n-4} = 0$

Now take λ^2 common

$\lambda^{2}(\lambda^{2} + 0.567\lambda + 33.3) = -1$

$\lambda^{2} = -1$ and $\lambda^{2} + 0.567\,\lambda + 33.3 = -1$

$\sqrt{\lambda^{2}} = \sqrt{-1}$

$\boxed{\lambda_1 = \pm 1i}$

$\lambda^{2} + 0.567\lambda = -1 - 33.3$

$\lambda^{2} + 0.567\lambda = -34.3$

Now again λ

$\lambda(\lambda + 0.567) = -34.3$

$\boxed{\lambda_2 = -34.3}$

and

$\lambda_3 + 0.567 = -34.3$

$\lambda_3 = -34.3 - 0.567$

$\boxed{\lambda_3 = -34.764}$

Now as we have three different types of roots 1 is imagnary , The 2nd is real and the 3rd is non-repeated

⇒ **For imagniary root**

$y_n(n) = C_1 \cos \lambda_1^{n} + C_2^{\sin} \lambda_2^{n}$

$y_n(n) = C_1 \cos (1)^{n}$

P.T.O

⇒ For real and non repeated roots:-

$y_n(n) = c_1 \cos c_1 \lambda_1^n + c_2 \lambda_2^n + c_3 \lambda_3^n$

∴ As we have

λ_2 and λ_3 So

$= c_1 \lambda_1^n + c_2 \lambda\, c_2 (-34.3)^n + c_3 (-34.869)^n$

Now put value of $c_1 \lambda_1^n = c_1 \cos \lambda_1^n$

$$\boxed{y_n(n) = c_1 \cos(1)^n + c_2(-34.3)^n + c_3(-34.764)^n}$$

Homogeneous solution :

⇒ Particular Solution :

As we know that

$y_p(n) = 10\, K u(n)$ So

$\Rightarrow 10\, K u(\cancel{n}) + 0.567(10)\, K u(\cancel{n}-1) + 33.3(10)\, K u(\cancel{n}-2) + (1) 10\, K u(\cancel{n}-4)\ 10 \cancel{u}(n)$

For unit step = 1 = u(n)

$\Rightarrow 10K + 5.67K + 33.3K + 10K = 10$

Now K common

$K(10 + 5.67 + 33.3 + 10) = 10$

$K(358.46) = 10$

Divide both side by 358.46

$K = 10/358.46$

$$\boxed{K = 0.027}$$

Now

$\Rightarrow x_p(n) = 10\, K u(n) \Rightarrow 10 \times \frac{10}{358.67} u(n) \Rightarrow 10 \times 0.027\, u(n)$

$\Rightarrow y_p(\cancel{n}) = 2.7\, u(\cancel{n}) \Rightarrow \boxed{y_p = 2.7}$

Now for total Solution

$y(n) = y_n(n) + y_p(n) \Rightarrow c_1\cos(1)^n + c_2(-34.3)^n + c_3(-34.867) + 2.7$

$\Rightarrow y(n) = c_1\cos(1)^n + c_2(-34.3)^n + c_3(-34.896)^n + 2.7$

Now apply initial condition

① $y(-1) = 1$

$\because c_1\cos(1)^{-1} = 0$

$\Rightarrow c_1\cos(-1) = 0$

$\Rightarrow c_1 = \frac{0}{\cos(-1)} \Rightarrow 0$

$\Rightarrow c_1\cos(-1)^{-1} + c_2(-343)^{-1} + c_3(-34.867)^{-1} = 1$

$\Rightarrow -c_1 + \left(\frac{-1}{34.3}\right)c_2 + \left(-1/34.867\right)c_3 = 1$

$\Rightarrow -0 - 0.02c_2 - 0.028c_3 = 1$

$\Rightarrow y(-1) = -0.02c_2 - 0.028c_3 = 1$ — ①

Now applying the 2nd condition

$y(-2) = -1$

$= c_1\cos(1)^{-2} + c_2(-34.3)^{-2} + c_3(-34.867)^{-2} = -1$

$y(-2) = 0 + \left(\frac{-2}{34.3}\right)c_2 + \left(-2/34.867\right) = -1$

$y(-2) = -0.05c_2 - 0.057c_3 = -1$ — ②

Now multifly eq ① with −5

$\Rightarrow -5(-0.02c_2 - 0.028c_3) = 1(-5)$

$\Rightarrow 0.1c_2 + 0.0114c_3 = -5$ — eq ③

Also multifly eq ② with 2

$2(-0.05c_2 - 0.057c_3) = -1(2)$

$-0.1c_2 - 0.114c_3 = -2$ — eq ④

Now by adding eq ③ and eq ④ we have

$$\begin{aligned} \cancel{0.1c_2} &+ 0.014c_3 = -5 \\ \cancel{-0.1c_2} &- 0.114c_3 = -2 \\ \hline &-0.1c_3 = -5-2 \\ &-0.1c_3 = -7 \\ &c_3 = +7/+0.9 \end{aligned}$$

$$\boxed{c_3 = 70}$$

Now by putting value of c_3 into eq ③ we have

$\Rightarrow 0.1c_2 + 0.014(70) = -5$

$\Rightarrow 0.1c_2 + 0.98 = -5$

$\Rightarrow \frac{0.1c_2}{0.1} = -\frac{5.98}{0.1}$

$\Rightarrow \boxed{c_2 = -59.8}$

Now

ⓑ Zero input and Zero state:

⇒ This is as same like Homogeneous and particular solution so the answer will be same.

Now for zero input:

$y_h(n) = c_1 \cos(1)^n + c_2(-34.3)^n + c_3(-34.867)^n$

and for zero state

$y_p(n) = 10\,K\,u(n)$

As we know the value of 10 Ku(n)
so which will be :

$$y_p(n) = 2.7$$

=> Total solution will be

$$y(n) = y_n(n) + y_p(n)$$

$$\Rightarrow y(n) = c_1 \cos(1)^n + c_2(-34.3)^n + c_3(-34.867)^n + 2.7$$

Now put the 4 random values in total solution

$$y(n) = n \Rightarrow 1, 2, 3, 4$$

Now

$$y(n) = 1 = n \Rightarrow c_1 \cos(1)^1 + c_2(-34.3)^1 + c_3(-34.867)^1 + 2.7$$

$$y(1) = c_1(1) + c_2(-34.3) + c_3(-34.867 + 2.7$$

Now 2nd

$$y(2) = c_1 \cos_2(2)^2 + c_2(-34.3)^2 + c_3(-34.867)^2 + 2.7$$

$$= c_1 \cos(1) + c_2(34.3)^2 + c_3(34.8)^2 + 2.7$$

$$\Rightarrow y(2) = c_1 + 1176.4c_2 + 1211.04c_3 + 2.7$$

Now 3rd :

$$y(3) = c_1 \cos(1)^3 + c_2(-34.3)^3 + c_3(-34.56)^3 + 2.7$$

$$y(3) = c_1 \cos(1) + c_2(-40353.6) + c_3(-42388.08) + 2.7$$

$$= c_1 \cos(1) - 40353.6c_2 - 42388.08c_3 + 2.9$$

Now 4th

$$y(4) = c_1 \cos(1)^4 + c_2(-34.3)^4 + c_3(-34.867)^4 + 2.7$$

$$y(4) = c_1 \cos(1) + c_2(1384128.7) + c_3(1477945.18) + 2.7$$

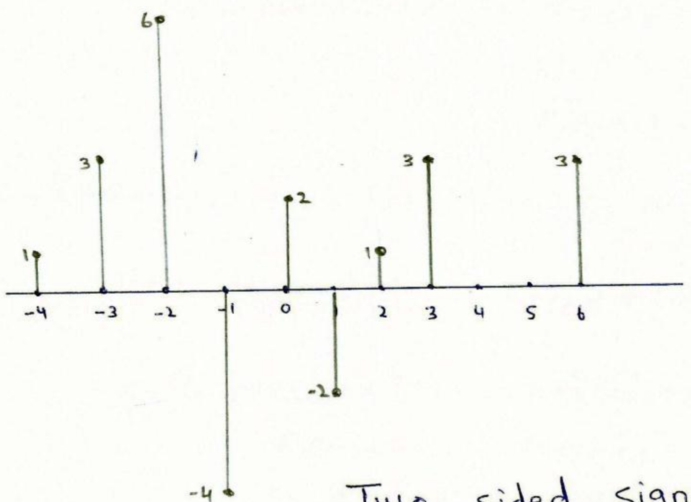
$$y(4) = c_1 + 1384128.7c_2 + 1477945.18c_3 + 2.7$$

Q3

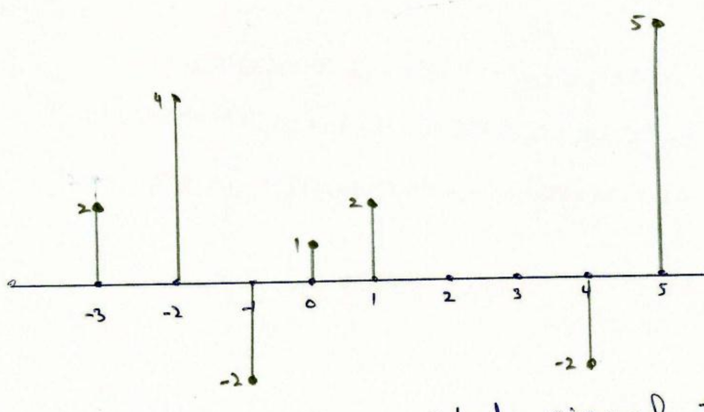
Part a :-

$$x[n] = [1, 3, 6, -4, \underset{\uparrow}{2}, -2, 1, 3, 0, 0, 3]$$

$$y[n] = [2, 4, -2, \underset{\uparrow}{1}, 2, 0, 0, -2, 5]$$



Two sided signal TSS



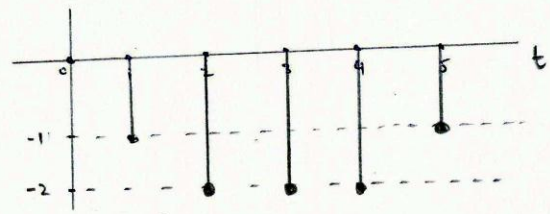
Two sided signal TSS

Q3

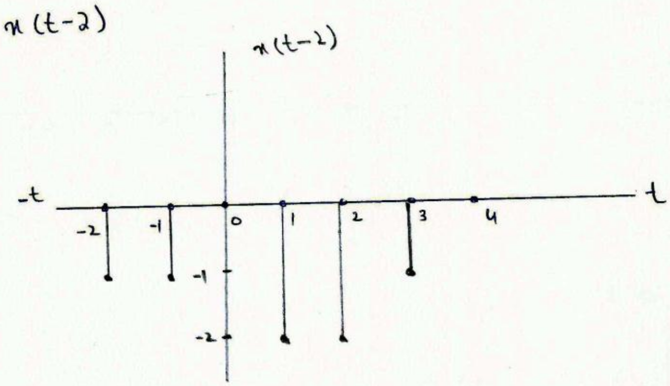
part (b) :

$$x(t) = (-1, -1, -2, -2, -2, -1)$$

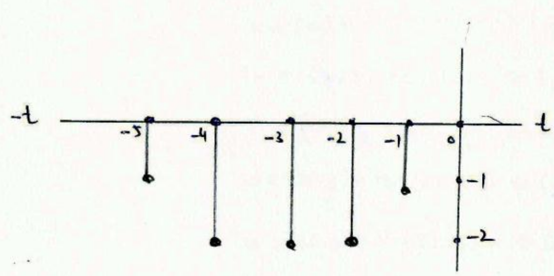
Plot :



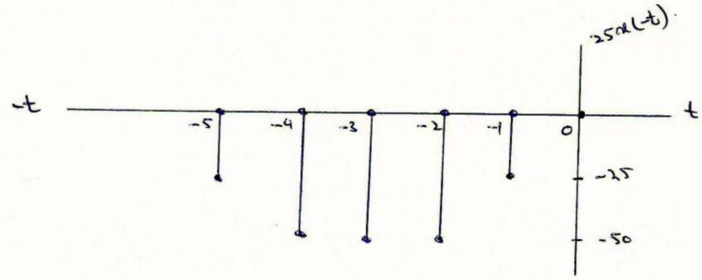
(1) $x(t-2)$



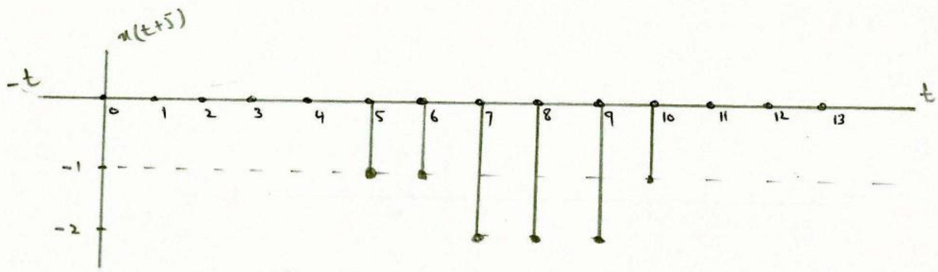
(2) $x(-t)$



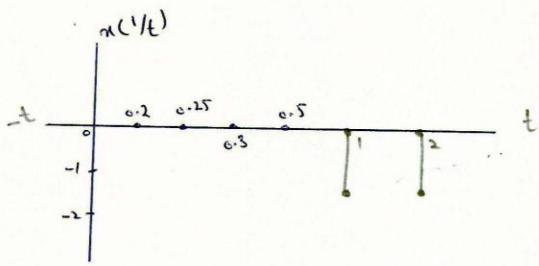
③ $25\,x(-t)$



④ $x(t+5)$



⑤ $x(1/t)$



at $t=0$ $\quad x(1/0) \Rightarrow x(\infty) \Rightarrow x(\infty) = 0$

at $t=1$ $\quad x(1/1) \Rightarrow x(1) \Rightarrow x(1) = -1$

at $t=2$ $\quad x(1/2) \Rightarrow x(0.5) \Rightarrow x(0.5) = 0$

at $t=3$ $\quad x(1/3) \Rightarrow x(0.33) \Rightarrow x(0.33) = 0$

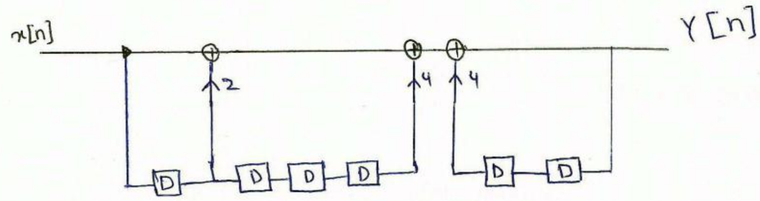
at $t=4$ $\quad x(1/4) \Rightarrow x(0.25) \Rightarrow x(0.25) = 0$

Q No 2 (b)

1 $y(n) = 4x[n-2] = 3x[n] + 2x[n-1] + 4x[n-4]$

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

Block diagram



As we know that order of the system is maximum number of delay

So (order of the system = 4)

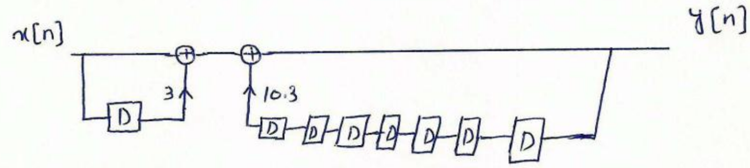
(Adders = 3
Scalers = 4)

2: $y[n] - 10.3y[n-8] = x[n] + 3x[n-1]$

Sol:

$y[n] = 10.3y[n-8] + x[n] + 3x[n-1]$

Block diagram!



(order = 8)
(Adders = 2)
(Scalers = 2)

Q2
part (a) Sampling frequency :→

$x(t) = 5000 \cos 5.0 \pi t + \sin 0.5 \pi t + 5$

$\cos \pi (t) = \sin 0.5 \pi t + \sin 1000 \pi t$

Solution :—

$5000 \cos 5.0 \pi t$

formula

$T = \frac{2\pi}{\omega}$ By putting values

$T = 2\cancel{\pi} / 5.0\cancel{5}\cancel{\pi}$ 2.5

$\boxed{T = 2.5}$

=> $\sin 0.5 \pi t$

By formula

$T = \frac{2\pi}{\omega}$

$T = \frac{2\cancel{\pi}}{0.\cancel{5}\cancel{\pi}}$

$\boxed{T = 0.25}$

=> $5.89 \cos 10 \pi t$

putting by formula

$T = \frac{2\pi}{\omega}$

$T = \frac{2\cancel{\pi}}{10\cancel{\pi}}$

$\boxed{T = 5}$

=> $\sin 0.5 \pi t$

$T = 2\pi / \omega$

$T = 2\cancel{\pi} / 0.\cancel{5}\cancel{\pi}$

$\boxed{T = 0.5}$

=> $\sin 100 \pi t$

$T = 2\pi / \omega$

$T = 2\cancel{\pi} / 100\cancel{\pi}$

$\boxed{T = 50}$

So

$f_1 = 2.5$, $f_2 = 0.25$, $f_3 = 5$

$f_4 = 0.25$, $f_5 = 50$

from the above equation the grea frequency is 50

$f_s = 2 f_m$

$f_s = 2(50)$

$\boxed{f_s = 100}$