M. Usama ① ID # 14156

Q = 1

Ans Sol:

$$y(n) + 0.567\,y(n-2) + 33.3\,y(n-3) + y(n-4) = x(n)$$

① Homogenious & particular solution

↳ Homogenious solution:

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

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

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

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

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

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

$$\lambda_1\ 2y\ 1\ 2^{\circ} \quad ; \quad \lambda(\lambda + 0.567\,\lambda) = -34.3$$

$$\lambda_2 = -34.3$$

$$\Rightarrow \lambda + 0.567 = -34.3$$

$$\lambda = -34.3 - 0.567$$

$$\lambda_2 = -34.8677$$

Now as we have Three different roots & 1 imaginary & two real and non-repeated i

=> For imaginary root i

$y_n(n) = 4\cos \lambda_1^n + C_2 \sin \lambda_2^n$

$y_n(n) = c_1 \cos (1)^n$

∴ For real & non-repeated roots i

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

∵ As we have λ_2 & λ_3 so

$= c_1 \lambda_1^n + C_2(-34.3)^n + c_3(-34.867)^n$

Putting value of $c_1 \lambda_1^n = c_1 \cos \lambda_1^n$

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

Homogenious Solution.

(a) **Particular Solution :-**

As we have That

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

so

$10\,k\,u(n) + 0.567\,(10)\,k\,u(n-1) + 33.3\,(10)\,k\,u(n-2) + (1)\,10\,k\,u(n-3) = 10\,u(n)$

Now for unit step $= 1 = u(n)$

$\Rightarrow 10k + 5.67k + 333k + 10k = 10$

$\Rightarrow k\,(10 + 5.67 + 333k + 10) = 10$

$\Rightarrow k$ by (358.67)

$k = 10/358.67$

$$\boxed{k = 0.027}$$

Now

$y_p(n) = 10/10k\, u(n)$

$= 10 \times 10/358.67\, u(n)$

$= 10 \times 0.087\, u(n)$

$\Rightarrow y_p(n) = 8.7\, u(n)$

$\boxed{y_p(n) = 8.7}$

Now for Total solution

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

$= (c_1 \cos 1)^n$ ~~8~~

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

$\Rightarrow y(n) = c_1(\cos 1)^n + c_2(-34.3)^n + c_3(-34.867)^n + 8.7$

Total solution.

Applying inital conditions

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

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

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

① $y(-1) = 1$

$$\boxed{c_1 = 0}$$

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

$$= -c_1 + \left(\tfrac{1}{34.3}\right) c_2 + \left(\tfrac{1}{34.876}\right) c_3 = 1$$

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

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

Now applying 2nd condition.

$$y(-2) = -1$$

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

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

$$= -0.05 c_2 - 0.057 c_3 = -1 \rightarrow ②$$

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Now $\times$ing equ (1) with (-5)

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

$$\Rightarrow 0.1c_2 + 0.014c_3 = -5 \rightarrow (3)$$

Also $\times$ing equ (2) with (2)

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

$$\Rightarrow -0.1c_2 - 0.114c_3 = -2 \rightarrow (4)$$

Adding equ (3) & (4)

$$0.1c_2 + 0.014c_3 = -5$$
$$-0.1c_2 - 0.114c_3 = -2$$

$$-0.1c_3 = -5 - 2$$
$$-0.1c_3 = -7$$
$$c_3 = -7/0.1$$
$$\boxed{c_3 = 70}$$

Now Putting The value of C_3 into eq (3)

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

$$\Rightarrow 0.1 c_2 + 0.98 = -5$$

$$\Rightarrow 0.1 c_2 = -5 - 0.98$$

$$\Rightarrow \frac{\cancel{0}.1 c_2}{\cancel{0}.1} = \frac{-5.98}{0.1}$$

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

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(Part B) Zero input & Zero state:

So This is as alike Homogenous & particular solution and The Answer Must be same.

So for zero input;

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

& for Zero state

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

which will be

$$y_p(n) = 9.7$$

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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 putting The 4 random values in total solution :-

Ex so $y(n) = n = 1, 2, 3, 4$

Now

$$y(n) = 1 = n$$

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

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

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Now 2nd

$y(2) = c_1 \cos(1)^2 + c_2 (-34.3)^2 + c_3 (-34.867)^2 + 2.7$

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

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

Now 3rd

$y(3) = c_1 \cos(1)^3 + c_2 (-34.3)^3 + c_3 (-34.867)^3 + 2.7$

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

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

Now 4th

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

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

$= c_1 + 1384128.7 c_2 + 1477945.18 c_3 \; 2.7$

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Q = 2(a)

Find The Sampling Frequancy of

$x(t) = 500 \cos 5.0\pi t + \sin 0.5\pi t + 5.89 \cos 10\pi t + \sin 0.5\pi t + \sin 100\pi t$

$\Rightarrow 5000 \cos 5.0 \pi t$

Solution

Formula

$$T = \frac{2\pi}{\omega} = \frac{2\cancel{\pi}}{5.0\cancel{\pi}}$$

$$T = 0.4$$

$$f_t = \frac{1}{T} = 2.5$$

$$\boxed{f_t = 2.5}$$

(4) sin $0.5\pi t$

sol:

$$T = \frac{2\pi}{\omega} = \frac{2\cancel{\pi}}{0.5\cancel{\pi}}$$

$$T = 4$$

$$f = \frac{1}{T} = \frac{1}{4} = 0.25$$

$$\boxed{f_4 = 0.25}$$

(5) sin $10\pi t$

sol:

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

so

$$T = 0.2$$

$$f = \frac{1}{T} = \frac{1}{0.2} = 5$$

$$\boxed{f_5 = 5}$$

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④ $\sin 0.5\pi t$

Sol:

$$T = \frac{2\pi}{\omega} = \frac{2\pi}{0.5\pi}$$

$$T = 4$$

$$F = \frac{1}{T} = \frac{1}{4} = 0.25$$

$$\boxed{f_4 = 0.25}$$

⑤ $\sin 100\pi t$

Sol:

$$T = \frac{2\pi}{\omega} = \frac{2\pi}{100\pi} = 0.02$$

$$f = \frac{1}{T} = \frac{1}{0.02} = 50$$

$$\boxed{f_5 = 50}$$

So

$f_1 = 2.5$

$f_2 = 0.25$

$f_3 = 5$

$f_4 = 0.25$

$f_5 = 50$

So greater is $f_5 = 50$

Formula

$f_s = 2f_m$

$f_s = 2 \times 50 = 100$

$$\boxed{f_s = 100}$$

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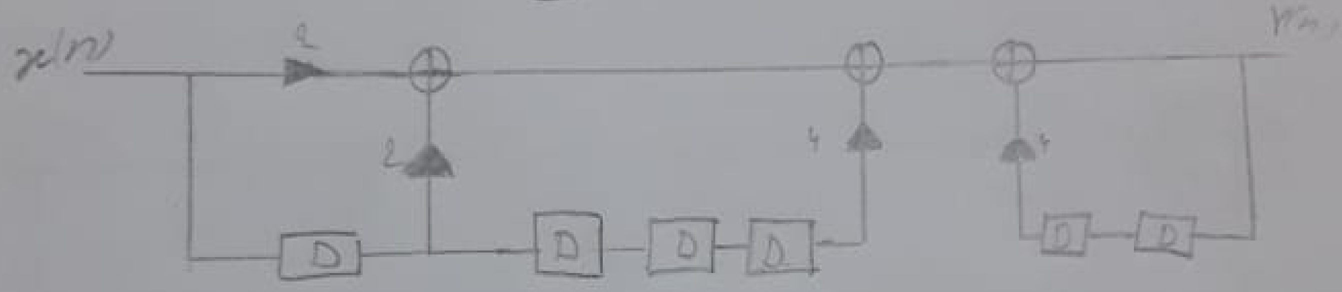
Q = 2 (b)

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

Sol:

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

Block diagram



we Know That

order of The system is

maximum delay

so order of The system = 4

Address = 3

sclars = 4

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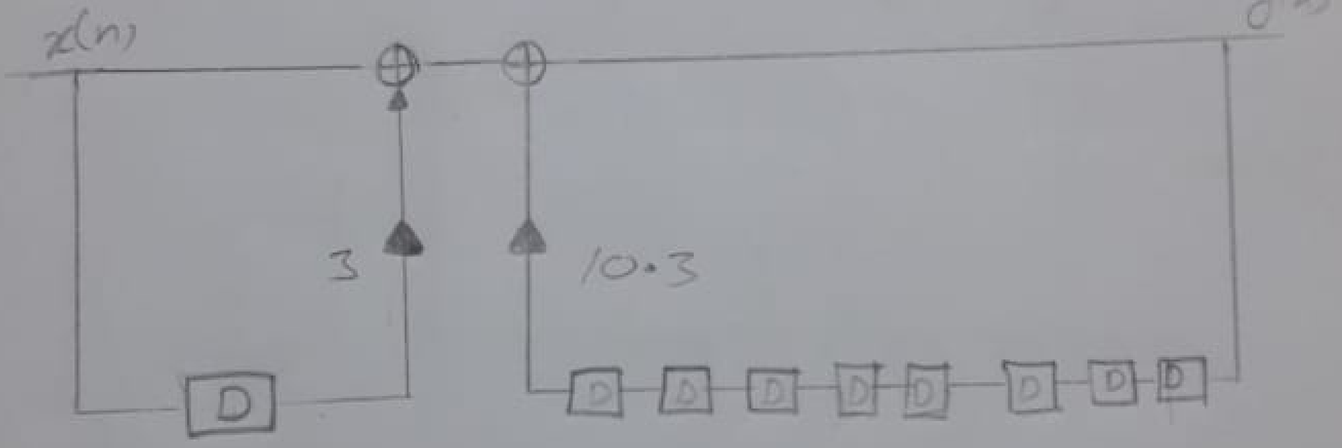
(4) $y[n] - 10.3\,y[n-8] = x[n] + 3\,x[n-1]$

sol

$y[n] = 10.3\,y[n-8] + x(n) + 3\,x(n-1)$

Block diagram :-



order = 2

Address = 2

scllors = 2

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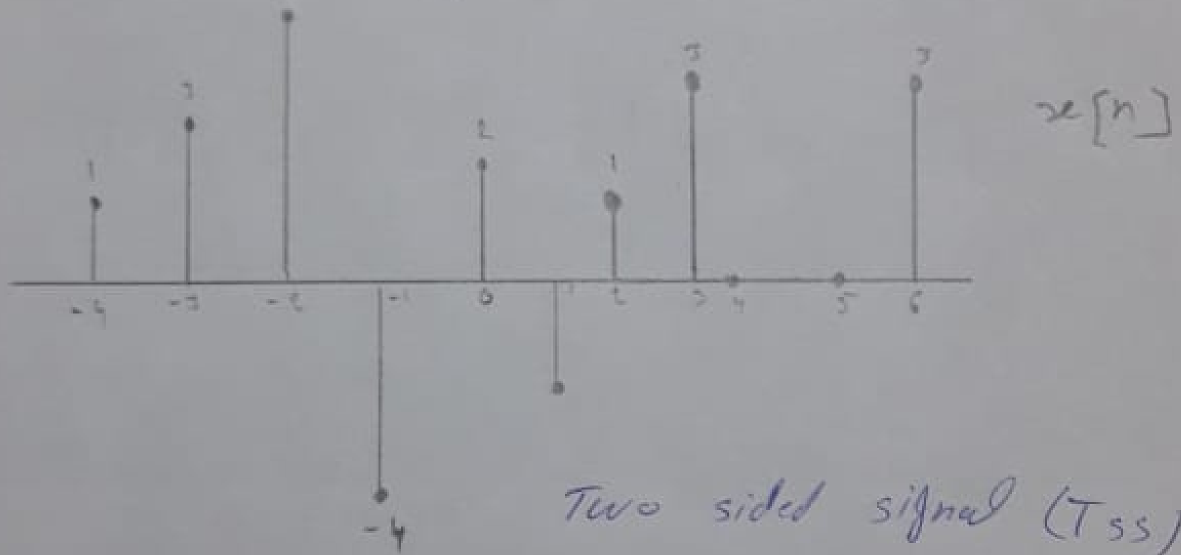
Q = 3

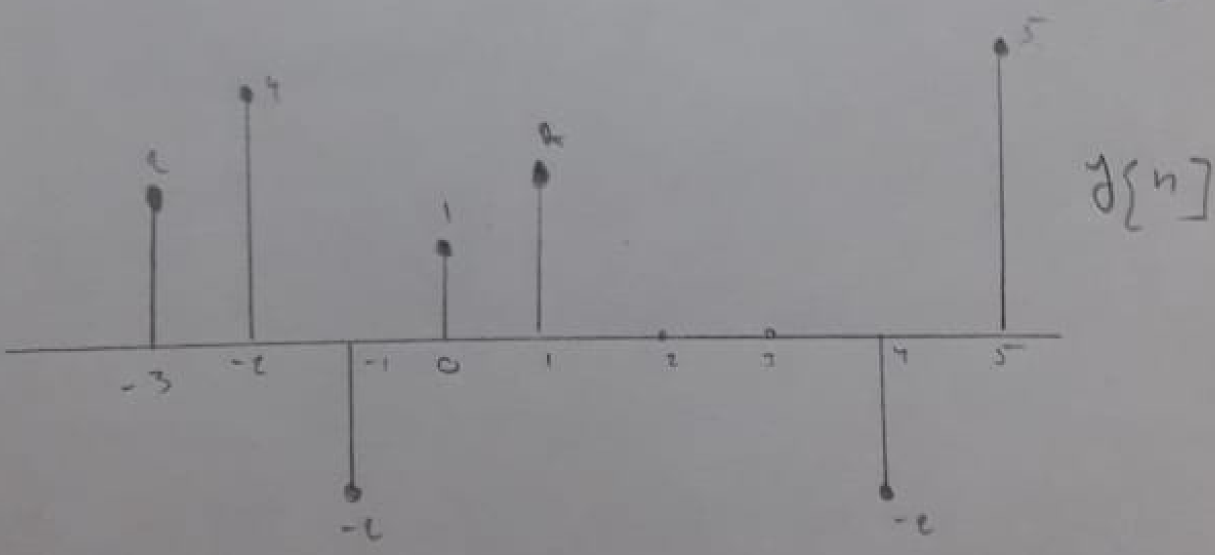
consider the following two sequences $x(n)$ & $y(n)$

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

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



Two sided signal (TSS)



Two sided signal [TSS]