Department of Electrical Engineering

Assignment

Date: 14/04/2020

Course Details

Course Title: Signals and Systems | Module: 6th

Instructor: Engr=Aamir aman | Total Marks: 30

Student Details

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Q1.	(a)	Find the total solution of the following Linear Constant difference equation by a) Homogeneous and Particular solution method b) Zero input and Zero State solution method. After finding total solution plot the responses by putting at least four different values and comment on both methods. $Y[n] + 0.567\, Y[n-1] + 33.3Y[n-2] + Y[n-4] = x[n]$ For unit step $x[n] = 10u[n]$ with $y[-1] = 1,\ y[-2] = -1$	Marks 10 CLO 1
Q2.	(a)	Find the sampling frequency of $x(t) = 5000\cos 5.0\pi t + \sin 0.5\pi t + 5.89\cos 10\pi t \sin 0.5\pi t + \sin 100\pi t$	Marks 05 CLO 1
	(b)	Sketch the block diagram representation of discrete-time systems described by the following input-output relation. Also find order of the system, total number of Adders and Scalars. i) $y[n] - 4\, y[n-2] = 3\, x[n] + 2\, x[n-1] + 4x[n-4]$ ii) $y[n] - 10.3\, y[n-8] = x[n] + 3\, x[n-1]$	Marks 05 CLO 1
Q3.	(a)	Consider the following two sequences x[n] and y[n]: $x[n] = [1, 3, 6, -4, 2, -2, 1, 3, 0, 0, 3]$ $y[n] = [2, 4, -2, 1, 2, 0, 0, -2, 5]$	Marks 05 CLO 2

Q.1) Find the totel Solution of the Following Linear constant difference equation by

(a) Homogeneous and particular method

(b) zero input and zero solution method

$$y(n) + 0.567\,y(n-1) + 33.3\,y(n-2) + y(n-4) = x(n)$$

Homogeneous and Particular Solution

Homogeneous

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

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

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

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

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

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

$$\boxed{\lambda_1^{2} = \lambda_2} \qquad \lambda(\lambda + 0.567) = -343$$

$$\lambda_2 = 34.3$$

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

$$\lambda = -343\;\;0.567$$

$$\boxed{= -34.867}$$

we have 3 diffent roots
1 imagnary and 2 real ~~and~~ and
~~Non re~~ non repeated

$\Rightarrow$ Imagnary root

$$yx(n) = C_1 \cos \lambda_1^n + C_2 \lambda_2^n$$
$$yx(n) = C_1 \cos(1)^n$$

$\Rightarrow$ real and non repeated

$$yn(n) = C_1 \lambda_1^n + C_2 \lambda_2^n + C_3 \lambda_3^n$$

$\because \lambda_2$ and λ_3

$$= C_1 \lambda_1^n + C_2(-34.3)^n + C_3(-34.867)^n$$

Putting the value of $C_1 \lambda_1^n$ $C_1 \cos \lambda_1$

$$\Rightarrow \boxed{yx(n) = C_1 \cos(1)^n + C_2(-34.3)^n + C_3(-34.867)^n}$$

Solution

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=> Now particular Solution

We know that $y_p(n) = 10 k u(n)$

=> $10 k u(n)' + 0.567 (10) k u(n)' + 33.3 (10) k u(n/2)' + (1) 10 k u(n-1)' = 10 u(n)$

For unit step $= 1 = u(n)$

=> $10k + 5.67k + 333k + 10k = 10$

=> $k(10 + 5.67 + 333k + 10) = 10$

=> $k(358.67) = 10$

pulling by "358.67"

$k = 10/358.67$

$\boxed{k = 0.027}$

=> $yp(n) = 10 k u(n)$

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

$= 10 \times 0.027 \; u(n)$

=> $yp(n) = 2.70 \; u(n)$

$\boxed{=> yP(n) = 2.7}$

Total Solution

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

$= C_1 \cos(1)^n + C_2(-34.3)^n + (-34.867)^n + 2.7$

$\Rightarrow y(n) = C_1 \cos 1)^n + C_2(-34.3)^n + C_3 (-34.867)^n + 2.7$

Total Solution

Now appling Initial Condition

$\therefore C_1 \cos(1)^{-1} = 0$

$\Rightarrow C_1 \cos(-1) = 0$

$\Rightarrow C_1 = 0/\cos(-1) = 0/0$

① $y(-1) = 1$

$\boxed{C_1 = 0}$

$= C_1 \cos(1)^{-1} + C_2(-34.3)^{-1} + C_3 (-34.867)^{-1} = 1$

$= C_1 + (-1/34.3) C_2 + (-1/34.867) C_3 = 1$

$= -0 - 0.02 C_2 - 0.028 C_3 = 1$

$\Rightarrow y(-1) = -0.02 C_2 - 0.028 C_3 = 1$

①

2nd Condition

$y(-2) = 1$

$= C_1 \cos(1)^{-2} + C_2(-34.3)^{-2} + C_3(-34.867)^{-2} = 1$

P.T.O →

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$= 0 + (-2/34.3)\,L_2 + (-2/34.867) = 1$

$= -0.5L_2 - 0.057\,L_3 = -1$

(2)

xing eq (1) with "-5"

$\Rightarrow -5(-0.02L_2 - 0.028L_3) = 1(-5)$

$\Rightarrow 0.1L_2 + 0.014L_3 = -5$ (3)

xing eq (2) with (2)

$2(-0.05L_2 - 0.057L_3) = -1(2)$

$-0.1L_2 - 0.114\,L_3 = -2$ (4)

Adding eq (3) and (4)

$\cancel{0.1L_2} + 0.014L_3 = -5$

$\cancel{0.1}L_2 - 0.114L_3 = -2$

$-0.1L_3 = -5-2$

$-0.1\,L_3 = -7$

$L_3 = -7/0.1$

$\boxed{L_3 = 70}$

Putting the value of L_3 into eq (3)

$$\Rightarrow 0.1L_2 + 0.014(70) = -5$$
$$\Rightarrow 0.1L_2 + 0.98 = -5$$
$$\Rightarrow 0.1L_2 = -5 - 0.98$$
$$\Rightarrow \frac{\cancel{0.1}\,L_2}{\cancel{0.1}} = \frac{-5.98}{0.1}$$
$$\boxed{L_2 = -59.8}$$

(b) Zero Input and Zero State

$$y_n(n) = L_1 \cos(1)^n + L_2(-34.3)^n + L_3(-34.867)^n$$

Zero State

$$y_p(n) = 10u(n)$$

$$y_p(n) = 2.7$$

$\Rightarrow$ Total Solution

$$y(n) = y_n(n) + y_p(n)$$
$$\Rightarrow y(n) = L_1 \cos(1)^n + L_2(-34.3)^n + L_3(-34.867)^n + 2.7$$

Putting the random values in total solution

P.T.O →

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$y(n) = N - 1, 2, 3, 4$

$y(n) = 1 = n$

$= L_1 \cos(1)^1 + L_2(-34.3)^1 + L_3$
$(-34.867)^1 + 2.7$

$\Rightarrow y(1) = L_1(1) + L_2(-34.3)$
$+ L_3(-34.867) + 2.7$

2nd

$y(2) = L_1 \cos(1)^2 + L_2(-34.3)^2 + L_3$
$(-34.867)^2 + 2.7$

$= L_1 \cos(1) + L_2(34.3)^2 + L_3$
$(34.8)^2 + 2.7$

$y(2) = L_1 + 1176.4 L_2 + 1211.04 L_3 + 2.7$

3rd

$y(3) = L_1 \cos(1)^3 + L_2(-34.3)^3 + L_3(-34.867)^3$
$+ 2.7$

$y(3) = L_1 \cos(1) + L_2(-40353.6) + L_3$
$(-42388.68) + 2.7$

$= L_1 \cos(1) - 40353.6 L_2 - 42388.68 L_3 + 2.7$

4th $y(4) = L_1 \cos(1)^4 + L_2(-34.3)^4 + L_3(-34.867)^4 + 2.7$

$= L_1 \cos(1) + L_2(1384128.7) + L_3(1477945.18)$
$+ 2.7$

$\Rightarrow L_1 + 1384128.7 L_2 + 1477945.18 L_3 + 2.7$

Q 2 Find the Sampling Frequency of

(a) $x(t) = 5000 \cos 50\pi t + \sin 0.5 \; 89 \cos$

$10\pi t \quad \sin 0.5\pi \sin 10\pi t$

Sol: We know that by Formula

$$T = 2\pi/\omega \quad \text{and} \quad F = 1/T$$

(i) For $5000 \cos 50\pi t$

$T_1 = 2\pi/\omega_1 = 2\pi/5.0\pi = 0.4$

Now

$F_1 = 1/T_1 = 1/0.4 = 2.5\ Hz$

(ii) For $\sin 0.5\pi t$

$T_2 = 2\pi/\omega_2 = 2\pi/0 = 5\pi^2 = 4$

$F_2 = 1/T_2 = 1/4 = 0.25$

(iii) For $5.89 \cos 10\pi t$

$T_3 = 2\pi/\omega_3 = 2\pi/10\pi = 0.2$

$F_3 = 1/T_3 = 1/0.2 = 5\ Hz$

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(iv) For $\sin 0.5\pi t$

$T_4 = 2\pi / w_4 = 2\pi / 0.5\pi = 4$

Now

$F_4 = 2 \, 1/T_4 = 1/4 = 0.25 \, Hz$

(v) For $\sin 100\pi t$

$T_s = 2\pi / w_s = 2\pi / 100\pi = 0.02$

Now

$F_s = 1/T_s = 1/0.02 = 50 \, Hz$

So

$F_1 = 2.5 H$, $F_2 = 0.25 Hz$, $F_3 = 5 Hz$

$F_4 = 0.25 Hz$ and $DS = 50 Hz$

the greater Freqmancy

$F_S = F_m = 50 \, Hz$ (Max)

$F_s = 2F_m \Rightarrow F_s = 2(50)$

$F_s = 2(50) \Rightarrow F_s = 100 \, Hz$

So Sampling frequancy

$\boxed{\Rightarrow F_s = 100 \, Hz}$

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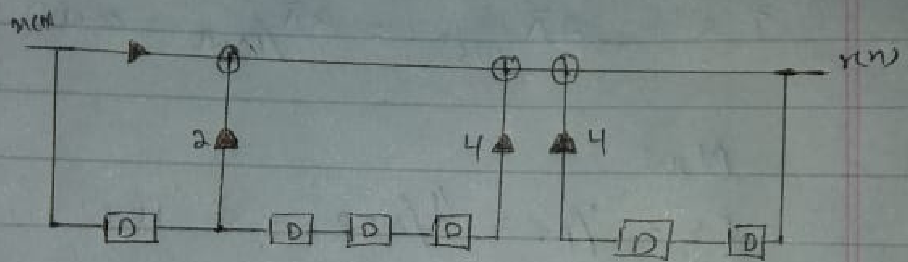
Q NO (2) (B)

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

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

Block diagram



we know that

order of the System is the maximum delay

So (order of the System = 4)

adder = 3
Sclars = 4

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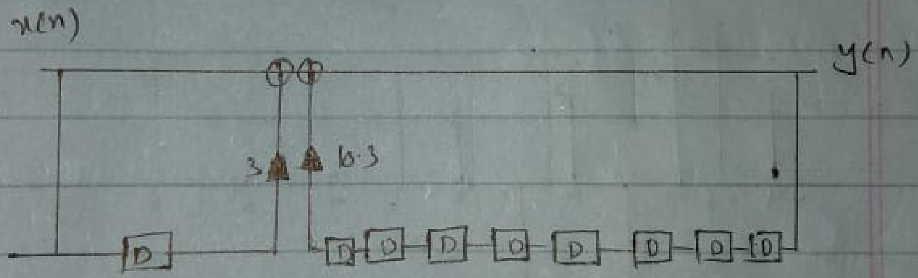
(11) $y(n) - 10.3y(n-8) = x(n) + 3x(n-1)$

Sol

$\Rightarrow y(n) = 10.3y(n-8) + x(n) + 3(n-1)$

diagram

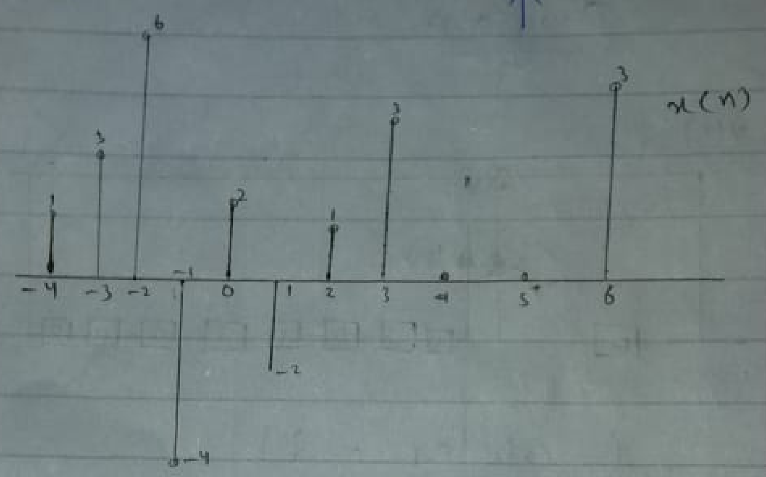


(order = 8)
(Adders = 2)
(Scallars = 2)

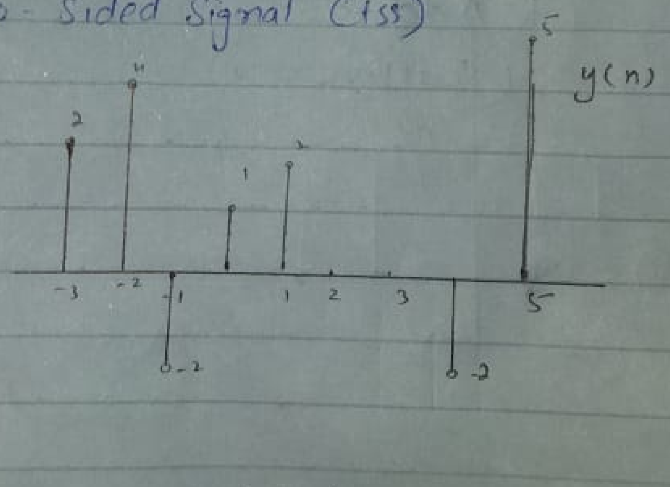
Q.3

(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)

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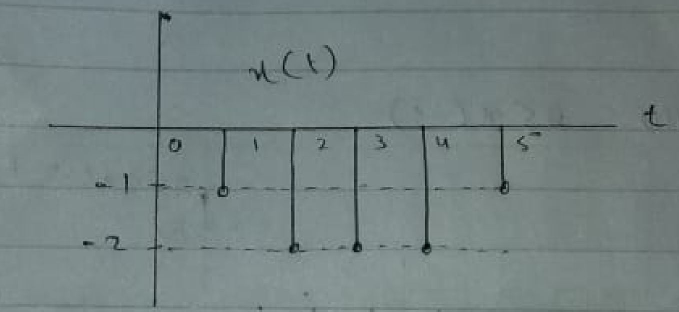
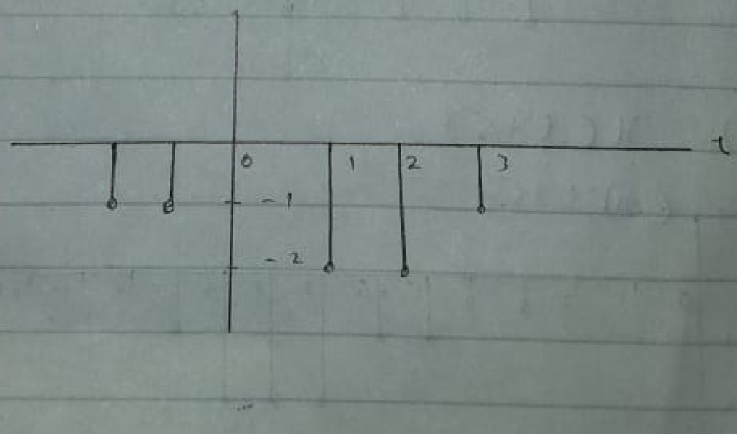
Q No 3 => (B)

$x(t) = (\underset{0}{-1}, \underset{1}{-1}, \underset{2}{-2}, \underset{3}{-2}, \underset{4}{-2}, \underset{5}{-1})$

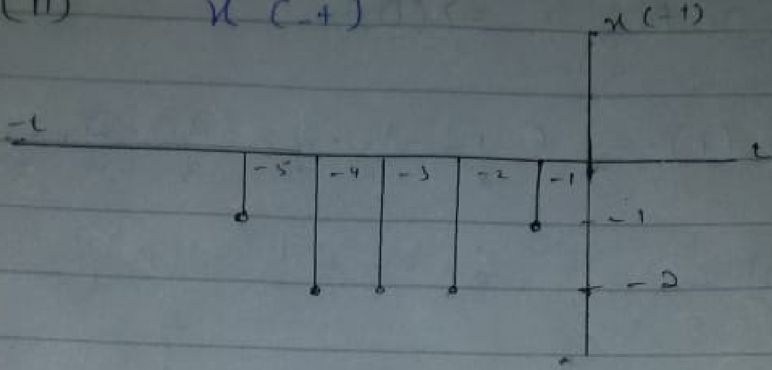
Sol =>



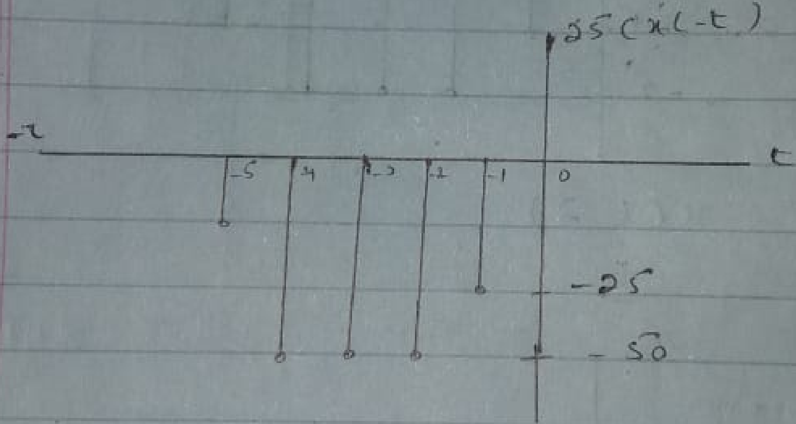
(1) x(t-2)



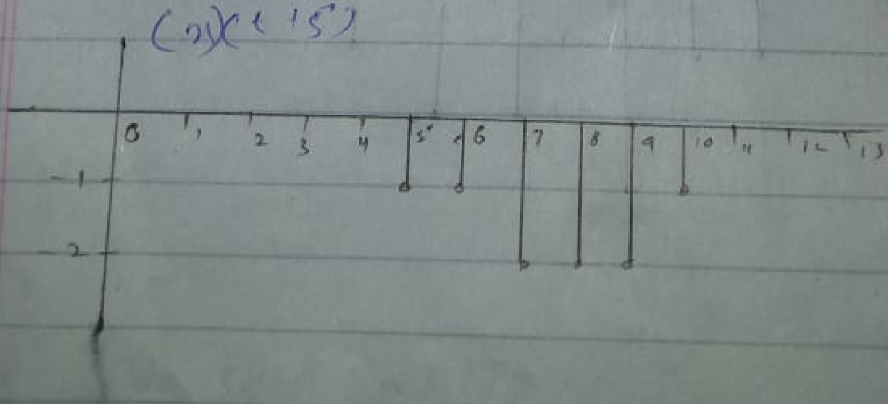
(ii) $x(-t)$



(iii) $25x(-t)$



(iv) $x(t+5)$



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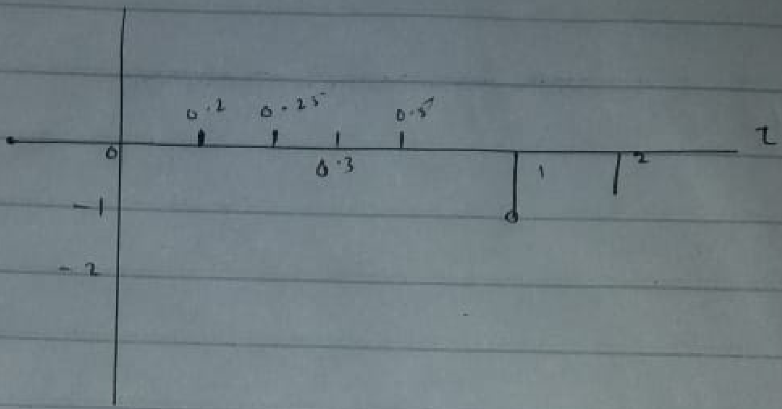
(v) $x(1/t)$



at $t = 0$ $x(\frac{1}{0}) \Rightarrow (\alpha) \Rightarrow x(\alpha) = 0$

at $t = 1$ $x(\frac{1}{1}) \Rightarrow x(1) \Rightarrow x(1) = -1$

at $t = 2$ $x(\frac{1}{2}) \Rightarrow x(0.5) \Rightarrow x(0.5) = 0$

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

$t = 4$ $x(1/4) \Rightarrow x(0.25) \Rightarrow x(10.25) = 0$