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Q. 1) Sol^n: Given, $y(n) = x(n) + 3$

for $t = -1$, $y(-1) = x(-1) + 3$

$t = 0$, $y(0) = x(0) + 3$

$t = 1$, $y(1) = x(1) + 3$

∴ the values of n, the output depends only on the present values of input.

∴ The signal is casual.

for i/p, $x_1(n)$, $y_1(n) = x_1(n) + 3$

for o/p, $x_2(n)$, $y_2(n) = x_2(n) + 3$

∴ $ay_1(n) + by_2(n) = ax_1(n) + 3a + bx_2(n) + 3b$

$= [ax_1(n) + bx_2(n)] + 3(a+b)$.

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The o/p due to weighted sum of i/p s are,

$$y_3(n) = T[x_1(n) + x_2(n)]$$
$$= ax_1(n) + bx_2(n) + 3$$

$\therefore y_3(n) \neq ay_1(n) + by_2(n)$

$\therefore$ system is non-linear

$\therefore$ Ans :- (b) 2 & 3 are correct

Q.2) Sol^n :-

for input $x_1(t)$, output is $y_1(t)$

for i/p $x_2(t)$, o/p is $y_2(t)$

(a)

$$ay_1(t) + by_2(t) = 2[ax_1(t-1) + bx_2(t-1)] - 3[ax_1(t-2) + bx_2(t-2)] + [ax_1(t-3) + bx_2(t-3)]$$

$$y_3(t) = T[x_1(n) + x_2(n)] = ay_1(t) + by_2(t)$$

(b)

$$ay_1(t) + by_2(t) = 5[ax_1(t) + bx_2(t)] = y_3(t).$$

(c)

$$ay_1(t) + by_2(t) = 2[ax_1(t-1) + bx_2(t-1)] - [ax_1(t-2) + b(x_1(t-2))] - [ax_1(t-4) + bx_2(t-4)]$$
$$= y_3(t)$$

(d) $ay_1(t) + by_2(t) = 2[ax_1(t) + bx_2(t)] + 3°C \quad (a+b)$

$$y_3(t) = 2[ax_1(t) + bx_2(t)] + 3°C$$

$y_3(t) \neq ay_1(t) + by_2(t)$

$\therefore$ Non-linear

Ans :- (d) $y(t) = 2x(t) + 3°C$

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Q. 3) Sol^n: Here,

$$y(n) = x(n^2)$$

for $t=-1$, $y(-1) = x(1)$

$t = 0$, $y(0) = x(0)$

$t = 1$, $y(1) = x(1)$

∴ for some values of 'n', o/p depends on future values of i/p s.

∴ The system is non-casual.

For, $x_1(n)$, $y_1(n) = x_1(n^2)$

$x_2(n)$, $y_2(n) = x_2(n^2)$

∴ $a y_1(n) + b y_2(n) = a x_1(n^2) + b x_2(n^2)$

& $y_3 = a x_1(n^2) + b x_2(n^2)$

∴ $y_3 = a y_1(n) + b y_2(n)$

∴ The system is linear.

Again,

$$y(n, T) = x[(n-T)^2]$$

$$y(n-T) = x[(n-T)^2]$$

∴ The signal is time invariant

Ans:- © non-casual, linear, time invariant

Q. 4) Sol^n: Here,

$$y(n) = x(n)\,x(n-1)$$

for $t=-1$, $y(-1) = x(-1)\,x(-2)$

$t = 0$, $y(0) = x(0)\,x(-1)$

$t = 1$, $y(1) = x(1)\,x(0)$

∴ The o/p depends on present and past values of i/p.

∴ The system is dynamic and the system is non-casual too.

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Again,

$$ay_1(n) + by_2(n) = [ax_1(n) + bx_2(n)][ax_1(n-1) + bx_2(n-1)]$$
$$= y_3(n)$$

∴ The system is linear.

Again,

$$y(n, T) = x(n-T)\,x(n-T-1)$$
$$y(n-T) = x(n-T)\,x(n-T-1)$$

∴ $y(n, T) = y(n-T)$

∴ time invariant

Ans :- (a) dynamic and linear

Q. 5] Soln :-

Here,

$$y(t) = e^{x(t)}$$

For $t = -1$, $e^{x(-1)} = 1/e^{x}$

$t = 0$, $e^{x(0)} = .$

$t = 1$, $e^{x(2)}$

∴ System depends only on present inputs

∴ The system is casual.

Again,

$$y(t) = \int_{-\infty}^{\infty} |h(t)|\,dt$$
$$= \int_{-\infty}^{\infty} |e^{x(t)}|\,dt$$
$$= \infty$$

∴ The system is unstable.

Ans :- (c) unstable, casual

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