Quiz-2 Solutn

d) $y(t) = at^2 x(t) + bt x(t-4)$

a) Linear OR Non-Linear
b) Static OR Dynamic
c) Stable OR Unstable
d) Causal OR Non-Causal
e) Time-invariant or time-variant

Sol a) For Linear

for I/p $x_1(t)$

$$y_1(t) = at^2 x_1(t) + bt x_1(t-4)$$

for an I/p $x_2(t)$

$$y_2(t) = at^2 x_2(t) + bt x_2(t-4)$$

∴ weighted sum of O/P's.

$$py_1(t) + qy_2(t) = pat^2 x_1(t) + pbt x_1(t-4) + qat^2 x_2(t) + qbt x_2(t-4)$$

$$= at^2 [p x_1(t) + q x_2(t)] + bt [p x_1(t-4) + q x_2(t-4)]$$

The O/p due to weighted sum of I/P's is:

$$y_3(t) = T[p x_1(t) + q x_2(t)] = at^2 [p x_1(t) + q x_2(t)] + bt [p x_1(t-4) + q x_2(t-4)]$$

$$\therefore y_3(t) = a y_1(t) + b y_2(t)$$

As, superposition is satisfied ∴ System is Linear Ans

b) As the o/p depends on past inputs. So it requires a memory. Hence, the system is Dynamic

(c) Stable OR Unstable

$$y(t) = at^2 x(t) + bt\, x(t-4)$$

if we take Bounded I/p lets say $x(t) = 1$ & $x(t-4) = 1$

then $y(t) = at^2 + bt$ (i.e) $y(t)$ is unbounded

∴ System is unstable.

(d) Causal OR Non-Causal

As the o/p depends only on the present & past inputs, and donot depend upon future I/p's.

∴ The system is Causal.

(e) Time-invariant OR time variant

$$y[t] = T[x(t)] = at^2 x(t) + bt\, x(t-4)$$

The o/p due to I/p delayed by T sec is

$$y(t,T) = T[x(t-T)] = y(t)\Big|_{x(t) = x(t-T)}$$

$$= at^2 x(t-T) + bt\, x(t-4-T)$$

The o/p delayed by T second is:

$$y(t-T) = y(t)\Big|_{t=t-T} = a(t-T)^2 x(t-T) + b(t-T)x(t-T-4)$$

$$y(t,T) \neq y(t,-T)$$

∴ system is Time-Variant. Ans.