Anas Nimer Quiz -2- 1180180

Q1:

* fixed or not $\Rightarrow$ delay time $y_1(t-t_0) = \sqrt{(x(t-t_0)^2))} \longrightarrow (1)$

delay function $y_2(t-t_0) = \sqrt{(x(t^2-t_0))} \longrightarrow (2)$

$y_1 \neq y_2$ $\therefore$ the system time variant

* Causal / non-causal : when $t=2 \Rightarrow y(2) = \sqrt{x(4)}$

$\therefore$ the system non-causal

* Dynamic / instantanueons : when $t=0 \Rightarrow y(0) = \sqrt{x(0)}$

$t=1 \Rightarrow y(1) = \sqrt{x(1)}$

$\therefore$ the system dynamic

* linear / non-linear $\Rightarrow$ 1) $\alpha_1 y_1(t) = \alpha_1 \sqrt{(x_1(t^2))}$

2) $\alpha_2 y_2(t) = \alpha_2 \sqrt{(x_2(t^2))}$

3) $\alpha_1 y_1(t) + \alpha_2 y_2(t) = \alpha_1 \sqrt{x_1(t^2)} + \alpha_2 \sqrt{x_2(t^2)} \longrightarrow (1)$

4) assume $\alpha_3 y_3 = \alpha_1 y_1 + \alpha_2 y_2$

$\alpha_3 x_3 = \alpha_1 x_1 + \alpha_2 x_2$

$\alpha_3 y_3(t) = \alpha_3 \sqrt{(x_3(t^2))}$

5) $\alpha_1 y_1 + \alpha_2 y_2 = \alpha_3 \sqrt{x_3(t^2)} \longrightarrow (2)$

Eq 1 $\neq$ Eq 2 $\therefore$ so the system non-linear

Q2. $x(t) = \delta(t-2) + 3r(t-3) - u(t+1)$

$$5\frac{dy(t)}{dt} + y(t) = x(t)$$

$h(t) = g(t) * u(t)$

$$\frac{dh(t)}{dt} = g(t)\,\delta(t) + u(t)\,g'(t)$$

$g(t) = Ae^{\lambda t}$ $\quad \lambda = 5$

$A = g(0) = \frac{1}{\lambda} = \frac{1}{5}$

So the pulse response is $\frac{1}{5}e^{-\frac{t}{5}}$

$$y_s = \int_0^t \frac{1}{5}e^{-\frac{t}{5}} = -e^{-\frac{t}{5}}\Big|_0^t$$

$$= -e^{-\frac{t}{5}} + 1$$

$$y_r(t) = \int_0^t y_s(t) = \int_0^t -e^{-\frac{t}{5}} - 1 = 5e^{-\frac{t}{5}} + t\Big|_0^t$$

$$= 5e^{-\frac{t}{5}} + t - 5$$

$$\cancel{y(t) = \left[3\left(5e^{-\frac{(t-3)}{5}} + (t-3) - 5\right) + \left(-e^{-\frac{(t+1)}{5}} + 1\right) + \frac{1}{5}e^{-\frac{(t-2)}{5}}\right)}$$

$$y(t) = \left[3\left(5e^{-\frac{(t-3)}{5}} + (t-3) - 5\right) + \left(-e^{-\frac{(t+1)}{5}} + 1\right) + \frac{1}{5}e^{-\frac{(t-2)}{5}}\right)$$