Modeling in Frequency Domain
Transfer Function

① $F(s) = \frac{2}{(s+1)(s+2)} = \frac{k_1}{(s+1)} + \frac{k_2}{(s+2)}$

$= \frac{2}{s+1} + \frac{-2}{s+2}$

$f(t) = (2e^{-2t} - e^{-t})\, u(t)$

② $F(s) = \frac{2}{(s+1)(s+2)^2}$

$= \frac{k_1}{(s+1)} + \frac{k_2}{(s+2)^2} + \frac{k_3}{(s+2)}$

$\left[\frac{2}{(s+1)(s+2)^2} = \frac{2}{(s+1)} + \frac{k_2}{(s+2)^2} + \frac{k_3}{(s+2)}\right] \times (s+2)^2$

$\frac{2}{s+1} = \frac{2(s+2)^2}{s+1} + k_2 + k_3(s+2)$

at $s = -2$

$-2 = k_2$

at $s = 0$

$2 = \frac{2 \times 4}{1} + -2 + k_3 \cdot 2 \quad \Rightarrow k_3 = -2$

$$F(s) = \frac{2}{s+1} - \frac{2}{(s+2)^2} - \frac{2}{(s+2)}$$

$$f(t) = \left[2e^{-t} - 2te^{-2t} - 2e^{-2t} \right] u(t)$$

(8) $$F(s) = \frac{3}{s(s^2+2s+5)}$$

$s = 0$

$$s_{1,2} = \frac{-b \pm \sqrt{4ab}}{2a} = \frac{-1 \pm \sqrt{4-20}}{2}$$

$$= -1 \pm \sqrt{-9}$$

$$= -1 \pm j2$$

$$= \frac{k_1}{s} + \frac{k_2 s + k_3}{s^2 + 2s + 5}$$

$$\left[\frac{3}{s(s^2+2s+5)} = \frac{3/5}{s} + \frac{k_2 s + k_3}{s^2+2s+5} \right] \times (s^2+2s+5)$$

$$3 = \frac{3}{5}(s^2 + 2s + 5) + k_2 s^2 + k_3 s$$

$$3 = \left(\frac{3}{5} + k_2\right)s^2 + \left(\frac{6}{5} + k_3\right)s + 3$$

$$k_2 = \frac{-3}{5}, \quad k_3 = \frac{-6}{5}$$

$$F(s) = \frac{3/5}{s} + \frac{-\frac{3}{5}s - \frac{6}{5}}{s^2+2s+5}$$

$$= \frac{3/5}{s} - \frac{3}{5} \cdot \frac{(s+2)}{s^2+2s+5+1-1}$$

$$= \frac{3/5}{s} - \frac{3}{5} \cdot \frac{(s+2)}{(s+1)^2+4}$$

$$= \frac{3/5}{s} - \frac{3}{5} \cdot \frac{(s+2)}{(s+1)^2+2^2}$$

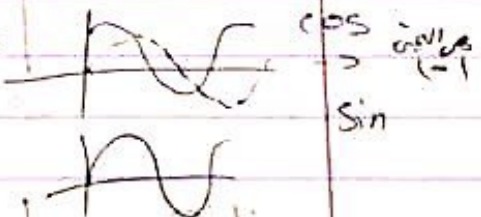
$$= \frac{3/5}{s} - \frac{3}{5} \cdot \frac{(s+1)+1}{(s+1)^2+2^2}$$

$$= \frac{3/5}{s} - \frac{3}{5} \cdot \frac{(s+1)}{(s+1)^2+2^2} + \frac{1}{(s+1)^2+2^2} \quad \times\frac{2}{2}$$

$$= \left(3/5 - 3/5\left[e^{-t}\cos 2t + \frac{1}{2}e^{-t}\sin 2t\right]\right) u(t)$$

$$= \frac{3}{5} - \frac{3}{5}e^{-t}\left[\cos 2t + \frac{1}{2}\sin 2t\right]$$

$\cos 2t + \frac{1}{2}\sin 2t$



$\cos 2t + \frac{1}{2}\cos(2t-90^\circ)$ *

$1\angle 0^\circ + \frac{1}{2}\angle -90$

$1 - \frac{1}{2}j = \frac{\sqrt{5}}{2}\angle -26^\circ$

$\Rightarrow \frac{3}{5} - \frac{3}{5}e^{-t}\left[\frac{\sqrt{5}}{3}\cos(2t-26)\right]$