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ME - 4205

LABORATORY 1

PART 2

NUMBER 1.

$$\mathcal{L}^{-1}\left[\frac{8-3s+s^2}{s^3}\right] = f(t)$$

$$\mathcal{L}^{-1}\left[\left(\frac{8}{s^3} - \frac{3}{s^2} + \frac{1}{s}\right)\right] = f(t)$$

$$\Rightarrow \quad 8\,\mathcal{L}^{-1}\left\{\frac{1}{s^3}\right\} : I4 \quad ; \quad \frac{1}{2!}\mathcal{L}^{-1}\left\{\frac{2!}{s^3}\right\} = \frac{1}{\cancel{2}}t^2\cdot\cancel{8} = 4t^2$$

$$\Rightarrow \quad 3\,\mathcal{L}^{-1}\left\{\frac{1}{s^2}\right\} : I3 \quad ; \quad 3\cdot t = 3t$$

$$\Rightarrow \quad \mathcal{L}^{-1}\left\{\frac{1}{s}\right\} : I2 = 1\,u(t)$$

$$\therefore \boxed{f(t) = 4t^2 - 3t + 1}$$

PART 3

NUMBER 1.

1. $$F(s) = \frac{1}{s(s^2+2s+2)} \Rightarrow \left[\mathcal{L}^{-1}\left\{\frac{1}{s(s^2+2s+2)}\right\} = \frac{A}{s} + \frac{Bs+C}{s^2+2s+2}\right]$$

Evaluating,

$$1 = A(s^2+2s+2) + s(Bs+C)$$

$\Rightarrow$ if $s = 0$,

$$1 = A(\cancel{0^2} + \cancel{2(0)} + 2) + \cancel{0(B(0)+C)} \Rightarrow 1 = A(2) \quad \therefore A = 1/2$$

$\Rightarrow$ Substitute A,

$$2\left[1 = \frac{1}{2}(s^2+2s+2) + s(Bs+C)\right]2$$

$$2 = s^2 + 2s + 2 + 2Bs^2 + 2Cs$$

$$2 = s^2 + (2B+1) + s(2C+2) + 2$$

$$0 = s^2 + (2B+1) + s(2C+2)$$

$\Rightarrow 2B + 1 = 0$

$\therefore B = -1/2$

$\Rightarrow 2C + 2 = 0$

$\therefore C = -1$

Thus, $$\mathcal{L}^{-1}\left\{\frac{1/2}{s} - \frac{1/2\,s - 1}{s^2+2s+2}\right\} = \frac{1}{2}\mathcal{L}^{-1}\left\{\frac{1}{s} - \frac{s+2}{s^2+2s+2}\right\}$$

① $$\mathcal{L}^{-1}\{1/2s\} \Rightarrow \frac{1}{2}\mathcal{L}^{-1}\left\{\frac{1}{s}\right\} = 1/2$$

② NOTE $$\mathcal{L}^{-1}\left[\frac{(s+a)+\omega}{(s+a)^2+\omega^2}\right] = e^{-at}\left[\cos\omega t + \sin\omega t\right]u(t)$$

THEN,

$$\frac{1}{2}\mathcal{L}^{-1}\left\{\frac{(s+1)+1}{(s^2+2s+2)}\right\} \Rightarrow \frac{1}{2}\mathcal{L}^{-1}\left\{\frac{(s+1)+1}{(s+1)^2+1^2}\right\} = \frac{1}{2}e^{-t}(\cos t + \sin t)$$

$$\boxed{f(t) = \frac{1}{2} - \frac{e^{-t}(\cos t + \sin t)}{2}}$$