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ME -4203

ASSIGNMENT 1

I.1. $\mathcal{L}[3 - e^{-3t} + 5\sin 2t] = F(s)$

$F(s) = 3\mathcal{L}\{1\} - \mathcal{L}\{e^{-3t}\} + 5\mathcal{L}\{\sin 2t\}$

$F(s) = \dfrac{3}{s} - \dfrac{1}{s+3} + \dfrac{5(2)}{s^2+4}$

$$\boxed{F(s) = \frac{3}{s} - \frac{1}{s+3} + \frac{10}{s^2+4}}$$

2. $\mathcal{L}[3 + 12t + 42t^3 - 3e^{2t}] = F(s)$

$F(s) = 3\mathcal{L}\{1\} + 12\mathcal{L}\{t\} + 42\mathcal{L}\{t^3\} - 3\mathcal{L}\{e^{2t}\}$

$F(s) = \dfrac{3}{s} + \dfrac{12}{s^2} + \dfrac{42(3!)}{s^{3+1}} - \dfrac{3}{s-2}$

$$\boxed{F(s) = \frac{3}{s} + \frac{12}{s^2} + \frac{252}{s^4} - \frac{3}{s-2}}$$

3. $\mathcal{L}[(t+1)(t+2)] = F(s)$

$F(s) = \mathcal{L}\{t^2 + 3t + 2\}$

$F(s) = \mathcal{L}\{t^2\} + 3\mathcal{L}\{t\} + 2\mathcal{L}\{1\}$

$F(s) = \dfrac{2!}{s^{2+1}} + \dfrac{3}{s^2} + \dfrac{2}{s}$

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

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

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

$= \dfrac{8}{2!}\mathcal{L}^{-1}\left\{\dfrac{2!}{s^{2+1}}\right\} - 3t + 1$

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

2. $\mathcal{L}^{-1}\left[\dfrac{5}{s-2} - \dfrac{4s}{s^2+9}\right] = f(t)$

$$\boxed{f(t) = 5e^{2t} - 4\cos 3t}$$

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CONTINUATION:

3. $\mathcal{L}^{-1}\left[\dfrac{7}{s^2+6}\right] = f(t)$

$$f(t) = \frac{7}{\sqrt{6}}\,\mathcal{L}^{-1}\left\{\frac{\sqrt{6}}{s^2+\sqrt{6}^2}\right\}$$

$$= \frac{7}{\sqrt{6}}\sin\sqrt{6}\,t \cdot \frac{\sqrt{6}}{\sqrt{6}}$$

$$\boxed{f(t) = \frac{7\sqrt{6}}{6}\sin\sqrt{6}\,t}$$

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ASSIGNMENT 2

1. $F(s) = \dfrac{1}{s(s^2+2s+2)}$

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

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

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

if $s = 0$; $1 = 2A \approx A = 1/2$

A.) $1 = \left[\dfrac{s^2+2s+2}{2} + Bs^2 + Cs\right] 2$

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

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

$2B+1 \qquad 2C+2$

$2B = -1 \qquad 2C = -2$

B.) $B = -1/2$ C.) $C = -1$

$$\mathcal{L}^{-1} \frac{1/2}{s} - \frac{1/2\, s + 1}{s^2+2s+2}$$

$$\frac{1}{2}\mathcal{L}^{-1}\frac{1}{s} - \frac{1}{2}\mathcal{L}^{-1}\frac{s+2}{s^2+2s+2} \; ; \frac{1}{2}\mathcal{L}^{-1}\frac{1}{s} - \frac{1}{2}\mathcal{L}^{-1}\frac{s+2}{s^2+2s+1+1}$$

$$\frac{1}{2}\mathcal{L}^{-1}\frac{1}{s} - \frac{1}{2}\mathcal{L}^{-1}\frac{(s+1)+1}{(s+1)^2+1}$$

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

2. $F(s) = \dfrac{5(s+2)}{s^2(s+1)(s+3)}$

$$5\mathcal{L}^{-1}\frac{s+2}{s^2(s+1)(s+3)}$$

$$\left[\frac{s+2}{s^2(s+1)(s+3)} = \frac{A}{s+1} + \frac{B}{s+3} + \frac{C}{s} + \frac{D}{s^2}\right] s^2(s+1)(s+3)$$

$s+2 = As^3(s+3) + Bs^2(s+1) + Cs(s+1)(s+3) + D(s+1)(s+3)$

IF $s = -3$

$-1 = B(-3)^2(-3+1)$

$-1 = 9B(-2)$

$-1 = -18B$

$B = 1/18$

IF $s = -1$

$1 = A(-1)^2(-1+3)$

$1 = 2A$

$A = 1/2$

IF $s = 0$

$2 = D(0+1)(0+3)$

$2 = 3D$

$D = 2/3$

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CONTINUATION:

IF $s = 1$

$$3 = 4A + 2B + C(2)(4) + D(2)(4)$$

$$3 = 2 + 1/9 + 8C + 16/3$$

$$C = -5/9$$

$$5\left[\mathcal{L}^{-1}\left\{\frac{1/2}{s+1} + \frac{1/18}{s+3} + \frac{-5/9}{s} + \frac{2/3}{s^2}\right\}\right]$$

$$5\left[\frac{1}{2}\mathcal{L}^{-1}\frac{1}{s+1} + \frac{1}{18}\mathcal{L}^{-1}\frac{1}{s+3} - \frac{5}{9}\mathcal{L}^{-1}\frac{1}{s} + \frac{2}{3}\mathcal{L}^{-1}\frac{1}{s^2}\right]$$

$: a = 1$ & $a = 3$

$$5\left(\frac{1}{2}e^{-t} + \frac{1}{18}e^{-3t} - \frac{5}{9} + \frac{2}{3}t\right)$$

$$\boxed{f(t) = \frac{10}{3}t - \frac{25}{9} + \frac{5}{2}e^{-t} + \frac{5}{18}e^{-3t}}$$

3. $F(s) = \dfrac{s^4 + 2s^3 + 3s^2 + 4s + 5}{s(s+1)}$

$$\begin{array}{r|l} & s^2 + s + 2 \\ \hline s^2+5 & s^4 + 2s^3 + 3s^2 + 4s + 5 \\ & s^4 + s^3 \\ \hline & s^3 + 3s^2 \\ & s^3 + s^2 \\ \hline & 2s^2 + 4s \\ & 2s^2 + 2s \\ \hline & 2s + 5 \end{array}$$

$$\mathcal{L}^{-1}\, s^2 + s + 2 + \frac{2s+5}{s^2+s}$$

$$\frac{d^2f}{dt^2} + \frac{df}{dt} + 2\,\delta(t) \rightarrow \text{EQ1}$$

$$\mathcal{L}^{-1}\frac{2s+5}{s^2+s} \rightarrow \mathcal{L}^{-1}\frac{2s+5}{s(s+1)}$$

$$\mathcal{L}^{-1}\frac{(2s+2)+3}{s(s+1)}$$

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CONTINUATION:

$$2\mathcal{L}^{-1}\frac{(s+1)}{s(s+1)} + 3\mathcal{L}^{-1}\frac{1}{s(s+1)} \Rightarrow 2\mathcal{L}^{-1}\frac{1}{s} + 3\mathcal{L}^{-1}\frac{1}{s(s+1)}$$

$$\left[\frac{1}{s(s+1)} = \frac{A}{s} + \frac{B}{s+1}\right] s(s+1)$$

$1 = A(s+1) + Bs$

IF $s = -1$ IF $s = 0$

$1 = -1B$ $1 = 1A$

$B = -1$ $A = 1$

$$3\left[\mathcal{L}^{-}\frac{1}{s} - \mathcal{L}^{-}\frac{1}{s+1}\right] ;\ a = 1$$

$3 - 3e^{-t} \Rightarrow 2 + 3 - 3e^{-t}$

$5 - 3e^{-t} \Rightarrow$ EQ2

EQ1 & EQ2

$$\boxed{f(t) = \frac{d^2f}{dt^2} + \frac{df}{dt} + 2\delta(t) + 5 - 3e^{-t}}$$