GROUP 11- ME- 4205
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PART 1:

1. $\mathcal{L}[3-e^{-3t}+5\sin 2t] = F(s)$
   a. $3\mathcal{L}[1] = 3/s$
   b. $\mathcal{L}[e^{-3t}] = 1/s+3$
   c. $5\mathcal{L}[5\sin 2t] = 2/s^2+4$

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

2. $\mathcal{L}[3+12t+42t^3-3e^{2t}] = F(s)$
   a. $3\mathcal{L}[1] = 3/s$
   b. $\mathcal{L}[12t] = 12/s^2$
   c. $42\mathcal{L}[t^3] = 6/s^4 = 252/s^4$
   d. $3\mathcal{L}[e^{2t}] = 3/s-2$

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

3. $\mathcal{L}[(t+1)(t+2)] = F(s)$
   $\mathcal{L}[t^2+3t+2] = F(s)$
   a. $\mathcal{L}[t^2] = 2/s^3$
   b. $\mathcal{L}[3t] = 3/s^2$
   c. $2\mathcal{L}[1] = 2/s$

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

PART 2:

1. $\mathcal{L}^{-1}\left[\frac{8-3s+s^2}{s^3}\right] = f(t)$
   a. $\mathcal{L}^{-1}[8/s^3] = 4\,2!/s^{2+1} = 4t^2$
   b. $\mathcal{L}^{-1}[3s/s^3] = 3/s^2 = 3\left(\frac{1}{s^2}\right) = 3t$
   c. $\mathcal{L}^{-1}[s^2/s^3] = 1/s = 1$

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

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

a. $5\mathcal{L}^{-1}\left[\frac{1}{s-2}\right] = 5e^{2t}$

b. $4\mathcal{L}^{-1}\left[\frac{s}{s^2+9}\right] = 4\cos 3t$

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

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

$7\mathcal{L}^{-1}\left[\frac{1}{s^2+6}\right] \frac{\sqrt{6}}{\sqrt{6}} \Rightarrow 7\mathcal{L}^{-1}\left[\frac{\sqrt{6}}{s^2+(\sqrt{6})^2}\right] \Rightarrow \frac{7}{\sqrt{6}}\mathcal{L}^{-1}\left[\frac{\sqrt{6}}{s^2+(\sqrt{6})^2}\right] \sqrt{6}/\sqrt{6}$

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

PART 3:

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

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

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

IF $s=0$; $1 = A2 \Rightarrow A = \frac{1}{2}$

$1 = \frac{s^2+2s+2}{2} + Bs^2 + Cs$

$1 = \frac{s^2+2s+2+2Bs^2+2Cs}{2}$

$2 = s^2+2s+2+2Bs^2+2Cs = s^2(2B+1) + s(2+2C) + 2$; $B = -\frac{1}{2}$; $C = -1$

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

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

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

$= \frac{s+1+1}{(s+1)^2+1}$; $\omega = 1$; $a = 1$

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

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

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

$5\mathcal{L}^{-1}\left[\left\{\frac{s+2}{s^2(s+1)(s+3)}\right\} \frac{A}{s^2} + \frac{B}{s} + \frac{C}{s+1} + \frac{D}{s+3}\right] s^2(s+1)(s+3)$

$s+2 = [A(s+1)(s+3)] + [B(s)(s+1)(s+3)] + [C(s^2)(s+1)] + [D(s^2)(s+1)]$

IF $s=0$	IF $s=-3$	IF $s=-1$	IF $s=1$
$2 = 3A$	$-1 = 18D$	$1 = 2C$	$3 = \frac{16}{3} + 8B + 2 + \frac{1}{9}$
$A = \frac{2}{3}$	$D = -\frac{1}{18}$	$C = \frac{1}{2}$	$-40/9 = 8B$
			$B = -5/9$

$5\mathcal{L}^{-1}\left\{\frac{2/3}{s^2} - \frac{5/9}{s} + \frac{1/2}{s+1} - \frac{1/8}{s+3}\right\}$

$\frac{2}{3}\mathcal{L}^{-1}\left\{\frac{1}{s^2}\right\} - \frac{5}{9}\mathcal{L}^{-1}\left\{\frac{1}{s}\right\} + \frac{1}{2}\mathcal{L}^{-1}\left\{\frac{1}{s+1}\right\} - \frac{1}{8}\mathcal{L}^{-1}\left\{\frac{1}{s+3}\right\}$

$5\left[\frac{2}{3}t - \frac{5}{9} + \frac{1}{2}e^{-t} - \frac{1}{8}e^{3t}\right]$

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

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

$\mathcal{L}^{-} = \left\{ \dfrac{s^4+2s^3+3s^2+4s+5}{s^2+s} \right\}$

$$
\begin{array}{r}
s^2+s+2 \\
s^2+s \;\overline{\big)\, s^4+2s^3+3s^2+4s+5} \\
\underline{-s^4+s^3} \\
s^3+3s^2 \\
\underline{s^3+s^2} \\
2s^2+4s \\
\underline{2s^2+2s} \\
2s+5
\end{array}
$$

$= \mathcal{L}^{-}\left[s^2+s+2+\dfrac{2s+5}{s^2+5}\right] \Rightarrow \mathcal{L}^{-}\left[\dfrac{2s+5}{s(s+1)}\right] \Rightarrow \mathcal{L}^{-}\left[\dfrac{(2s+2)+3}{s(s+1)}\right]$

$f(t) = d^2f/dt^2$ ①

$f(t) = df/dt$ ②

$f(t) = 2\delta$ ③

$f(t) = 5-3e^{-t}$ ④

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

$= 2+ \left[\dfrac{1}{s(s+1)} = \dfrac{A}{s}+\dfrac{B}{s+1}\right] s(s+1)$

$1 = A(s+1)+Bs$; IF $A=-1$, $B=-1$; IF $B=0$, $A=1$

$= 2+3\,\mathcal{L}^{-}\left[\dfrac{1}{s}-\dfrac{1}{s+1}\right]$

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

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

$= 2+3-3e^{-t}$

$= 5-3e^{-t}$

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