1) $f(t) = -6t^2$

$-6\mathcal{L}\{t^2\}$

$\mathcal{L}\{t^2\} = \dfrac{2}{s^3} = -6 * \dfrac{2}{s^3}$

$-\dfrac{2*6}{s^3} = -\dfrac{12}{s^3}$

2) $f(t) = (t-2)^2$

$\mathcal{L}\{t^2 - 4t + 4\}$

$\mathcal{L}\{t^2\} = \dfrac{2}{s^3}$

$\mathcal{L}\{t\} = \dfrac{1}{s^2}$

$\mathcal{L}\{4\} = \dfrac{4}{s}$

$\dfrac{2}{s^3} - 4 * \dfrac{1}{s^2} + \dfrac{4}{s}$

3) $f(t) = 4e^{5t} - 3sen(4t)$

$4\mathcal{L}\{e^{5t}\} - 3\mathcal{L}\{ sen (4t)\}$

$\mathcal{L}\{e^{5t}\} = \dfrac{1}{s-5}$

$\mathcal{L}\{sen(4t)\} = \dfrac{4}{s^2+16}$

$\dfrac{4}{s-5} - \dfrac{12}{s^2+16}$

4) $f(t) = 6t^3 + 2cos9t$

$6\mathcal{L}\{t^3\} + 2\mathcal{L}\{\cos(9t)\}$

$\mathcal{L}\{t^3\} = \dfrac{6}{s^4}$

$\mathcal{L}\{\cos(9t)\} = \dfrac{s}{s^2+81}$

$\dfrac{36}{s^4} + \dfrac{2s}{s^2+81}$

5) $f(t) = \cos(2t) + sen (3t)$

$\mathcal{L}\{\cos(2t)\} + \mathcal{L}\{sen(3t)\}$

$\mathcal{L}\{\cos(2t)\} = \dfrac{s}{s^2+4}$

$$\mathcal{L}\{sen(3t)\} = \frac{3}{s^2 + 9}$$

$$= \frac{s}{s^2 + 4} + \frac{3}{s^2 + 9}$$

6) $\mathcal{L}^{-1}\left\{\frac{6}{s-2}\right\}$

$$\mathcal{L}^{-1}\left\{6 * \frac{1}{s - 2}\right\}$$

$$6\mathcal{L}^{-1}\left\{\frac{1}{s - 2}\right\}$$

$$= 6e^{2t}$$

7) $\mathcal{L}^{-1}\left\{\frac{1}{s^4}\right\}$

$$\mathcal{L}^{-1}\left\{\frac{1}{6} * \frac{6}{s^4}\right\}$$

$$\frac{1}{6}\mathcal{L}^{-1}\left\{\frac{6}{s^4}\right\}$$

$$\frac{1}{6}t^3$$

$$= \frac{t^3}{6}$$

8) $\mathcal{L}^{-1}\left\{\frac{4}{s} + \frac{6!}{s^7}\right\}$

$$\mathcal{L}^{-1}\left\{\frac{4}{s}\right\} + \mathcal{L}^{-1}\left\{\frac{6!}{s^7}\right\}$$

$$\mathcal{L}^{-1}\left\{\frac{4}{s}\right\}$$

$$= 4h(t)$$

$$\mathcal{L}^{-1}\left\{\frac{6!}{s^7}\right\}$$

$$= t^6$$

$$= 4h(t) + t^6$$

9) $\mathcal{L}^{-1}\left\{\frac{17}{s} - \frac{3}{s^4} + \frac{6}{s+10}\right\}$

$$\mathcal{L}^{-1}\left\{\frac{17}{s}\right\} - \mathcal{L}^{-1}\left\{\frac{3}{s^4}\right\} + \mathcal{L}^{-1}\left\{\frac{6}{s} + 10\right\}$$

$$\mathcal{L}^{-1}\left\{\frac{17}{s}\right\}$$

$17h(t)$

$\mathcal{L}^{-1}\left\{\dfrac{3}{s^4}\right\}$

$\mathcal{L}^{-1}\left\{\dfrac{1}{2}*\dfrac{6}{s^4}\right\}$

$=\dfrac{1}{2}\mathcal{L}^{-1}\left\{\dfrac{6}{s^4}\right\}$

$=\dfrac{1}{2}t^3$

$=\dfrac{t^3}{2}$

$\mathcal{L}^{-1}\left\{\dfrac{6}{s+10}\right\}$

$\mathcal{L}^{-1}\left\{6*\dfrac{1}{s+10}\right\}$

$6\mathcal{L}^{-1}\left\{\dfrac{1}{s+10}\right\}$

$=6e^{-10t}$

$=17h(t)-\dfrac{t^3}{2}+6e^{-10t}$

10) $\mathcal{L}^{-1}\left\{\dfrac{3}{s^2-4}+\dfrac{1}{s^5}\right\}$

$\mathcal{L}^{-1}\left\{\dfrac{3}{4(s+2)}\right\}+\mathcal{L}^{-1}\left\{\dfrac{3}{4(s-2)}\right\}+\mathcal{L}^{-1}\left\{\dfrac{6}{s^5}\right\}$

$\mathcal{L}^{-1}\left\{\dfrac{3}{4}*\dfrac{1}{s+2}\right\}$

$\dfrac{3}{4}\mathcal{L}^{-1}\left\{\dfrac{1}{s+2}\right\}$

$=\dfrac{3}{4}e^{-2t}$

$\mathcal{L}^{-1}\left\{\dfrac{3}{4(s-2)}\right\}$

$\mathcal{L}^{-1}\left\{\dfrac{3}{4}*\dfrac{1}{s-2}\right\}$

$=\dfrac{3}{4}e^{2t}$

$$\mathcal{L}^{-1}\left\{\frac{1}{4}*\frac{24}{s^5}\right\}$$

$$\frac{1}{4}\mathcal{L}^{-1}\left\{\frac{24}{s^5}\right\}$$

$$=\frac{1}{4}t^4=\frac{t^4}{4}$$

$$=-\frac{3}{4}e^{2t}+\frac{3}{4}e^{2t}+\frac{t^4}{4}$$

11) $\mathcal{L}^{-1}\left\{\frac{2s+1}{s^3-3s^2+2s}\right\}$

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

$$\mathcal{L}^{-1}\left\{\frac{1}{2}*\frac{1}{s}\right\}$$

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

$$\frac{1}{2}h(t)$$

$$\mathcal{L}^{-1}\left\{3*\frac{1}{s-1}\right\}$$

$$3\mathcal{L}^{-1}\left\{\frac{1}{s-1}\right\}=3e^{t}$$

$$\mathcal{L}^{-1}\left\{\frac{5}{2}*\frac{1}{s-2}\right\}$$

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

$$=\frac{1}{2}h(t)-3e^{t}+\frac{5}{2}e^{2t}$$

12) $\mathcal{L}^{-1}\left\{\frac{s+1}{s^2-s-42}\right\}$

$$\mathcal{L}^{-1}\left\{\frac{s-\frac{1}{2}}{\left(s-\frac{1}{2}\right)^2+\frac{167}{4}}+\frac{3}{2}*\frac{1}{\left(s-\frac{1}{2}\right)^2+\frac{167}{4}}\right\}$$

$$e^{\frac{1}{2}t}\mathcal{L}^{-1}\left\{\frac{s}{s^2+\frac{167}{4}}\right\}=e^{\frac{t}{2}}\cos\left(\frac{\sqrt{167}t}{2}\right)$$

$$e^{\frac{1}{2}t}\mathcal{L}^{-1}\left\{\frac{1}{s^2+\dfrac{167}{4}}\right\}=e^{\frac{t}{2}}\frac{2}{\sqrt{167}}\sin\left(\frac{\sqrt{167}\,t}{2}\right)$$

$$=e^{\frac{t}{2}}\cos\left(\frac{\sqrt{167}\,t}{2}\right)+\frac{3e^{\frac{t}{2}}\sin\left(\dfrac{\sqrt{167}\,t}{2}\right)}{\sqrt{167}}$$