$$L\{\sin 3t\ \ e^{-t}\} = \frac{3}{(s+1)^2+9} = \frac{3}{s^2+2s+1-1+10}$$

$$L\{\sin 3t\} = \frac{3}{s^2+9},$$

$$L\{\frac{\cos t}{e^t}\} = L\{e^{\ t}\cos t\} = \frac{s+1}{(s+1)^2+1} \qquad\qquad L\{\cos t\} = \frac{s}{s^2+1}$$

$$L^{-1}\{\frac{s}{s^2+3s+\frac{9}{4}-\frac{9}{4}+6}\} = L^{-1}\{\frac{s}{(s+\frac{3}{2})^2+\frac{15}{4}}\} = e^{-\frac{3}{2}t}L^{-1}\{\frac{s-\frac{3}{2}}{s^2+\frac{15}{4}}\} = e^{-\frac{3}{2}t}\left(L^{-1}\{\frac{s}{s^2+\frac{15}{4}}\} - L^{-1}\{\frac{\frac{3}{2}}{s^2+\frac{15}{4}}\}\right) = e^{-\frac{3}{2}t}\left(\cos(\sqrt{\frac{15}{4}}\,t) - L^{-1}\{\frac{\frac{3}{2}\sqrt{\frac{4}{15}}\sqrt{\frac{15}{4}}}{s^2+\frac{15}{4}}\}\right)$$

$$= e^{-\frac{3}{2}t}\left(\cos(\sqrt{\frac{15}{4}}\,t) - \frac{3}{\sqrt{15}}\sin(\sqrt{\frac{15}{4}}\,t)\right)$$

$$L^{-1}\{\frac{s}{s^2+5s+6}\} = L^{-1}\{\frac{s}{(s+2)(s+3)}\} = L^{-1}\{\frac{-2}{s+2}+\frac{3}{s+3}\} = -2e^{-2t}+3e^{-3t}$$

$$L\{u_1(t)t^2\} = e^{-s}L\{(t+1)^2\} = e^{-s}L\{t^2+2t+1\} = e^{-s}\left(\frac{2!}{s^3} + 2\frac{1!}{s^2} + \frac{1}{s}\right)$$

$$L^{-1}\{e^{-3s}\frac{s}{s^2+1}\} = u_3(t)\cos(t-3) = \begin{cases} 0 & t < 3 \\ \cos(t-3) & t \geq 3 \end{cases}$$

$$L\{\delta_2(t)(\arctan t^2 + \sin 3t)\} = e^{-2s}(\arctan 4 + \sin 6)$$

$$L\{\sin t\} = \frac{1}{s^2+1} \quad L\{\sin 3t\} = \frac{1}{3}\frac{1}{(\frac{s}{3})^2+1} = \frac{1}{3}\frac{1}{\frac{s^2+9}{9}} = \frac{3}{s^2+9}$$

$$L\{\sin t\} = \frac{1}{s^2+1}$$

$$L\{\cos t\} = s\frac{1}{s^2+1} - \sin(0) = \frac{s}{s^2+1}$$

$$L\{f''(t)\} = sL\{f'(t)\} - f'(0)$$

$$= s(sL\{f(t)\} - f(0)) - f'(0) = s^2L\{f(t)\} - sf(0) - f'(0)$$

$$L\{f'''(t)\} = s^3L\{f(t)\} - s^2f(0) - sf'(0) - f''(0)$$