$$\mathcal{L}\left\{\frac{df}{dt}(t)\right\} = s\mathcal{L}\{f(t)\} - f(0)$$

$$= \int_0^\infty e^{-st} f'(t)\,dt$$

$$= e^{-st} f(t)\Big|_0^\infty - (-s)\int_0^\infty e^{-st} f(t)\,dt$$

$$= -f(0) + s\mathcal{L}$$

$$\mathcal{L}^{-1}\{F(s-a)\} = e^{at} f(t)$$

$$\mathcal{L}^{-1}\{e^{at} f(t)\} =$$

$$\ddot{y} + 4\dot{y} + 5y = t$$

$$s^2 Y - 1 + 4sY + 5Y = \frac{1}{s^2}$$

$$Y(s^2 + 4s + 5) = \frac{1}{s^2}$$

$$Y = \frac{1}{s^2+4s+5} + \frac{1}{s^2(s^2+4s+5)}$$

$$\frac{1}{s^2(s^2+4s+5)} = \frac{A}{s} + \frac{B}{s^2} + \frac{C}{s^2+4s+5} + \frac{D(s+2)}{(s+2)^2+1}$$

$$1 = A(s)(s^2+4s+5) + B(s^2+4s+5) + Cs^2 + D(s+2)s^2$$

$$B = \frac{1}{5}$$

$$f_T(t) = t^2 - t^2 u(t-1)$$

$$= t^2 - [(t-1)^2 + 2t - 1]\, u(t-1)$$

$$= t^2 - (t-1)^2 u(t-1) - (2t-2+1)\, u(t-1)$$

$$= t^2 - (t-1)^2 u(t-1) - 2(t-1) u(t-1) + u(t-1)$$

$$\therefore F(s) = \frac{1}{s^3} - \frac{2}{s^3} e^{-s} - \frac{2}{s^2} e^{-s} + \frac{e^{-s}}{s}$$