Solve the IVP (initial value problem)

$$y'' + 3y' = 0, \quad y(0) = 1, \quad y'(0) = 2$$

Char. Poly: $r^2 + 3r = 0$ $\quad r(r+3) = 0$

$r = 0$

$r = -3$

$r = 0, -3$

$y = c_1 e^{0t} + c_2 e^{-3t}$

$y' = -3c_2 e^{-3t}$

$y(0) = 1, \quad y'(0) = 2$

$c_1 = \frac{5}{3}, \quad c_2 = -\frac{2}{3}$

$y(t) = \frac{5}{3} - \frac{2}{3} e^{-3t}$

$$y'' + 3y' = 0, \quad y(0) = 1, \quad y'(0) = 2$$

$$\mathcal{L}\left\{\frac{d^n}{dt^n} f(t)\right\} = s^n \mathcal{L}\{f(t)\} - \left[s^{n-1} f(0) + s^{n-2} f^{(n-1)}(0) + \dots f^{(n)}(0)\right]$$

$$\mathcal{L}\left\{\frac{d^2}{dt^2} f(t)\right\} = s^2 \mathcal{L}\{f(t)\} - s f'(0) - f(0)$$

$$y'' + 3y' = 0,\quad y(0) = 1,\quad y'(0) = 2$$

$$s^2 Y(s) - s\,y(0) - y'(0) + 3\left[sY(s) - y(0)\right] = 0$$

$$s^2 Y(s) - s - 2 + 3sY(s) - 3 = 0$$

$$Y(s)\left[s^2 + 3s\right] = s + 5$$

$$Y(s) = \frac{s+5}{s(s+3)}$$

$$\frac{s+5}{s(s+3)} = \frac{A}{s} + \frac{B}{s+3}$$

$$s + 5 = A(s+3) + Bs$$

$$\Big|_{s=0} \quad 5 = 3A \qquad A = \frac{5}{3}$$

$$\Big|_{s=-3} \quad -3 + 5 = A(0) - 3B$$

$$2 = -3B$$

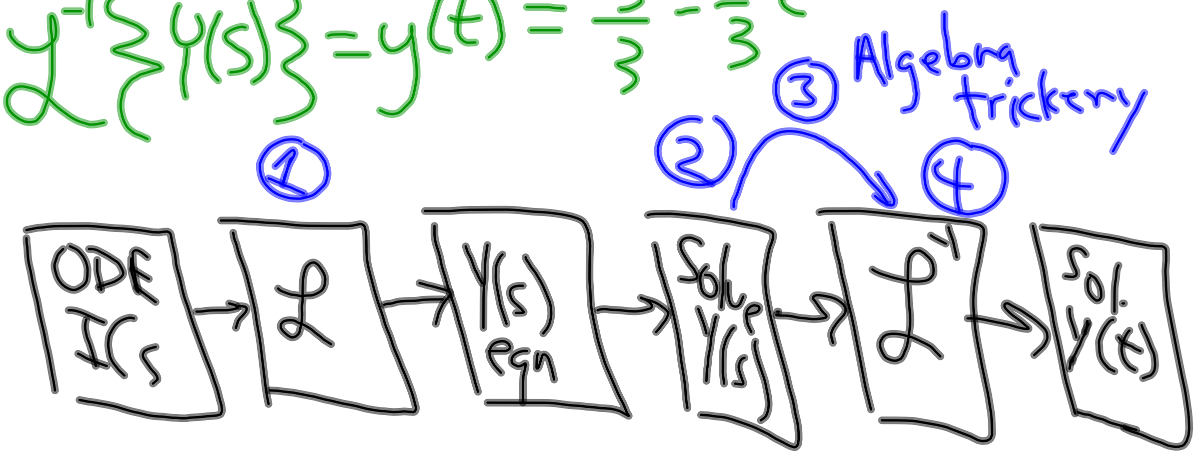
$$B = \frac{-2}{3}$$

$$Y(s) = \frac{s+5}{s(s+3)} = \frac{5/3}{s} - \frac{2/3}{s+3}$$

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

$$1 \Longleftrightarrow \frac{1}{s} \qquad e^{at} \Longleftrightarrow \frac{1}{s-a}$$

$$\mathcal{L}^{-1}\{Y(s)\} = y(t) = \frac{5}{3} - \frac{2}{3}e^{-3t}$$



① $F(s) = \dfrac{3}{s-5}$ $\quad f(t) = 3e^{5t}$

② $F(s) = \dfrac{-1/2}{s+2} \longleftrightarrow f(t) = -1/2\, e^{-2t}$

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

$f(t) = 5t - 3$

④ $F(s) = \dfrac{2s}{s^2+9} = 2\left(\dfrac{s}{s^2+3^2}\right)$

$f(s) = 2\cos 3t$

⑤ $F(s) = \dfrac{-5}{s^2+9} = -\dfrac{5}{3}\left(\dfrac{3}{s^2+9}\right)$

$f(t) = -\dfrac{5}{3}(\sin(3t))$

⑥ $F(s) = \dfrac{2s-3}{s^2-4s-5} = \dfrac{7/6}{s-5} + \dfrac{5/6}{s+1}$

$f(t) = 7/6\, e^{5t} + 5/6\, e^{-t}$

⑦ $F(s) = \dfrac{2s-3}{s^2+25} = 2\dfrac{s}{s^2+25} - 3\dfrac{1}{s^2+25}$

$= 2\dfrac{s}{s^2+25} - \dfrac{3}{5} \cdot \dfrac{5}{s^2+25}$

$f(t) = 2\cos 5t - \frac{3}{5}\sin 5t$

Apr 5-9:32 AM