Calcolo risposta al gradino per un sistema LTI-TC che presenta poli multipli

Fdt

In[∘]:= $G[s\_] := \frac{s-3}{s^3 + 6 s^2 + 9 s + 4}$

Calcolo i poli del sistema

In[∘]:= `Solve[Denominator[G[s]] == 0, s]`

Out[∘]=

$\{\{s \to -4\}, \{s \to -1\}, \{s \to -1\}\}$

Calcolo la risposta forzata in s

In[∘]:= $Y_f[s\_] := G[s] \left(\frac{1}{s}\right)$

In[∘]:= $Y_f[s]$

Out[∘]=

$$\frac{-3 + s}{s\left(4 + 9 s + 6 s^2 + s^3\right)}$$

In[∘]:= $\text{Apart}[Y_f[s]]$

Out[∘]=

$$-\frac{3}{4 s} + \frac{4}{3 (1+s)^2} + \frac{5}{9 (1+s)} + \frac{7}{36 (4+s)}$$

Scrivo Yf[s]

In[∘]:= $C_1 \left(\frac{1}{s}\right) + C_2 \left(\frac{1}{s+4}\right) + C_{31} \left(\frac{1}{s+1}\right) + C_{32} \left(\frac{1}{(s+1)^2}\right)$

Out[∘]=

$$\frac{C_1}{s} + \frac{C_2}{4+s} + \frac{C_{31}}{1+s} + \frac{C_{32}}{(1+s)^2}$$

In[∘]:= $C_1 = G[0]$

Out[∘]=

$$-\frac{3}{4}$$

In[ ]:= $C_2 = \lim_{s \to -4} (s+4)\, Y_f[s]$

Out[ ]=

$$\frac{7}{36}$$

In[ ]:= $C_{32} = \lim_{s \to -1} (s+1)^2\, Y_f[s]$

Out[ ]=

$$\frac{4}{3}$$

In[ ]:= $C_{31} = \lim_{s \to -1} D\left[(s+1)^2\, Y_f[s],\ s\right]$

Out[ ]=

$$\frac{5}{9}$$

In[ ]:= InverseLaplaceTransform[Y_f[s], s, t]

Out[ ]=

$$\frac{1}{36}\left(-27 + 7\, e^{-4\,t} + 4\, e^{-t}\,(5 + 12\,t)\right)$$

In[ ]:= y_f[t_] := C_1 UnitStep[t] + C_2 Exp[-4 t] UnitStep[t] + C_{31} Exp[-t] UnitStep[t] + C_{32} t Exp[-t] UnitStep[t]

In[ ]:= Plot[y_f[t], {t, 0, 10}, PlotRange → All]

Out[ ]=