POLI SEMPLICI

ES 2.3

$$F(S) = \frac{S+3}{(S+1)(S+2)} = \frac{r_1}{S+1} + \frac{r_2}{S+2}$$

$den = S^2 + 2S + S + 2 = S^2 + 3S +$

$\Rightarrow p_1 = -1 \quad p_2 = -2$

$$r_1 = \lim_{S \to -1} \cancel{(S+1)} \cdot \frac{S+3}{\cancel{(S+1)}(S+2)} = \frac{-1+3}{-1+2} = 2 \quad r_1$$

$$r_2 = \lim_{S \to -2} \cancel{(S+2)} \frac{S+3}{(S+1)\cancel{(S+2)}} = \frac{-2+3}{-2+1} = -1 \quad r_2$$

$$\rightsquigarrow F(S) = \frac{2}{S+1} - \frac{1}{S+2} = 2 \cdot \underbrace{\frac{1}{S+1}}_{EXP_1} - \underbrace{\frac{1}{S+2}}_{EXP_2} \rightleftarrows f(t) = 2 \cdot e^{-t} - e^{-2t}, \; t \geq$$

(α_1 = 1, α_2 = 2)

Varianti:

(a) La funzione di partenza era: $F(S) = \dfrac{S+3}{S^2+3S+2}$

1. Trovo i poli

$$S^2 + 3S + 2 \to p_{1,2} = \frac{-3 \pm \sqrt{9-4\cdot 2}}{2} \begin{cases} p_1 = \frac{-3+1}{2} = -1 & p_1 \\ p_2 = -\frac{4}{2} = -2 & p_2 \end{cases}$$

2. Riscrivo F(S)

$$F(S) = \frac{S+3}{(S-p_1)(S-p_2)} = \frac{S+3}{(S+1)(S+2)}$$

3. Procedo come prima...

(b) Metodo esplicito

$$\overset{①}{\frac{S+3}{(S+1)(S+2)}} = \frac{r_1}{S+1} + \frac{r_2}{S+2} = \frac{r_1 S + 2r_1 + r_2 S + r_2}{(S+1)(S+2)} = \overset{②}{\frac{(r_1+r_2)S + 2r_1 + r_2}{(S+1)(S+2)}}$$

$$① = ② \Rightarrow \begin{cases} r_1 + r_2 = 1 \\ 2r_1 + r_2 = 3 \end{cases} \to \begin{cases} r_1 = 1 - r_2 \\ 2 - 2r_2 + r_2 = 3 \to r_2 = \frac{1}{-1} = -1 \; r_2 \end{cases}$$

$r_1 = 1 - (-1) = 2 \; r_1$

ES 2.4

$$G(s) = \frac{s^3+5s^2+9s+7}{(s+1)(s+2)}$$

$\deg(N) > \deg(D)$!!

DIVISIONE TRA POLINOMI

$$\underset{\text{DIVIDENDO}}{A(x)} = \underset{\text{DIVISORE}}{B(x)} \cdot \underset{\text{QUOZIENTE}}{Q(x)} + \underset{\text{RESTO}}{R(x)}$$

$$\begin{array}{r|l} \cancel{x^3}-2x^2+\cancel{x}-3 & x^2+1 \quad \text{DIVISORE} \\ \hline -\cancel{x^3}+0-\cancel{x}+0 & x-2 \quad \text{QUOZIENTE} \\ \hline -2x^2 \quad -3 & \\ +2x^2+2 & \\ \hline 1 \; R(x) & \end{array}$$

$\rightarrow$ Tornando all'esercizio

$$\begin{array}{r|l} \overset{A(x)}{\cancel{s^3}+5s^2+9s+7} & s^2+3s+2 \quad B(x) \\ \hline -\cancel{s^3}-3s^2-2s+0 & s+2 \quad Q(x) \\ \hline \cancel{2s^2}+7s+7 & \\ -\cancel{2s^2}-6s-4 & \\ \hline s+3 \; R(x) & \end{array}$$

$$\rightsquigarrow \frac{s^3+5s^2+9s+7}{(s+1)(s+2)} = \underset{Q(x)}{s+2} + \frac{\overset{R(x)}{s+3}}{\underset{B(x)}{(s+1)(s+2)}}$$

$$\Rightarrow \boxed{\begin{cases} p_1 = -1 \\ p_2 = -2 \end{cases}}$$

$$\Rightarrow G(s) = s+2 + \frac{r_1}{s+1} + \frac{r_2}{s+2}$$

$$r_1 = \lim_{s\to -1} \cancel{(s+1)} \frac{s^3+5s^2+9s+7}{\cancel{(s+1)}(s+2)} \rightarrow \frac{-1+5-9+7}{-1+2} \rightarrow 2 \; r_1$$

$$r_2 = \lim_{s\to -2} (s+2) \ldots \rightarrow \frac{-8+20-18+7}{-1} = -1 \; r_2$$

$$\Rightarrow G(s) = s + 2 + \frac{2}{s+1} - \frac{1}{s+2} \rightleftharpoons g(t) = \frac{d\delta}{dt} + 2\delta + 2e^{-t} - e^{-2t}, \quad t \geq 0$$

Ans

$$\mathcal{L}[\delta] = 1 \rightarrow \mathcal{L}\left[\frac{dy}{dt}\right] = s \cdot Y(s)$$

$$\Rightarrow \mathcal{L}\left[\frac{d\delta}{dt}\right] = s \cdot 1 \Rightarrow \mathcal{L}^{-1}[s] = \frac{d\delta}{dt}$$

ES 2.5

$$F(s) = \frac{2s+12}{s^2+2s+5} \qquad P_{1,2} = \frac{-2 \pm \sqrt{4-4\cdot 1\cdot 5}}{2} = \frac{-2\pm 4j}{2} \begin{cases} -1+2j \\ -1-2j \end{cases}$$

$\sqrt{-16}$

$$\Rightarrow s^2+2s+5 = (s-p_1)(s-p_2) = (s+1-2j)(s+1+2j)$$

$$\Rightarrow \frac{2s+12}{s^2+2s+5} = \frac{2s+12}{(s+1-2j)(s+1+2j)} = \frac{r_1}{(s+1-2j)} + \frac{r_2}{(s+1+2j)}$$

Ci conviene scrivere come una somma di cos e sin smorzati

$$\mathcal{L}[\cos(\omega t)\cdot 1(t)] = \frac{s}{s^2+\omega^2} \qquad \mathcal{L}[\sin(\omega t)] = \frac{\omega}{s^2+\omega^2}$$

ma dalla proprietà: $\mathcal{L}[e^{-\alpha t}\cdot f(t)] = F(s+\alpha)$

$$\Rightarrow \begin{cases} \mathcal{L}[\cos(\omega t)\cdot e^{-\alpha t}\cdot 1(t)] = \dfrac{(s+\alpha)}{(s+\alpha)^2\cdot\omega^2} \\ \mathcal{L}[\sin(\omega t)\cdot e^{-\alpha t}\, 1(t)] = \dfrac{\omega}{(s+\alpha)^2\cdot\omega^2} \end{cases}$$

mi riconduco a questa forma

$$\frac{2s+12}{s^2+2s+5} = \frac{10+2+2s}{//} = \frac{10+2(s+1)}{s^2+2s+5} = \frac{10+2(s+1)}{(s+1)^2+\underbrace{5-1}_{2^2}} = \frac{10+\overbrace{2(s+1)}^{A\cdot(s+\alpha)}}{\underbrace{(s+1)^2}_{(s+\alpha)^2}+\underbrace{2^2}_{\omega^2}}$$

Cerco $(s+1)^2$ al denom

$$= \frac{10}{(s+1)^2+2^2} + 2\,\frac{s+1}{(s+1)^2+2^2} = 5\cdot\frac{2}{(s+1)^2+2^2} + 2\,\frac{s+1}{(s+1)^2+2^2}$$

$10 \rightarrow 2\cdot 5$, $\omega = 2$, $\omega^2 = 2^2$, $\alpha = 1$

$e^{-2t}\sin(\omega t)$ $\qquad$ $e^{-t}\cos(\omega t)$

$$\Rightarrow F(s) \rightleftharpoons f(t) = 5e^{-t}\sin(2t) + 2\cos(2t)$$

Ans

POLI MULTIPLI

Chiamato $\frac{B(s)}{A(s)}$

$$F(s) = \frac{s^2+2s+3}{(s+1)^3} = \frac{r_1}{s+1} + \frac{r_2}{(s+1)^2} + \frac{r_3}{(s+1)^3}$$

(1) Moltiplico per il denom:

$$\left(\frac{r_1}{s+1} + \frac{r_2}{(s+1)^2} + \frac{r_3}{(s+1)^3}\right) \cdot (s+1)^3 = r_1(s+1)^2 + r_2(s+1) + r_3 \quad [a(s)]$$

$$= r_1 s^2 + 2r_1 s + r_1 + r_2 s + r_2 + r_3$$

(2) Calcolo nel polo $(s+1)^3 = 0$ per $s=-1$

$$\rightarrow (s+1)^3 \cdot F(s) \Big|_{s=-1} = r_3$$

(3) DERIVO $a(s)$

$$\frac{d}{ds}\left[(s+1)^3 \cdot F(s)\right] = \frac{d}{ds}(a) = 2r_1 s + 2r_1 + r_2 = 2r_1(s+1) + r_2 \quad [b(s)]$$

(4) Calcolo nel polo $s=-1$

$$\rightarrow \frac{d}{dt}\left[a(s)\right]\Big|_{s=-1} = [b(s)]\Big|_{s=-1} = r_2$$

(5) Derivo $b(s)$

$$\frac{d}{dt}\left[b(s)\right] = 2r_1 \quad [c(s)]$$

$$\cancel{(s+3)^3} \cdot \frac{B(s)}{\cancel{A(s)}} = \frac{[s^2+2s+3]}{\cancel{(s+1)^3}} \cdot \cancel{(s+1)^3}$$

r_3 $\quad s=p_1$

$$r_2 = \frac{d}{ds}[N(s)]\Big|_{s=p_1}$$

$$r_1 = \frac{d}{ds} \cdot \frac{1}{2}[N(s)]\Big|_{s=p_1}$$

$$\boxed{r_n = \frac{d^n}{ds^n} \cdot \frac{1}{n!}\left[N(s)\right]\Big|_{s=p_n}}$$

In realtà calcolo il 1° elemento ...

(6) Calcolo nel polo $s=-1$

$$[2r_1]\Big|_{s=-1} = 2r_1$$

POSSO CONCLUDERE CHE...

- $$r_1 = \left[(s+1)^3 \cdot \frac{B(s)}{A(s)}\right]\Big|_{s=-1} = \left[s^2+2s+3\right]\Big|_{s=-1} = 1-2+3 = 2 \quad r_3$$
- $$r_2 = \left\{\frac{d}{ds}\left[(s+1)^3 \cdot \frac{B(s)}{A(s)}\right]\right\}\Big|_{s=-1} = \frac{d}{ds}[N(s)]\Big|_{s=-1} = -2+2 = 0 \quad r_2$$
- $$r_2 = \frac{1}{2}\left\{\frac{d^2}{ds^2}\left[(s+1)^3 \cdot \frac{B(s)}{A(s)}\right]\right\}\Big|_{s=-1} = \frac{d^2}{ds^2}\left[\frac{1}{2!}N(s)\right] = \frac{1}{2}(2) = 1 \quad r_1$$

$$\Rightarrow F(S) = \underbrace{\frac{1}{S+1}}_{a} + \underbrace{\frac{2}{(S+1)^3}}_{b} =$$

(b) $\mathcal{L}[F(S)] = f(t) \rightarrow \mathcal{L}[F(S+\alpha)] = e^{-\alpha t} \cdot f(t)$

in (b) $\alpha = 1$, $F(S) = \frac{1}{S^3} \rightleftharpoons \frac{t^2}{2} \Rightarrow \mathcal{L}^{-1}[(b)] = t^2 e^{-t}$

(a) $\mathcal{L}^{-1}[(a)] = e^{-t}$

$$\Rightarrow \mathcal{L}^{-1}[F(S)] = e^{-t}(1+t^2), \quad t \geq 0$$

ES:

$$F(S) = \frac{10}{S+2} \rightleftharpoons 10 \cdot e^{-2t}, \quad t \geq 0$$

- VALORE INIZIALE

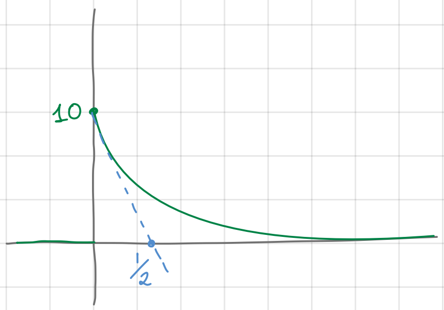
(a) $\lim_{t \to 0^+} f(t) = \lim_{S \to \infty} S \cdot F(S) = \lim_{S \to \infty} \cancel{S} \cdot \frac{10}{\cancel{S+2}} \rightarrow 10$

QED

(b) $\lim_{t \to 0^+} f(t) = \lim_{t \to 0^+} 10 \cdot \cancel{e^{-2t}}_{1} \rightarrow 10$

- Valore finale

$$\lim_{t \to \infty} f(t) = \lim_{S \to 0} S \cdot F(S) = \lim_{S \to 0} S \cdot \frac{10}{S+2} = 0$$



ES:

$$F(S)=\frac{2S-1}{3S+2}=\frac{2}{3}\left(\frac{S-\frac{1}{2}}{S+\frac{2}{3}}\right)$$

$$\mathcal{L}\left[\sin(\omega t)\mathbb{1}(t)\right]=\frac{\omega}{S^2+\omega^2}$$

$$\mathcal{L}\left[\cos(\omega t)\mathbb{1}(t)\right]\ \frac{S}{S^2+\omega^2}$$

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

$$=\frac{2}{3}\left(\overset{1}{\cancel{\frac{S+\frac{2}{3}}{S+\frac{2}{3}}}}-\frac{\frac{2}{3}+\frac{1}{2}}{S+\frac{2}{3}}\right)$$

$$=\frac{2}{3}\left(1-\frac{\frac{7}{6}}{S+\frac{2}{3}}\right)=\frac{2}{3}\left(\overset{\delta}{1}-\frac{7}{6}\cdot\overset{e^{-\frac{2}{3}t}}{\frac{1}{S+\frac{2}{3}}}\right)\rightleftharpoons f(t)=\frac{2}{3}\delta(t)-\frac{7}{9}e^{-\frac{2}{3}t}$$

ES:

$$F(S)=\frac{2S}{S^2+3S+2}$$

$$P_{1,2}=\frac{-3\pm\sqrt{9-4\cdot2}}{2}\ \begin{matrix}\nearrow \frac{-3+1}{2}=-1\ \ P_1\\ \searrow \frac{-3-1}{2}=-2\ \ P_2\end{matrix}$$

$$=\frac{r_1}{(S+1)}+\frac{r_2}{(S+2)}$$

$$\begin{cases} r_1=\lim\limits_{S\to-1}\frac{2S}{(S+2)}=\frac{-2}{1}=-2\\ r_2=\lim\limits_{S\to-2}\frac{2S}{(S+1)}=\frac{-4}{-1}=4\end{cases}$$

$$\Rightarrow F(S)=-\frac{2}{S+1}+\frac{4}{S+2}$$

$$\rightleftharpoons f(t)=-2e^{-t}+4e^{-2t},\ t\geq0$$

ES:

$$F(S)=\frac{S+8}{S^2+2S+2}$$

$$P_{1,2}=\frac{-2\pm\sqrt{4-4\cdot2}}{2}=\frac{-2\pm2j}{2}\ \begin{matrix}\nearrow -1+2j\\ \searrow -1-2j\end{matrix}$$

$$=\frac{S+8}{(S+1)^2+2-1}=\frac{S+1+7}{(S+1)^2+1}$$

$$\mathcal{L}\left[\sin(\omega t)\mathbb{1}\right]=\frac{\omega}{S^2+\omega^2}$$

$$\mathcal{L}\left[\cos(\omega t)\mathbb{1}\right]=\frac{S}{S^2+\omega^2}$$

$$=\frac{S+1}{(S+1)^2+1}+\frac{7}{(S+1)^2+1}$$

$$\mathcal{L}^{-1}\left[F(S+\alpha)\right]=e^{\alpha t}\cdot f(t)$$

$$\Rightarrow F(S)\rightleftharpoons f(t)=e^{-t}\cdot\cos(t)+7\cdot e^{-t}\sin(t),\ t\geq0$$

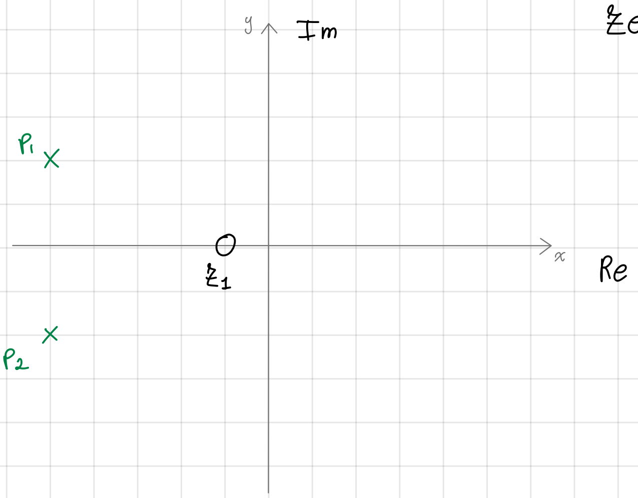
ES:

$$S(S^2+4S+5)=0 \rightsquigarrow P_1 = 0$$

$$F(S) = \frac{10S+3}{S^3+4S^2+5S}$$

$$\rightarrow P_{2,3} = \frac{-4 \pm \sqrt{16-4\cdot 5}}{2} = \frac{-4 \pm 2j}{2} \begin{cases} -2+j & P_2 \\ -2-j & P_3 \end{cases}$$

Zero: $10S+3=0 \rightarrow S = -\frac{3}{10}$



$$F(S) = \frac{10S+3}{S^3+4S^2+5S} = \frac{10S+3}{S(S^2+4S+5)} = \frac{z_1}{S} + \underbrace{\frac{z_2}{(S+2-j)} + \frac{z_3}{(S+2+j)}}_{} = \frac{z_1}{S} + \frac{??}{??}$$

$$= S^2+\cancel{2S}+\cancel{jS}+\cancel{2S}+4+\cancel{2j}-\cancel{jS}-\cancel{2j}-\cancel{j^2}$$

$4S$ $\quad +5 \quad +\cancel{1}$

$$= S^2+4S+5$$

STESSA FORMA

~~!! Il prof non dà Dim:~~

$N: z_1 \cdot S + z_2$

$$\rightsquigarrow F(S) = \frac{z_1}{S} + \frac{z_2 S + z_3}{S^2+4S+5}$$

$$z_1 = \lim_{S\to 0} \cancel{S}\, \frac{10S+3}{S^{\cancel{3}\,2}+4S^{\cancel{2}}+5\cancel{S}} = \lim_{S\to 0} \frac{\cancel{10S}+3}{\cancel{S^2}+\cancel{4S}+5} \rightarrow \frac{3}{5} \quad z_1$$

$$\frac{10S+3}{S^3+4S^2+5S} = \frac{z_1}{S} + \frac{z_2 S + z_3}{S^2+4S+5} = \frac{z_1(S^2+4S+5)+z_2S^2+z_3S}{//} = \frac{z_1S^2+z_1 4S+5z_1+z_2S^2+z_3S}{//}$$

$$= \frac{S^2(z_1+z_2)+S(4z_1+z_3)+5z_1}{//} \Rightarrow \begin{cases} z_1+z_2=0 \rightsquigarrow z_2 = -z_1 = -\frac{3}{5} \quad z_2 \\ 4z_1+z_3 = 10 \rightsquigarrow -\frac{12}{5}+z_3 = 10 \\ 5z_1 = 3 \end{cases}$$

$$z_3 = \frac{62}{5} \quad z_3$$

$$\Rightarrow F(S) = \frac{3}{5}\cdot\frac{1}{S} + \frac{-\frac{3}{5}S + \frac{38}{5}}{S^2+4S+5}$$

$$= \frac{3}{5}\left(\frac{1}{S} + \frac{S+\frac{38}{3}}{S^2+4S+5}\right) = \frac{3}{5}\left(\frac{1}{S} - \frac{S}{S^2+4S+5} + \frac{38}{S^2+4S+5}\right)$$

$$= \frac{3}{5}\left(\frac{1}{s} - \frac{s+2}{(s+2)^2+1} + 38 \cdot \frac{1}{(s+\underset{\alpha}{2})^2+\underset{\omega}{1}} \right) \rightleftharpoons \frac{3}{5}\left[1 - e^{-2t}\cos(t) + e^{-2t} + \cos(t) \right] \cdot \mathbb{1}(t)$$

ESERCIZI CAPITOLO 2

ES 2.1

$$F(S) = \frac{1}{1-e^{-S}} \qquad p = 1 - e^{-S} = 0 \rightarrow e^{-S} = 1 \sim\rightarrow e^{-(jw+\alpha)} = 1$$

?

$$e^{-\alpha} \cdot e^{-jw} = 1 \rightarrow e^{-\alpha} \cdot \cos(w) - j\sin(w) = 1 \rightarrow \alpha = -\ln \frac{1}{\cos(w) - j\sin(w)}$$

per $w = 2K\pi \quad \cos(w) = 1 \;, \sin(w) = 0$

$\Rightarrow \alpha = \pm j\, 2K\pi$ per $K = 1, 2, \dots, n$

ES. 2.2

$$\begin{cases} f(t) = 0 & t < 0 \\ f(t) = t \cdot e^{-3t} & t \geq 0 \end{cases} \sim\rightarrow \mathcal{L}(0) = 0$$

α

Siccome $\mathcal{L}\left[e^{-\alpha t} f(t)\right] = F(S+\alpha) \qquad \mathcal{L}[t] = 1/S^2$

$$\Rightarrow F(s) = \frac{1}{(S+3)^2}, \quad t \geq 0 \quad \text{Ans}$$

ES 2.3

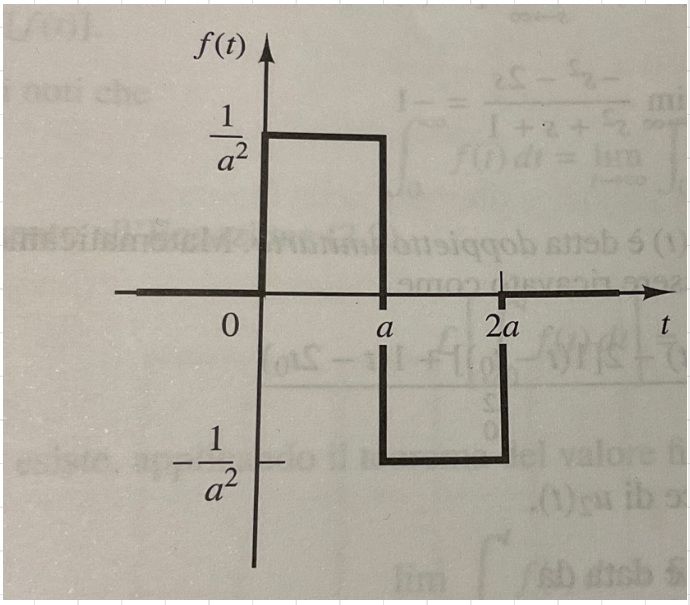
$$\begin{cases} f = 0 & t < 0 \\ f = \sin(wt+\alpha) & t \geq 0 \end{cases} \qquad \mathcal{L}\left[\sin(wt) \cdot 1\!\!1(t)\right] = \frac{w}{S^2 + w^2}$$

dalle formule di duplicazione: $\sin(wt+\alpha) = \underbrace{\sin(wt)}_{\mathcal{L}_1}\underbrace{\cos(\alpha)}_{K_1} + \underbrace{\sin(\alpha)}_{K_2}\underbrace{\cos(wt)}_{\mathcal{L}_2}$

$$\begin{cases} \sin(wt) = \dfrac{w}{S^2+w^2} \\ \cos(wt) = \dfrac{S}{S^2+w^2} \end{cases} \Rightarrow F(S) = \cos(\alpha)\frac{w}{S^2+w^2} + \sin(\alpha)\frac{S}{S^2+w^2}$$

$$= \frac{w\cos(\alpha) + S\sin(\alpha)}{S^2+w^2} \quad \text{Ans}$$

ES 2.4



$$\begin{cases} f(t) = 0 & t < 0 \\ f(t) = \frac{1}{a^2}\cdot 1\!\!1(t) & 0 < t \leq a \\ f(t) = -\frac{1}{a^2}\cdot 1\!\!1(t) & a < t \leq 2a \\ f(t) = 0 & t > 2a \end{cases}$$

Dobbiamo scriverla come SOMMA di segnali

$$\frac{1}{a^2} 1\!\!1(t) - \frac{2}{a^2}\cdot 1\!\!1(t-a) + \frac{1}{a^2} 1\!\!1(t-2a)$$

$$\Rightarrow F(s) = \frac{1}{sa^2} - \frac{2e^{-as}}{sa^2} + \frac{e^{-2as}}{sa^2}$$ Ans 1

Q_2: Valore limite $F(s)$ $a \to 0$

$$\lim_{a\to 0} F(s) = \lim_{a\to 0} \frac{1-2e^{-as}+e^{-2as}}{s a^2} \underset{\text{Hôpital } \frac{d}{da}}{=} \lim_{a\to 0} \frac{2se^{-as}-2se^{-2as}}{2sa}$$

$$= \lim_{a\to 0} \frac{e^{-as}-e^{-2as}}{a} \underset{\text{Hôp}}{=} \lim_{a\to 0} \frac{-s\cancel{e^{-as}} + 2s\cancel{e^{-2as}}}{1} \to -s+2s = s$$

($e^{-as} \to 1$, $e^{-2as} \to 1$)

Valore finale $\lim_{t\to\infty} f(t) = \lim_{s\to 0} s\,F(s)$

$$\to \lim_{s\to 0} \frac{1-2e^{-as}+e^{-2as}}{s a^2} \underset{\substack{\text{Hôp} \\ \frac{d}{ds}}}{=} \frac{+2a\cancel{e^{-as}} - 2a\cancel{e^{-2as}}}{a^2} \to 0$$ Valore finale

($e^{-as} \to 1$, $e^{-2as} \to 1$)

V.I.

$$\lim_{s\to\infty} \frac{1-2\cancel{e^{-as}}+\cancel{e^{-2as}}}{sa^2} \to \frac{1}{\infty} \to 0$$

($e^{-as} \to 0$, $e^{-2as} \to 0$)

Posso Applicare i Teoremi?

$$sF(s) = \frac{1-2e^{-as}+e^{-2as}}{a^2} = 0$$

per $2e^{-as} - e^{-2as} = 1$

$s \in \mathrm{Imm}$

II Teorema NON Vale!

ES 2.5

$F(s) = \dfrac{2s+1}{s^2+s+1}$ Q: V.I. di $\dfrac{d}{dt} f(t)$

$\mathcal{L}[\dot{f}(t)] = sF(s) - f(0)$ non conosciamo $f(t)$ → Non posso calcolare $f(0)$

→ Uso il T.V.I $\lim_{t \to 0} f(t) = \lim_{s \to \infty} s \cdot F(s) = \lim_{s \to \infty} \dfrac{2s^2+s}{s^2+s+1} = \lim \dfrac{\cancel{s^2}(2+\cancel{\frac{1}{s}})}{\cancel{s^2}(1+\cancel{\frac{1}{s}}+\cancel{\frac{1}{s^2}})} = 2$ ⇒ $f(0^+) = 2$

⇒ $\mathcal{L}[\dot{f}(t)] = \dfrac{2s^2+s}{s^2+s+1} - 2 = \dfrac{\cancel{2s^2}+s-\cancel{2s^2}-2s-2}{s^2+s+1} = -\dfrac{s+2}{s^2+s+1}$

⇒ $\dfrac{d}{dt} f(0^+) = \lim_{s \to \infty} -s \dfrac{s+2}{s^2+s+1} = -\dfrac{\cancel{s^2}(1+\cancel{\frac{2}{s}})}{\cancel{s^2}(1+0+0)}$ → -1 V.I di $\dot{f}(t)$