SISTEMAS DE CONTROLO - FORMULÁRIO

Transformadas de Laplace retiradas de Richard C. Dorf and Robert H. Bishop, Modern Control Systems, 7ª ed., Addison Wesley, 1995.

$F(s)$	$f(t),\ t \geq 0$
1. 1	$\delta(t_0)$, unit impulse at $t = t_0$
2. $1/s$	1, unit step
3. $\dfrac{n!}{s^{n+1}}$	t^n
4. $\dfrac{1}{(s+a)}$	e^{-at}
5. $\dfrac{1}{(s+a)^n}$	$\dfrac{1}{(n-1)!} t^{n-1} e^{-at}$
6. $\dfrac{a}{s(s+a)}$	$1 - e^{-at}$
7. $\dfrac{1}{(s+a)(s+b)}$	$\dfrac{1}{(b-a)}(e^{-at} - e^{-bt})$
8. $\dfrac{s+\alpha}{(s+a)(s+b)}$	$\dfrac{1}{(b-a)}[(\alpha - a)e^{-at} - (\alpha - b)e^{-bt}]$
9. $\dfrac{ab}{s(s+a)(s+b)}$	$1 - \dfrac{b}{(b-a)} e^{-at} + \dfrac{a}{(b-a)} e^{-bt}$
10. $\dfrac{1}{(s+a)(s+b)(s+c)}$	$\dfrac{e^{-at}}{(b-a)(c-a)} + \dfrac{e^{-bt}}{(c-a)(a-b)} + \dfrac{e^{-ct}}{(a-c)(b-c)}$
11. $\dfrac{s+\alpha}{(s+a)(s+b)(s+c)}$	$\dfrac{(\alpha - a)e^{-at}}{(b-a)(c-a)} + \dfrac{(\alpha - b)e^{-bt}}{(c-b)(a-b)} + \dfrac{(\alpha - c)e^{-ct}}{(a-c)(b-c)}$
12. $\dfrac{ab(s+\alpha)}{s(s+a)(s+b)}$	$\alpha - \dfrac{b(\alpha - a)}{(b-a)} e^{-at} + \dfrac{a(\alpha - b)}{(b-a)} e^{-bt}$
13. $\dfrac{\omega}{s^2 + \omega^2}$	$\sin \omega t$
14. $\dfrac{s}{s^2 + \omega^2}$	$\cos \omega t$
15. $\dfrac{s+\alpha}{s^2 + \omega^2}$	$\dfrac{\sqrt{\alpha^2 + \omega^2}}{\omega} \sin(\omega t + \phi),\ \phi = \tan^{-1} \omega/\alpha$

16. $\dfrac{\omega}{(s+a)^2+\omega^2}$	$e^{-at}\sin\omega t$
17. $\dfrac{(s+a)}{(s+a)^2+\omega^2}$	$e^{-at}\cos\omega t$
18. $\dfrac{s+\alpha}{(s+a)^2+\omega^2}$	$\dfrac{1}{\omega}[(\alpha-a)^2+\omega^2]^{1/2}\, e^{-at}\sin(\omega t+\phi)$, $\phi=\tan^{-1}\dfrac{\omega}{\alpha-a}$
19. $\dfrac{\omega_n^2}{s^2+2\zeta\omega_n s+\omega_n^2}$	$\dfrac{\omega_n}{\sqrt{1-\zeta^2}}\, e^{-\zeta\omega_n t}\sin\omega_n\sqrt{1-\zeta^2}\, t,\quad \zeta<1$
20. $\dfrac{1}{s[(s+a)^2+\omega^2]}$	$\dfrac{1}{a^2+\omega^2}+\dfrac{1}{\omega\sqrt{a^2+\omega^2}}\, e^{-at}\sin(\omega t-\phi)$, $\phi=\tan^{-1}\omega/-a$
21. $\dfrac{\omega_n^2}{s(s^2+2\zeta\omega_n s+\omega_n^2)}$	$1-\dfrac{1}{\sqrt{1-\zeta^2}}\, e^{-\zeta\omega_n t}\sin(\omega_n\sqrt{1-\zeta^2}\, t+\phi)$, $\phi=\cos^{-1}\zeta,\ \zeta<1$
22. $\dfrac{(s+\alpha)}{s[(s+a)^2+\omega^2]}$	$\dfrac{\alpha}{a^2+\omega^2}+\dfrac{1}{\omega}\left[\dfrac{(\alpha-a)^2+\omega^2}{a^2+\omega^2}\right]^{1/2} e^{-at}\sin(\omega t+\phi)$, $\phi=\tan^{-1}\dfrac{\omega}{\alpha-a}-\tan^{-1}\dfrac{\omega}{-a}$
23. $\dfrac{1}{(s+c)[(s+a)^2+\omega^2]}$	$\dfrac{e^{-ct}}{(c-a)^2+\omega^2}+\dfrac{e^{-at}\sin(\omega t+\phi)}{\omega[(c-a)^2+\omega^2]^{1/2}}$, $\phi=\tan^{-1}\dfrac{\omega}{c-a}$

Parâmetros dum sistema de 2ª ordem:

$$G(s)=\frac{\omega_n^2}{s^2+2\zeta\omega_n s+\omega_n^2}$$

Sobreelevação S(%): $S(\%)=100e^{-\frac{\zeta\pi}{\sqrt{1-\zeta^2}}}$

Tempo de pico Tp: $T_p=\dfrac{\pi}{\omega_n\sqrt{1-\zeta^2}}$

Tempo de estabelecimento Ts: $T_s=\dfrac{3}{\zeta\omega_n}$