Table 12.1 LAPLACE TRANSFORM PAIRS

Item Number	$f(t)$	$\mathcal{L}[f(t)] = F(s)$
1	$K\delta(t)$	K
2	$Ku(t)$ or K	K/s
3	$r(t)$	$1/s^2$
4	$t^n u(t)$	$\frac{n!}{s^{n+1}}$
5	$e^{-at}u(t)$	$1/(s+a)$
6	$te^{-at}u(t)$	$1/(s+a)^2$
7	$t^n e^{-at}u(t)$	$\frac{n!}{(s+a)^{n+1}}$
8	$\sin(\omega t)u(t)$	$\frac{\omega}{s^2+\omega^2}$
9	$\cos(\omega t)u(t)$	$\frac{s}{s^2+\omega^2}$
10	$e^{-at}\sin(\omega t)u(t)$	$\frac{\omega}{(s+a)^2+\omega^2}$
11	$e^{-at}\cos(\omega t)u(t)$	$\frac{(s+a)}{(s+a)^2+\omega^2}$
12	$t\sin(\omega t)u(t)$	$\frac{2\omega s}{(s^2+\omega^2)^2}$
13	$t\cos(\omega t)u(t)$	$\frac{s^2-\omega^2}{(s^2+\omega^2)^2}$
14	$\sin(\omega t+\phi)u(t)$	$\frac{s\sin(\phi)+\omega\cos(\phi)}{s^2+\omega^2}$
15	$\cos(\omega t+\phi)u(t)$	$\frac{s\cos(\phi)-\omega\sin(\phi)}{s^2+\omega^2}$
16	$e^{-at}[\sin(\omega t)-\omega t\cos(\omega t)]u(t)$	$\frac{2\omega^3}{[(s+a)^2+\omega^2]^2}$

17	$te^{-at}\sin(\omega t)u(t)$	$2\omega\dfrac{s+a}{[(s+a)^2+\omega^2]^2}$
18	$e^{-at}\left[C_1\cos(\omega t)+\left(\dfrac{C_2-C_1a}{\omega}\right)\sin(\omega t)\right]u(t)$	$\dfrac{C_1s+C_2}{(s+a)^2+\omega^2}$

Table 12.2 LAPLACE TRANSFORM PROPERTIES

Property	Transform Pair
Linearity	$\mathcal{L}[a_1f_1(t) + a_2f_2(t)] = a_1F_1(s) + a_2F_2(s)$
Time Shift	$\mathcal{L}[f(t-T)u(t-T)] = e^{-sT}F(s),\ T > 0$
Multiplication by t	$\mathcal{L}[tf(t)u(t)] = -\dfrac{d}{ds}F(s)$
Multiplication by t^n	$\mathrm{L}[t^n f(t)] = (-1)^n \dfrac{d^nF(s)}{ds^n}$
Frequency Shift	$\mathcal{L}[e^{-at}f(t)] = F(s+a)$
Time Differentiation	$\mathcal{L}\left[\dfrac{d}{dt}f(t)\right] = sF(s) - f(0^-)$
Second-Order Differentiation	$\mathrm{L}\left[\dfrac{d^2f(t)}{dt^2}\right] = s^2F(s) - sf(0^-) - f^{(1)}(0^-)$
nth-Order Differentiation	$\mathrm{L}\left[\dfrac{d^nf(t)}{dt^n}\right] = s^nF(s) - s^{n-1}f(0^-) - s^{n-2}f^{(1)}(0^-)$ $-\ldots - f^{(n-1)}(0^-)$
Time Integration	(i) $\mathrm{L}\left[\int_{-\infty}^{t} f(q)dq\right] = \dfrac{F(s)}{s} + \dfrac{\int_{-\infty}^{0^-} f(q)dq}{s}$ (ii) $\mathrm{L}\left[\int_{0^-}^{t} f(q)dq\right] = \dfrac{F(s)}{s}$
Time/Frequency Scaling	$\mathcal{L}[f(at)] = \dfrac{1}{a}F\left(\dfrac{s}{a}\right)$