**TABLE 6.2.1** Elementary Laplace Transforms

| $f(t) = \mathcal{L}^{-1}\{F(s)\}$ | $F(s) = \mathcal{L}\{f(t)\}$ | Notes |
|---|---|---|
| 1. $1$ | $\dfrac{1}{s}, \quad s > 0$ | Sec. 6.1; Ex. 4 |
| 2. $e^{at}$ | $\dfrac{1}{s-a}, \quad s > a$ | Sec. 6.1; Ex. 5 |
| 3. $t^n; \quad n = \text{positive integer}$ | $\dfrac{n!}{s^{n+1}}, \quad s > 0$ | Sec. 6.1; Prob. 27 |
| 4. $t^p, \; p > -1$ | $\dfrac{\Gamma(p+1)}{s^{p+1}}, \quad s > 0$ | Sec. 6.1; Prob. 27 |
| 5. $\sin at$ | $\dfrac{a}{s^2+a^2}, \quad s > 0$ | Sec. 6.1; Ex. 6 |
| 6. $\cos at$ | $\dfrac{s}{s^2+a^2}, \quad s > 0$ | Sec. 6.1; Prob. 6 |
| 7. $\sinh at$ | $\dfrac{a}{s^2-a^2}, \quad s > |a|$ | Sec. 6.1; Prob. 8 |
| 8. $\cosh at$ | $\dfrac{s}{s^2-a^2}, \quad s > |a|$ | Sec. 6.1; Prob. 7 |
| 9. $e^{at}\sin bt$ | $\dfrac{b}{(s-a)^2+b^2}, \quad s > a$ | Sec. 6.1; Prob. 13 |
| 10. $e^{at}\cos bt$ | $\dfrac{s-a}{(s-a)^2+b^2}, \quad s > a$ | Sec. 6.1; Prob. 14 |
| 11. $t^n e^{at}, \; n = \text{positive integer}$ | $\dfrac{n!}{(s-a)^{n+1}}, \quad s > a$ | Sec. 6.1; Prob. 18 |
| 12. $u_c(t)$ | $\dfrac{e^{-cs}}{s}, \quad s > 0$ | Sec. 6.3 |
| 13. $u_c(t)f(t-c)$ | $e^{-cs}F(s)$ | Sec. 6.3 |
| 14. $e^{ct}f(t)$ | $F(s-c)$ | Sec. 6.3 |
| 15. $f(ct)$ | $\dfrac{1}{c}F\left(\dfrac{s}{c}\right), \quad c > 0$ | Sec. 6.3; Prob. 19 |
| 16. $\displaystyle\int_0^t f(t-\tau)g(\tau)\,d\tau$ | $F(s)G(s)$ | Sec. 6.6 |
| 17. $\delta(t-c)$ | $e^{-cs}$ | Sec. 6.5 |
| 18. $f^{(n)}(t)$ | $s^n F(s) - s^{n-1}f(0) - \cdots - f^{(n-1)}(0)$ | Sec. 6.2 |
| 19. $(-t)^n f(t)$ | $F^{(n)}(s)$ | Sec. 6.2; Prob. 28 |

| f(t), t ≧ 0 | F(s) | ROC |
|---|---|---|
| 1. $\delta(t)$ | $1$ | All $s$ |
| 2. $u(t)$ | $\dfrac{1}{s}$ | $\text{Re}(s) > 0$ |
| 3. $t$ | $\dfrac{1}{s^2}$ | $\text{Re}(s) > 0$ |
| 4. $t^n$ | $\dfrac{n!}{s^{n+1}}$ | $\text{Re}(s) > 0$ |
| 5. $e^{-at}$ | $\dfrac{1}{s + a}$ | $\text{Re}(s) > -a$ |
| 6. $te^{-at}$ | $\dfrac{1}{(s + a)^2}$ | $\text{Re}(s) > -a$ |
| 7. $t^n e^{-at}$ | $\dfrac{n!}{(s + a)^{n+1}}$ | $\text{Re}(s) > -a$ |
| 8. $\sin bt$ | $\dfrac{b}{s^2 + b^2}$ | $\text{Re}(s) > 0$ |
| 9. $\cos bt$ | $\dfrac{s}{s^2 + b^2}$ | $\text{Re}(s) > 0$ |
| 10. $e^{-at} \sin bt$ | $\dfrac{b}{(s + a)^2 + b^2}$ | $\text{Re}(s) > -a$ |
| 11. $e^{-at} \cos bt$ | $\dfrac{s + a}{(s + a)^2 + b^2}$ | $\text{Re}(s) > -a$ |
| 12. $t \sin bt$ | $\dfrac{2bs}{(s^2 + b^2)^2}$ | $\text{Re}(s) > 0$ |
| 13. $t \cos bt$ | $\dfrac{s^2 - b^2}{(s^2 + b^2)^2}$ | $\text{Re}(s) > 0$ |