Refer to the notes at the end of the Table

FUNCTION-TRANSFORM PAIRS

No.	$F(s)$	$f(t),\ t \geq 0$
1	1	$\delta(t)$
2	$\dfrac{1}{s}$	$U(t)$
3	$\dfrac{1}{s^n}\ (n = 1, 2, 3, \ldots)$	$\dfrac{t^{n-1}}{(n-1)!}$
4	$\dfrac{1}{s+a}$	ϵ^{-at}
5	$\dfrac{1}{(s+a)(s+b)}$	$\dfrac{1}{b-a}(\epsilon^{-at} - \epsilon^{-bt})$
6	$\dfrac{s}{(s+a)(s+b)}$	$\dfrac{1}{a-b}(a\epsilon^{-at} - b\epsilon^{-bt})$
7	$\dfrac{1}{(s+a)(s+b)(s+c)}$	$\dfrac{\epsilon^{-at}}{(b-a)(c-a)} + \dfrac{\epsilon^{-bt}}{(a-b)(c-b)} + \dfrac{\epsilon^{-ct}}{(a-c)(b-c)}$
8	$\dfrac{s}{(s+a)(s+b)(s+c)}$	$-\dfrac{a\epsilon^{-at}}{(b-a)(c-a)} - \dfrac{b\epsilon^{-bt}}{(a-b)(c-b)} - \dfrac{c\epsilon^{-ct}}{(a-c)(b-c)}$
9	$\dfrac{s^2}{(s+a)(s+b)(s+c)}$	$\dfrac{a^2\epsilon^{-at}}{(b-a)(c-a)} + \dfrac{b^2\epsilon^{-bt}}{(a-b)(c-b)} + \dfrac{c^2\epsilon^{-ct}}{(a-c)(b-c)}$
10	$\dfrac{1}{(s+a)^2}$	$t\epsilon^{-at}$
11	$\dfrac{s}{(s+a)^2}$	$(1 - at)\epsilon^{-at}$
12	$\dfrac{1}{(s+a)(s+b)^2}$	$\dfrac{1}{(a-b)^2}\epsilon^{-at} + \dfrac{(a-b)t - 1}{(a-b)^2}\epsilon^{-bt}$
13	$\dfrac{s}{(s+a)(s+b)^2}$	$-\dfrac{a}{(a-b)^2}\epsilon^{-at} - \dfrac{b(a-b)t - a}{(a-b)^2}\epsilon^{-bt}$
14	$\dfrac{s^2}{(s+a)(s+b)^2}$	$\dfrac{a^2}{(a-b)^2}\epsilon^{-at} + \dfrac{b^2(a-b)t + b^2 - 2ab}{(a-b)^2}\epsilon^{-bt}$

15	$\frac{1}{(s+a)^n}$	$\frac{1}{(n-1)!} t^{n-1} \epsilon^{-at}$
16	$\frac{1}{s^2+a^2}$	$\frac{1}{a} \sin at$
17	$\frac{s}{s^2+a^2}$	$\cos at$
18	$\frac{1}{s^2-a^2}$	$\frac{1}{a} \sinh at$
19	$\frac{s}{s^2-a^2}$	$\cosh at$
20	$\frac{1}{s(s^2+a^2)}$	$\frac{1}{a^2}(1-\cos at)$
21	$\frac{1}{s^2(s^2+a^2)}$	$\frac{1}{a^3}(at-\sin at)$
22	$\frac{1}{(s+a)(s^2+b^2)}$	$\frac{1}{a^2+b^2} \left[\epsilon^{-at}+\frac{1}{b}\sqrt{a^2+b^2}\sin(bt-\theta)\right],$ $\theta=\tan^{-1}\left(\frac{b}{a}\right)$
23	$\frac{s}{(s+a)(s^2+b^2)}$	$-\frac{a}{a^2+b^2} \left[\epsilon^{-at}-\frac{1}{a}\sqrt{a^2+b^2}\sin(bt+\theta)\right],$ $\theta=\tan^{-1}\left(\frac{a}{b}\right)$
24	$\frac{s^2}{(s+a)(s^2+b^2)}$	$\frac{a^2}{a^2+b^2} \left[\epsilon^{-at}-\frac{b}{a^2}\sqrt{a^2+b^2}\sin(bt-\theta)\right],$ $\theta=\tan^{-1}\left(\frac{b}{a}\right)$
25	$\frac{1}{s[(s+a)^2+b^2]}$	$\frac{1}{a^2+b^2} \left[1-\frac{1}{b}\sqrt{a^2+b^2}\,\epsilon^{-at}\sin(bt+\theta)\right],$ $\theta=\tan^{-1}\left(\frac{b}{a}\right)$

26	$\dfrac{1}{s^2[(s+a)^2+b^2]}$	$\dfrac{1}{a^2+b^2}\left[t-\dfrac{2a}{a^2+b^2}+\dfrac{1}{b}\,\epsilon^{-at}\sin(bt+\theta)\right],\ \theta = 2\tan^{-1}\left(\dfrac{b}{a}\right)$
27	$\dfrac{s}{(s^2+a^2)(s^2+b^2)}$	$\dfrac{1}{b^2-a^2}(\cos at - \cos bt)$
28	$\dfrac{1}{(s^2+a^2)^2}$	$\dfrac{1}{2a^3}(\sin at - at\cos at)$
29	$\dfrac{s}{(s^2+a^2)^2}$	$\dfrac{t}{2a}\sin at$
30	$\dfrac{s^2}{(s^2+a^2)^2}$	$\dfrac{1}{2a}(\sin at + at\cos at)$
31	$\dfrac{s^2-a^2}{(s^2+a^2)^2}$	$t\cos at$
32	$\dfrac{1}{s(s^2+a^2)^2}$	$\dfrac{1}{a^4}(1-\cos at) - \dfrac{1}{2a^3}t\sin at$
33	$\dfrac{4a^3}{s^4+4a^4}$	$\sin at\cosh at - \cos at\sinh at$
34	$\dfrac{s}{s^4+4a^4}$	$\dfrac{1}{2a^2}\sin at\sinh at$
35	$\dfrac{1}{s^4-a^4}$	$\dfrac{1}{2a^3}(\sinh at - \sin at)$
36	$\dfrac{s}{s^4-a^4}$	$\dfrac{1}{2a^2}(\cosh at - \cos at)$
37	$\dfrac{s^2}{s^4-a^4}$	$\dfrac{1}{2a}(\sinh at + \sin at)$
38	$\dfrac{s^3}{s^4-a^4}$	$\dfrac{1}{2}(\cosh at + \cos at)$

Note 1: One can generate pairs in the table (or not in the Table) from some pairs in the Table. For example, we can generate Pair 10 from Pair 5 by taking the limit as parameter b approaches parameter a.

$$\frac{1}{(s+a)(s+b)} \leftrightarrow \frac{1}{b-a}(e^{-at}-e^{-bt})$$

$$\lim_{b\to a}\frac{1}{(s+a)(s+b)} = \frac{1}{(s+a)^2} \leftrightarrow \lim_{b\to a}\frac{1}{b-a}(e^{-at}-e^{-bt}) = \frac{0}{0}$$

Employ L'Hospital Rule:

$$\lim_{b\to a}\frac{1}{b-a}(e^{-at}-e^{-bt})=\lim_{b\to a}\frac{\frac{d}{db}(e^{-at}-e^{-bt})}{\frac{d}{db}(b-a)}=\lim_{b\to a}te^{-bt}=te^{-at}$$

Resulting in Pair 10:

$$\frac{1}{(s+a)^2}\leftrightarrow te^{-at}$$

Note 2: The transform of the rational function $\frac{s+a_0}{(s+a)^2}$ is not in the Table. We may rewrite this function as

$$\frac{s+a_0}{(s+a)^2}=\frac{s}{(s+a)^2}+\frac{a_0}{(s+a)^2}$$

and take advantage of the linearity and scaling of the s-operator along with Pairs 10 & 11 and write

$$\frac{s}{(s+a)^2}+\frac{a_0}{(s+a)^2}\leftrightarrow(1-at)e^{-at}+a_o te^{-at}=[(a_0-a)t+1]e^{-at}$$

Resulting in the new Pair

$$\frac{s+a_0}{(s+a)^2}\leftrightarrow[(a_0-a)t+1]e^{-at}$$

[All time-domain functions must be multiplied by the unit-step function $u(t)$]