5-1. (1) $1 \longleftrightarrow \frac{1}{s}$, $e^{-t} \longleftrightarrow \frac{1}{s+1}$

$\therefore 1-e^{-t} \longleftrightarrow \frac{1}{s} - \frac{1}{s+1} = \frac{1}{s(s+1)}$, $Re[s]>0$

(3) $\sin t \longleftrightarrow \frac{1}{s^2+1}$, $\cos t \longleftrightarrow \frac{s}{s^2+1}$

$\therefore 3\sin t + 2\cos t \longleftrightarrow \frac{2s+3}{s^2+1}$, $Re[s]>0$

(8) $\delta(t) \longleftrightarrow 1$, $Re[s]>-\infty$, $e^{-t} \longleftrightarrow \frac{1}{s+1}$, $Re[s]>-1$

$\therefore 2\delta(t) - e^{-t} \longleftrightarrow \frac{2s+1}{s+1}$, $Re[s]>-1$

5.2 (a) 由图，$f(t) = g_3(t-\frac{3}{2}) + g_1(t-\frac{3}{2})$

$\because g_\tau(t-\frac{\tau}{2}) \longleftrightarrow \frac{1-e^{-s\tau}}{s}$

$\therefore f(t) \longleftrightarrow \frac{1-e^{-3s}}{s} + \frac{(1-e^{-s})e^{-s}}{s} = \frac{1-e^{-3s}-e^{-2s}-e^{-s}}{s}$, $Re[s]>-\infty$

(f) $\because \sin(\pi t)\varepsilon(t) \longleftrightarrow \frac{\pi}{s^2+\pi^2}$

$f(t) = \sin(\pi t)[\varepsilon(t) - \varepsilon(t-1)] = \sin(\pi t)\varepsilon(t) + \sin[\pi(t-1)]\varepsilon(t-1)$

$\therefore f(t) \longleftrightarrow \frac{\pi}{s^2+\pi^2} + \frac{\pi e^{-s}}{s^2+\pi^2} = \frac{\pi+\pi e^{-s}}{s^2+\pi^2}$, $Re[s]>0$

5.3

(1) $e^{-t}\varepsilon(t) \longleftrightarrow \frac{1}{s+1}$ $\quad e^{-(t-2)}\varepsilon(t-2) \longleftrightarrow e^{-2s}\cdot\frac{1}{s+1}$

$\therefore e^{-t}\varepsilon(t) - e^{-(t-2)}\varepsilon(t-2) \longleftrightarrow \frac{1}{s+1}(1-e^{-2s})$

(3) $\sin(\pi t)\varepsilon(t) \longleftrightarrow \frac{\pi}{s^2+\pi^2}$

$\sin(\pi t)[\varepsilon(t) - \varepsilon(t-1)] = \sin(\pi t)\varepsilon(t) + \sin[\pi(t-1)]\varepsilon(t-1)$

$\longleftrightarrow \frac{\pi}{s^2+\pi^2} + \frac{\pi}{s^2+\pi^2}e^{-s} = \frac{\pi(1+e^{-s})}{s^2+\pi^2}$

(5) $\delta(4t-2) \longleftrightarrow \frac{1}{4}e^{-\frac{1}{2}s}$

(7) $\sin(2t-\frac{\pi}{4})\varepsilon(t) = \frac{\sqrt{2}}{2}\sin(2t)\varepsilon(t) - \frac{\sqrt{2}}{2}\cos(2t)\varepsilon(t)$

$\because \sin(2t)\varepsilon(t) \longleftrightarrow \frac{2}{s^2+4}$, $\cos(2t)\varepsilon(t) \longleftrightarrow \frac{s}{s^2+4}$

$\therefore \sin(2t-\frac{\pi}{4})\varepsilon(t) \longleftrightarrow \frac{\sqrt{2}}{2}\left(\frac{2}{s^2+4} - \frac{s}{s^2+4}\right)$

(9) $\sin(\pi t) \longleftrightarrow \frac{\pi}{s^2+\pi^2}$ $\quad \therefore \int_0^t \sin(\pi x)dx \longleftrightarrow \frac{\pi}{s(s^2+\pi^2)}$

(11)

$\sin(\pi t)\varepsilon(t) \longleftrightarrow \frac{\pi}{s^2+\pi^2}$ $\quad \therefore \frac{d^2}{dt^2}[\sin(\pi t)\varepsilon(t)] \longleftrightarrow \frac{\pi s^2}{s^2+\pi^2}$

13. $\because (-t)^2\varepsilon(t) \longleftrightarrow \frac{d^2}{ds^2}\left(\frac{1}{s}\right) = \frac{2}{s^3}$

$\therefore t^2 e^{-2t}\varepsilon(t) \longleftrightarrow \frac{2}{(s+2)^3}$

15. $te^{-(t-3)}\varepsilon(t-1) = e^2 t e^{-(t-1)}\varepsilon(t-1)$

而 $e^{-(t-1)}\varepsilon(t-1) \longleftrightarrow \frac{1}{s+1}e^{-s}$

则：$e^2 t e^{-(t-1)}\varepsilon(t-1) \longleftrightarrow e^2\left[-\frac{d}{ds}\left(\frac{e^{-s}}{s+1}\right)\right] = \frac{s+2}{(s+1)^2}e^{-(s-2)}$

5.4(2) $f(t-1) \longleftrightarrow F(s)e^{-s} = \frac{e^{-s}}{s^2-s+1}$

$f(2t-1) \longleftrightarrow \frac{1}{2}\cdot\frac{e^{-\frac{s}{2}}}{(\frac{s}{2})^2-\frac{s}{2}+1} = \frac{2e^{-\frac{s}{2}}}{s^2-2s+4}$

$e^{-3t}f(2t-1) \longleftrightarrow \frac{2e^{-\frac{s+3}{2}}}{s^2+4s+7}$

(4) 由(2)得：

$f(2t-1) \longleftrightarrow \frac{2e^{-\frac{s}{2}}}{s^2-2s+4}$

则 $tf(2t-1) \longleftrightarrow -\frac{d}{ds}\frac{2e^{-\frac{s}{2}}}{s^2-2s+4} = \frac{s(s+2)e^{-\frac{s}{2}}}{(s^2-2s+4)^2}$