Table 1: Fourier Transform Pairs

Time	**Frequency**
$x(t) = \frac{1}{2\pi}\int_{\mathbb{R}} X(\omega)e^{j\omega t}d\omega$	$X(\omega) = \int_{\mathbb{R}} x(t)e^{-j\omega t}dt$
1	$\delta(\omega)$
$\delta(t)$	1
$\sum_{n=-\infty}^{\infty} \delta\left(t - nT\right)$	$\frac{2\pi}{T}\sum_{n=-\infty}^{\infty} \delta\left(\omega - \frac{2\pi n}{T}\right)$
$e^{-t/\tau}u(t)$	$\frac{\tau}{1+j\omega\tau}$
$\frac{1}{\sqrt{2\pi\sigma^2}}\, e^{-t/2\sigma^2}$	$e^{-\sigma^2\omega^2/2}$

Table 2: Fourier Transform Rules

Time	**Frequency**
$y(t) = h(t) * x(t)$	$Y(\omega) = H(\omega)X(\omega)$
$y(t) = h(t)x(t)$	$Y(\omega) = H(\omega) * X(\omega)$
$x(t - t_o)$	$e^{-j\omega t_o}X(\omega)$
$e^{j\omega_o t}x(t)$	$X(\omega - \omega_o)$
$\frac{d}{dt}x(t)$	$j\omega X(\omega)$
$-jtx(t)$	$\frac{d}{d\omega}X(\omega)$
$\int_{\mathbb{R}} x(t)dt$	$H(\omega = 0)$

Table 3: z-transform Pairs

n	**z**
$x(t) = \frac{1}{2\pi j} \oint_{\mathcal{C}} X(z) z^{n-1} dz$	$X(z) = \sum_{n=-\infty}^{\infty} x[n] z^{-n}$
$\delta[n-N]$	z^{-N}
$u[n]$	$\frac{1}{1-z^{-1}}$
$p^n u[n]$	$\frac{1}{1-pz^{-1}}$
$(n+1)p^n u[n]$	$\frac{1}{(1-pz^{-1})^2}$

Table 4: z-transform Rules

n	**z**
$y[n] = h[n] * x[n]$	$Y(z) = H(z)X(z), \quad \text{ROC}_H \cap \text{ROC}_X$
$y[n] = h[n]x[n]$	$Y(z) = H(z) * X(z), \quad \text{ROC}_H \cap \text{ROC}_X$
$x[n-N]$	$z^{-N}X(z)$
$\sum_{n=-\infty}^{\infty} x[n]$	$X(z=1)$

Table 5: Miscellaneous

Description	**Expression**
Superposition	$x[n] = \sum_{k=-\infty}^{\infty} \delta[n-k]x[k]$
Convolution	$y[n] = \sum_{k=-\infty}^{\infty} h[n-k]x[k]$
Partial-Fraction Expansion	$K\,\frac{\prod_{i=1}^{N_P}(1-z_i\,z^{-1})}{\prod_{i=1}^{N_Q}(1-p_i\,z^{-1})} = \sum_{i=0}^{\#\text{direct terms}} D_i z^{-i}$
	$+\sum_{j=1}^{\#\text{non-degen poles}} \frac{A_j}{1-p_j\,z^{-1}} + \sum_{s=0}^{\#\text{degen order}} \frac{C_s}{(1-p_d\,z^{-1})^s}$
Moments of $h[n]$	$M_0 = H(\zeta=+1), \quad \zeta \equiv z^{-1}$
	$M_1 = \frac{d}{d\zeta}H(\zeta)\Big\vert_{\zeta=+1}$
	$M_2 - M_1 = \frac{d^2}{d\zeta^2}H(\zeta)\Big\vert_{\zeta=+1}$
Full width (FW) of $h[n]$	$\text{FW} \equiv 2\sqrt{M_2 - M_1^2}$

Table 6: Laplace Transform Pairs

t	**s**
$x(t) = \int_{\mathbb{R}} X(s)e^{st}ds$	$X(s) = \int_{\mathbb{R}} x(t)e^{-st}dt$
$\delta(t - t_o)$	e^{-st_o}
$u(t)$	$1/s$
$e^{-\alpha t}u(t)$	$\dfrac{1}{s+\alpha}$

Table 7: Laplace Transform Rules

t	**s**
$h(t) * x(t)$	$H(s)X(s)$
$x(t - t_o)$	$e^{-st_o}X(s)$
$x(-t)$	$X(-s)$
$M_k = \int_{\mathbb{R}} t^k x(t)dt$	$M_k = (-1)^k \dfrac{d^k}{ds^k} H(s)\Big\|_{s=0}$
Full width (FW) of $h(t)$	FW $\equiv 2\sqrt{M_2 - M_1^2}$