Euler's Formula and Trig. Identities

$$\begin{aligned}
e^{j\theta} &= \cos(\theta) + j\sin(\theta) \\
\cos(\theta) &= \frac{1}{2}[e^{j\theta} + e^{-j\theta}] \\
\sin(\theta) &= \frac{1}{2j}[e^{j\theta} - e^{-j\theta}] \\
\sin(\alpha+\beta) &= \sin(\alpha)\cos(\beta) + \cos(\alpha)\sin(\beta) \\
\cos(\alpha+\beta) &= \cos(\alpha)\cos(\beta) - \sin(\alpha)\sin(\beta) \\
\sin(\alpha)\sin(\beta) &= \frac{1}{2}\cos(\alpha-\beta) - \frac{1}{2}\cos(\alpha+\beta) \\
\cos(\alpha)\cos(\beta) &= \frac{1}{2}\cos(\alpha-\beta) + \frac{1}{2}\cos(\alpha+\beta) \\
\sin(\alpha)\cos(\beta) &= \frac{1}{2}\sin(\alpha+\beta) + \frac{1}{2}\sin(\alpha-\beta) \\
\sin^2(\alpha) &= \frac{1}{2}(1-\cos(2\alpha)) \\
\cos^2(\alpha) &= \frac{1}{2}(1+\cos(2\alpha))
\end{aligned}$$

Impulse Function Properties

$$\begin{aligned}
g(t)A\delta(t-t_0) &= g(t_0)A\delta(t-t_0) \\
g(t_0) &= \int_{-\infty}^{+\infty} g(t)\delta(t-t_0)\mathrm{d}t
\end{aligned}$$

Convolution

$$x(t) * h(t) = \int_{-\infty}^{+\infty} x(\tau)h(t-\tau)\mathrm{d}\tau$$

Power and Energy

$$\begin{aligned}
E_x &= \int_{-\infty}^{\infty} |x(t)|^2\mathrm{d}t \\
P_x &= \lim_{T\to\infty}\frac{1}{T}\int_{<T>} |x(t)|^2\mathrm{d}t
\end{aligned}$$

Continuous-Time Fourier Series and Parseval's Theorem

$$\begin{aligned}
x(t) &= \sum_{n=-\infty}^{\infty} \mathrm{x}_n e^{jn\omega_0 t} \\
\mathrm{x}_n &= \frac{1}{T_0}\int_{<T_0>} x(t)e^{-jn\omega_0 t}dt \\
P_x &= \sum_{n=-\infty}^{\infty} |\mathrm{x}_n|^2
\end{aligned}$$

Continuous-Time Fourier Transform and Parseval's Theorem

$$\begin{aligned}
X(\omega) &= \int_{-\infty}^{\infty} x(t)e^{-j\omega t}dt \\
x(t) &= \frac{1}{2\pi}\int_{-\infty}^{\infty} X(\omega)e^{j\omega t}d\omega \\
E_x &= \frac{1}{2\pi}\int_{-\infty}^{\infty} |X(\omega)|^2 d\omega
\end{aligned}$$

Continuous-Time Fourier Transform Pairs

$e^{j\omega_0 t}$	$2\pi\delta(\omega-\omega_0)$
$\cos(\omega_0 t)$	$\pi[\delta(\omega-\omega_0)+\delta(\omega+\omega_0)]$
$\sin(\omega_0 t)$	$j\pi[\delta(\omega+\omega_0)-\delta(\omega-\omega_0)]$
1	$2\pi\delta(\omega)$
$x(t) = \begin{cases} 1, & \lvert t\rvert < T \\ 0, & T \le \lvert t\rvert \end{cases}$	$\frac{2\sin(\omega T)}{\omega}$
$\frac{\sin(\omega_0 t)}{\pi t}$	$X(\omega) = \begin{cases} 1, & \lvert\omega\rvert < \omega_0 \\ 0, & \omega_0 \le \lvert\omega\rvert \end{cases}$
$\delta(t)$	1
$u(t)$	$\frac{1}{j\omega} + \pi\delta(\omega)$
$\delta(t-t_0)$	$e^{-j\omega t_0}$
$e^{-at}u(t),\ \Re\{a\} > 0$	$\frac{1}{a+j\omega}$
$te^{-at}u(t),\ \Re\{a\} > 0$	$\frac{1}{(a+j\omega)^2}$
$\sum_{n=-\infty}^{+\infty} \mathrm{x}_n e^{jn\omega_0 t}$	$2\pi\sum_{n=-\infty}^{+\infty} \mathrm{x}_n \delta(\omega - n\omega_0)$

Continuous-Time Fourier Transform Properties

$ax(t)+by(t)$	$aX(\omega)+bY(\omega)$
$x(t-t_0)$	$e^{-j\omega t_0}X(\omega)$
$e^{j\omega_0 t}x(t)$	$X(\omega-\omega_0)$
$x(-t)$	$X(-\omega)$
$x(at)$	$\frac{1}{\lvert a\rvert}X\left(\frac{\omega}{a}\right)$
$x(t)*y(t)$	$X(\omega)Y(\omega)$
$x(t)y(t)$	$\frac{1}{2\pi}X(\omega)*Y(\omega)$
$\frac{\mathrm{d}x(t)}{\mathrm{d}t}$	$j\omega X(\omega)$
$\int_{-\infty}^{t} x(\tau)\mathrm{d}\tau$	$\frac{1}{j\omega}X(\omega)+\pi X(0)\delta(\omega)$
$x(t)$ real	$X(\omega) = X^*(-\omega)$
$x(t)$ real and even	$X(\omega)$ real and even
$x(t)$ real and odd	$X(\omega)$ imaginary and odd
even{x(t)}	$\Re\{X(\omega)\}$
odd{x(t)}	$j\Im\{X(\omega)\}$