

Properties of Fourier Transforms

Property	$x(t), y(t)$	$X(j\omega), Y(j\omega)$
Linearity	$ax(t) + by(t)$	$aX(j\omega) + bY(j\omega)$
Time Shifting	$x(t - t_0)$	$e^{-j\omega t_0} X(j\omega)$
Frequency Shifting	$e^{j\omega_0 t} x(t)$	$X(j(\omega - \omega_0))$
Conjugation	$x^*(t)$	$X^*(-j\omega)$
Time Reversal	$x(-t)$	$X(-j\omega)$
Time and Frequency Scaling	$x(at)$	$\frac{1}{ a } X\left(\frac{j\omega}{a}\right)$
Convolution	$x(t) ** y(t)$	$X(j\omega)Y(j\omega)$
Multiplication	$x(t)y(t)$	$X(j\omega) ** Y(j\omega)$
Differentiation in Time	$\frac{d}{dt} x(t)$	$j\omega X(j\omega)$
Integration	$\int_{-\infty}^t x(t) dt$	$\frac{1}{j\omega} X(j\omega) + \pi X(0)\delta(\omega)$
Differentiation in Frequency	$tx(t)$	$j \frac{d}{d\omega} X(j\omega)$
Conjugate Symmetry for Real Signals	$x(t) \text{ is real}$	$\begin{cases} X(j\omega) = X^*(-j\omega) \\ \text{Re}\{X(j\omega)\} = \text{Re}\{X^*(j\omega)\} \\ \text{Im}\{X(j\omega)\} = -\text{Im}\{X(-j\omega)\} \\ X(j\omega) = X(-j\omega) \\ \angle X(j\omega) = -\angle X(-j\omega) \end{cases}$
Symmetry for Real and Even Signals	$x(t) \text{ is real and even}$	$X(j\omega) \text{ real and even}$
Symmetry for Real and Odd Signals	$x(t) \text{ is real and odd}$	$X(j\omega) \text{ purely imag and odd}$
Even-Odd Decomposition For Real Signals	$x_e(t) = \text{Ev}\{x(t)\} [x(t) \text{ real}]$ $x_o(t) = \text{Od}\{x(t)\} [x(t) \text{ real}]$	$\text{Re}\{X(j\omega)\}$ $j\text{Im}\{X(j\omega)\}$