ECE 3500: Fundamentals of Signals and Systems

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Fourier Transform Handout

Fourier Transform Pairs	
$x(t)$	$X(j\omega)$
$\delta(t)$	1
$e^{j\omega_0 t}$	$2\pi\delta(\omega - \omega_0)$
$\cos\omega_0 t$	$\pi[\delta(\omega - \omega_0) + \delta(\omega + \omega_0)]$
$\sin\omega_0 t$	$\dfrac{\pi}{j}[\delta(\omega - \omega_0) - \delta(\omega + \omega_0)]$
$u(t)$	$\pi\delta(\omega) + \dfrac{1}{j\omega}$
1	$2\pi\delta(\omega)$
$u(t)e^{at}$	$\dfrac{1}{j\omega - a}$
$u(t)te^{at}$	$\dfrac{1}{(j\omega - a)^2}$
$\displaystyle\sum_{n=-\infty}^{\infty} \delta(t - nT)$	$\dfrac{2\pi}{T}\displaystyle\sum_{k=-\infty}^{\infty} \delta\left(\omega - \dfrac{2\pi k}{T}\right)$
$\begin{cases} 1, |t| < T \\ 0, |t| > T \end{cases}$	$\dfrac{2\sin\omega T}{\omega}$
$\dfrac{\sin Wt}{\pi t}$	$\begin{cases} 1, |\omega| < W \\ 0, |\omega| > W \end{cases}$
e^{-at^2}	$\sqrt{\dfrac{\pi}{a}}e^{-\omega^2/4a}$

Fourier Transform Relations	
$x(t - \tau)$	$e^{-j\omega\tau} X(s)$
$x(t)e^{j\omega_0 t}$	$X(j(\omega - \omega_0))$
$x(at)$	$\dfrac{1}{|a|} X\left(\dfrac{j\omega}{a}\right)$
$\dfrac{d}{dt}x(t)$	$j\omega X(j\omega)$
$\displaystyle\int_{-\infty}^{t} x(\tau)d\tau$	$\dfrac{1}{j\omega}X(j\omega) + \pi\delta(\omega)X(0)$
$x_1(t) * x_2(t)$	$X_1(j\omega)X_2(j\omega)$
$x_1(t)x_2(t)$	$\dfrac{1}{2\pi}X_1(j\omega) * X_2(j\omega)$