

# ECE 3500: Fundamentals of Signals and Systems

Instructor: Samuel D. Bellows

## Discrete-Time Fourier Transform Handout

Discrete-Time Fourier Transform Pairs	
$x[n]$	$X(e^{j\omega}), \quad 0 \leq \omega < 2\pi$
$\delta[n]$	1
$e^{j\omega_0 n}$	$2\pi\delta(\omega - \omega_0)$
$\cos \omega_0 n$	$\pi[\delta(\omega - \omega_0) + \delta(\omega + \omega_0)]$
$\sin \omega_0 n$	$\frac{\pi}{j}[\delta(\omega - \omega_0) - \delta(\omega + \omega_0)]$
$u[n]$	$\pi\delta(\omega) + \frac{1}{1 - e^{-j\omega}}$
1	$2\pi\delta(\omega)$
$u[n]a^n,  a  < 1$	$\frac{1}{1 - ae^{-j\omega}}$
$\sum_{k=-\infty}^{\infty} \delta[n - kN]$	$\frac{2\pi}{N} \sum_{k=-\infty}^{\infty} \delta(\omega - \frac{2\pi k}{N})$
$\begin{cases} 1,  n  \leq N \\ 0,  n  > N \end{cases}$	$\frac{2 \sin(\omega N + 1/2)}{\sin(\omega/2)}$
$\frac{\sin Wn}{\pi n}$	$\begin{cases} 1, 0 \leq  \omega  \leq W \\ 0, W <  \omega  \leq \pi \end{cases}$
$x[n - n_0]$	$e^{-j\omega n_0} X(e^{j\omega})$
$x[n]e^{j\omega_0 n}$	$X(e^{j(\omega - \omega_0)})$
$x_1[n] * x_2[n]$	$X_1(e^{j\omega})X_2(e^{j\omega})$
$x_1[n]x_2[n]$	$\frac{1}{2\pi} \int_0^{2\pi} X_1(e^{j\omega})X_2(e^{j(\omega - \theta)})d\theta$