Formula Sheet for Signals and Systems

$cos^2(x) = \frac{1}{2}[1+\cos(2x)]$	$\sin^2(x) = \frac{1}{2}[1-\cos(2x)]$	$\sin(a+b)$ $= \sin(a)\cos(b)+\cos(a)\sin(b)$	$\frac{d}{dx}n = 0$	$\frac{d}{dx}\cos(x) = \sin(x)$
$e^{ix} = \cos(x) + i\ sin(x)$	$e^x = \cosh(x) + sinh(x)$	$\cos(a+b)$ $= \cos(a)\cos(b)-\sin(a)\sin(b)$	$\frac{d}{dx}x = 1$	$\frac{d}{dx}\sin(x) = cos(x)$
$\cos(x) = \frac{1}{2}(e^{ix}+e^{-ix})$	$\sin(x) = \frac{1}{2i}(e^{ix}-e^{-ix})$	$\sin(x) = x - \frac{x^3}{3!} + \frac{x^5}{5!} - \frac{x^7}{7!} + \cdots$	$\frac{d}{dx}x^n = nx^{n-1}$	$\frac{d}{dx}\cos(x) = -\sin(x)$
$\cosh(x) = \frac{1}{2}(e^{-x}+e^{x})$	$\sinh(x) = \frac{1}{2}(e^{x}-e^{-x})$	$\cos(x) = 1 - \frac{x^2}{2!} + \frac{x^4}{4!} - \frac{x^6}{6!} + \cdots$	$\frac{d}{dx}e^x = e^x$	$\frac{d}{dx}\tan(x) = sec^2(x)$
$\tan(x) = \sin(x)/\cos(x)$	$\cot(x) = 1/tan(x)$	$\tanh(x) = \frac{\sinh(x)}{\cosh(x)} = \frac{e^x - e^{-x}}{e^{-x}+e^x}$	$\frac{d}{dx}\ln x = \frac{1}{x}$	$\frac{d}{dx}\cot(x) = csc^2(x)$
$cos(2x) = 2(\cos x)^2 - 1$ $= 1 - 2(\sin x)^2$	$\sin(2x) = 2\sin(x)\cos(x)$	$\coth(x) = \frac{\sinh(x)}{\cosh(x)} = \frac{e^{-x}+e^x}{e^x - e^{-x}}$	$\frac{d}{dx}n^x = n^x \ln x$	$\frac{d}{dx}\arcsin(x) = \frac{1}{\sqrt{1-x^2}}$
$\sin(w_1 t) + \sin(w_2 t) = 2\sin\left(\frac{w_1+w_2}{2}t\right)\cos\left(\frac{w_1-w_2}{2}t\right) = \pm\sqrt{2+2\cos((w_1-w_2)t)}\sin\left(\frac{w_1+w_2}{2}t\right)$				$\frac{d}{dx}\arccos(x) = -\frac{1}{\sqrt{1-x^2}}$
$\sec(x) = 1/\cos(x)$	$\text{cosec}(x) = 1/\sin(x)$	$\frac{d}{dx}\text{arcsec}(x) = \frac{1}{x\sqrt{x^2-1}}$	$e^{-1} = 0.37$	$\frac{d}{dx}\arctan(x) = \frac{1}{1+x^2}$
$\text{sech}(x) = 1/\cosh(x)$	$cosech(x) = 1/\sinh(x)$	$\frac{d}{dx}\text{arccsc}(x) = -\frac{1}{x\sqrt{x^2-1}}$		$\frac{d}{dx}\text{arccot}(x) = -\frac{1}{1+x^2}$
$(cosx)^2 + (sinx)^2 = 1$	$\cos(2x) = (\cos x)^2 - (\sin x)^2$	$P = \frac{1}{T}\int_0^T \lvert x(t)\rvert^2\,dt$	$E = \int_0^T \lvert x(t)\rvert^2\,dt$	$E = \sum_{n=-N}^{N} \lvert x[n]\rvert^2$
$x_e(t) = \frac{1}{2}\{x(t)+x(-t)\}$	$x_o(t) = \frac{1}{2}\{x(t)-x(-t)\}$	$P = \lim_{N\to\infty}\frac{1}{2N+1}\sum_{n=-N}^{N}\lvert x[n]\rvert^2$	$e^{-jk\pi} = (-1)^k$	$y[n] = \sum_{k=-\infty}^{\infty} x[k]h[n-k]$
$x_e[n] = \frac{1}{2}\{x[n]+x[-n]\}$	$x_o[n] = \frac{1}{2}\{x[n]-x[-n]\}$			$y(t) = \int_{-\infty}^{\infty} x(\tau)h(t-\tau)d\tau$

$x(at) \leftrightarrow \frac{1}{\lvert a\rvert}X\left(\frac{jw}{a}\right)$	$\frac{d}{dt}x(t) \leftrightarrow jwX(jw)$	$-jtx(t) \leftrightarrow \frac{d}{dw}X(jw)$	$x[n-n_0] \overset{DTFT}{\longleftrightarrow} e^{-j\Omega n_0}X(e^{-j\Omega})$	$x(t-t_0) \overset{FT}{\longleftrightarrow} e^{-jwt_0}X(jw)$
$x(at) \leftrightarrow \frac{1}{\lvert a\rvert}X\left(\frac{jw}{a}\right)$		$\int_{-\infty}^{\tau} x(\tau)\,d\tau = \frac{1}{jw}X(jw)$	$x[n-n_0] \overset{DTFS}{\longleftrightarrow} e^{-jk\Omega_0 n_0}X[k]$	$x(t-t_0) \overset{FS}{\longleftrightarrow} e^{-jkw_0 t_0}X[k]$

Periodic-Continuous (Fourier Series)		Non-Periodic-Continuous (Fourier Transform)	
$x(t) = \sum_{k=-\infty}^{\infty} X[k]e^{jkw_0 t}$	$X[k] = \frac{1}{T}\int_0^T x(t)e^{-jkw_0 t}\,dt$	$x(t) = \frac{1}{2\pi}\int_{-\infty}^{\infty} X(jw)e^{jwt}\,dw$	$X(jw) = \int_{-\infty}^{\infty} x(t)e^{-jwt}\,dt$
Periodic-Discrete (DTFS)		**Non-Periodic-Discrete (DTFT)**	
$x[n] = \sum_{k=0}^{N-1} X[k]e^{jk\Omega_0 n}$	$X[k] = \frac{1}{N}\sum_{n=0}^{N-1} x[n]e^{-jk\Omega_0 n}$	$x[n] = \frac{1}{2\pi}\int_{-\pi}^{\pi} X(e^{j\Omega})e^{j\Omega n}\,d\Omega$	$X(e^{j\Omega}) = \sum_{n=-\infty}^{\infty} x[n]e^{-j\Omega n}$

$\int_{-\infty}^{\infty} e^{-j2\pi(f-A)t}\,dt = \delta(f-A)$	$\int dx = x + c$	$\int \sec(ax)\,dx = \frac{1}{a}ln\lvert\sec(ax)+\tan(ax)\rvert + c$	
$\int \sin(x)dx = -\cos(x) + c$	$\int x^n dx = \frac{x^{n+1}}{n+1} + c$	$\int a^x dx = \frac{a^n}{\ln a} + c$	$\int e^{ax}dx = \frac{e^{ax}}{a} + c$
$\int \cos(x)dx = sin(x) + c$	$\int u\,dv = u\,v - \int v\,du + c$	$\int cot(x)dx = ln\lvert\sin(x)\rvert + c$	$\int xe^{ax}dx = \frac{e^{ax}(ax-1)}{a^2} + c$
$\int \tan(x)dx = -ln\lvert\cos(x)\rvert + c$	$\int \frac{dx}{ax+b} = \frac{1}{a}ln\lvert ax+b\rvert + c$	$\int sec^2(ax)dx = \frac{1}{a}\tan(ax) + c$	$\int csc^2(ax)dx = -\frac{1}{a}\cot(ax) + c$

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