Table 3.1: Properties of Continuous Time Fourier Series		
Property	Periodic Signal	Fourier Transform
$\begin{cases} x(t) \\ y(t) \end{cases}$ *Periodic with Period T and fundamental frequency* $\omega_0 = \frac{2\pi}{T}$		$\begin{cases} a_k \\ b_k \end{cases}$
Linearity	$Ax(t) + By(t)$	$Aa_k + Bb_k$
Time Shifting	$x(t - t_0)$	$a_k e^{-jk\omega_0 t_0} = a_k e^{-jk(\frac{2\pi}{T})t_0}$
Frequency Shifting	$e^{jM\omega_0 t}x(t)$	a_{k-M}
Conjugation	$x^*(t)$	a^*_{-k}
Time Reversal	$x(-t)$	a_{-k}
Time Scaling	$x(at),\quad a > 0$ $(Periodic\ with\ period\ \frac{T}{a})$	a_k
Periodic Convolution	$x(t) * y(t) = \int_T x(\tau)y(t-\tau)d\tau$	$Ta_k b_k$
Multiplication	$x(t)y(t)$	$\sum_{l=-\infty}^{+\infty} a_l b_{k-l}$
Differentiation	$\frac{d}{dt}x(t)$	$jk\omega_o a_k = jk\frac{2\pi}{T}a_k$
Integration	$\int_{-\infty}^{t} x(\tau)d\tau$ (finite value and periodic only if $a_0 = 0$)	$\left(\frac{1}{jk\omega_o}\right)a_k = \left(\frac{1}{jk\frac{2\pi}{T}}\right)a_k$
Conjugate Symmetry for Real Signals	$x(t)\ is\ real$	$\begin{cases} a_k = a_{-k}^* \\ Re\{a_k\} = Re\{a_{-k}\} \\ Im\{a_k\} = -Im\{a_{-k}\} \\ \lvert a_k\rvert = \lvert a_{-k}\rvert \\ \sphericalangle a_k = -\sphericalangle a_{-k} \end{cases}$
Symmetry for Real and Even Signals	$x(t) is\ real\ and\ even$	$a_k\ \ is\ real\ and\ even$
Symmetry for Real and Odd Signals	$x(t) is\ real\ and\ odd$	$a_k\ \ is\ purely\ inmaginary\ and\ odd$
Even-Odd Decomposition for Real Signals	$x_r(t) = Ev\{x(t)\}\quad [x(t) real]$ $x_o(t) = Od\{x(t)\}\quad [x(t) real]$	$Re\{a_k\}$ $jIm\{a_k\}$
Parseval's Relation for Periodic Signals	$\frac{1}{T}\int_T \lvert x(t)\rvert^2 dt = \sum_{k=-\infty}^{\infty} \lvert a_k\rvert^2$	

Table 3.2: Properties of Discrete Time Fourier Series		
Property	Periodic Signal	Fourier Transform
$\begin{cases} x[n] \\ y[n] \end{cases}$ Periodic with Period N and fundamental frequency $\omega_0 = \frac{2\pi}{N}$		$\begin{cases} a_k \\ b_k \end{cases}$ Periodic with Period N
Linearity	$Ax[n] + By[n]$	$Aa_k + Bb_k$
Time Shifting	$x[n - n_0]$	$a_k e^{-jk(\frac{2\pi}{N})n_0}$
Frequency Shifting	$e^{jM(\frac{2\pi}{N})n} x[n]$	a_{k-M}
Conjugation	$x^*[n]$	a^*_{-k}
Time Reversal	$x[-n]$	a_{-k}
Time Scaling	$x_{(m)}[n] = \begin{cases} x\left[\frac{n}{m}\right] & if\ n\ is\ a\ multiple\ of\ m \\ 0 & if\ n\ is\ not\ a\ multiple\ of\ m \end{cases}$ (periodic with period *mN*)	$\frac{1}{m} a_k$ (viewed as periodic With period *mN*)
Periodic Convolution	$\sum_{r=<N>} x[r]y[n-r]$	$N a_k b_k$
Multiplication	$x[n]y[n]$	$\sum_{l=<N>} a_l b_{k-l}$
First Difference	$x[n] - x[n-1]$	$(1 - e^{-jk2\pi/N})a_k$
Running Sum	$\sum_{k=-\infty}^{n} x[k]$ Finite valued and periodic only if $a_0 = 0$	$\left(\frac{1}{\left(1 - e^{-\frac{jk2\pi}{N}}\right)}\right) a_k$
Conjugate Symmetry for Real Signals	$x[n]\ is\ real$	$\begin{cases} a_k = a_{-k}{}^* \\ Re\{a_k\} = Re\{a_{-k}\} \\ Im\{a_k\} = -Im\{a_{-k}\} \\ \lvert a_k \rvert = \lvert a_{-k} \rvert \\ \sphericalangle a_k = -\sphericalangle a_{-k} \end{cases}$
Symmetry for Real and Even Signals	$x[n] is\ real\ and\ even$	$a_k\ \ is\ real\ and\ even$
Symmetry for Real and Odd Signals	$x[n]\ is\ real\ and\ odd$	$a_k\ \ is\ purely\ inmaginary\ and\ odd$
Even-Odd Decomposition for Real Signals	$x_r[n] = Ev\{x[n]\}\quad [x(t) real]$ $x_o[n] = Od\{x[n]\}\quad [x(t) real]$	$Re\{a_k\}$ $jIm\{a_k\}$
Parseval's Relation for Periodic Signals	$\frac{1}{N} \sum_{n=<N>} \lvert x[n] \rvert^2 = \sum_{k=<N>} \lvert a_k \rvert^2$	

Table 4.1: Properties of the Fourier Transform		
Property	Aperiodic Signal	Fourier Transform
	$x(t)$ $y(t)$	$X(j\omega)$ $Y(j\omega)$
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	$e^{j\omega_0 t}x(t)$	$X\big(j(\omega-\omega_0)\big)$
Conjugation	$x^*(t)$	$X^*(-j\omega)$
Time Reversal	$x(-t)$	$X(-j\omega)$
Time and Frequency Scaling	$x(at)$	$\frac{1}{\lvert a\rvert}X\left(\frac{j\omega}{a}\right)$
Convolution	$x(t)*y(t)$	$X(j\omega)Y(j\omega)$
Multiplication	$x(t)y(t)$	$\frac{1}{2\pi}X(j\omega)*Y(j\omega)$
Differentiation in Time	$\frac{d}{dt}x(t)$	$j\omega X(j\omega)$
Integration	$\int_{-\infty}^{t}x(\tau)d\tau$	$\frac{1}{j\omega}X(j\omega)+\pi X(0)\delta(\omega)$
Differentiation in Frequency	$tx(t)$	$j\frac{d}{d\omega}X(j\omega)$
Conjugate Symmetry for Real Signals	$x(t)\ is\ \ real$	$\begin{cases} X(j\omega)=X^*(-j\omega) \\ Re\{X(j\omega)\}=Re\{X(-j\omega)\} \\ Im\{X(j\omega)\}=-Im\{X(-j\omega)\} \\ \lvert X(j\omega)\rvert=\lvert X(-j\omega)\rvert \\ \sphericalangle X(j\omega)=-\sphericalangle X(-j\omega) \end{cases}$
Symmetry for Real and Even Signals	$x(t) is\ real\ and\ even$	$X(j\omega)\ \ \ is\ real\ and\ even$
Symmetry for Real and Odd Signals	$x(t) is\ real\ and\ odd$	$X(j\omega)\ \ is\ purely\ inmaginary\ and\ odd$
Even-Odd Decomposition for Real Signals	$x_r(t)=Ev\{x(t)\}\quad [x(t) real]$ $x_o(t)=Od\{x(t)\}\quad [x(t) real]$	$Re\{X(j\omega)\}$ $jIm\{X(j\omega)\}$
Parseval's Relation for Aperiodic Signals	$\int_{-\infty}^{+\infty}\lvert x(t)\rvert^2dt=\frac{1}{2\pi}\int_{-\infty}^{+\infty}\lvert X(j\omega)\rvert^2d\omega$	

Table 4.2: Basic Fourier Transform Pairs		
Signal	Fourier transform	Fourier Series Coefficients (if periodic)
$\sum_{k=-\infty}^{\infty} a_k e^{jk\omega_0 t}$	$2\pi \sum_{k=-\infty}^{\infty} a_k \delta(\omega - k\omega_0)$	a_k
$e^{j\omega_0 t}$	$2\pi\delta(\omega - \omega_0)$	$a_1 = 1$ $a_k = 0$ otherwise
$\cos(\omega_0 t)$	$\pi[\delta(\omega - \omega_0) + \delta(\omega + \omega_0)]$	$a_1 = a_{-1} = \frac{1}{2}$ $a_k = 0$ otherwise
$\sin(\omega_0 t)$	$\frac{\pi}{j}[\delta(\omega - \omega_0) - \delta(\omega + \omega_0)]$	$a_1 = -a_{-1} = \frac{1}{2j}$ $a_k = 0$ otherwise
$x(t) = 1$	$2\pi\delta(\omega)$	$a_1 = 1\,,\ a_k = 0,\ k \neq 0$ (this is the Fourier series representation for any choice of $T > 0$)
$x(t) = \begin{cases} 1, & \lvert t\rvert < T_1 \\ 0, & T_1 < \lvert t\rvert \leq \frac{T}{2} \end{cases}$ And $x(t) = x(t+T)$	$\sum_{k=-\infty}^{\infty} \frac{2\sin(k\omega_0 T_1)}{k} \delta(\omega - k\omega_0)$	$\frac{\omega_0 T_1}{\pi} \text{sinc}\left(\frac{k\omega_0 T_1}{\pi}\right) = \frac{\sin(k\omega_0 T_1)}{k\pi}$
$\sum_{n=-\infty}^{\infty} \delta(t - nT)$	$\frac{2\pi}{T} \sum_{k=-\infty}^{\infty} \delta\left(\omega - \frac{2\pi}{T}k\right)$	$a_k = \frac{1}{T}$ *for all k*
$x(t) = \begin{cases} 1, & \lvert t\rvert < T_1 \\ 0, & T_1 < \lvert t\rvert \end{cases}$	$\frac{2\sin(\omega T_1)}{\omega}$	------
$\frac{\sin(Wt)}{\pi t}$	$X(j\omega) = \begin{cases} 1, & \lvert\omega\rvert < W \\ 0, & W < \lvert\omega\rvert \end{cases}$	-------
$\delta(t)$	1	-------
$u(t)$	$\frac{1}{j\omega} + \pi\delta(\omega)$	-------
$\delta(t - t_0)$	$e^{-j\omega t_0}$	-------
$e^{-\alpha t}u(t),\ Re\{\alpha\} > 0$	$\frac{1}{\alpha + j\omega}$	-------
$te^{-\alpha t}u(t),\ Re\{\alpha\} > 0$	$\frac{1}{(\alpha + j\omega)^2}$	------
$\frac{t^{(n-1)}}{(n-1)!} e^{-\alpha t}u(t),\ Re\{\alpha\} > 0$	$\frac{1}{(\alpha + j\omega)^n}$	------