

# DISCRETE-TIME FOURIER TRANSFORM PROPERTIES

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## **Abstract**

Gives various Fourier transform properties

## **Discrete-Time Fourier Transform Properties**

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**Discrete-Time Fourier Transform Properties**

	Sequence Domain	Frequency Domain
Linearity	$a_1 s_1(n) + a_2 s_2(n)$	$a_1 S_1(e^{i2\pi f}) + a_2 S_2(e^{i2\pi f})$
Conjugate Symmetry	$s(n)$ real	$S(e^{i2\pi f}) = \overline{S(e^{-i2\pi f})}$
Even Symmetry	$s(n) = s(-n)$	$S(e^{i2\pi f}) = S(e^{-i2\pi f})$
Odd Symmetry	$s(n) = -s(-n)$	$S(e^{i2\pi f}) = -S(e^{-i2\pi f})$
Time Delay	$s(n - n_0)$	$e^{-i2\pi f n_0} S(e^{i2\pi f})$
Complex Modulation	$e^{i2\pi f_0 n} s(n)$	$S(e^{i2\pi(f-f_0)})$
Amplitude Modulation	$s(n) \cos(2\pi f_0 n)$	$\frac{S(e^{i2\pi(f-f_0)}) + S(e^{i2\pi(f+f_0)})}{2}$
	$s(n) \sin(2\pi f_0 n)$	$\frac{S(e^{i2\pi(f-f_0)}) - S(e^{i2\pi(f+f_0)})}{2i}$
Multiplication by n	$ns(n)$	$\frac{1}{-2i\pi} \frac{d}{df} (S(e^{i2\pi f}))$
Sum	$\sum_{n=-\infty}^{\infty} (s(n))$	$S(e^{i2\pi 0})$
Value at Origin	$s(0)$	$\int_{-\frac{1}{2}}^{\frac{1}{2}} S(e^{i2\pi f}) df$
Parseval's Theorem	$\sum_{n=-\infty}^{\infty} ( s(n) ^2)$	$\int_{-\frac{1}{2}}^{\frac{1}{2}} ( S(e^{i2\pi f}) )^2 df$

**Figure 1:** Discrete-time Fourier transform properties and relations.

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