

# Power Density Spectrum - Continuous Time

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Based on  
Probability, Random Variables and Random Signal Principles,  
P.Z. Peebles,Jr. and B. Shi



# Fourier Transform

$N$  Gaussian random variables

## Definition

$$X(\omega) = \int_{-\infty}^{\infty} x(t) e^{-j\omega t} dt$$

$$x(t) = \frac{1}{2\pi} \int_{-\infty}^{\infty} X(\omega) e^{j\omega t} d\omega$$

# Average Power

$N$  Gaussian random variables

## Definition

$$x_T(t) = \begin{cases} x(t) & -T < t < T \\ 0 & \text{otherwise} \end{cases}$$

$$E(T) = \int_{-T}^{+T} x^2(t) dt$$

$$P(T) = \frac{1}{2T} \int_{-T}^{+T} x^2(t) dt$$

# Measuring Average Power

$N$  Gaussian random variables

## Definition

$$P(T) = \frac{1}{2T} \int_{-T}^{+T} x^2(t) dt$$

$$\begin{aligned} P_{XX} &= \lim_{T \rightarrow \infty} \frac{1}{2T} \int_{-T}^{+T} E[x^2(t)] dt \\ &= A[E[x^2(t)]] \end{aligned}$$



