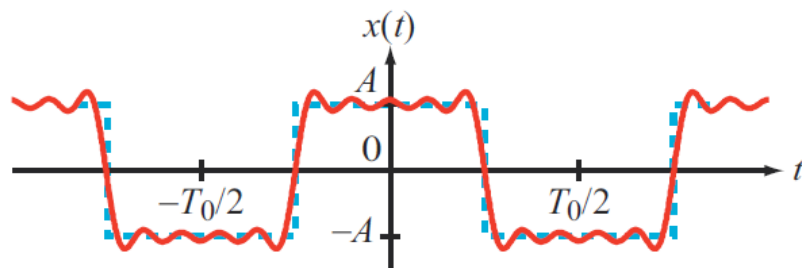
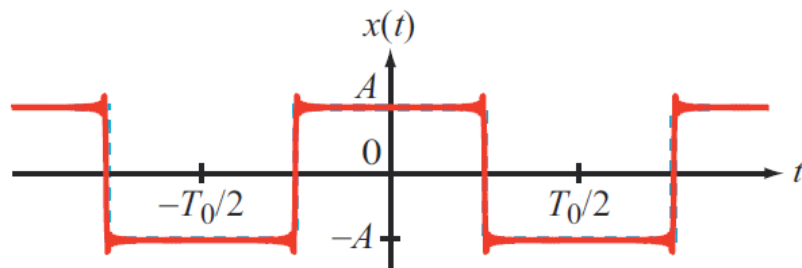


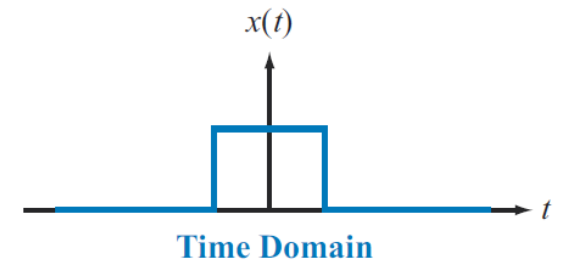
(c) Fourier series with 3 terms



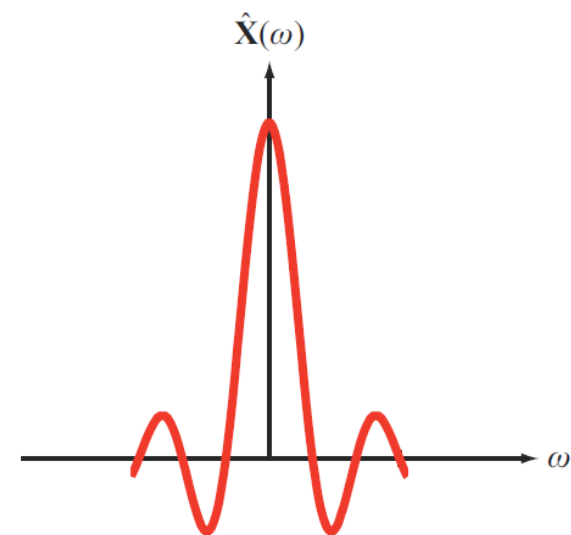
(d) Fourier series with 10 terms



(e) Fourier series with 100 terms



Time Domain



Frequency Domain

5. FOURIER ANALYSIS TECHNIQUE

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Objectives

Learn to:

- Apply the phasor-domain technique to analyze systems driven by sinusoidal excitations.
- Express periodic signals in terms of Fourier series.
- Use Fourier series to analyze circuits driven by continuous periodic signals.
- Apply Parseval's theorem to compute the power or energy contained in a signal.
- Compute the Fourier transform of nonperiodic signals and use it to analyze the system response to nonperiodic excitations.

Phasor Analysis: Basics

- If an LTI system is described by a differential equation with an eternal sinusoidal input, then **phasor analysis** is a simple procedure for computing the system response.
- The system response is also an eternal sinusoidal signal.
- The **phasor** associated with **signal** $v(t) = V_0 \cos(\omega t + \phi)$ is the **complex number** $\mathbf{V} = V_0 e^{j\phi}$

$$v(t) = V_0 \cos(\omega t + \phi) \iff \mathbf{V} = V_0 e^{j\phi}$$

- If $\mathbf{X} = |\mathbf{X}| e^{j\phi}$ then $\Re[|\mathbf{X}| e^{j\phi} e^{j\omega t}] = |\mathbf{X}| \cos(\omega t + \phi)$

Phasor Analysis: Basics

- The effects of differentiation and integration are:

$x(t)$		\mathbf{X}
$A \cos \omega t$	\longleftrightarrow	A
$A \cos(\omega t + \phi)$	\longleftrightarrow	$Ae^{j\phi}$
$-A \cos(\omega t + \phi)$	\longleftrightarrow	$Ae^{j(\phi \pm \pi)}$
$A \sin \omega t$	\longleftrightarrow	$Ae^{-j\pi/2} = -jA$
$A \sin(\omega t + \phi)$	\longleftrightarrow	$Ae^{j(\phi - \pi/2)}$
$-A \sin(\omega t + \phi)$	\longleftrightarrow	$Ae^{j(\phi + \pi/2)}$
$\frac{d}{dt}[A \cos(\omega t + \phi)]$	\longleftrightarrow	$j\omega Ae^{j\phi}$
$\int A \cos(\omega t' + \phi) dt'$	\longleftrightarrow	$\frac{1}{j\omega} Ae^{j\phi}$

$$i(t) = \Re[\mathbf{I}e^{j\omega t}]$$

$$\frac{di}{dt} \longleftrightarrow j\omega \mathbf{I}$$

$$\int i dt' \longleftrightarrow \frac{\mathbf{I}}{j\omega}$$

- Use these properties to convert manipulations of sines and cosines into manipulations of complex numbers.