# 6.3000: Signal Processing
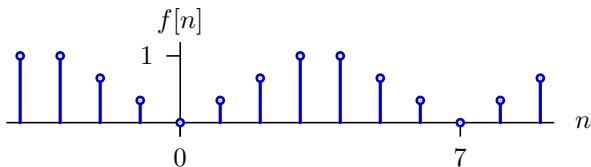
## Discrete-Time Fourier Series

### Synthesis Equation

$$f[n] = f[n+N] = \sum_{k=\langle N \rangle} a_k\, e^{j\frac{2\pi k}{N}n}$$

### Analysis Equation

$$a_k = \frac{1}{N} \sum_{n=\langle N \rangle} f[n]\, e^{-j\frac{2\pi k}{N}n}$$

*September 19, 2024*

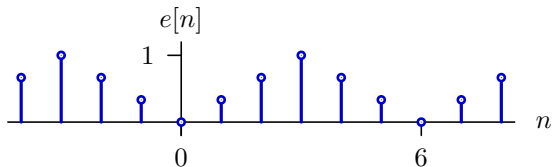## Find the DT Fourier Series Coefficients

Let $f[n]$ represent a periodic DT signal with period $N = 7$:



Determine the Fourier series coefficients $F[k]$ for $f[n]$.

## Find the DT Fourier Series Coefficients

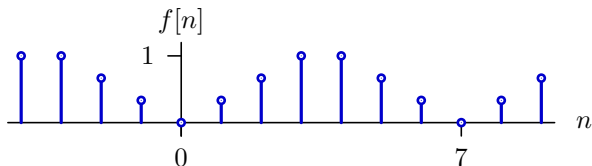How would the answer change if the period were $N = 6$?



$e[n]$

Determine the Fourier series coefficients $E[k]$ for $e[n]$.

## Find the DT Fourier Series Coefficients

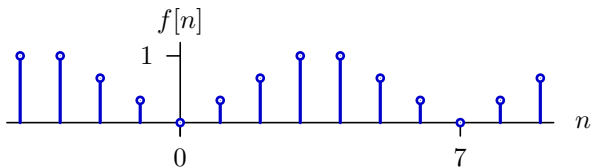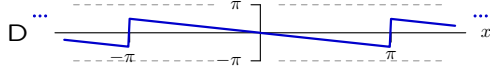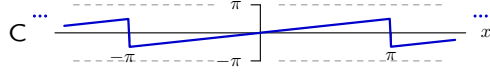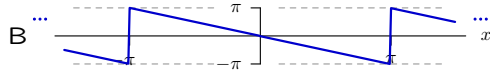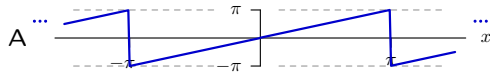Consider a new signal $g[n]$ derived from $f[n]$ as follows:

$$g[n] = 9 - 3f[n-1]$$



$f[n]$

$1$

$0$         $7$     $n$

Find the DTFS coefficients of $g[n]$.

# Find the DT Fourier Series Coefficients

Consider another new signal

$$h[n] = (-1)^n f[n]$$
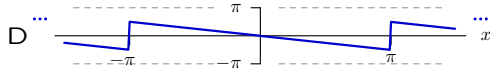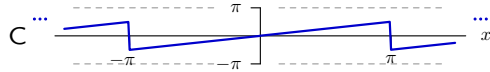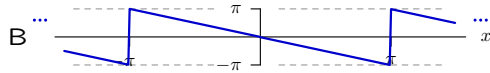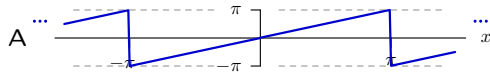
where



$f[n]$

Find the DTFS coefficients of $h[n]$.

# Angular Trends
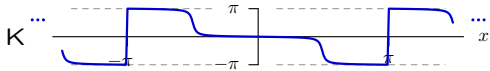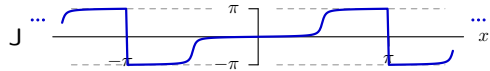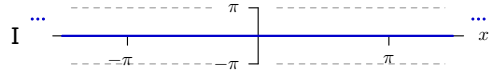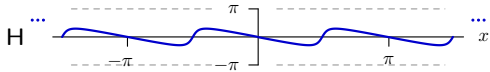
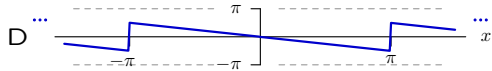Which of the following plots shows the angle of $e^{-jx}$?
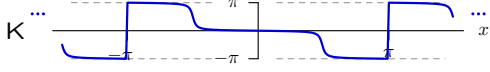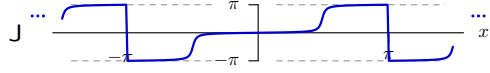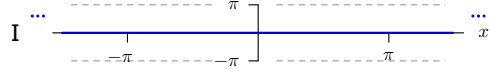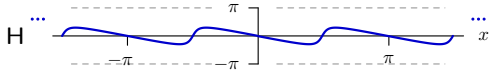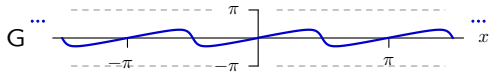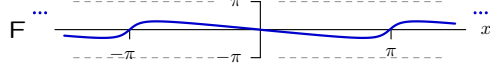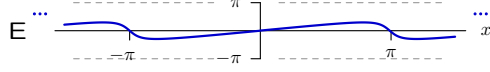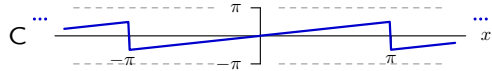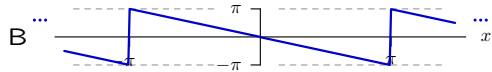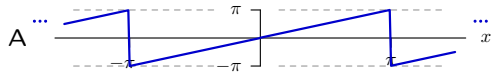
## Angular Trends

Which of the following plots shows the angle of $(1 + 0.8e^{jx})$?
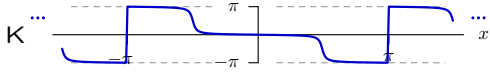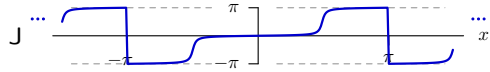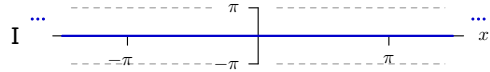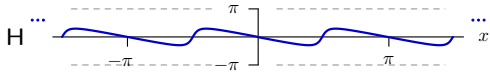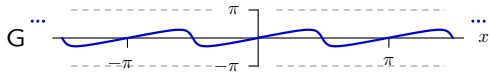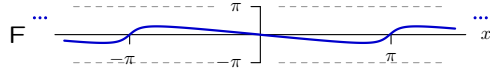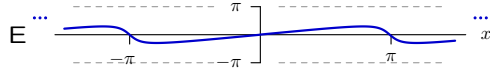
## Angular Trends

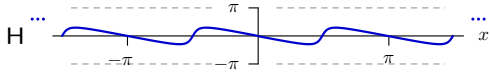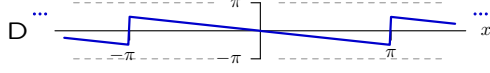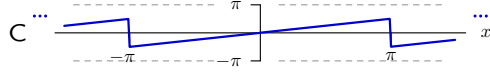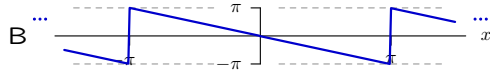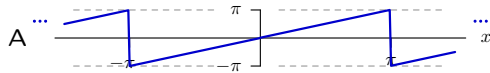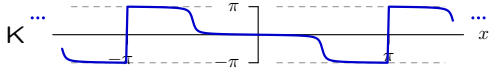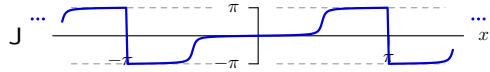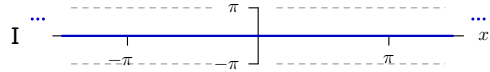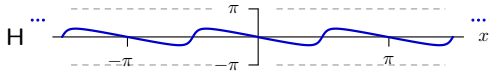Which of the following plots shows the angle of $\left(\frac{1+0.4e^{jx}}{2+0.8e^{jx}}\right)$?
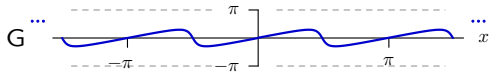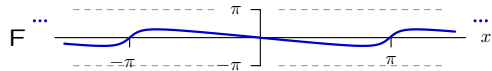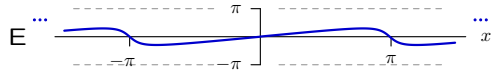
## Angular Trends

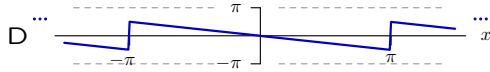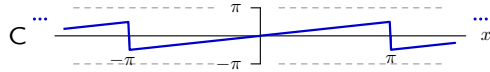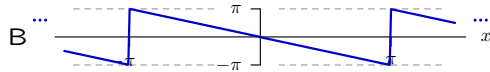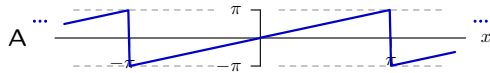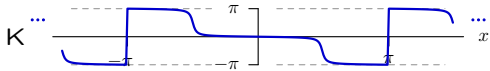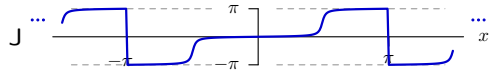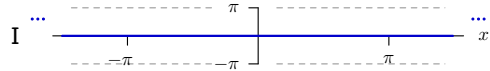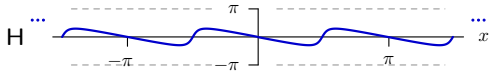Which of the following plots shows the angle of $(1 + e^{jx})$?
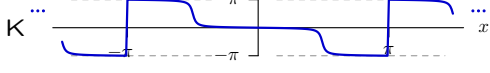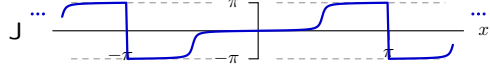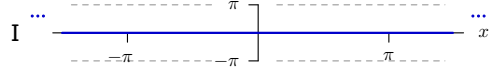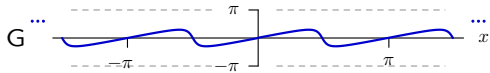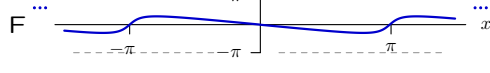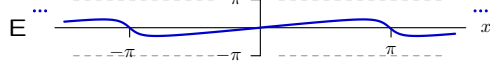
## Angular Trends

Which of the following plots shows the angle of $(1 + 0.8e^{j2x})$?
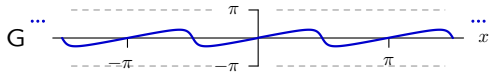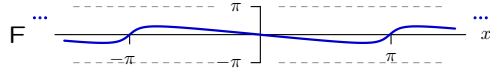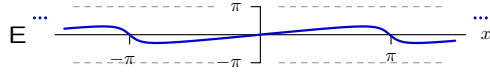
# Angular Trends

Which of the following plots shows the angle of $(0.9e^{jx}+0.8e^{-jx})$?



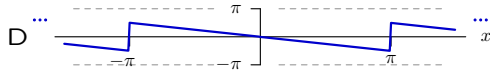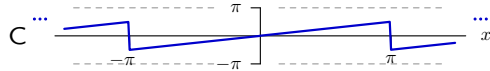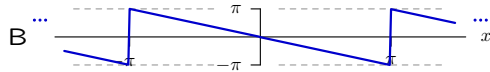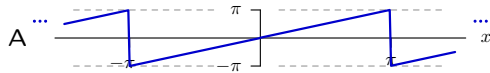The plot that shows the angle of $(0.9e^{jx}+0.8e^{-jx})$ is **J**.
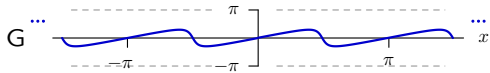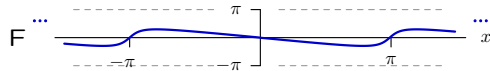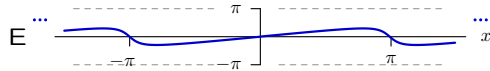
## Angular Trends

Which of the following plots shows the angle of $\left(\frac{1}{1+0.8e^{jx}}\right)$?