

# 6.003: Signal Processing

## Discrete-Time Fourier Series

### Synthesis Equation

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

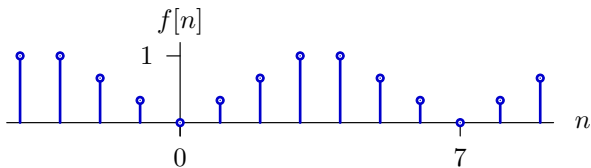
### Analysis Equation

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

## Find the DT Fourier Series Coefficients

---

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

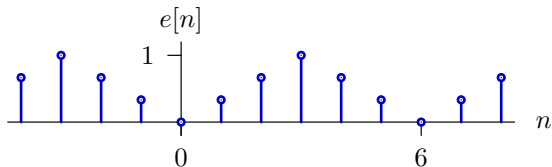


Determine the Fourier series coefficients  $F[k]$  for  $f[n]$ .

## Find the DT Fourier Series Coefficients

---

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



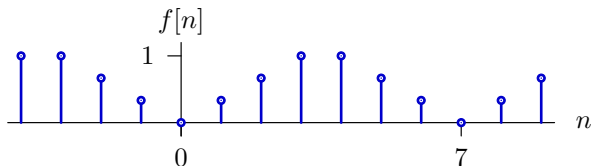
Determine the Fourier series coefficients  $E[k]$  for  $e[n]$ .

## Find the DT Fourier Series Coefficients

---

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

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

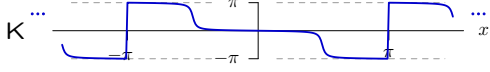
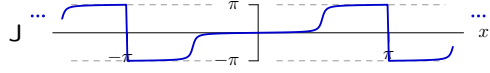
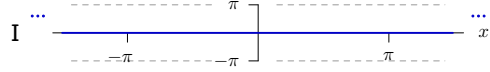
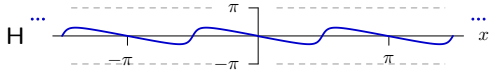
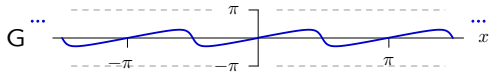
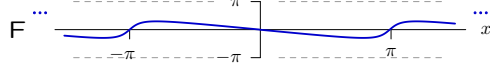
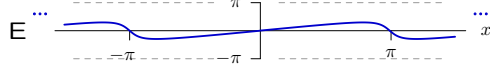
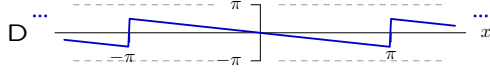
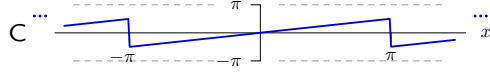
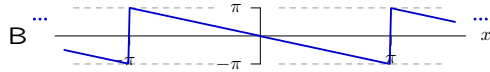
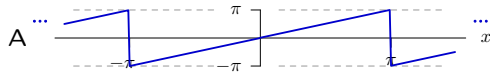


Find the DTFS coefficients of  $g[n]$ .



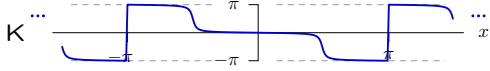
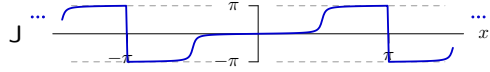
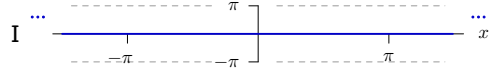
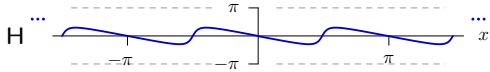
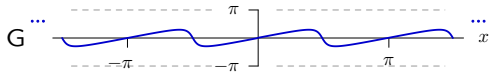
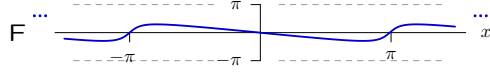
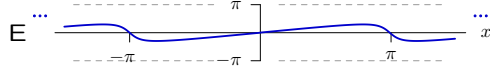
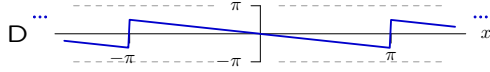
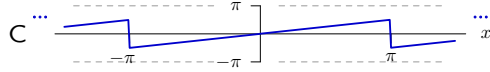
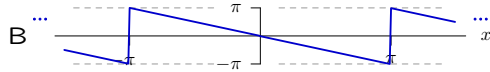
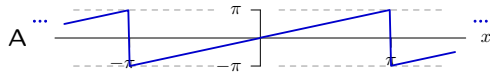
# Angular Trends

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



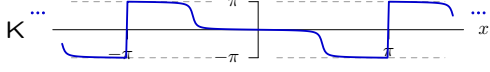
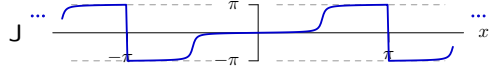
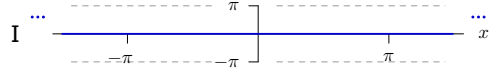
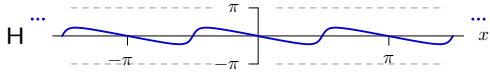
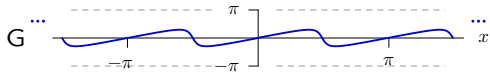
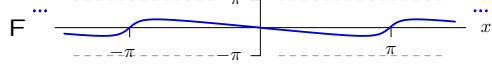
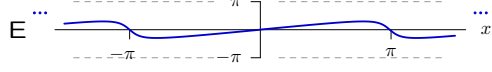
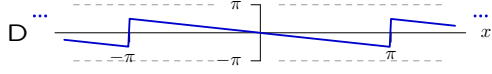
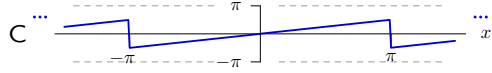
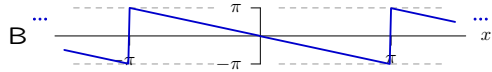
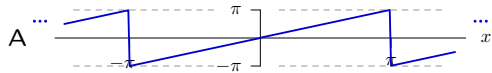
## Angular Trends

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



## Angular Trends

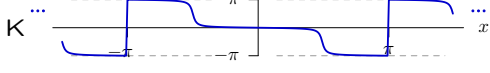
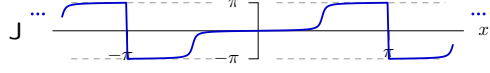
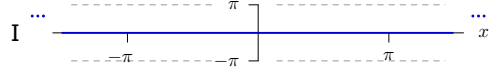
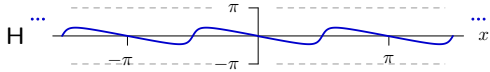
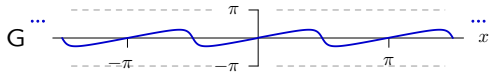
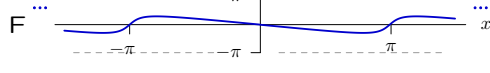
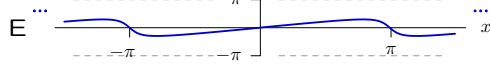
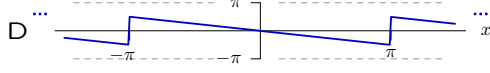
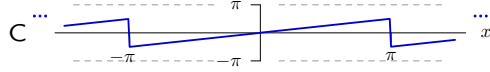
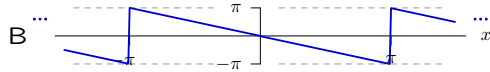
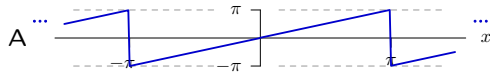
Which of the following plots shows the angle of  $\left(\frac{1+0.4e^{jx}}{2+0.8e^{jx}}\right)$ ?





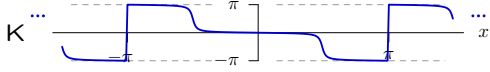
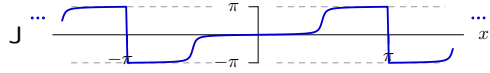
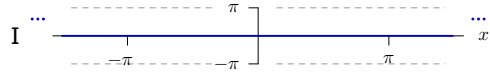
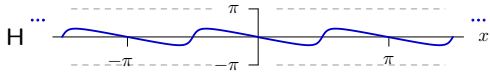
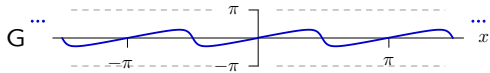
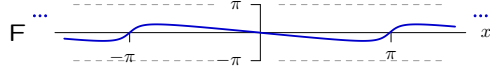
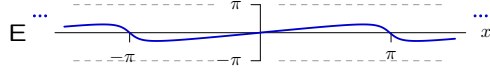
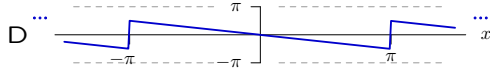
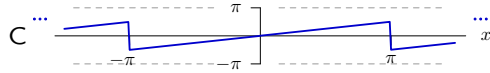
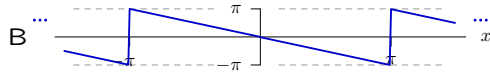
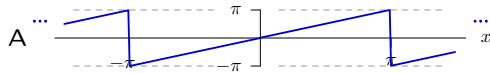
# Angular Trends

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



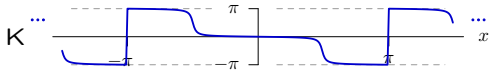
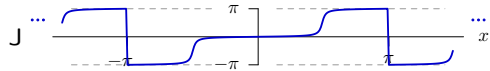
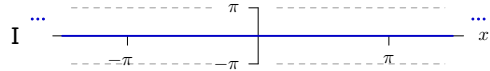
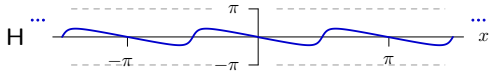
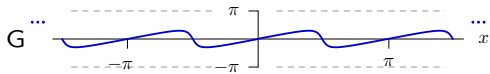
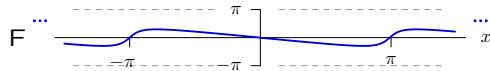
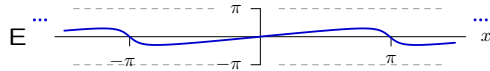
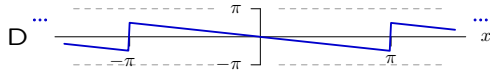
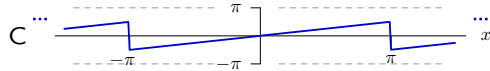
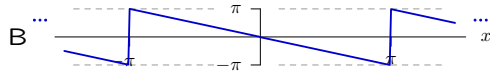
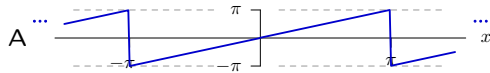
## Angular Trends

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



## Angular Trends

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



## Angular Trends

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

