# -Digital Signal Processing-
# DFT Examples

Lecture-20
01-June-16

# Example #1

- Suppose $x_c(t)$ is a periodic continuous-time signal with period 1ms and for which the Fourier series is:

$$x_c(t) = \sum_{k=-9}^{9} a_k e^{j\left(2\pi k t/10^{-3}\right)}$$

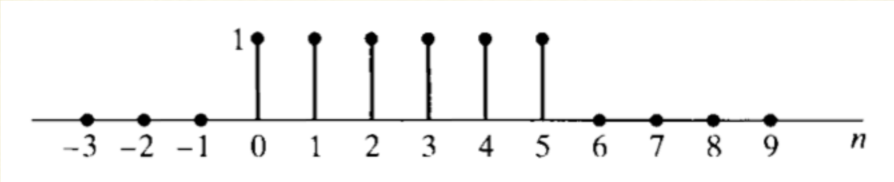
- The Fourier series coefficients $a_k$ are zero for $|k|>9$. $x_c(t)$ is sampled with a sample spacing $T=(1/6)\times 10^{-3}$s to form x[n]. That is:

$$x[n] = x_c\left(\frac{n10^{-3}}{6}\right)$$

  - (a): Is x[n] periodic and if so with what period?
  - (b): Is the sampling rate above the Nyquist rate? That is, is T sufficiently small to avoid aliasing?

# Example #2

- Consider the finite-length sequence x[n] shown below:



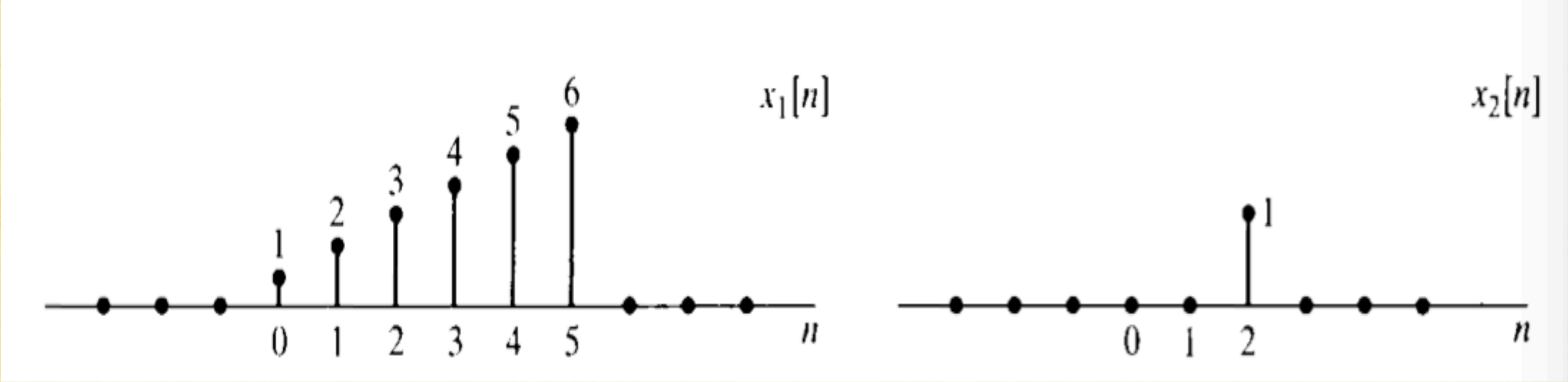

- Let X(z) be the z-transform of x[n]. If we sample X(z) at $z=e^{j(2\pi/4)k}$, k=0,1,2,3 we obtain:

$$X_1[k] = X(z)\Big|_{z=e^{j(2\pi/4)k}}, k = 0,1,2,3$$

- Sketch the sequence $x_1[n]$ obtained as the inverse DFT of $X_1[k]$.

# Example #3

- Figure below shows two finite-length sequences $x_1[n]$ and $x_2[n]$. Sketch their six-point circular convolution.

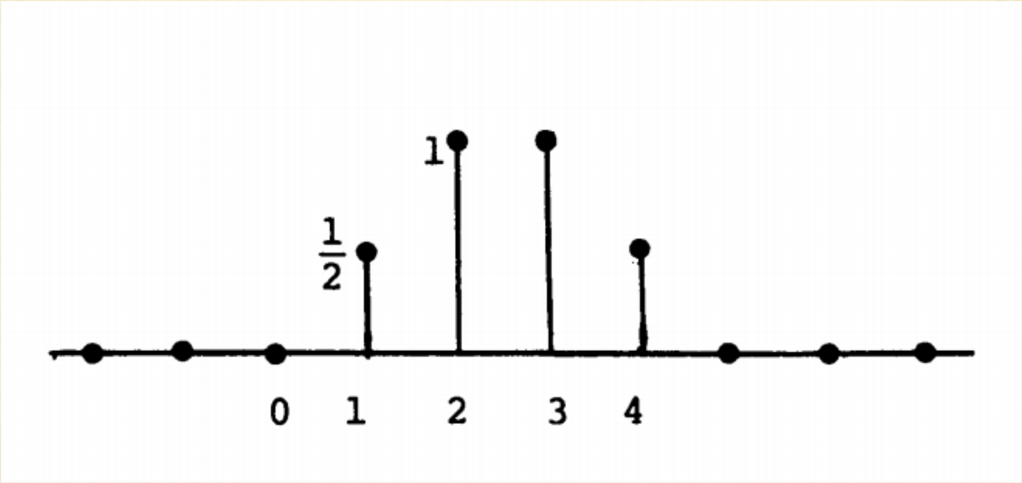


# Example #4

- Compute the DFT of each of the following finite-length sequences considered to be of length N:
  - (a): $x(n) = \delta(n)$
  - (b): $x(n) = \delta(n-n_0)$, where $0<n_0<N$.
  - (c): $x(n) = a^n$, $0 \leq n \leq N-1$

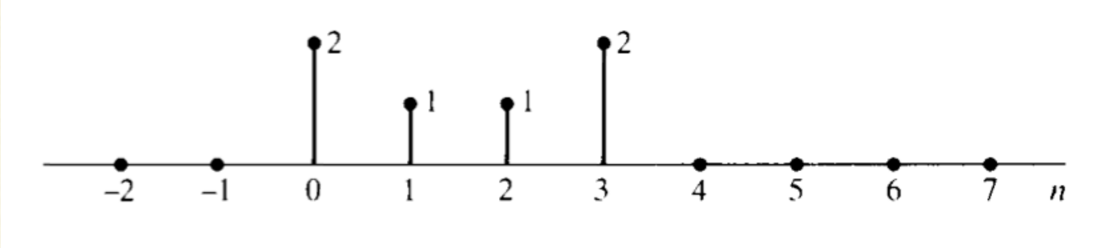
# Example #5

- In the figure below is shown a four-point sequence x(n):
  - (a): Sketch the linear convolution of x(n) with x(n).
  - (b): Sketch the Four-point circular convolution of x(n) with x(n).
  - (c): Sketch the ten-point circular convolution of x(n) with x(n).



# Example #6

- Consider the finite-length sequence x[n] shown below:

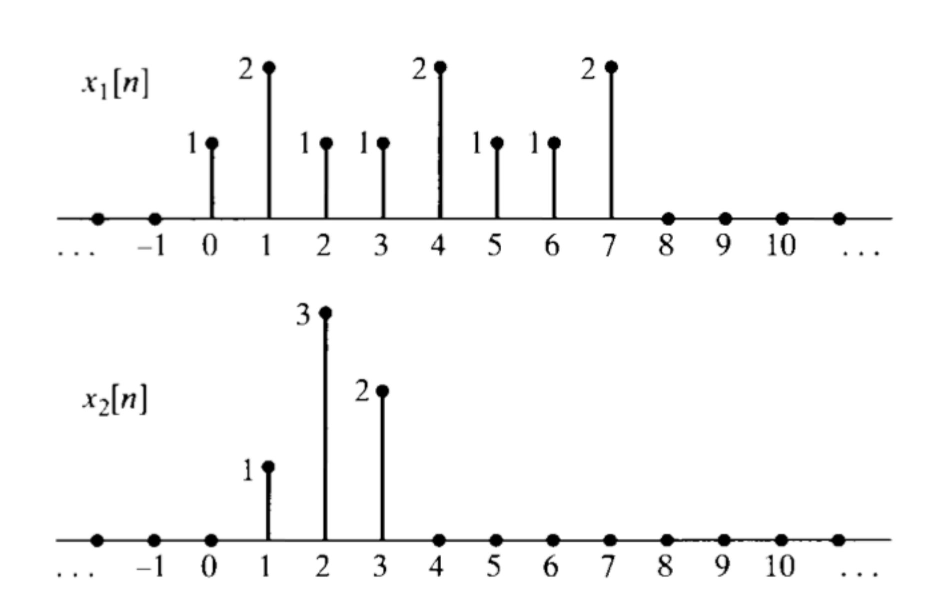



- The five point DFT of x[n] is denoted by X[k]. Plot the sequence y[n] whose DFT is:

$$Y[k] = W_5^{-2k} X[k]$$

# Example #7

- Two finite-length signals $x_1[n]$ and $x_2[n]$ are sketched below:




- Assume that $x_1[n]$ and $x_2[n]$ are zero outside of the region shown in the figure. Let $x_3[n]$ be the eight-point circular convolution of $x_1[n]$ with $x_2[n]$ i.e., $x_3[n] = x_1[n] \circledast_8 x_2[n]$. . Determine $x_3[2]$.

**<u>“The End”</u>**

**<u>Best of the Luck for Final Paper</u>**