# 6.3000: Signal Processing

## **Discrete-Time Fourier Transform**

#### Synthesis Equation

$$x[n] = \frac{1}{2\pi} \int_{2\pi} X(\Omega) e^{j\Omega n} d\Omega$$

#### **Analysis Equation**

$$X(\Omega) = \sum_{n = -\infty}^{\infty} x[n] e^{-j\Omega n}$$

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## **Discrete-Time Fourier Transform**

Find the Fourier transforms of the following discrete-time signals.

- $x_1[n] = \begin{cases} a^n & \text{if } n \ge 0\\ 0 & \text{otherwise} \end{cases}$
- $x_2[n] = x_1[n n_0]$
- $x_3[n] = \text{Symmetric}\{x_1[n]\}$
- $x_4[n] = \text{Antisymmetric}\{x_1[n]\}$
- $x_5[n] = nx_1[n]$

### **Discrete-Time Fourier Transform**

Find the Fourier transform of  $x_6[n]$ :  $x_6[n] = \begin{cases} \left(\frac{1}{2}\right)^{n/2} & n = 0, 2, 4, 6, 8, ..., \infty \\ 0 & \text{otherwise} \end{cases}$ 

-1 0 1

 $2 \ 3 \ 4 \ 5 \ 6 \ 7$ 

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8 9 10

## Inverse Discrete-Time Fourier Transform

Find the signal whose Fourier transform is

 $X(\Omega)=e^{-j3\Omega}$