

# ELE 321

# Linear System Analysis

Ankara University

Faculty of Engineering

Electrical and Electronics Engineering Department

# The Discrete-Time Fourier Transform

ELE321 Linear System Analysis

Lecture 12

# Agenda

- Discrete-Time Fourier Transform for Aperiodic Signals
- Convergence of Fourier Transform
- Discrete-Time Fourier Transform for Periodic Signals

# DT Fourier Transform for Aperiodic Signals

- $x[n]$  is an aperiodic signal
- $x[n] = \frac{1}{2\pi} \int_0^{2\pi} X(e^{j\omega}) e^{j\omega n} d\omega$
- $X(e^{j\omega}) = \sum_{n=-\infty}^{\infty} x[n] e^{-j\omega n}$
- $X(e^{j\omega})$  is a periodic signal with period  $2\pi$

# Convergence of DT Fourier Transform

- Aperiodic signal must be absolutely summable.

# DT Fourier Transform for Periodic Signals

- Fourier series coefficients,  $a_k$
- $x[n] = \sum_{k=0}^{N-1} a_k e^{jk\omega_0 n}$  : periodic signal
- $X(e^{j\omega}) = \sum_{k=-\infty}^{\infty} 2\pi a_k \delta(\omega - k\omega_0)$ 
  - Train of impulses

# References

- Signals and Systems, 2nd Edition, Oppenheim, Willsky, Nawab