

ECE 3640 - Discrete-Time Signals and Systems

The Discrete-Time Fourier Transform

Things To Know and Do

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things to know and do

- properties of continuous-time and discrete-time complex exponentials and sinusoids
 - periodicity
 - uniqueness and non-uniqueness of frequency
 - highest frequency
 - number of harmonically related frequencies
 - eigenfunction property of LTI systems
- sampling complex exponentials and sinusoids
- finding frequency aliases in the fundamental interval

things to know and do

- continuous-time Fourier series (CTFS)
 - convergence conditions
 - compute CTFS and ICTFS
- continuous-time Fourier transform (CTFT)
 - convergence conditions
 - compute CTFT $X(F)$ and ICTFT $x(t)$
 - properties and symmetries: multiplication, convolution, etc.
 - famous transform pairs: sinc, square, sinusoid, constant, delta, etc.
- ability to derive properties, symmetries, and pairs

things to know and do

- discrete-time Fourier series (DTFS)
 - convergence conditions
 - compute DTFS and IDTFS
- discrete-time Fourier transform (DTFT)
 - convergence conditions (absolutely summable, energy, power signals)
 - compute DTFT and IDTFT
 - properties and symmetries: multiplication, convolution, etc.
 - famous transform pairs: sinc, square, sinusoid, constant, delta, etc.
 - relation to the z -transform
- ability to derive properties, symmetries, and pairs

things to memorize (partial list)

- formulas for Laplace transform, z -transform, CTFS, CTFT, DTFS, DTFT
- geometric series:

$$\sum_{n=N}^{M-1} a^n = \begin{cases} M - N, & a = 1, \\ \frac{a^N - a^M}{1 - a}, & a \neq 1 \end{cases}$$

$$\sum_{n=0}^{\infty} a^n = \frac{1}{1 - a}, \quad \text{provided } |a| < 1$$

- sine construction:

$$\frac{e^{jA} - e^{-jB}}{2j} = \frac{e^{j\frac{A+B}{2}} - e^{-j\frac{A+B}{2}}}{2j} e^{j\frac{A-B}{2}} = \sin\left(\frac{A+B}{2}\right) e^{j\frac{A-B}{2}}$$