Assignment 5
Fourier Transform and Series Properties

ECE 223 Signals and Systems II
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1. Interpretation of the transforms.

a. How can you tell from the magnitude of the transforms what the DC component of
   the signal is?

b. Which transforms can be calculated on a computer exactly, ignoring finite precision
effects?

c. Why do we represent signals as linear combinations of complex sinusoids rather than
   as real sinusoids?

2. Relationship to CTFS Coefficients. Suppose that we have a periodic signal \( x(t) \)
with fundamental period \( T \). Define the truncated signal \( x_T(t) \) as follows.

\[
x_T(t) = \begin{cases} 
  x(t) & |t| < \frac{T}{2} \\
  0 & |t| \geq \frac{T}{2}
\end{cases}
\]

a. Determine how the Fourier transform of \( x_T(t) \) is related to the continuous-time Fourier
   series coefficients of \( x(t) \).

b. Can the CTFT be used to calculate the CTFS coefficients of a periodic signal? If so,
   how?

c. Can the CTFS be used to calculate the CTFT of a signal with finite duration? If so,
at what frequencies?

3. Fourier properties concepts.
a. Suppose a music signal is bandlimited from 50 Hz to 20 kHz. If you wish to put this through a channel that is bandlimited from 0 to 5 kHz, how much would you have to stretch the signal in time?

b. What is the practical relevance of Parseval’s theorem?

c. Why do we primarily use the Laplace transform to analyze the effect of LTI systems on signals instead of the Fourier transform?


a. What is an ideal window?

b. Why can’t it be used in practical applications such as integration with oscilloscopes?

c. What effect does using a finite window have on the spectrum?