Midterm Review

Midterm information

- The midterm will be given in class on Tuesday March 9 (45 minutes-part A) and Wednesday March 10 (45 minutes-part B).
- Part A and part B will each count 15% towards your final course mark.
- This midterm will test your knowledge about the Frequency Domain and Z Domain Representations of discrete signals and systems.

Materials allowed

- Both parts will be closed book and closed notes.
- For each part of your midterm, you will be allowed a ***one-sided sheet of formulas*** (tables of FT and ZT transform pairs, and FT and ZT properties will be provided).
- We will collect your formula sheets with your midterms and you will receive them back with your marked midterms.
- You are also allowed to bring a calculator, although I will try to choose numbers that can be manipulated without one.

PART A. THE DISCRETE-TIME FOURIER TRANSFORM

Materials for study:

- Slides for L12-L17
- Textbook Chapter 2. Sections: 2.6, 2.7, 2.8, 2.9
- Your notes from class
- Examples posted on the web site
- Assignment 2

Part A. Main topics

- How to use the eigenfunction property
- How to compute the direct and inverse Fourier Transform of a given aperiodic signal $x[n]$ and $X(e^{j\omega})$ respectively.
- How to compute the Fourier Transform of periodic signals.
- How to make use of the DTFT properties.
- How to describe systems given by Linear Constant Coefficient Equations (LCCDE) in the frequency domain

Example 1.

a) Determine the Fourier Transform $R(e^{j\omega})$ of the following signal

$$r[n] = \begin{cases} 1 & 0 \le n \le M \quad M \text{ is an even integer greater than 1} \\ 0 & \text{otherwise} \end{cases}$$

b) Consider the signal

$$w[n] = \begin{cases} \frac{1}{2}\left(1 - \cos\frac{2\pi n}{M}\right) & 0 \le n \le M \\ 0 & \text{otherwise} \end{cases}$$

Express its Fourier Transform $W(e^{j\omega})$ as a function of $R(e^{j\omega})$.

c) Is there a positive integer M that will make $W(e^{j\omega})$ real? If yes, find such a value. If not, explain why.

Example 2

- Consider a discrete-time LTI system with impulse response

$$h[n] = \left(\frac{1}{2}\right)^n u[n]$$

- Use Fourier Transforms to determine the response of the system to

$$x[n] = \left(\frac{3}{4}\right)^n u[n]$$

PART B. THE Z-TRANSFORM

- The relationship between the Z and Fourier transforms
- Region of Convergence
- Poles and Zeros
- Properties of the Region of Convergence
- The Inverse z-Transform
  - 3 computational methods
- The z-Transform and LTI Systems

  The eigenfunction property

  Causality and ROC

  Stability and ROC

  Systems described by linear constant-coefficient difference equations

PART B. THE Z TRANSFORM

Materials for study:

- Slides for L18-L21
- Textbook Chapter 3. Sections: 3.0-3.5
- Your notes from class
- Examples and problem solutions posted on the web site
- Assignment 3 (solution to be posted on Saturday)

Example 3

- Consider an LTI system with input x[n] and output y[n] for which

$$y[n-1]-\frac{5}{2}y[n]+y[n+1]=x[n]$$

- By considering the pole-zero pattern associated with the difference equation, determine three possible choices for the unit sample response of the system.