EE7150 Theory and Applications of Digital Signal Processing

Homework 1

Due on February 20, 2006, by 3:45 pm. (NO LATE SUBMISSION IS ALLOWED!)

Check Chapter Three in Cristi’s text. Work on Problem 3, 4, 6, 12, 14, 15, 28, 29.

Extra Problem 1

A truncated low-pass signal is 
\[ x[n] = \frac{\sin(\omega_c n)}{n}, \quad 0 \leq n \leq 2L - 1. \]
\[ X[k] \]
denotes the DFT of \( x[n] \) and \( X_{II}[k] \) denotes the type-II DCT of \( x[n] \). The \( 3dB\)-DFT-bandwidth \( k_{3dB,DFT} \) is defined as
\[ \frac{|X[k_{3dB,DFT}]}{|X[0]|} = \frac{1}{\sqrt{2}} \]
and the \( 3dB\)-DCT-bandwidth \( k_{3dB,DCT} \) is defined as
\[ \frac{|X_{II}[k_{3dB,DCT}]}{|X_{II}[0]|} = \frac{1}{\sqrt{2}}. \]
Show that the condition \( k_{3dB,DCT} \leq k_{3dB,DFT} \) exists.

Extra Problem 2

Verify the conclusion in Extra Problem 1 using the MATLAB experiments for
\( \omega_c = \frac{\pi}{5}, \frac{\pi}{3}, \frac{\pi}{2} \).