EC516 HW03 (Fall 2018)

Due: **Wednesday, September 26** *at the beginning of lecture*

Problem 3.1

Sketch the *analog envelope* of $x[n] = \delta[n-5]$. Show your work.

Problem 3.2

Let $x_b(t)$ be the *analog envelope* of a discrete-time signal $x_b[n] = \dfrac{\sin(2.25\pi n)}{\pi n}$. Specify the values of *t* for which $x_b(t) = 0$. *Justify your answer.*

Problem 3.3

Let $x_b(t) = \sin(0.5\pi(t-3.5))/(\pi(t-3.5))$ be the analog envelope of a discrete-time signal $x_b[n]$. For what values of n is it guaranteed that $x_b[n] = 0$? *Justify your answer.*

Problem 3.4

Consider the signal $x[n] = u[n] - u[n-10]$ with DTFT $X(e^{j\omega})$ and *N*-point DFT $X[k]_N$ for $N \geq 10$.

(a) Sketch $|X(e^{j\omega})|$

(b) Sketch $|X[k]_{10}|$

(c) Sketch $|X[k]_{20}|$

(d) Sketch $|X[2k]_{20}|$

Problem 3.5

(a) If $x[n]$ is a 2-point signal with 2-point DFT $X[k]_2$, show that $X[0]_2 = x[0] + x[1]$ and $X[1]_2 = x[0] - x[1]$. Also, show that it is possible to reconstruct the signal $x[n]$ from knowledge of its 2-point DFT $X[k]_2$.

(b) If $x[n]$ is any 6-point signal whatsoever with 6-point DFT $X[k]_6$, does there exist an integer k_0 for which it is guaranteed that $X[k_0]_6 = x[0]-x[1]+x[2]-x[3]+x[4]-x[5]$. Justify your answer.

(c) If $x[n]$ is any 5-point signal whatsoever with 5-point DFT $X[k]_5$, does there exist an integer k_0 for which it is guaranteed that $X[k_0]_5 = x[0]-x[1]+x[2]-x[3]+x[4]$. *Justify your answer*.

Problem 3.6

(a) Sketch the signal $x[n] = 1 + e^{j\frac{2\pi}{4}n} + e^{j\frac{4\pi}{4}n} + e^{j\frac{6\pi}{4}n}$ and show that it is periodic. Specify the fundamental period *N* of $x[n]$, defined as the smallest positive integer *N* for which $x[n] = x[n-N]$. *Show your reasoning*.

(b) Sketch a 4-point signal $g[n]$ that has a 4-point DFT $G[k]_4$ such that $G[n]_4 = x[n]$ for $0 \le n \le 3$, where $x[n]$ is the signal specified in part (a) of this problem. *Justify your answer.*