

FALL 24 EC516 Problem Set 09

Due: Sunday November 10 (Before 11:59pm)

You must submit your homework attempt on Blackboard Learn. For this purpose, you must convert your homework attempt to a pdf file and upload it at the corresponding homework assignment on Blackboard Learn.

Problem 9.1

If $x[n]$ is an N -point signal, then the N -point DFT of $x[n]$ is defined as:

$$X[k]_N = \begin{cases} X\left(e^{j\frac{2\pi k}{N}}\right) & \text{for } 0 \leq k < N \\ 0 & \text{otherwise} \end{cases}$$

In the above equation, $X(e^{j\omega})$ is the DTFT of $x[n]$. Throughout this problem, we consider the signal $x[n] = u[n] - u[n - 4]$

- (a) Sketch $|X(e^{j\omega})|$, the magnitude of the DTFT of $x[n]$.
- (b) For what values of k is it guaranteed that $X[k]_4 = 0$? Justify your answer.
- (c) For what values of k is it guaranteed that $X[k]_8 = 0$? Justify your answer.
- (d) If $y[n] = (-1)^n x[n]$, sketch the magnitude of the 4-point DFT of $y[n]$.

Problem 9.2

A) Let $q[n]$ be a 128-point signal whose DTFT is $Q(e^{j\omega})$ and whose 256-point DFT is $Q[k]_{256}$.

(a) Does there exist an integer k_0 such that $Q[k_0]_{256} = Q(e^{-j\pi/2})$? Justify your answer.

(b) Let $r[n] = q[n - 16]$ and let $R[k]_{256}$ be the 256-point DFT of $r[n]$. Is it true that $|R[k]_{256}| = |Q[k]_{256}|$ for all k ? Justify your answer.