# GATE Assignment

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Download all latex-tikz codes from

https://github.com/cmaspi/EE3900/blob/main/GateAssignment/assignment.tex

## 1 Problem

(EC-2020/Q.29) A finite duration discrete-time signal $x[n]$ is obtained by sampling the continuous-time signal $x(t) = cos(200\pi t)$ at sampling instants $t = \frac{n}{400}$, $n = 0, 1, ..., 7$. The 8-point discrete Fourier transform (DFT) of $x[n]$ is defined as

$$X[k] = \sum_{n=0}^{7} x[n] e^{-j\frac{\pi kn}{4}}, \quad k = 0, 1, 2, ..., 7 \tag{1.0.1}$$

Which of the following is true?

1) All $X[k]$ are non-zero
2) Only $X[4]$ is non-zero
3) Only $X[2]$, $X[6]$ are non-zero
4) Only $X[2]$, $X[6]$ are non-zero

## 2 solution

*Lemma* 2.1. The first half of the even index rows of the DFT matrix is same as the second half of the same

*Proof.*

$$\because w^{2kn} = w^{2kn+Nn} \tag{2.0.1}$$

□

Given,

$$x(t) = \cos(200\pi t) \tag{2.0.2}$$

$$x[n] = \cos\left(\frac{n\pi}{2}\right) \tag{2.0.3}$$

The discrete input signal is given as

$$x = [1, 0, -1, 0, 1, 0, -1, 0] \tag{2.0.4}$$

This input signal is circular, the first half and second half are equal.

$$\mathbf{X}^T = \mathbf{W}\mathbf{x}^T \tag{2.0.5}$$

where, $\mathbf{X}$ is the 8 point fourier transform of $\mathbf{x}$ From (2.1) the odd index entries will trivially be 0

Therefore, **Option C** is correct