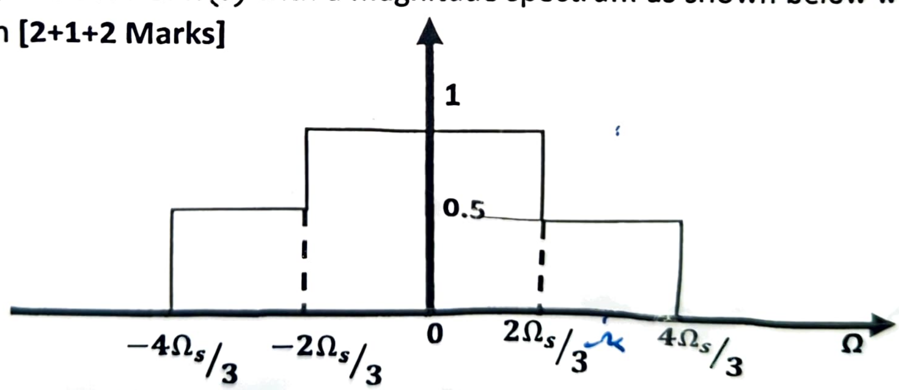
Quiz-2, 2023

Answer all the questions.

1. A signal $x[n] = \{x[0], x[1], x[2], x[3], x[4], x[5], x[6], x[7]\}$ of length 8 i.e., there are 8 non-zero consecutive values and the remaining values are zero. For this signal, it is required to obtain following four DFT values $X[1], X[3], X[5], X[7]$ using FFT chips. Unfortunately, there is no 8-point FFT chip, only one 4-point FFT chip is available. Let's assume that the 4-point chip takes any arbitrary signal $y[n] = \{y[0], y[1], y[2], y[3]\}$ as the input in the normal sequence order and compute its respective 4-point DFT in the normal sequence order $Y[k] = \{Y[0], Y[1], Y[2], Y[3]\}$. **[5 Marks]**
    a. Using this 4-point FFT chip, can the required DFT values $(X[1], X[3], X[5], X[7])$ computed for any $x[n]$? if yes derive the necessary equations and draw the complete connections else argue the reasons by deriving the necessary equations.

2. There is an 8-point DIT FFT chip, which takes the arbitrary signal $x[n] = \{x[0], x[1], x[2], x[3], x[4], x[5], x[6], x[7]\}$ in normal sequence order and produce the DFT in bit reversal order $\{X[0], X[4], X[2], X[6], X[1], X[3], X[5], X[7]\}$. To this chip, instead of $x[n]$, $X[k]$ is giving as the input in the normal sequence order. Under this condition, is the chip perform the computation without leading to chip damage? If yes, derive the output else argue the necessary reasons. **[5 Marks]**

3. Let's consider $H(J\Omega)$ is a CTFT of $h(t)$ with a magnitude spectrum as shown below with zero phase spectrum then **[2+1+2 Marks]**



    a. Plot the amplitude spectrum of DTFT $H(e^{j\omega})$ of $h[n]$, where $h[n]$ is the discrete time signal obtained from $h(t)$ using sampling frequency F_s $(\Omega_s = 2\pi F_s)$.
    b. Let $H[k]$ is the values obtained by sampling $H(e^{j\omega})$ at four equidistance locations of ω between $-\pi$ to π or Ω between ${-\Omega_s}/{2}$ to ${\Omega_s}/{2}$, then compute $h[n]$.
    c. Let $H_1(z)$ and $H_2(z)$ are two z-transforms which results the same amplitude spectrum of $H(e^{j\omega})$ but with two different non-zero phase spectrums, then draw the pole-zero plots of $H_1(z)$ and $H_2(z)$?