Tutorial Sheet No. – 08

question no. 01 ⇒ Based on the frequency-sampling method, determine the coefficients of a linear-phase FIR filter of length $M = 15$, which has a symmetric response, and a response that satisfies the conditions.

$$H_r\left(\frac{2\pi k}{15}\right) = \begin{cases} 1 & k = 0, 1, 2, 3 \\ 0.4 & k = 4 \\ 0 & k = 5, 6, 7 \end{cases}$$

Hint:- $H\{k\} = G[k]\, e^{j\pi k/M} \quad k = 0, 1, \text{-----}, M-1$

$$G\{k\} = (-1)^k \, H_r\left(\frac{2\pi k}{M}\right)$$

$$h(n) = \frac{1}{M}\left\{ G(0) + 2\sum_{k=1}^{U} G(k) \cos\left[\left(\frac{2\pi k}{M}\right)\left(n + \frac{1}{2}\right)\right]\right\}$$

$$U = \begin{cases} \frac{M-1}{2} & ; \text{ when } M \text{ odd} \\ \frac{M}{2} - 1 & ; \text{ when } M \text{ even} \end{cases}$$

$$[h(n) = +h(M-1-n)]$$

question no. 02 ⇒ An ideal digital differentiator is defined as the one that has the frequency response

$$\hat{H}d(\omega) = j\omega \quad ; \quad -\pi < \omega \leq +\pi$$

Determine $\hat{h}d(n)$, and comment about this

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unit sample response type. Which type of FIR filter designs can be used for its implementation?

<u>question no. 03</u> $\Rightarrow$ The frequency response of the ideal Hibert transformer is specified as

$$\hat{H}_d(\omega) = \begin{cases} -j \; ; & 0 < \omega \leq \pi \\ +j \; ; & -\pi < \omega < 0 \end{cases}$$

Determine $\hat{h}_d(n)$, and comment about this unit sample response type. Which type of FIR filter designs can be used for its implementation? (under linear-phase constraint)

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