CSE 431 (DSP), TT # 4, Time: 30 min, Marks: 20

1. If $x(n)$ and $X(k)$ are N-point DFT pair, then $X(k+N) = ?$
2. If $X_1(k)$ and $X_2(k)$ are the N-point DFTs of $x_1(n)$ and $x_2(n)$, respectively, then what is the N-point DFT of $x(n)=ax_1(n)+bx_2(n)$?
3. How do you compute the response of the FIR filter with impulse response $h(n)$ to the input sequence $x(n)$?
4. A finite-duration signal of length L is given as $x(n) = \{1, 1, 1, 1, 1, 1, 1, 1, 1, 1, \ldots\}$. Determine the N-point DFT of this sequence.
5. Explain how the choice of window affects the spectrum estimation.
6. Describe the overlap-add method of linear filtering of long data sequence.

Tutorial - 4

(1)

$$X(k+N) = X(k)$$

(2)

$$x_1(n) = X_1(k)$$
$$x_2(n) = X_2(k)$$

$$x(n) = a x_1(n) + b x_2(n)$$
$$X(z) = a X_1(k) + b X_2(k)$$

(3)

$$y(n) = h(n) * x(n)$$

(4)

$$x(n) = \{1, 1, 1, 1, 1, 1, 1, 1, \ldots\}$$

N-Point DFT of this sequence :

$$x(k) = \sum_{n=0}^{L-1} x(n)\, e^{-j2\pi kn/N}$$

$$= \sum_{n=0}^{L-1} e^{-j2\pi kn/N}$$

$$= \frac{1-e^{-j2\pi kL/N}}{1-e^{-j2\pi k/N}}$$

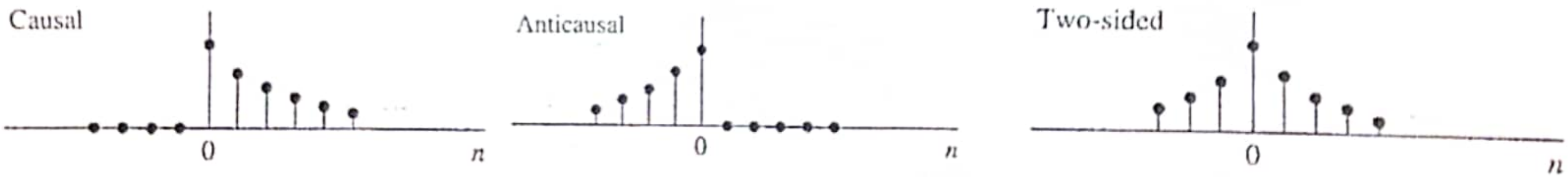
(5)

The choice of window affects the spectrum estimation. In rectangular window method there can be found better resolution but ~~if we~~ theres is leakage problem. If we ~~avoid the~~ want to avoid leakage problem, we can use Hamming window. But there is the resolution problem in Hamming window. So, the choice of window affects the spectrum estimation.

CSE 431, T#2, Marks: 20, Time: 40 min [Answer any five.]

1. Write down the z-transforms of δ(n), δ(n-k), and δ(n+k).
2. Determine the z-transforms of x(n) = [u(n) - u(n - 10)].
3. Determine the convolution of the following pairs of signals by means of the z-transform.
   x(n) = {1, -2, 1} and h(n) = {1, 1, 1, 1, 1, 1}.
4. An LTI system is characterized by the system function $H(z) = \dfrac{3-4z^{-1}}{1-3.5z^{-1}+1.5z^{-2}}$. Determine the ROC and *h(n)* if the system is causal and if the system is anticausal.

   $\frac{1}{1-\frac{1}{2}z^{-1}} + \frac{2}{1-3z^{-1}}$
5. Determine the system function *H(z)* and unit impulse response of the system described by
   y(n) = 0.5y(n-1) –2x(n).
6. Plot the ROC of the following infinite-duration signals.



Tutorial - 3

(1)

$$\delta(n) \xrightarrow{Z} 1$$
$$\delta(n-k) \xrightarrow{Z} z^{-k}$$
$$\delta(n+k) \xrightarrow{Z} z^{k}$$

(2)

$$x(n) = u(n) - u(n-10)$$
$$\xrightarrow{Z} \frac{1}{1-z^{-1}} - \frac{z^{-10}}{1-z^{-1}}$$

(3)

$$x(n) = \{1, -2, 1\}$$
$$h(n) = \{1, 1, 1, 1, 1, 1\}$$

$$X(z) = 1 - 2z^{-1} + z^{-2}$$
$$H(z) = 1 + z^{-1} + z^{-2} + z^{-3} + z^{-4} + z^{-5}$$

$$Y(z) = X(z)H(z)$$

$$= 1 - z^{-1} - z^{-6} + z^{-7}$$

$$y(n) = \{1, -1, 0, 0, 0, 0, -1, 1\}$$

(4)

$$H(z) = \frac{3 - 4z^{-1}}{1 - 3.5z^{-1} + 1.5z^{-2}}$$

$$= \frac{1}{1 - \frac{1}{2}z^{-1}} + \frac{2}{1 - 3z^{-1}}$$

(a) If the system is causal $\frac{1}{2} < z < 3$

$$h(n) = \left(\frac{1}{2}\right)^n u(n) + 2(3)^n u(n)$$

(b) If the system is anticausal $\frac{1}{2} < z < 3$

$$h(n) = -\left(\frac{1}{2}\right)^n u(-n-1) - 2(3)^n u(-n-1)$$

(5)

$$y(n) = 0.5y(n-1) - 2x(n)$$

$$Y(z) = 0.5z^{-1}Y(z) - 2X(z)$$

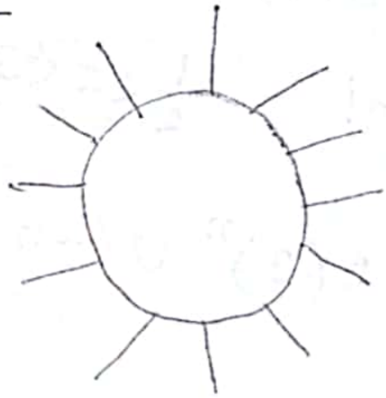
$$Y(z)(1-0.5z^{-1}) = -2X(z)$$

$$\frac{Y(z)}{X(z)} = \frac{-2}{1-0.5z^{-1}}$$

$$H(z) = -\frac{2}{1-0.5z^{-1}}$$

(6)

Causal:



Anticausal:

Two-sided: