UNIT - V

LTI - DISCRETE TIME SYSTEMS

Difference Equation :-

It is an efficient way to implement discrete time system. It is defined as the convolution of i/p sequence $x(n)$ and unit sample response $h(n)$ gives output $y(n)$

$$\therefore y(n) = \sum_{k=-\infty}^{\infty} h(k)\, x(n-k)$$

Finite Impulse Response System [FIR] :-

The system for which the unit sample response $h(n)$ (or) impulse response $h(n)$ has finite no of terms are called Finite Impulse Response system

$$y(n) = \sum_{k=0}^{M-1} h(k)\, x(n-k)$$

Infinite Impulse Response [IIR] System :-

The system is said to be an infinite impulse response system if the length of the impulse response is infinite

$$y(n) = \sum_{k=0}^{\infty} h(k)\, x(n-k)$$

Non-recursive system :- Analysis :-

when the o/p $y(n)$ of the system depends upon present and past input then it is called Non-recursive system.

$$y(n) = \sum_{k=0}^{M} h(k)\, x(n-k)$$

Recursive system :-

when the o/p $y(n)$ of the system depends on present and past inputs as well as past output is called recursive system.

$$y(n) = \sum_{k=0}^{n} x(k)$$

condition of causality LTI of a Discrete time signal.

$$h(n) = 0 \quad \text{for } n < 0$$

condition for stability :-

$$\sum_{k=-\infty}^{\infty} |h(k)| < \infty$$

z-transform Analysis :-

$$H(z) = \frac{Y(z)}{X(z)} \rightarrow \text{system Function.}$$

① A difference equation of a system is described by $y(n) = 0.5y(n-1) + x(n)$. Determine (i) system Function (ii) pole zero plot (iii) Unit sample response of the system.

Taking z-transform on both sides

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

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

$$Y(z)\left[1 - 0.5z^{-1}\right] = X(z)$$

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

$$H(z) = \frac{z-0}{z-0.5}$$

$$z_1 = 0, \; P_1 = 0.5$$

$$\therefore h(n) = (0.5)^n u(n).$$

Pole zero plot :- Multiply & Divide by z

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