Finite Impulse Response (FIR) system

1) h(n) has finite no. of elements

h (n) = {h (0) , h (1), h (2) …h(m)}

2) $H(Z) = \sum_{k=0}^{m} a_k \, Z^{-k}$

where a_k: system coefficients.

$H(Z) = h(o) + h(1)Z^{-1} + h(2)Z^{-2} + \cdots h(m)Z^{-m}$

(has only a numerator)

$H(z) = \frac{y(z)}{x(z)} = h(0) + h(1)Z^{-1} + \cdots + h_m Z^{-m}$

3) The difference equation is:

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

$y(n) = h(0)x(n) + h(1)x(n-1) + h(2)x(n-2) + \cdots h(m)x(n-m)$

4) Has no feedback

5) Always stable.

Infinite Impulse Response (IIR) system

1) h (n) here has infinite no. of elements

ex: $h(n) = \left(1/2\right)^n \, u(n)$

2) $H(Z) = \frac{\sum_{k=0}^{m} a_k Z^{-k}}{1+\sum_{k=1}^{r} b_k Z^{-k}} = \frac{y(z)}{x(z)}$

$H(Z) = \frac{a_0 + a_1 Z^{-1} + A_2 Z^{-2} + \cdots a^m z^{-m}}{1 + b_1 Z^{-1} + b_2 Z^{-2} + \cdots b_r Z^{-r}}$

3) The difference equation is:

$y(n) = \sum_{k=0}^{m} a_k x(n-k) - \sum_{k=1}^{r} b_k \, y(n-k)$

$y(n) = a_0 x(n) + a_1 x(n-1) + a_2 x(n-2) + \cdots a_m x(n-m) - b_1 y(n-1) - b_2 y(n-2) \ldots - b_r y(n-r)$

4) Has a feedback

5) May be stable or unstable.

6) Has one delay line with m-taps.	6) Has two tapped delay m-taps for (x) + r-taps for the feedback from (y).
7) The FIR system is open loop without a feedback, so it is called nonrecursive.	7) The IIR system has a feedback and it is called a closed loop system, so it is called recursive.
8) No poles outside the unit circle (zero poles Z=0)	8) Some poles are likely to exist outside the unit circle.