Tiansyh is Nonlinear
Most practical systems are nonlinear when range is large

1.15

$$x(n) \rightarrow \boxed{h(n)} \rightarrow y(n)$$

LTI

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

a. $h[n] = \delta[n-3]$ $y[n] = 5u[n-2] - u[n-6]$

$x[n] = 5u[n+1] - u[n-3]$

b. $\boxed{\begin{array}{l} h[n] = \delta[n-1] \\ y[n] = x[n] - x[n-1] \end{array}}$

$n=0$ $\sum h[k]\, x[-k] = 0$
$n=1$ $= h[k]\, x[1-k] = 1$
$n=2$ $= 1$

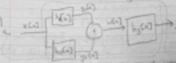
$y[n] = x[n-1]$?

Tabular Method of Convolution

c. $y[n] = x[n] - x[n-1]$ $n=2$ $y[-2] = x[-2] - x[-3] = 0$
$n=2$ $y[2] = x[2] - x[1] = 1$

5.19

a.



$h_1[n] = \delta[n] + 2\delta[n-1] + 3\delta[n-2] + 4\delta[n-3]$
$h_2[n] = \delta[n] + \delta[n-1] + \delta[n-2] + \delta[n-3]$
$h_3[n] = \delta[n] - \delta[n-1]$

b. $y_1[n] = h_1[n] * x[n]$
$y_2[n] = h_2[n] * x[n]$
$w[n] = y_1[n] + y_2[n]$
$y[n] = h_3[n] * w[n]$
$= h_3[n] * (y_1[n] + y_2[n])$
$= h_3[n] * (h_1[n] * x[n] + h_2[n] * x[n])$
$= [h_3[n] * (h_1[n] + h_2[n])] * x[n]$
$= [h_3[n] * (2\delta[n] + 3\delta[n-1] + 4\delta[n-2] + 5\delta[n-3])] * x[n]$
$= \delta[n] - \delta[n-1] * \quad] * x[n]$

h[n]


$(2\delta[n] + \delta[n-1] + \delta[n-2] + \delta[n-3] - 5\delta[n-4]) * x[n]$

x[n]


x[n]