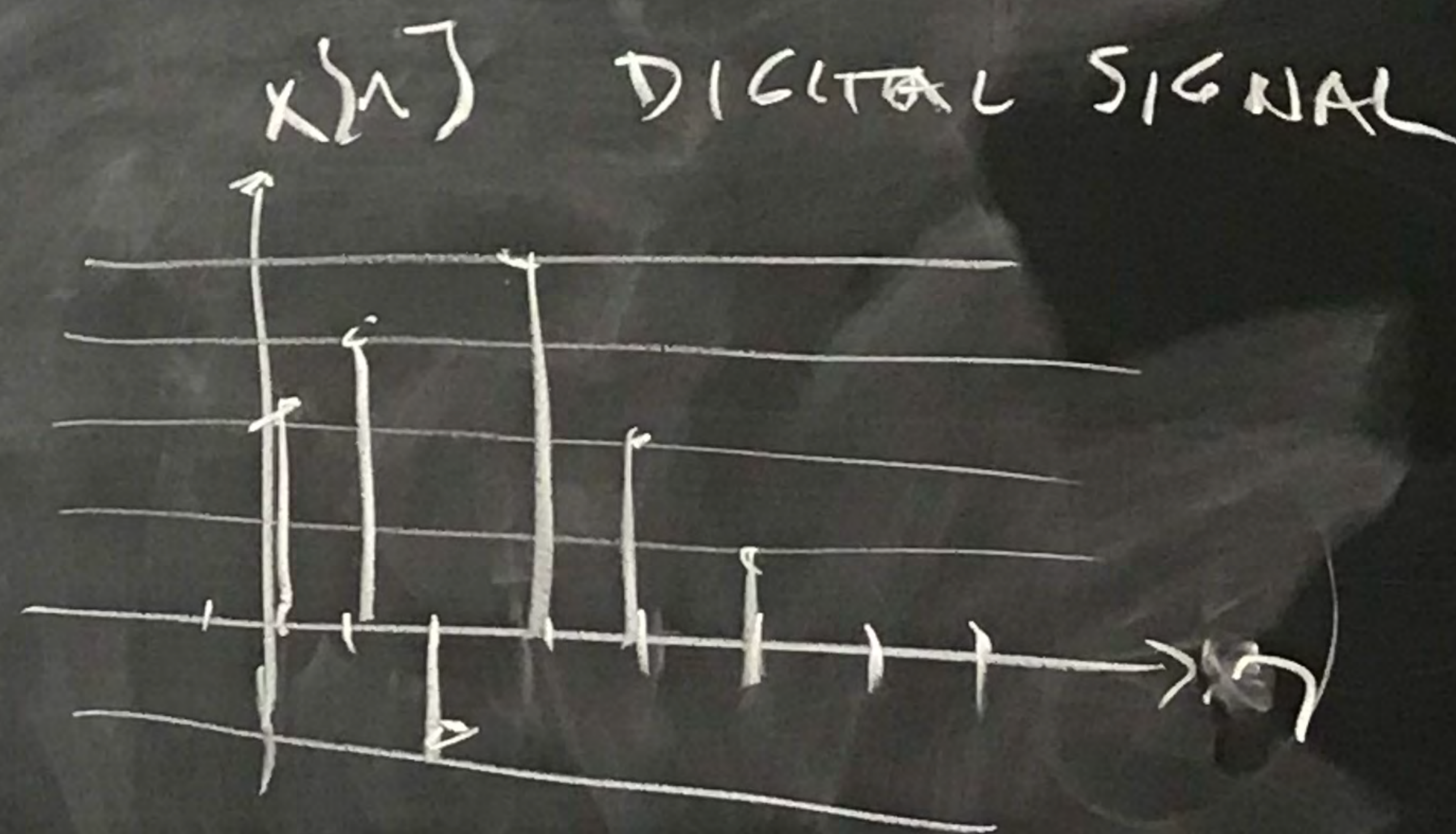
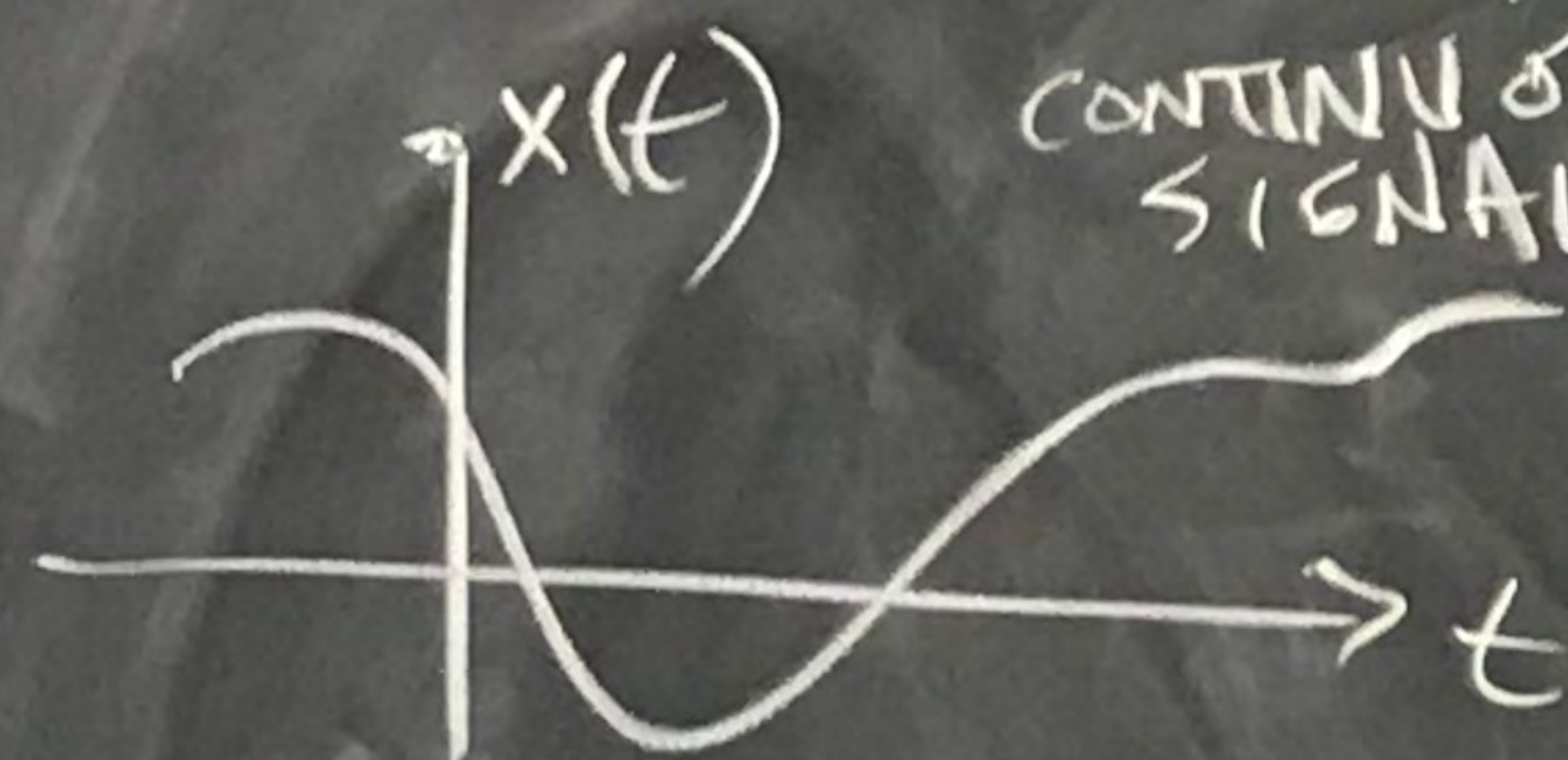


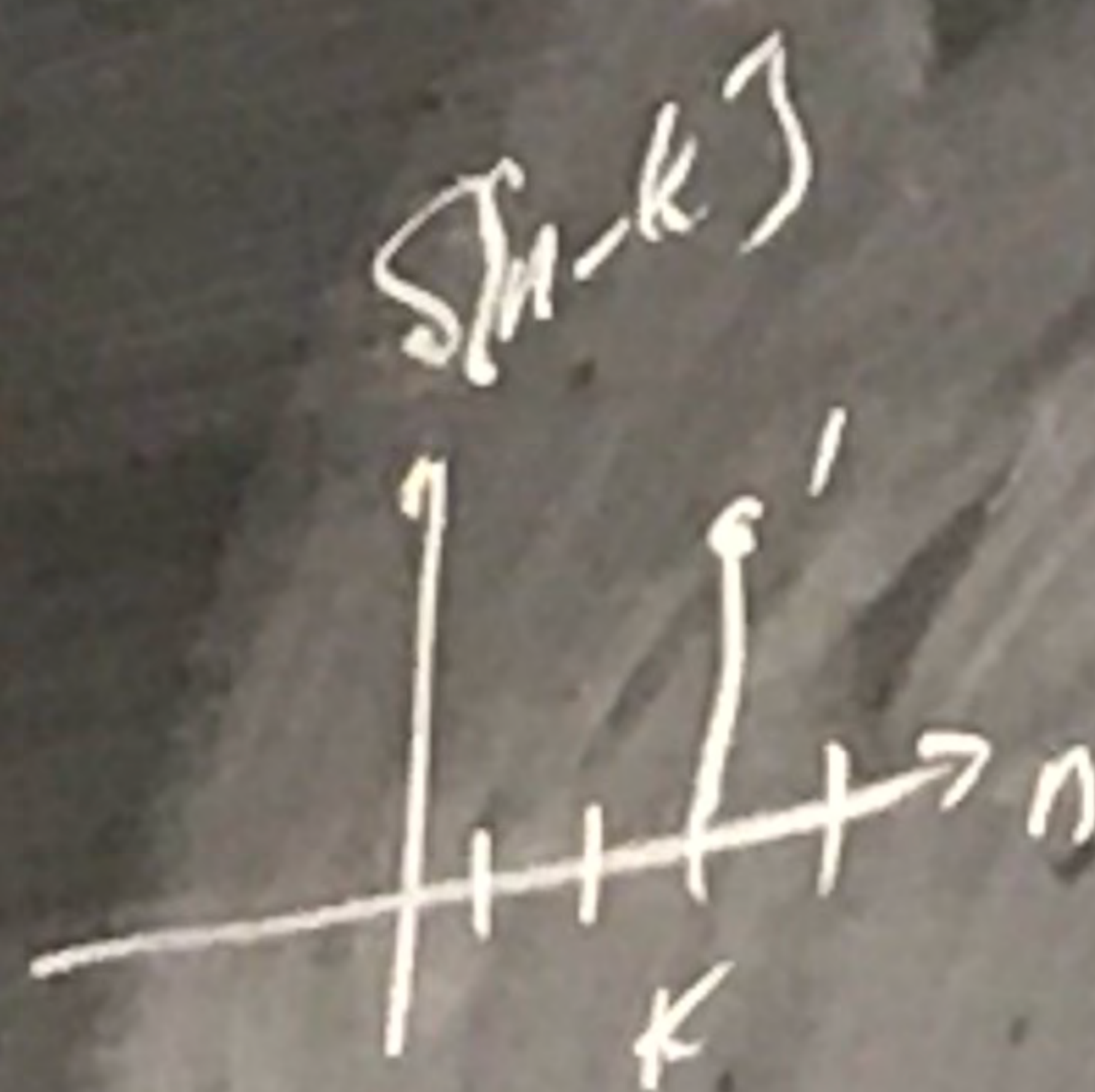
DT DSP IN THE TIME DOMAIN:

SIGNALS, SYSTEMS, + CONVOLUTION

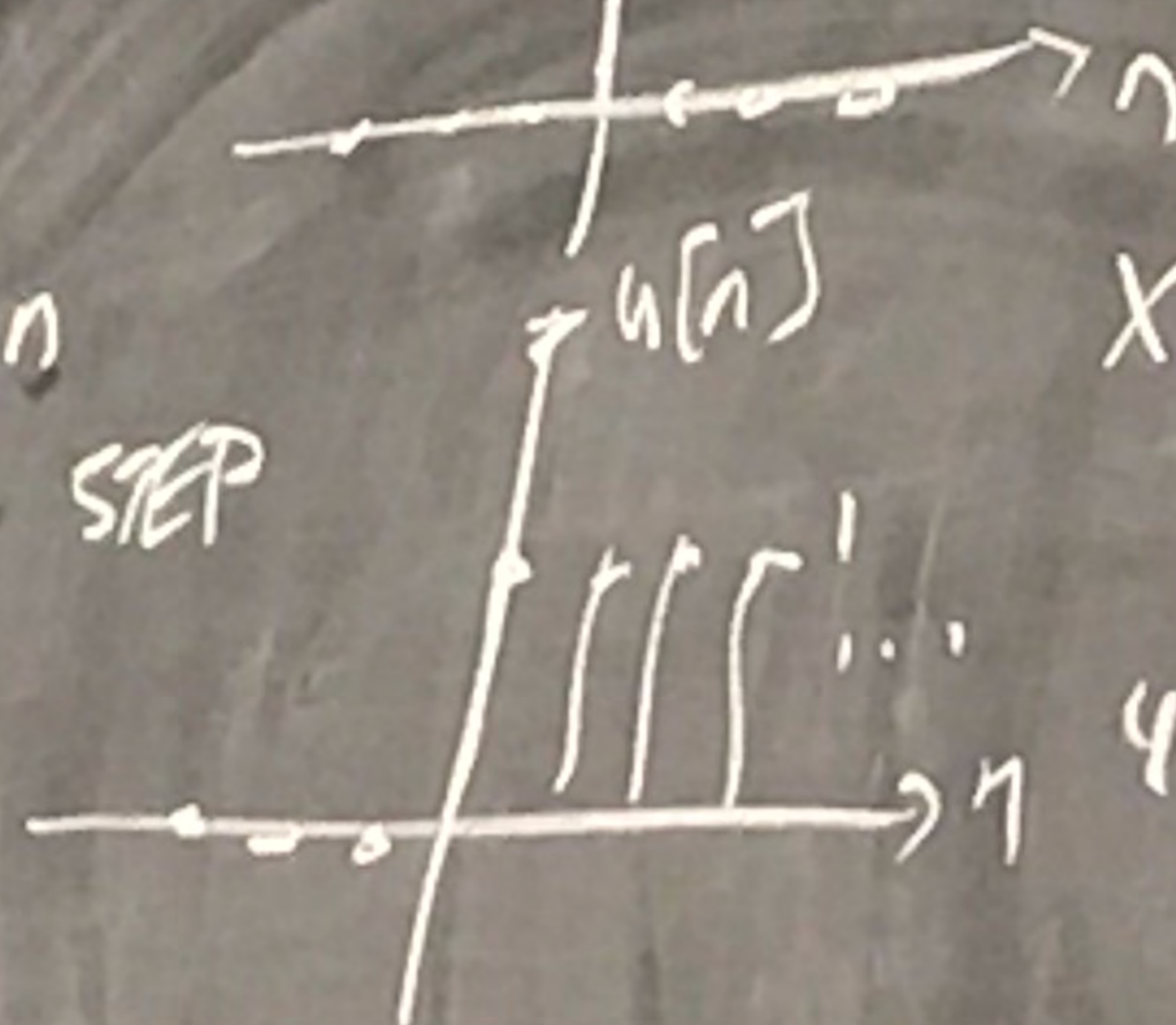
(OSYP 2.0-2.4)



SOME IMPORTANT SIGNALS



IMPULSE $\delta[n]$



STEP

$$\delta[n] = \begin{cases} 1, & n=0 \\ 0, & n \neq 0 \end{cases}$$

$$x[n] = \sum_{k=-\infty}^{\infty} x[k] \delta[n-k]$$

$$u[n] = \begin{cases} 1, & n \geq 0 \\ 0, & n < 0 \end{cases}$$

$$\delta[n] = u[n] - u[n-1]$$

$$u[n] = \sum_{k=-\infty}^n \delta[k]$$

$$u[n] = \sum_{k=-\infty}^{\infty} \delta[k]$$

PERIODIC SIGNALS

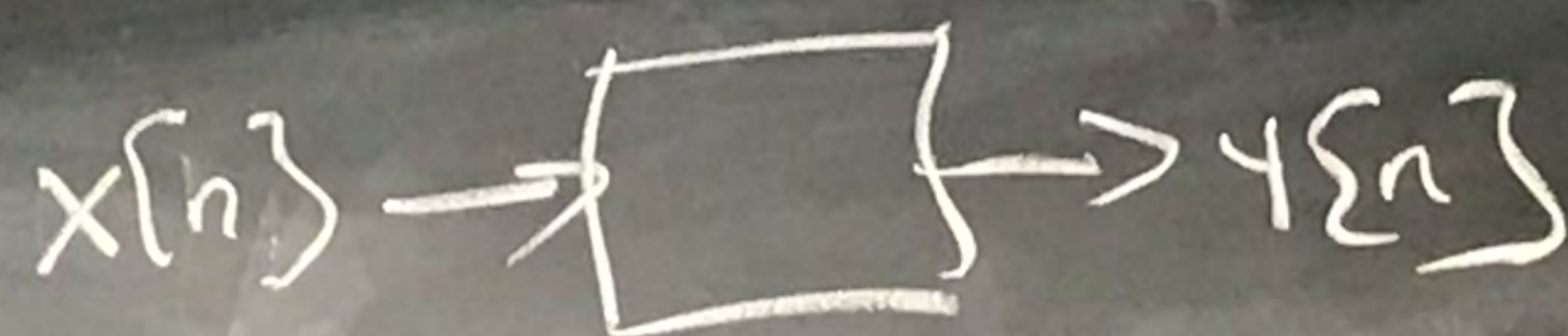
$x[n]$ PERIODIC IF $x[n] = x[n-N]$

$$x[n] = \cos\left(\frac{2\pi n}{N}\right)$$

$$N = 3/2, n = 3$$

$$N = 3/2 \Rightarrow x[n] = \cos\left(\frac{2\pi n}{3/2}\right) = \cos\left(\frac{2\pi \cdot 3}{3/2}\right)$$

PROPERTIES OF SYSTEMS.



LINEARITY
THEN

$$\text{IF } x[n] \rightarrow y[n]$$

$$a x[n] \rightarrow a y[n]$$

HOMOGENEITY

$$x_1[n] + x_2[n] \rightarrow y_1[n] + y_2[n]$$

SUPERPOSITION

$$a_1 x_1[n] + a_2 x_2[n] \rightarrow a_1 y_1[n] + a_2 y_2[n]$$

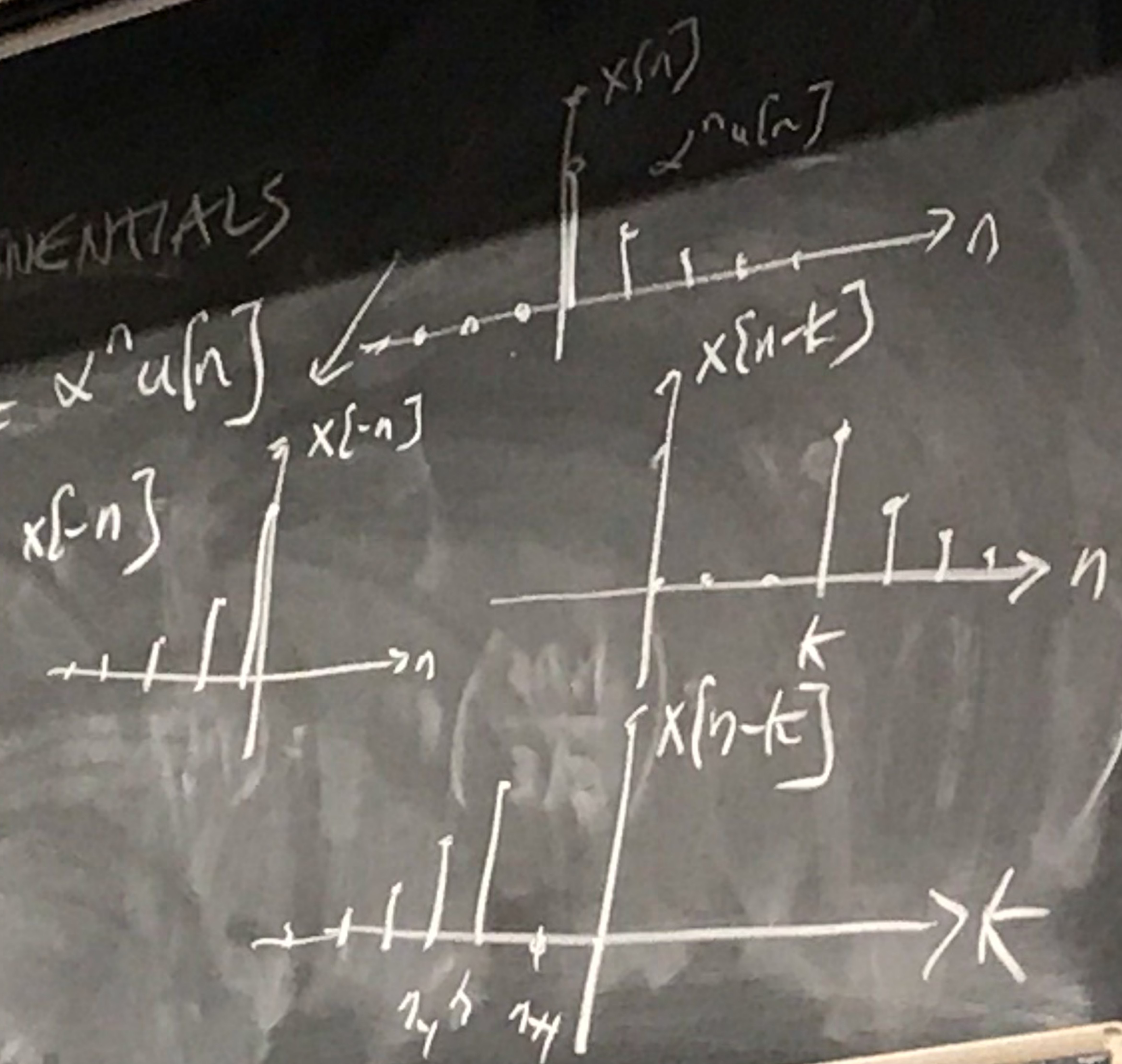
SHIFT INVARIANCE

$$x[n-N] \rightarrow y[n-N]$$

STABILITY

REAL EXPONENTIALS

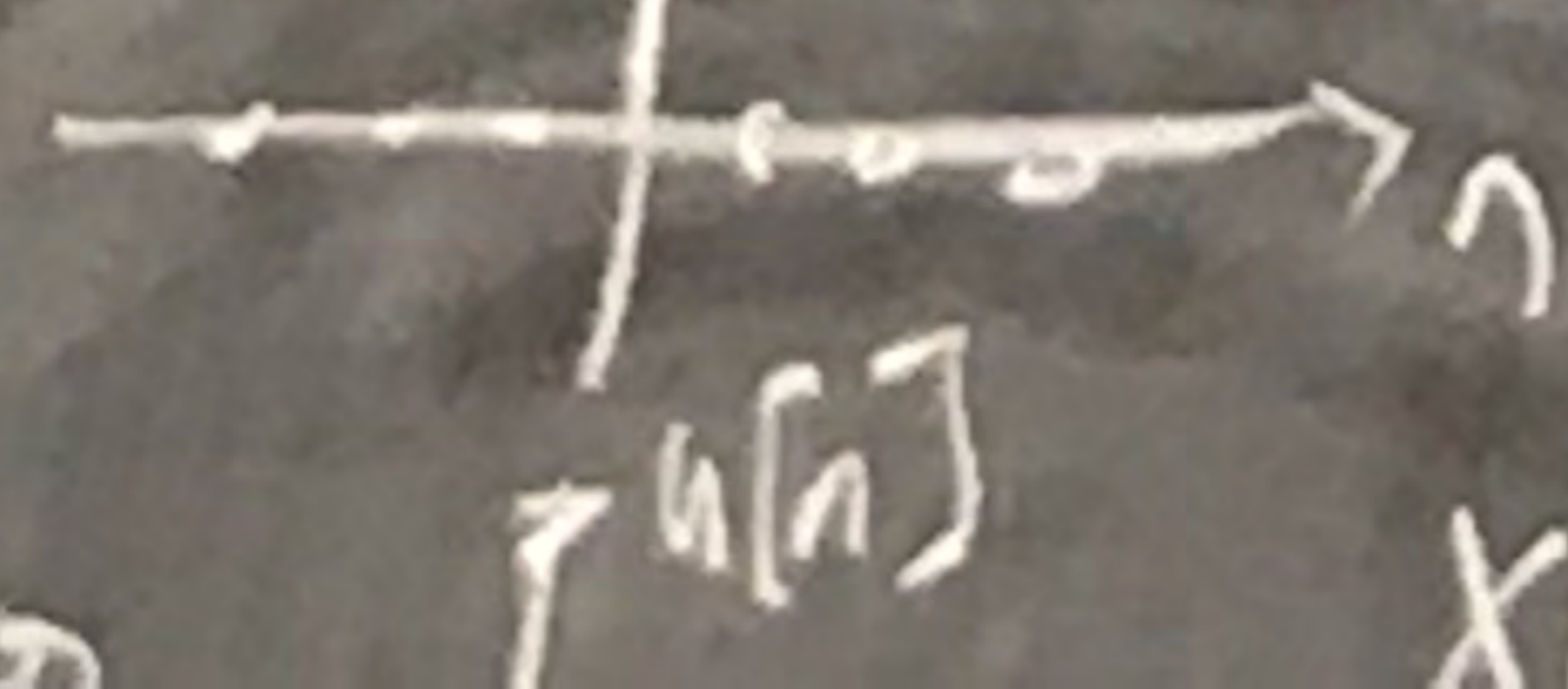
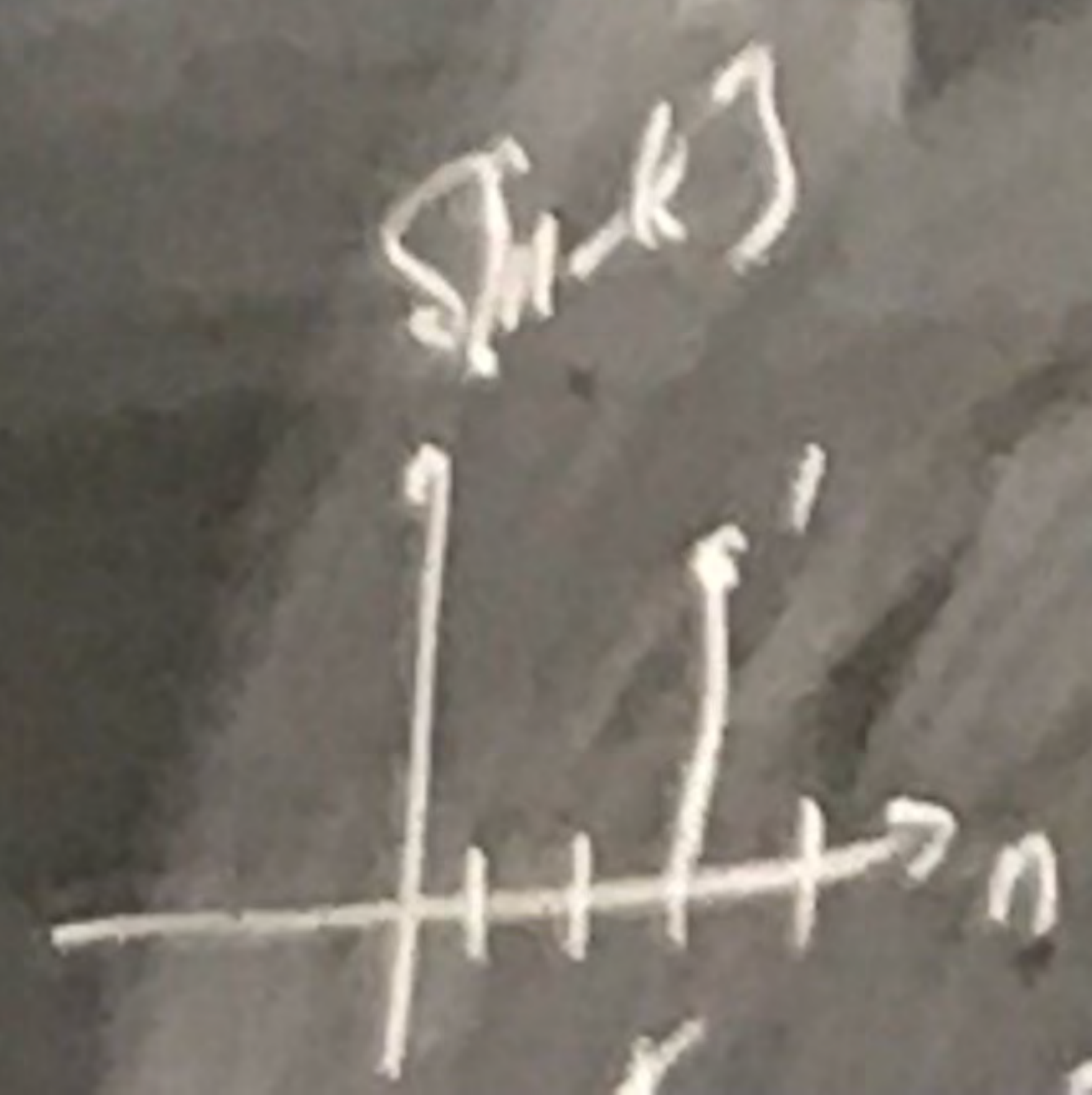
$$x[n] = \alpha^n u[n]$$



SOME IMPORTANT SIGNALS

IMPULSE $\delta[n]$

$$\delta[n] = \begin{cases} 1, & n=0 \\ 0, & n \neq 0 \end{cases}$$



$$x[n] = \sum_{k=-\infty}^{\infty} x[k] \delta[n-k]$$

STABILITY IF $|x[n]| < \infty, \forall n$

THEN $|y[n]| < \infty, \forall n$

CAUSALITY

$y[n]$ DEPENDS ONLY ON $x[k]$ FOR $k \leq n$

MEMORYLESSNESS

$y[n]$ DEPENDS ONLY ON $x[k]$ FOR $k = n$

CONVOLUTION FOR LSI SYSTEMS

$$x[n] \rightarrow \boxed{} \rightarrow y[n]$$

DEFINE $s[n] \rightarrow h[n]$

$$s[n-k] \rightarrow h[n-k] \quad \text{SI}$$

$$x[k] s[n-k] \rightarrow x[k] h[n-k] \quad L: H$$

$$x[n] = \sum_{k=-\infty}^{\infty} x[k] s[n-k] \rightarrow \sum_{k=-\infty}^{\infty} x[k] h[n-k] \quad L: S = y[n]$$