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Q5) $x_c(t) = 0$, for $t<0$ & $t>t_0$

$x_c(t) \rightarrow$ bandlimited to $3\pi \times 10^4$

$\Rightarrow$ Bandwidth of signal $= \frac{3\pi \times 10^4}{2\pi}$

$= 1.5 \times 10^4$ Hz

$\Rightarrow$ Nyquist rate $= 3 \times 10^4$ Hz

we want to estimate the area under the signal between time $t=0$ to $t=t_0$.

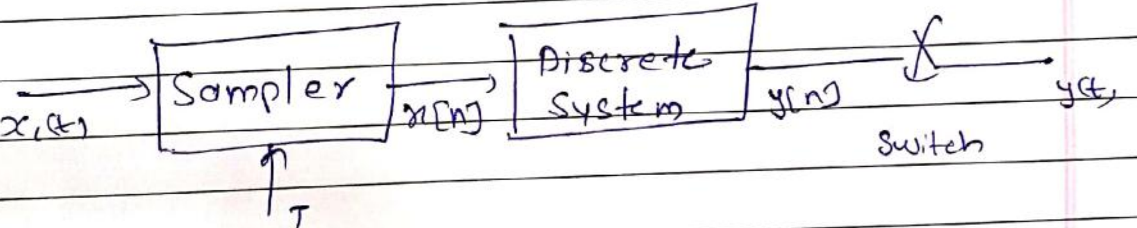
$\Rightarrow \int_0^{t_0} x_c(t)\,dt$ is required, which is equal to DC component of $X(\omega)$.

$\Rightarrow X(0)$ is required.

Here we can sample the signal below nyquist rate since only DC component is required.

$\Rightarrow$ Minimum required freq will be bandwidth.

$\Rightarrow \frac{1}{T} = 1.5 \times 10^4$ Hz



The spectrum of $x[n]$ at dc will be $\frac{1}{T} X(0)$.

$\Rightarrow$ we need ~~an~~ scaled accumulator in our discrete system.

$\Rightarrow$ Desired Discrete system is $T\,u[n]$.

~~But~~ this system will ~~continuously~~ integrate the signal over time.

No. of samples in t_0 time $= \frac{t_0}{T}$

Now if our system is ideal (Band and time limited) then output of discrete system will give the area under the signal.

Otherwise the area from $t=0$ to $t=t_0$ will be estimated by obtaining $y\left[\frac{t_0}{T}\right]$ $\Rightarrow$ After t_0 time we can turn on switch and get the area.

If $t_0 \uparrow$ then number of sample will also increase.