Introduction contd...

$x(t) = A\cos(\omega t)$

$\omega = 2\pi F$

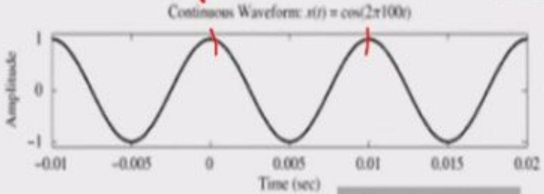
$\frac{1}{2000} = 0.0005$

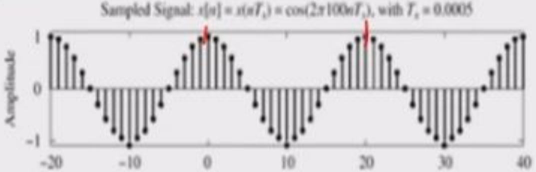
$x[n] = x(nT_s)$

$x[n] = A\cos(2\pi F n T_s)$

$x(t) \rightarrow$ **C-to-D** $\rightarrow x[n]$

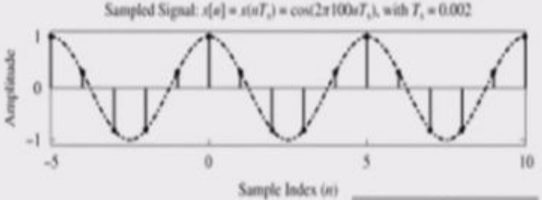
$f_s = 2\,\text{kHz}$





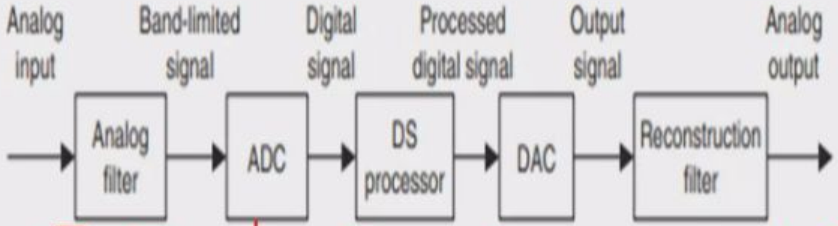
$f = 100\text{Hz}$

$\frac{0.01}{0.0005} = 20$



$f_s = 500\text{Hz}$

Introduction to DSP



LPF

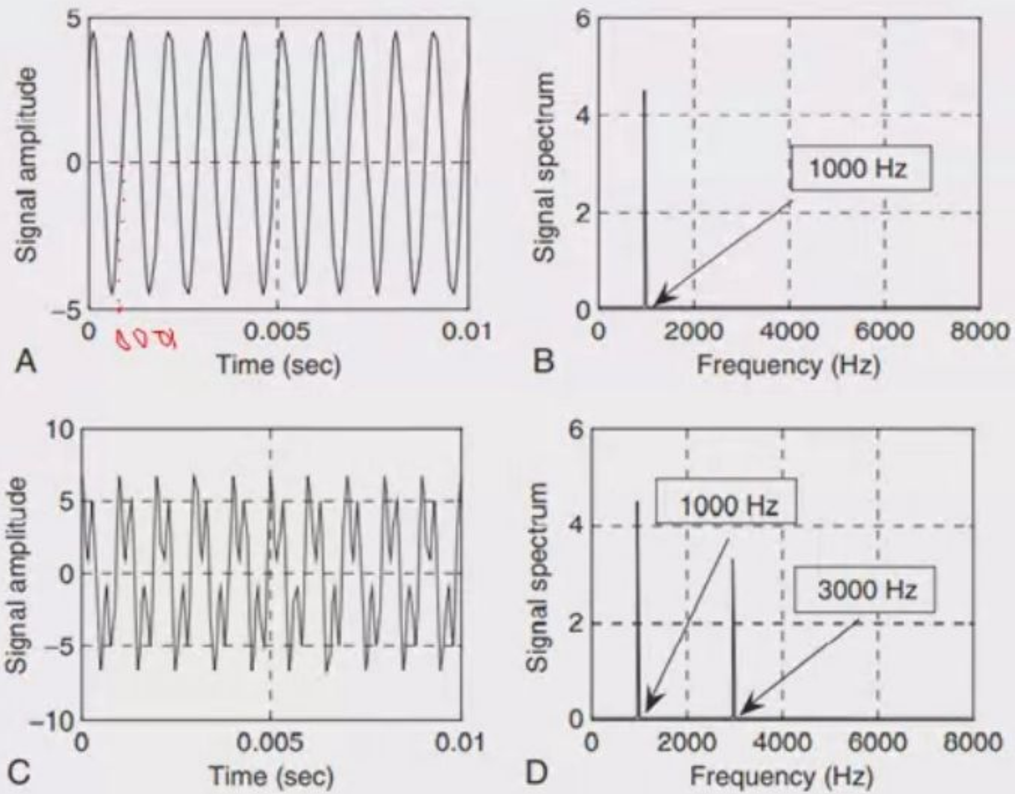
Sampling

LPF

Anti-aliasing filter

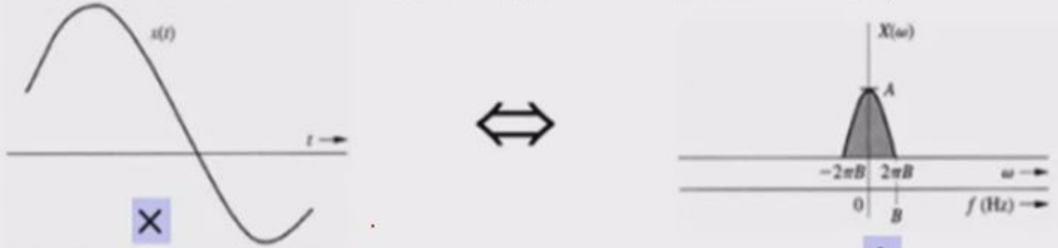
To bandlimit signal

frequency domain representation



Introduction contd...

- Consider a bandlimited signal x(t) and is spectrum X(ω):



- Ideal sampling = multiply x(t) with impulse train :

- Therefore the sampled signal has a spectrum (convolution):

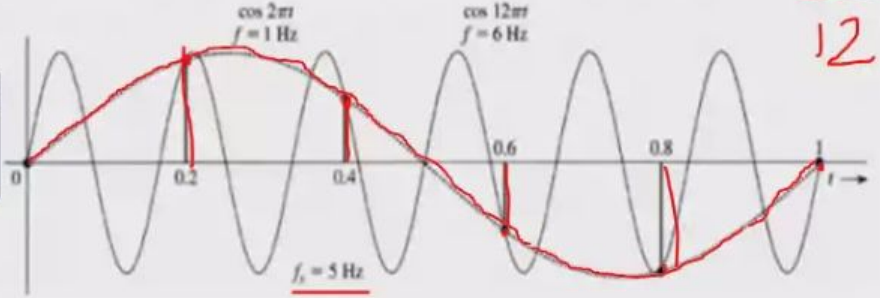
Sampling theorem contd...

$\frac{1}{5} = 0.2$

- Consider what happens when a 1Hz and a 6Hz sinewave is sampled at a rate of 5Hz.

$\frac{1}{12}$

1Hz & 6Hz sinewaves are indistinguishable after sampling



- In general, if a sinusoid of frequency f Hz is sampled at fs samples/sec, then sampled version would appear as samples of a continuous-time sinusoid of frequency $|f_a|$ in the band 0 to fs/2, where:

$$|f_a| = |f \pm m f_s| \qquad \text{where } |f_a| \le \frac{f_s}{2}, \text{ m is an integer}$$

- In other words, the 6Hz sinusoid is FOLDED to 1Hz after being sampled at 5Hz.

$m = 1$ — 6, 11, 16, 21 $\Rightarrow$ 1Hz