Unit-3

Conversion subsystem

The sampling theorem
The sampling theorem states that a band-limited signal can be uniquely specified by its sampled values if and only if the sampling frequency is at least twice the maximum frequency component contained within the original signal,

The frequency component at half the sampling frequency is known as the Nyquist frequency
The sampling process is effectively achieved by connecting an analogue signal f(t) to the data acquisition system by means of a fast acting switch, which closes for a very short time but remains open for the rest of the period .
This operation can be modeled by a multiplier where is the band-limited analogue signal to be sampled, and s(t) is known as a sampling function. The sampling function is, therefore, made of a train of pulses alternating between a value of + 1 and 0. It is thus defined as follows:

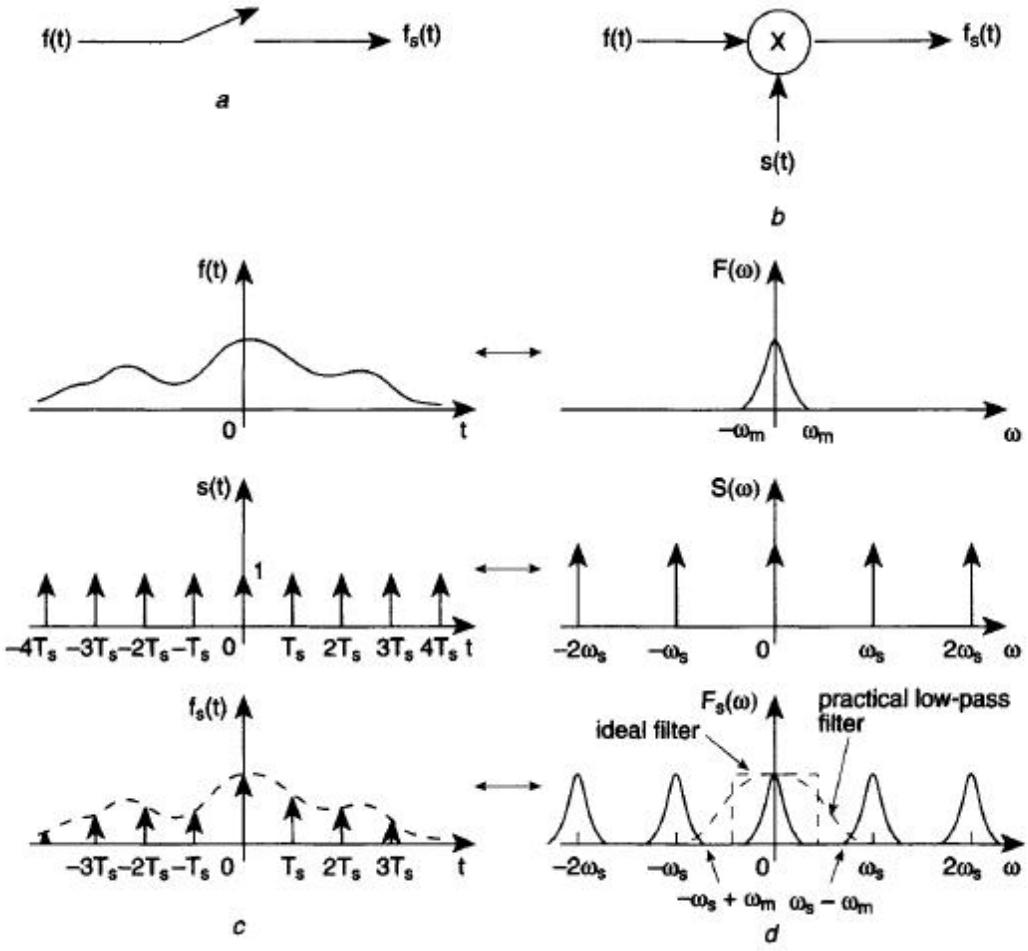
$$s(t) = \sum_{n=-\infty}^{\infty} \delta(t - nT_s)$$

The output of the multiplier $f_s(t)$ is then

$$f_s(t) = f(t) \sum_{n=-\infty}^{\infty} \delta(t - nT_s)$$

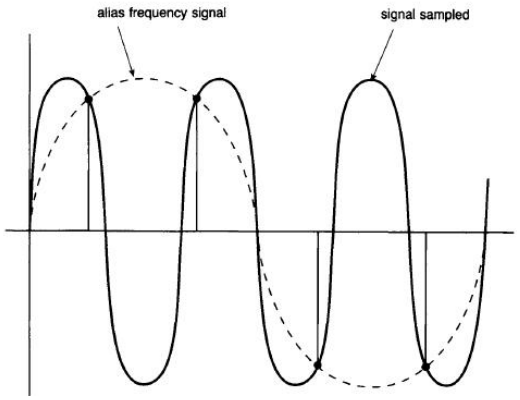
$$= \sum_{n=-\infty}^{\infty} f(nT_s)\delta(t - nT_s)$$

Sampling Process describe as below



Signal Aliasing Error: If the sampling rate is chosen so that the sampling frequency is less than twice the maximum significant frequency contained in the original signal, is not satisfied, then it can be seen from Figure (d) that there will be an overlap between adjacent parts of Fs. This leads to what is commonly known as an 'aliasing error', which in turn causes an error in the analysis as a result of the difficulty in distinguishing between low- and high-frequency components. In other words, if the sampling rate does not satisfy eqn., a low-frequency component that does not actually exist in the original signal, would nevertheless be apparent within the sampled signal. Below Figure gives an illustration of the aliasing phenomenon, in which the dotted line represents a low frequency that does not actually exist in the original signal.

Simple illustration of aliasing phenomenon.



Sample & Hold Circuit : Sample and hold circuit principle (a) switching circuit, (b) analogue input, (c) control waveform, (d) circuit output as shown in below figure.