PRINCIPLES OF COMMUNICATIONS

UNIT-4

LECTURE-1

Digital Modulation

- Continuous-wave(CW) modulation (recap):
  - A parameter of a sinusoidal carrier wave is varied continuously in accordance with the message signal.
    - Amplitude
    - Frequency
    - Phase
- Digital Modulation:
  - Pulse Modulation: Analog pulse modulation: A periodic pulse train isused as a carrier. The following parameters of the pulse are modified in accordance with the message signal. Signal is transmitted at discrete intervals of time.
    - Pulse amplitude
    - Pulse width
    - Pulse duration

- Pulse Modulation: Digital pulse modulation: Message signal represented in a form that is discrete in both amplitude and time.
  - The signal is transmitted as a sequence of coded pulses
  - No continuous wave in this form of transmission

Analog Pulse Modulation

- Pulse Amplitude Modulation(PAM)
  - Amplitudes of regularly spaced pulses varied in proportion to the corresponding sampled values of a continuous message signal.
  - Pulses can be of a rectangular form or some other appropriate shape.
  - Pulse-amplitude modulation is similar to natural sampling, where the message signal is multiplied by a periodic train of rectangular pulses.
  - In natural sampling the top of each modulated rectangular pulse varies with the message signal, whereas in PAM it is maintained flat. The PAM signal is shown in Figure 1.

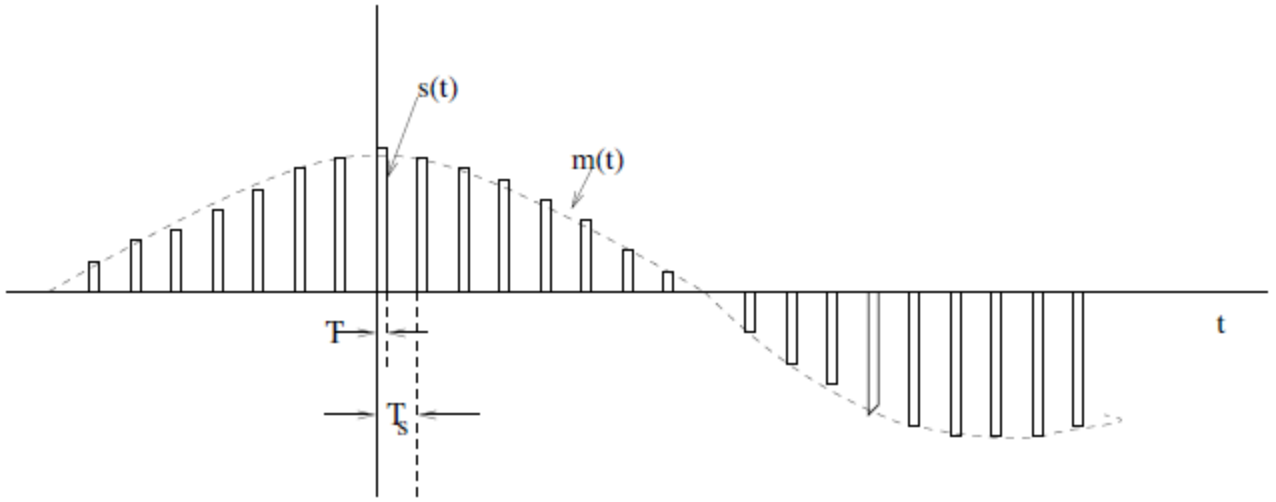

Figure 1: PAM signal

- Mathematical Analysis of PAM signals
  - Let $s(t)$ denote the sequence of the flat-top pulses generated in the manner described Figure 1. We may express the PAM signal as

$$s(t) = \sum_{n=-\infty}^{+\infty} m(nT_s)h(t - nT_s)$$

- $h(T_s)$ is a standard rectangular pulse of unit amplitude and duration T, defined as follows

$$h(t) = \begin{cases} = 1, & 0 \leq t \leq T \\ = \frac{1}{2}, & t = 0, t = T \\ = 0, \text{otherwise} & \end{cases}$$

- The instantaneously sampled version of $m(t)$ is given by

$$m_\delta(t) = \sum_{n=-\infty}^{+\infty} m(nT_s)\delta(t - nT_s)$$