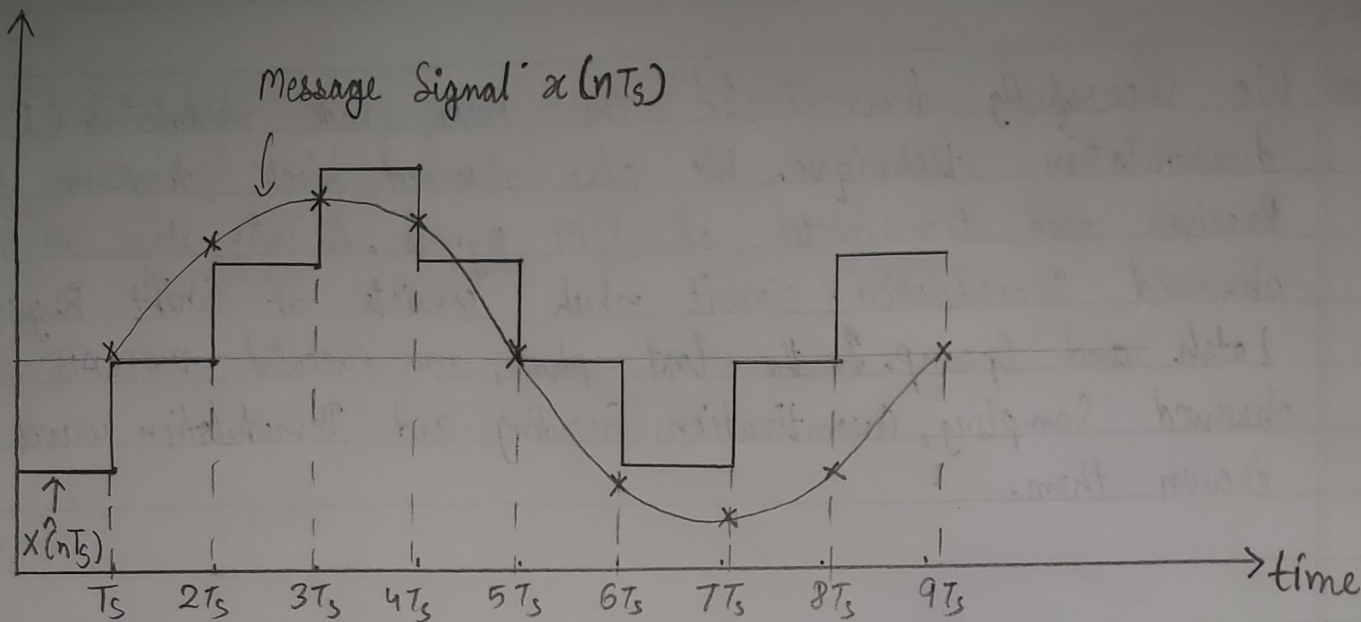# Experiment 11

Expt. No. ___11___

AIM : To demonstrate the delta modulation (DM) and demodulation technique.

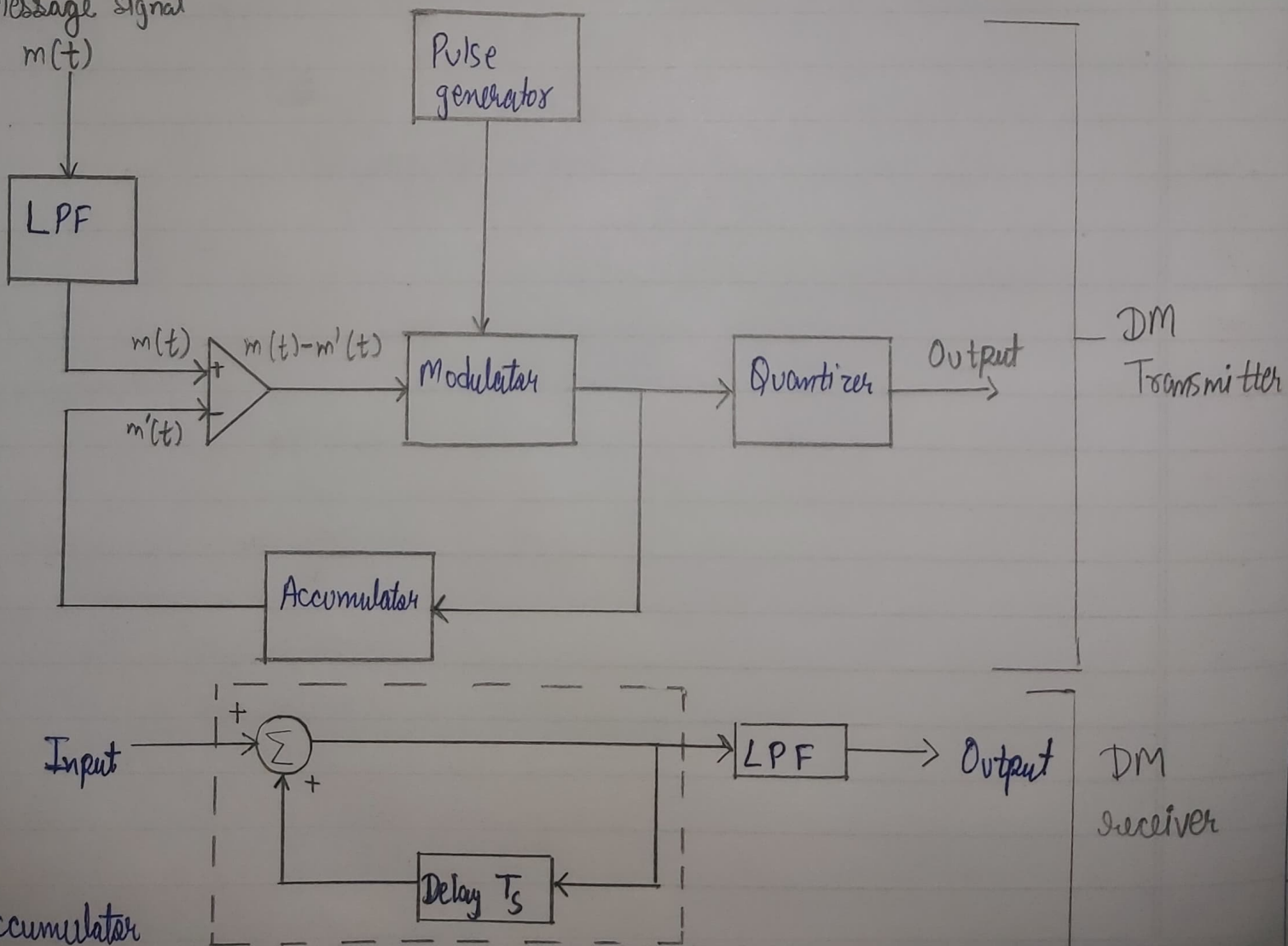**SOFTWARE** MATLAB

THEORY:

1. Delta modulation is a technique used to convert analog-to-digital and digital-to-analog signal.

- In this modulation signal is sent in differential form, the data is encrypted / transmitted in 1 bit.

- The analog signal is approximated with series of segments and each segment is compared to original analog to determine the change in relative amplitude.

- Hence, only changes in information is sent and if no change occurs it remains on the same state.

- This is the simplified form of Differential Pulse Code Modulation and also called as 1-bit (2 level) version of DPCM.

- It provides a staircase approximation of over-sampled base-band signal. Here, the difference between the present sample and previous approximated sample is quantized into two levels i.e. $\pm\Delta$ (delta).

- This is used for voice transmission.

Amplitude

Message Signal $x(nT_s)$

$x(nT_s)$

T_s $2T_s$ $3T_s$ $4T_s$ $5T_s$ $6T_s$ $7T_s$ $8T_s$ $9T_s$ → time

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Generation and detection of DM Signal

Message signal
$m(t)$

Pulse generator

LPF

$m(t)$ → $m(t) - m'(t)$ → Modulator → Quantizer → Output

$m'(t)$

Accumulator

DM Transmitter

Input → + Σ + → LPF → Output   DM receiver

Delay T_s

Accumulator

2. Operating Principle

- The operating principle of DM is such that, a comparison between present and previously sampled value is performed, the difference of which decides the increment or decrement in the transmitted values.

- When the two sample values are compared, either we got difference having a positive polarity or negative polarity.

- If the difference polarity is positive, then the step of the signal denoted by Δ is increased by 1. As against in case when difference polarity is negative then step of the signal is decreased i.e. reduction in Δ.

- When +Δ is noticed i.e. increase the size step, then 1 is transmitted. However, in the case of -Δ i.e. decrease in step size, 0 is transmitted.
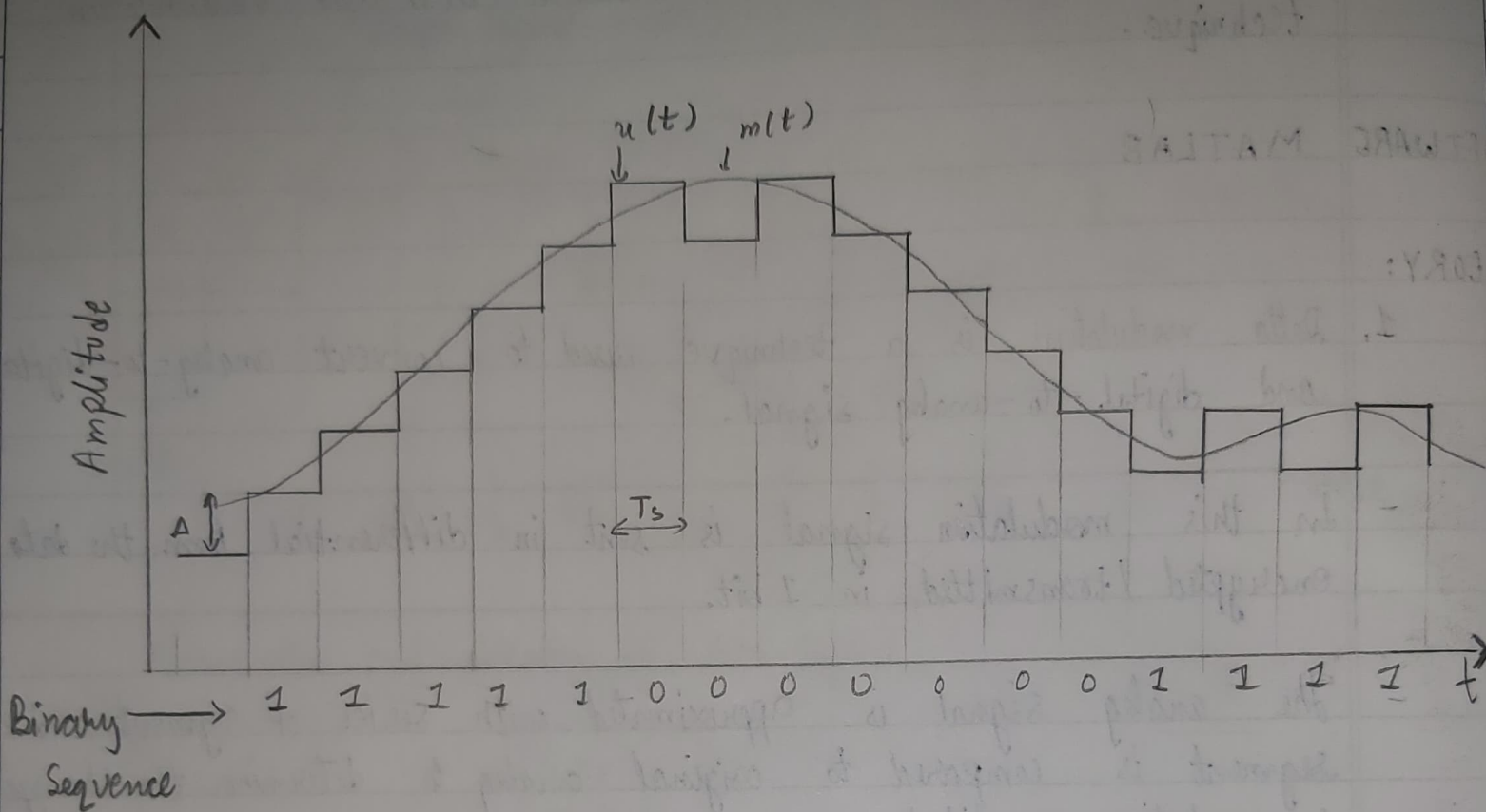
3. Advantages of delta modulation.

- Due to transmission of 1 bit per sample, it permits low channel bandwidth as well as signaling rate.

- ADC is not required. Thus permits easy generation and detection.

4. Disadvantages of delta modulation.

- Delta modulation leads to drawbacks such as slope overload distortion

Waveform representation of Delta Modulated Signal.

$u(t)$ $m(t)$

Δ

T_s

Amplitude

Binary →
Sequence

1 1 1 1 1 0 0 0 0 0 0 0 1 1 1 1 t

Expt. No.

AIM :

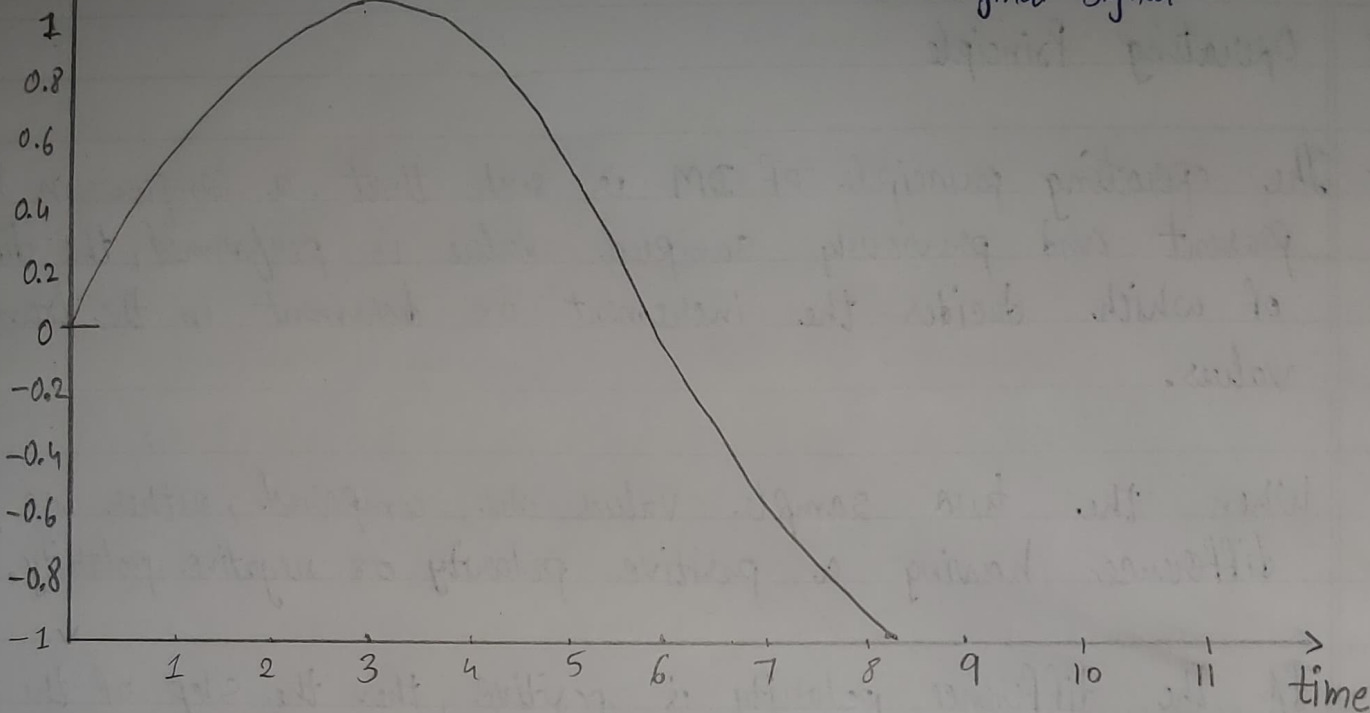(when Δ is small) and granular noise (when Δ is large).

5. Applications of delta modulation.

- It is widely used in radio communication devices and digital voice storage and voice transmission.
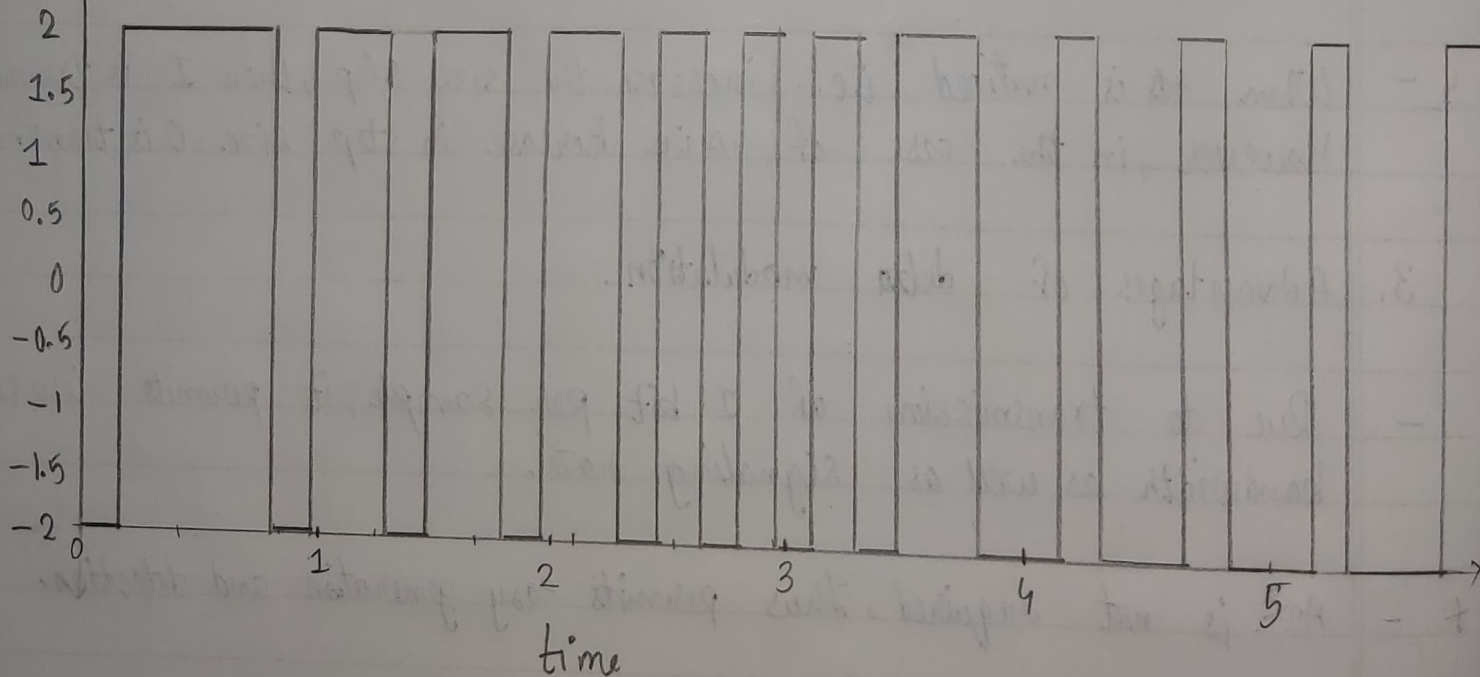
Outputs of MATLAB

← Original Signal

DM Output ↙

time

Received Signal ↓

Amplitude

time