

Assignment - 3

Question 01

What is an instrumentation system? Define its type. What components used in an analog data acquisition system?

Instrumentation system :-

An instrumentation system is collection of instruments used to measure, monitor, and control a process.

There are many applications of instrumentation systems, within technological areas as large as those associated with communications, defense, transportation, education, industrial manufacturing and research and development.

Instrumentation systems can be categorized into two major classes:-

1. Analog system
2. Digital system

Analog system :- An analog system deal with measurement of information of signal in analog form. An analog signal is a continuous function such as a plot of voltage against time or displacement against pressure.

Digital system :- Digital information in digital form. A digital quantity consists of a number of discrete or discontinuous pulses whose magnitude or nature varies with time.

Analog Data acquisition system :-

The data acquisition system, that are which can be operated with analog signals are known as analog data acquisition

Systems. Following are the components of analog data acquisition systems.

Transducer: - It converts physical quantities into electrical signals.

Signal conditioner: - It performs the functions like amplification and selection of desired portion of the signal.

Display device: - It displays the input signals for monitoring purpose.

Graphic recording instruments: - These can be used to make the record of input data permanently.

Magnetic tape instrumentation: - it is used for acquiring, storing & reproducing of input data.

Question no:- 02

Define digital data acquisition system.

What are the uses of data acquisition system?

Digital data acquisition system: -

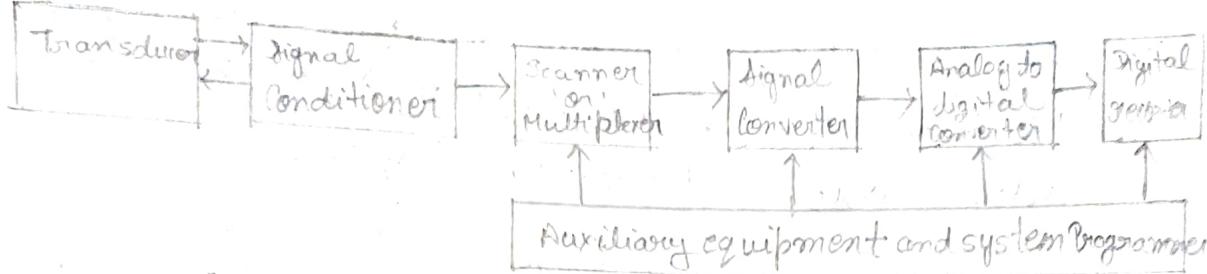
The data acquisition system, which can be operated with digital signals are known as digital data acquisition systems.

Digital data acquisition system include handling analog signals, making the measurement converting and handling digital data, internal Programming and control.

Mainly, the following operations take place in digital data acquisition:-

- Acquisition of analog signal
- Conversion of analog signals into digital signals or digital data.

- Processing of digital signals or digital data



Block Diagram of a digital data acquisition system

Transducer: - It converts Physical quantities into electrical signals.

Signal Conditioner: - It performs the functions like amplification and selection of desired portion of the signal.

Multiplexer: - Connects one of the multiple inputs to output. So, it acts as parallel to serial converter.

Analog to Digital Converter: - It converts the analog input into its equivalent digital output.

Display Device: - It displays the data in digital format.

Digital Recorder: - It is used to record the data in digital format.

Uses of Data acquisition system:

It is being used in various applications such as biomedical and aerospace. ~~so, we can choose either analog data~~

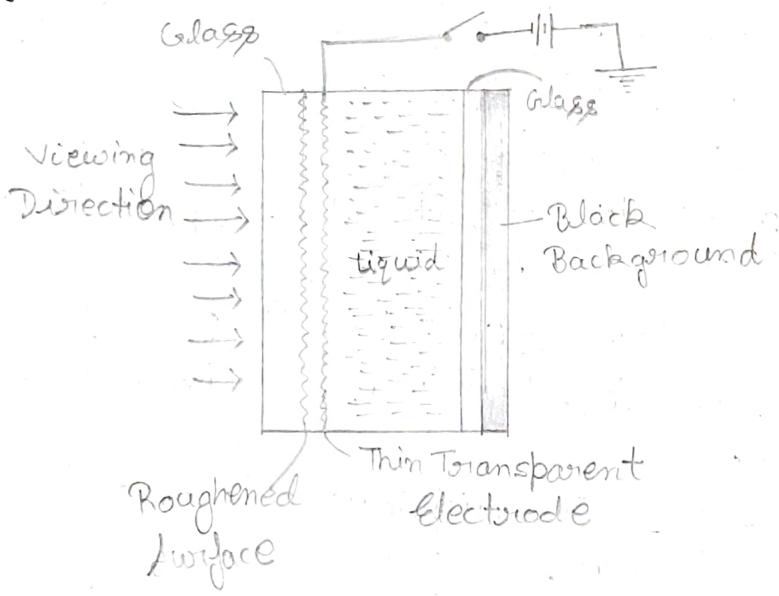
Data acquisition systems are principally in the business of measuring physical phenomena such as:

- Temperature
- Voltage
- Current strain and Pressure
- Angle and Discrete events weight.

Question no:- 03

Explain the construction and working of Liquid Vapour Display (LVD). Define their advantage and disadvantages.

Liquid Vapour Display (LVD) are the latest in economical display technology. They employ a new reflective passive display principle and depend on the presence of ambient lights for their operation.



Structure of an LVD Cell

Construction :- It consists of a transparent volatile liquid encased between two glass plates and side spacers. The rear glass plate has a black background and the front glass surface in contact with the liquid is roughened.

The transparent electrode is heated by using a voltage drive, which is the basis for the display function.

Working :-

In the off condition of display with no voltage applied across the transparent electrode, the viewer sees the black background through the front transparent glass electrode and the liquid.

In 'ON' condition of the display, a voltage is applied to the transparent electrode. This causes sufficient heat in the electrode, which evaporates the liquid in contact with it, and a combination of vapour film and vapour bubbles is formed around the roughened glass surface. As the refractive index of vapour is approximately 1, there is a discontinuity established at the interface between the front glass plate and the liquid, which gives rise to light scattering. This makes it a simple display device.

The liquid selected for LCD should have the following features:-

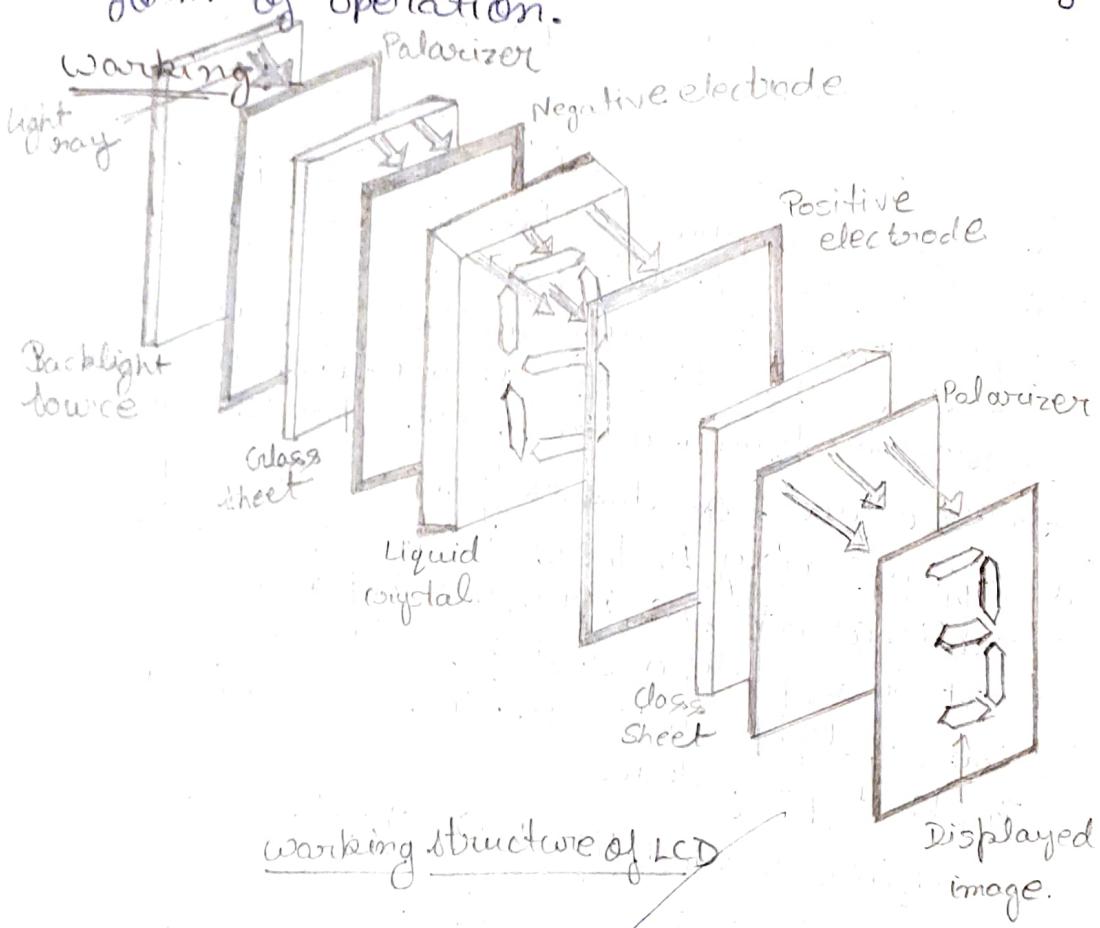
- Refractive index close to that of the glass plate
- Minimum energy for vapourising the liquid in contact with the roughened.

Question no :- 04

Explain the theory and working of LCDs. Describe the difference between light scattering and field effect types of LCDs. Also explain the advantages of LCDs.

LCD stands for Liquid Crystal Display. It is a flat panel display technology, mainly used in TVs and computer monitors, nowadays it is used for mobile phones also. These

LCDs are completely different from that old CRT displays. It uses liquid crystal instead of cathode ray in its primary form of operation.



when an electrical field is not applied to the liquid crystal molecules, the molecules twist 90 degrees in the LCD cell. when the light either from ambient light or from the backlight passes through through the first polarizer, the light is polarized and twisted with the liquid crystal molecular layer. when it reaches the second polarizer, it is blocked. The viewer sees the display is black.

when an electric field is applied to the liquid crystal molecules, they are untwisted. when the polarized light reaches the layer of liquid crystal molecules, the light passes straight through without being twisted. when it reaches the second polarizer, it will also

Pass through, the viewer sees the display is bright.

difference between light scattering LCD and field effect LCDs:-

Field-effect LCDs are normally used when a source of energy is a prime factor (e.g. in watches, portable instrumentation, etc.) since they absorb considerably less power than the light-scattering types - the microwatt range compared to the low milliwatt range. The cost is typically higher for field-effect units, and their height is limited to about 2 in. while light-scattering units are available up to 8 in.

advantage of LCDs :-

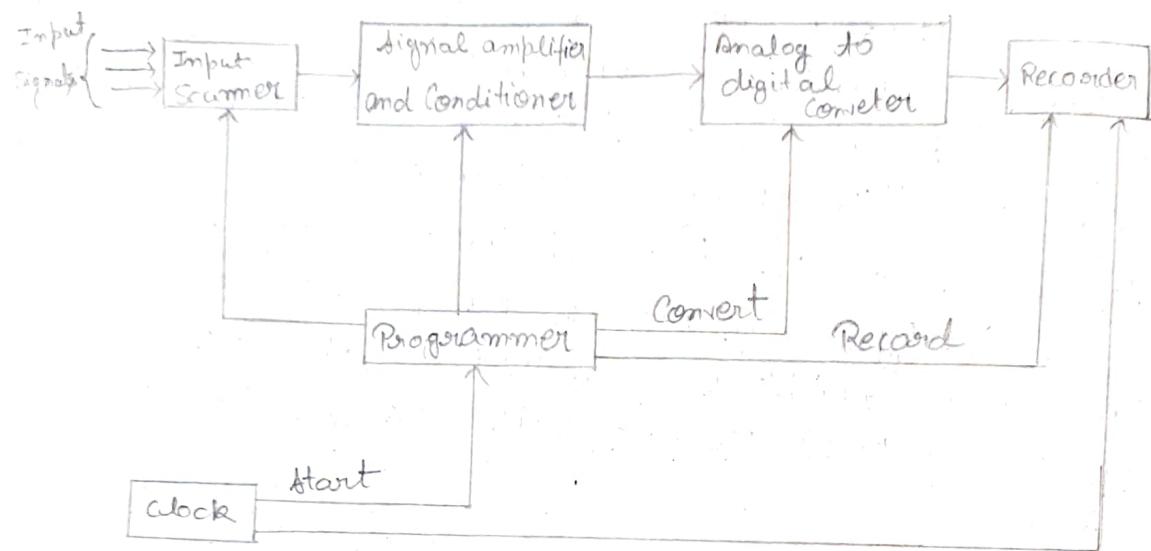
1. LCDs Monitors are very thin in shape and size
2. They do not consume much electricity and emits less heat
3. They do not affect any magnetic field
4. very low Power compared to CRT or Plasma.
5. energy efficient

Question no:- 05

Define the Data logger operation with their block diagram. Also define the benefits of using a data logger.

Data loggers are the devices used to measure and store the reading of instruments without any loss of accuracy. They are the application of data acquisition system. The output of a transducer can be measured and the value is logged automatically by the data

loggers. They also take care of suitable corrective action if the output signal goes beyond the predefined range.



Data logger

Input scanner :-

The various input signals fed to the input scanner are temp., Pressure, vibrations, on/off signals etc. The input scanner is an automatic switch that can select only one input signals at a time. In modern scanners, the state of scanning is upto 150 inputs.

Signal Amplifier and Conditioner :-

The input signal selected by Scanner is a low level signal. Hence a signal amplifier is used to amplify the low level signal so that input signal is maintained at 5V level.

The signal conditioner is placed between scanner and analog to digital converter. If a signal varies non linearly with respect to the measured parameter then linearization of signal is done by the signal conditioner.

Analog to Digital converter :-

The data loggers handle the data only in digital form and hence the analog signal have to be converted into digital form by employing analog to digital converter.

Recorder:- The data logger drives the output recorder which prints the signals obtained from the analog to digital converters. The recorder may consist of either typewriter or a punched tape.

Programmer:- It controls the sequence of operation of all other units of data logger. It takes information from scanner, analog to digital converter and recorder.

Clock:- The logging sequence is started automatically by a clock. The clock is used to automate the entire data logging system.

The clock gives command to the Programmer to start logging sequences at the intervals selected by the user.

Benefits of using data loggers :-

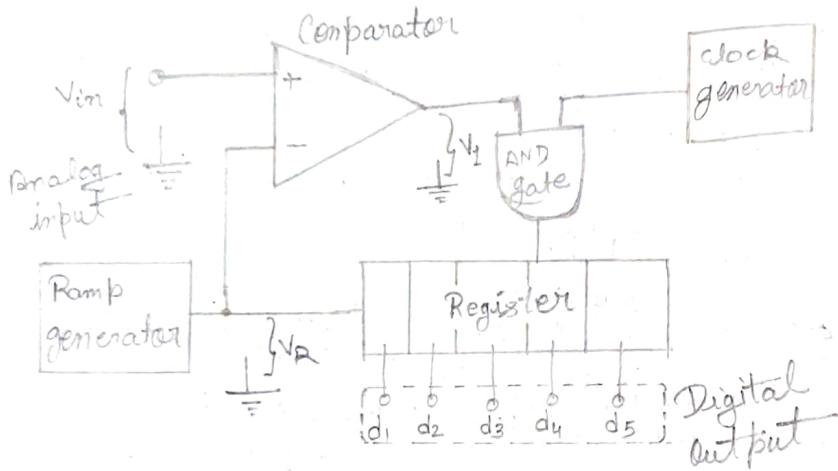
1. High efficiency and accuracy
2. versatile data acquisition
3. easy data analysis
4. Reliable technology
5. low -cost
6. time -efficient

Question no:-06

Explain the construction, working principle of A/D converters by using Op-Amp, Show it with their truth table.

An Analog - To - Digital Converter:-

Linear - ramp ADC :-



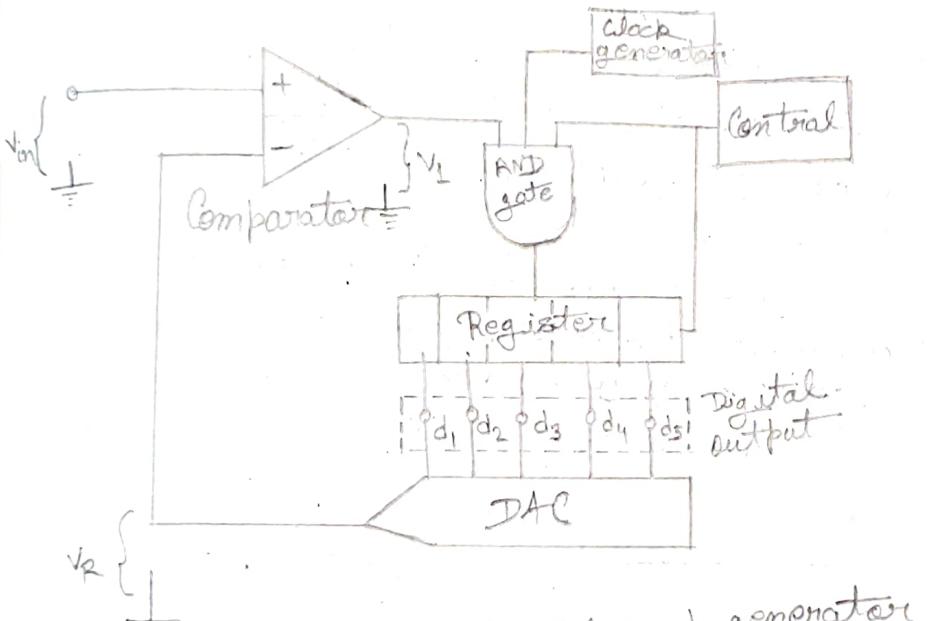
ADC using a linear - ramp generator

The block diagram for 5-bit linear - ramp ADC consists of a Counting register which is simply a cascade of flip-flops; a ramp generator which generates a linear - ramp output waveform; a clock generator to produce a triggering waveform with a precise frequency; an AND gate; and a voltage comparator which compares the voltages at its noninverting and inverting input terminals and produces a low or high output voltage.

Digital - ramp ADC

It is the modified version of the linear - ramp ADC. The ramp generator is replaced with a DAC, which converts the digital output back to analog. The output waveform from the DAC is a staircase, incremented by each clock pulse passed to the register. A rectangular - wave control input is used to cycle the system through the conversion process.

The leading edge of the control input pulse resets the register to zero at the commencement of the conversion cycle, and applies a high input voltage at the AND gate. At this instant, the analog input is greater than the DAC output, and so the Comparator output is high, thus allowing the AND gate to pass clock pulses to toggle the register.



ADC using a digital stamp generator

Truth table :-

Analog voltage	Digital code		
	d ₁	d ₂	d ₃
1V	0	0	1
2V	0	1	0
3V	0	1	1
4V	1	0	0
5V	1	0	1
6V	1	1	0
7V	1	1	1

Truth table for a 3-bit ADC showing digital output codes and the equivalent analog inputs.

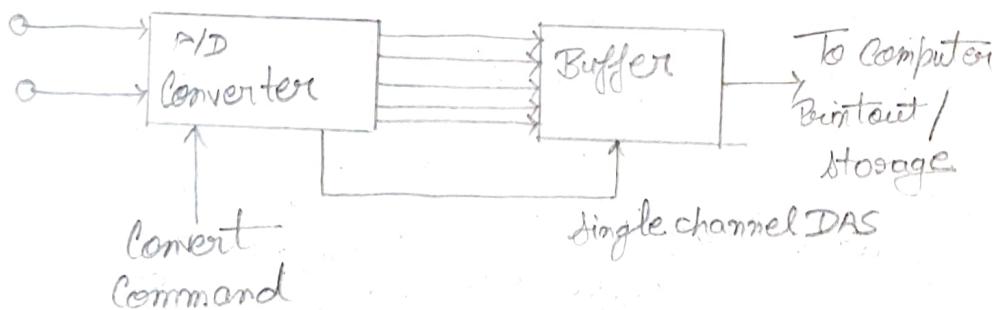
Question no:- 07

- Draw the block diagram of single and multi channel data Acquisition system (DAS), and explain the function of each stage of this system with truth table.

Single - channel ^ Acquisition System:

Data
It consists of a signal conditioner, analog to digital converter. The output of the signal conditioner is given to the A/D converter. This circuit performs repetitive conversions at a free running rate.

The rate of conversion is internally determined. The digital outputs from the buffer are fed to a storage system or a printer or to a computer for further analysis.



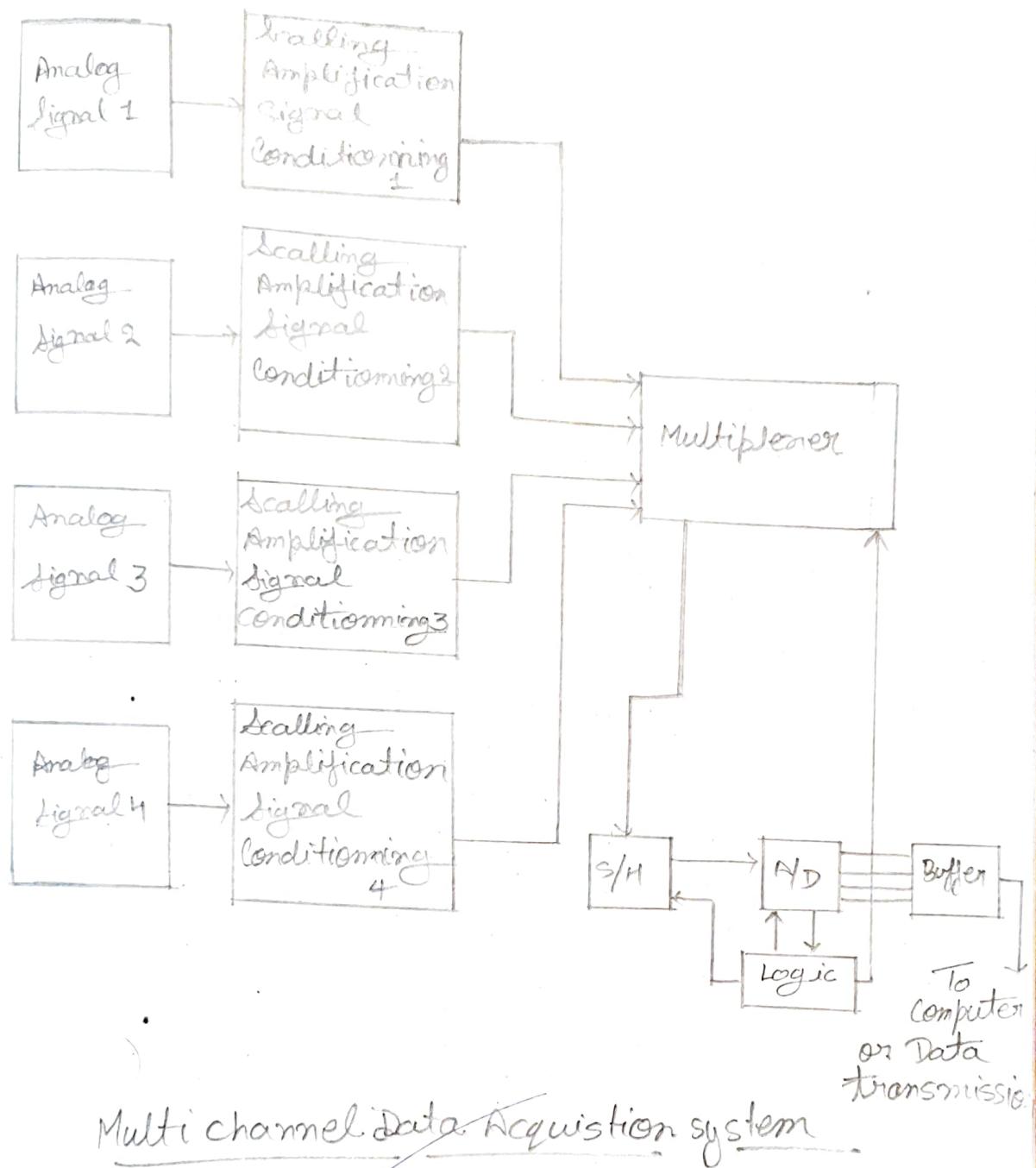
Block diagram of Single channel DAS

Multi - channel ^ Acquisition System:

There will be many subsystem in a DAS.

The multichannel DAS has a single A/D converter proceeded by a multiplexer.

There can be number of inputs. Each signal is given to individual amplifiers. The output of the amplifiers is given to signal condition circuits. From the outputs of the signal conditioning circuits the signals go to the multiplexer. The multiplexer output is converted into digital signals by the A/D converters sequentially.



Multi channel data Acquisition system

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