UINT III TELIMETRY & DATA ACQUIITION SYSTEM

The term data transmission and telemetry refer to the process by which information regarding the quantity being measured , may be using transducer and signal conditioning equipment is transformed to the remote location , perhaps be processed, recorded and displayed.

Telemetry is the technology which enables a user to collect data form several measurement points at inconvenient location, transmitted data to a convent location.

General Telemetry System:-

Telemetry may be defined as measurement a distance. A general telemetry system is shown below:-

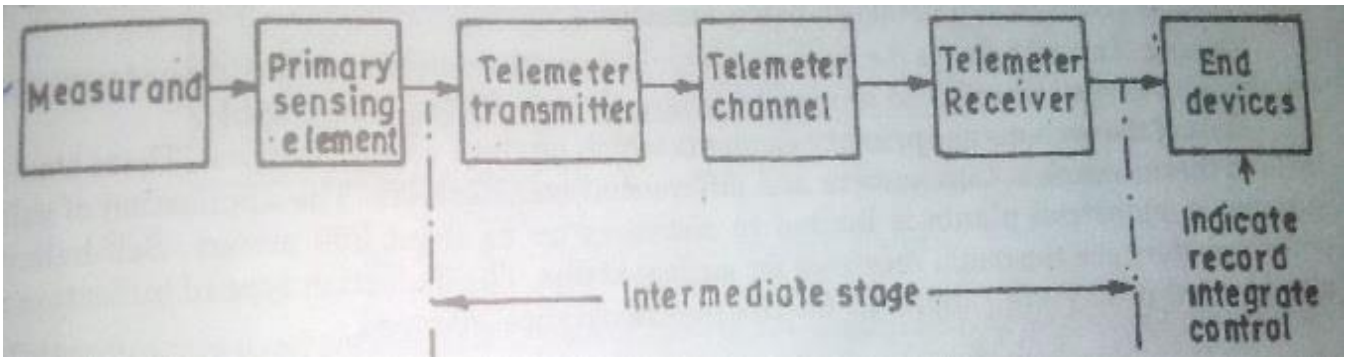


Fig. 1.1 Functional representation of general telemetering system

There are three system elements in the intermediate stage which are –

(i) Telemetry Transmitter
(ii) Telemetry channel
(iii) Telemetry Receiver

The function of the telemetry transmitted is to convert the o/p of a primary sensing element into an electrical signal and to transmit it over a telemetering channel. This signal is in electrical format and is received by a receiver placed at a remote location. The signal is converted in to a usable form by the receiver and is indicated or recorded by an end device.

Types of Telemetry Systems:-

There are two types of telemetering system:-

(i) Land line telemetry.
(ii) Radio frequency (R F.) telemetry.

Land Line Telemetry System:-

A land line telemetry system requires a telemeter channel which is a physical link b/w the telemeter transmitter and receiver. This physical link my b cable a specially laid out wire, existing telephone and telegraph cable or a power line carrier. The land line telemetering is a direct transmission of information via cable (current , voltage, frequency , position or impulse). Current , voltage and position type system can be used only for short distance while foe long distance pulse and frequency types are used . Only pulse signal can be used or telemetry.

Let land line telemetry system can be classified as:

(i) Voltage telemetering system
(ii) Current telemetering system
(iii) Position telemetering system.

Voltage Telemetering System:-

A voltage telemetering system transmits the measured variable as a function of an a.c. or d.c. voltage. A simple voltage system is shown below.

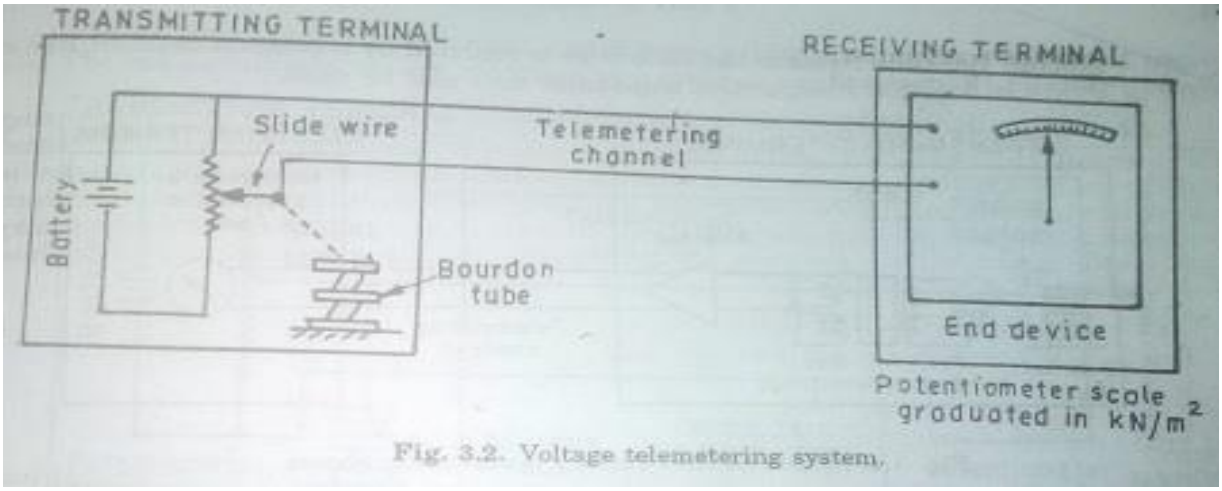


Fig. 3.2. Voltage telemetering system.

A slider wire potentiometer is connected is series with a battery. The sliding contact of the potentiometer is positioned by a pressure sensitive bourdon tube. The telemetering cannel consists of a pair of wire connected to a current measuring device.

As the pressure which is the measured and changes the bourdon tube moves and the changes the position of the sliding contact on the slide wire there by changing the voltage in the circuit. This voltage is measured with the help of null balance d. c. potentiometer indication or recorder.

Current Telemetering system:-

The basic current telemetering system shown below:-

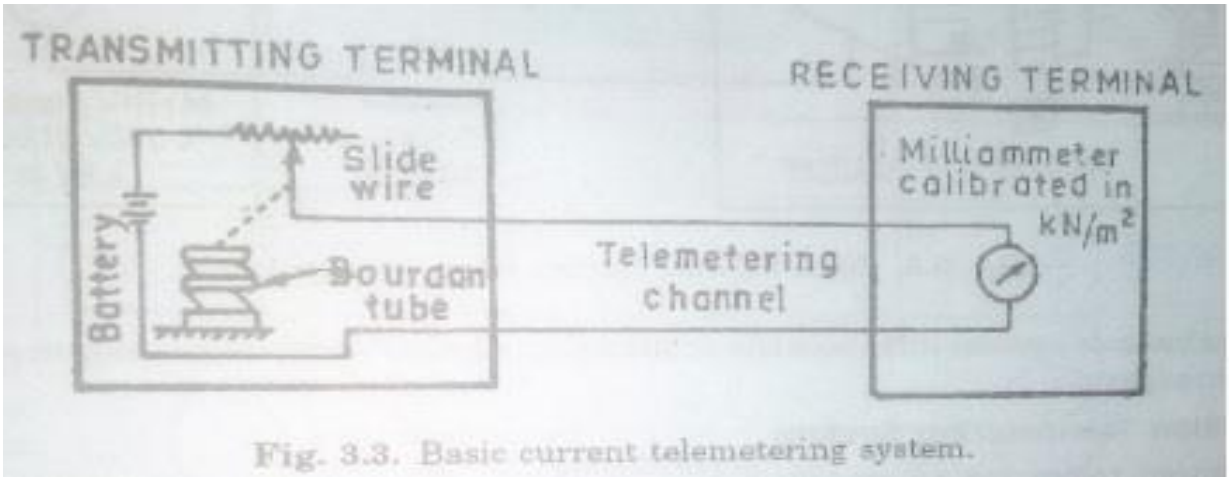


Fig. 3.3. Basic current telemetering system.

Current telemetering system similar to the voltage telemetering system, the current telemetering system also consists a slide wire potentiometer in series with a battery. Again the slider is connected to the bourdon tube which measure pressure. The telemetering channels nothing but a pair of wire.

When the pressure in the system changes, the bourdon tube moves the sliding contact thereby changing the current at the transmitting end . this current passes to the receiving end through the pair of wire and at the receiving end it is measured by the millimetre.

Now a day the improved form of the current telemetering system are extensively used. These modified forms are:-

(i) Motion balance current telemetering system.

(ii) Force balance current telemetering system.

A simple motion balance current telemetering system consists a displacement transducer used as position detector. The most commonly used transducers for motion balance current telemetering system are LVDT and capacitive transducers.

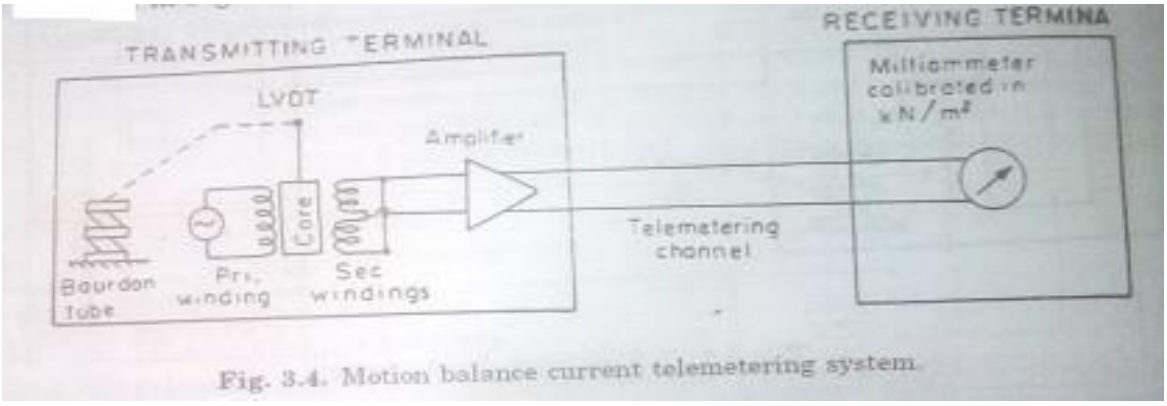


Fig. 3.4. Motion balance current telemetering system.

The change in the pressure is sensed by the burden tube which causes the displacement of the LVDT. Because the null position gets disturbed , a differential voltage is produced. This voltage is amplified output is then rectified which produced a dc current of the order of 4-20 mA in the telemetering channel. At the receiving end it is measured with the help of the millimetre.

Position telemetering system:-

A position telemetering system and reproduces the measured variable by position in variable resistors as other electrical component in a bridge circuit form so as to produce proportional changes at both the transmitter and the receiver ends. This is known as Bridge type system.

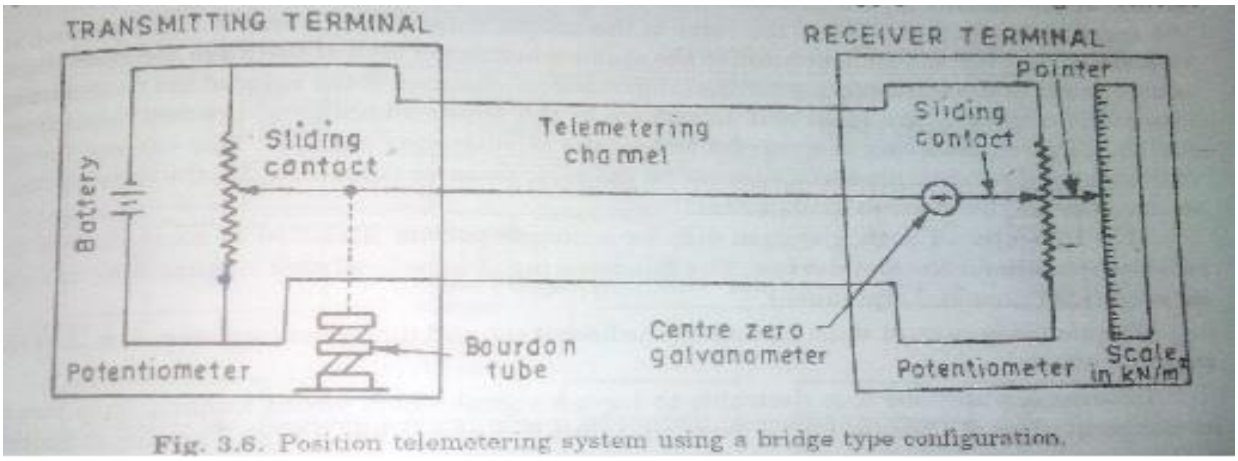


Fig. 3.6. Position telemetering system using a bridge type configuration.

Here two potentiometer are used at transmitting end and other at the receiving end . The sliding contact at the transmitting end is positioned by the bourdon tube as pressure is applied until the zero galvanometer indicates zero.

Another most commonly used telemetry system utilized a synchro-transmitter and receiver which is used in the torque transmission mode.

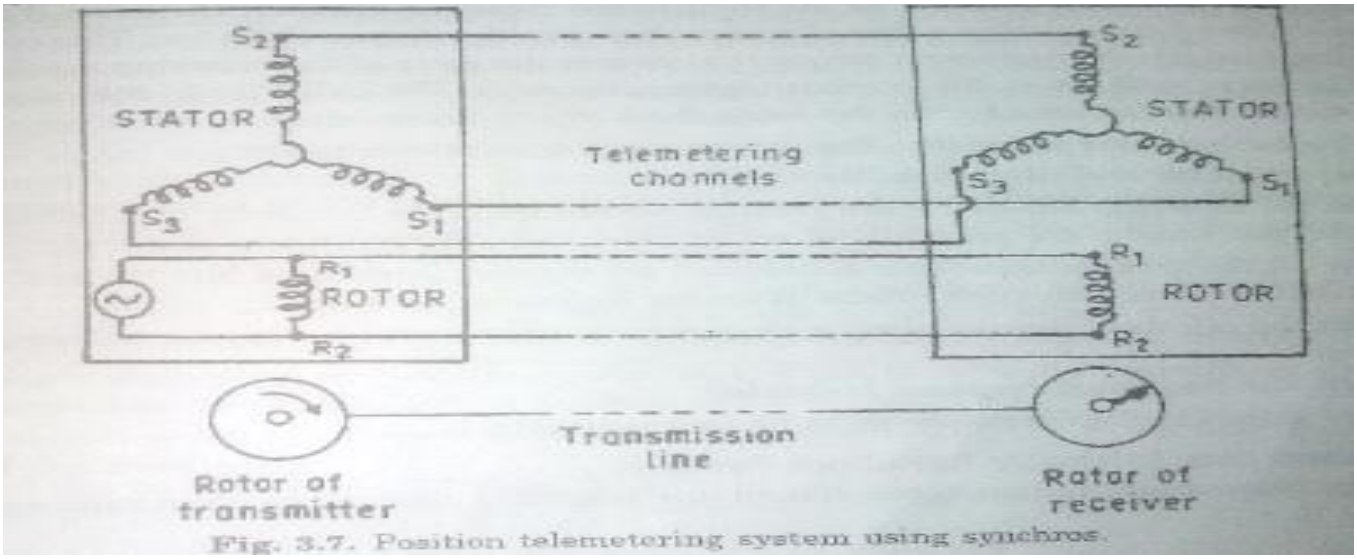


Fig. 3.7. Position telemetering system using synchros.

In the land line telemetry , the two primary considerations are:-

(i) Economy (ii) Reliability

In the land line telemetry , the greatest advantages is the simplicity of the set up and weight are generally of no consideration. The disadvantages are-

(i) All the transmission link distortions are directly introduced in to the system .
(ii) The frequency response is limited.
(iii) Signal multiplexing tends to be in practices

Land line telemetry feed-back system:-

The current and voltage types of land line telemetry system. The current type system employs a torque balance method which is shown below.

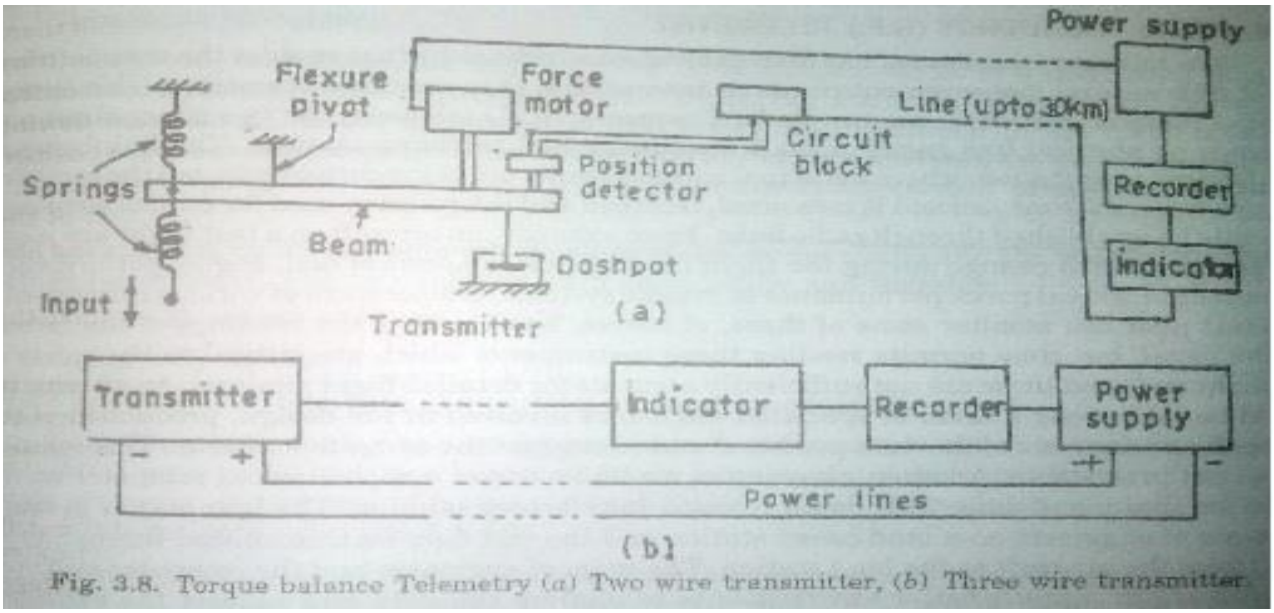


Fig. 3.8. Torque balance Telemetry (a) Two wire transmitter, (b) Three wire transmitter

A torque transmitter is shown in fig(a) . An input movement on a spring . due to signal form measured , produces a movement on a beam with a flux are pivot . Any movement of the beam is detected by a position detection and a current is produced in the force motor (which acts as an inverse transducer) to produce the balancing torque . Thus there is only a small movement of the beam and the o/p d. c. on account of this movement is linearly related to i/p movement

Radio Frequency (R.F.) Telemetry:-

The main difference between the radio frequency telemetry system and land line telemetry system is that in the telemetry system is that in the R. F. telemetry system there is no physical links between the telemeter transmitter and telemeter receiver. But the link between the transmitting end and the receiving end is stabilised through radio link.

The R. F. telemetry system is more suitable for the transmission of data over distance more than 1 KM. For the R F telemetry along with certain band of the radio frequency spectrum, a microwave link above 4 MHz is also allocated.

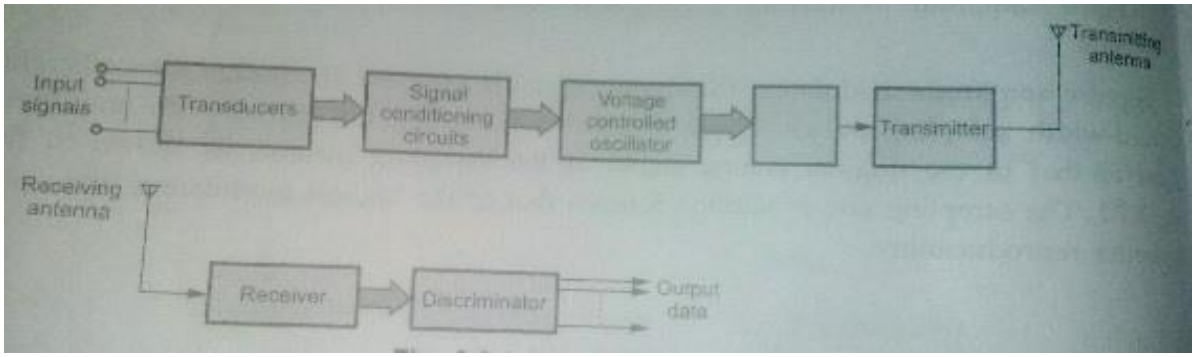
Modulation Method in R F telemetry System:-

In RF telemetry system information or signal to be transmitted through modulated with help of three parameter namely amplitude, frequency, and phase shift with respect to reference.
Thus in the RF telemetry system, the modulation method used are-

- Frequency Modulation telemetry system.
- Pulse amplitude modulation telemetry system.
- Pulse code modulation telemetry system.

Frequency Modulation telemetry system:-

Frequency modulation telemetry system is the earliest system which is still used in the telemetry field. A simple FM telemetry system used for mixing of the various data channels is as shown in the fig.

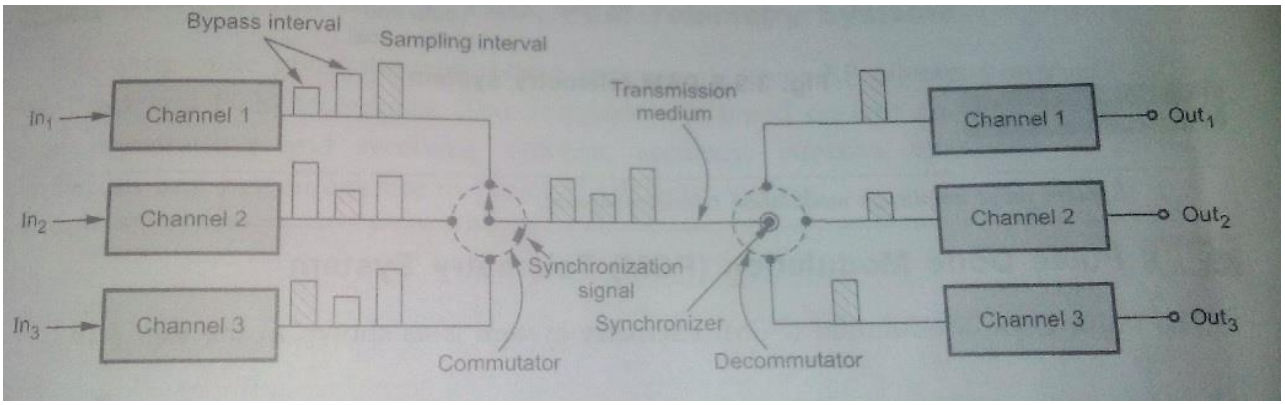


Using transducer, different quantities are measured. The output of the transducer is obtained in the representable from by using appropriate signal conditioning circuits. The outputs of the signal conditioning circuit are given to the controlled oscillator stage. There are number of VCO's present where each oscillator operate at dedicated frequency output of each signal conditioner circuit modulates and the VCO and its presented for radio transmission .

At receiver end, the FM demodulator called as discriminator is used. This discriminator is turned to the frequency of each subcarrier and the bandwidth is equal to that of the modulated sub carrier. So when the value of the measured quantity changes accordingly the output signal of the discriminator changes.

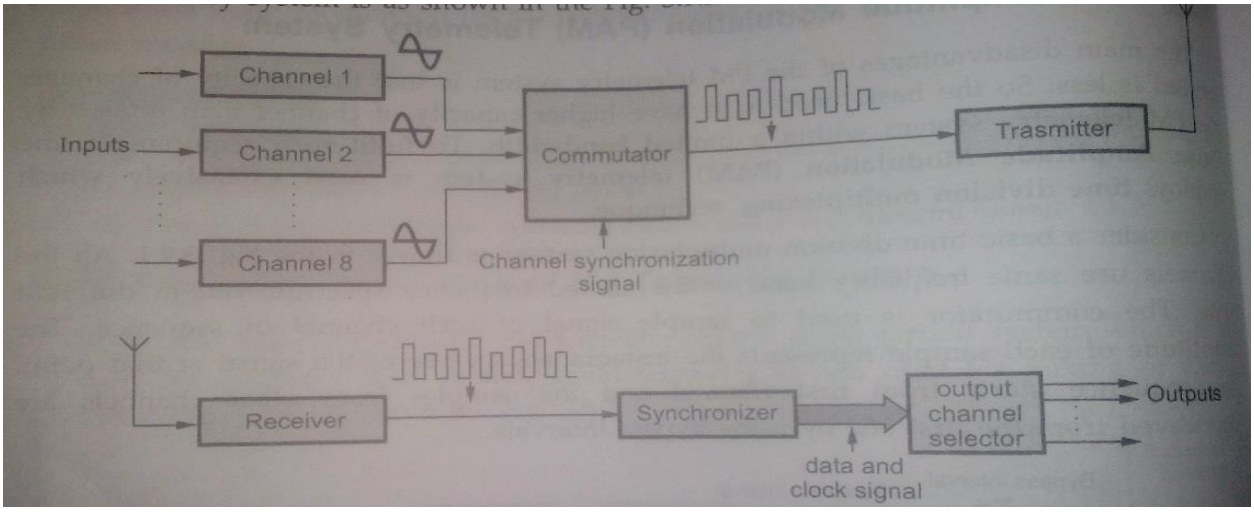
Pulse Amplitude Modulation Telemetry System:-

The Pulse Amplitude Modulation (PAM) telemetry system is used extensively which employee time division multiplexing technique.
Consider a basic time division multiplexing system as shown in the fig. All the channel use same frequency band of the allotted frequency spectrum but at different time. The commentator is used to sample signal of each channel in sequence. The amplitude of each sample represent the instantaneous value of the signal at the point. The sequence start from first channel and sample from other channels are interleaved from the first one by using bypass intervals.



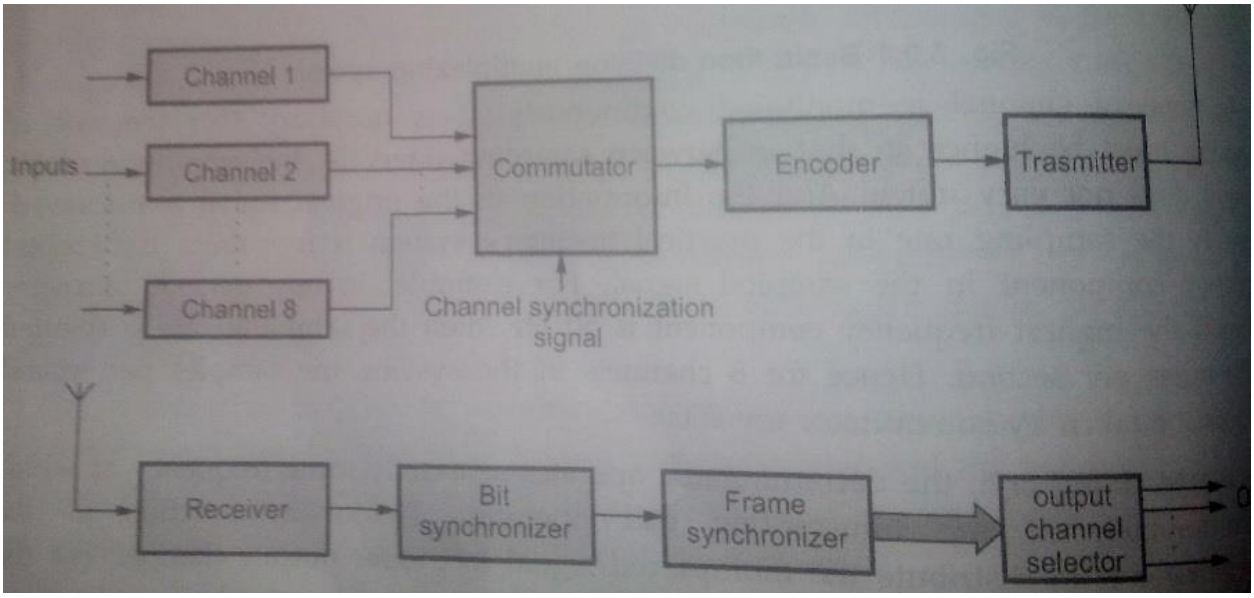
At receiving end, the de-commuator operates at exactly same frequency at which the commuator at the transmitting end operates. The main function of the de-commutator is to distribute the multiplexed signal to proper output channel.

The PAM telemetry system uses same time division multiplexing system. it is the simplest form as the sample are transmitted with no modification . The data at the receiving end is demodulated only when the channels are properly recognized. A simple PAM telemetry system shown in the fig.



Pulse Code Modulation Telemetry System:-

The pulse code modulation telemetry system is as shown in the fig.



The PCM telemetry system also make used of the time division multiplexing system. The main difference with the PAM telemetry system is that in the PCM telemetry system, an encoder is used after the commutator stage. The function of the encoder is to accept each PAM sample and convert it into a binary number and shift the bits of each number serially.

The receiver section is synchronized on the serial data stream . The bit synchronizer and the frame synchronizer identify each sequence of bits and converts its in to useful outputs. As measured data is represented in the form of binary weighted codes , the system is known as pulse code modulation telemetry system

Data Acquisition System

Data acquisition systems are used to measured and record analog signal in basically two different ways:-

(i) Signal which originate from direct quantities. These signal may be d.c. or a.c. voltages, frequency or resistance etc.

(ii) Signal which originate from use of transducers.

Types of instrumentation system:-

(i) Analog system

(ii) Digital system

Analog data-acquisition system:-

This system deal with information in analog form which is a continuous function. An Analog data-acquisition consist of some are all of the following elements:-

(a) **Transducer:-** An emf obtained form the transducer preparation to the quantity bring measured is used as an input to the DAS .

(b) Signal conditioning equipment:- Signal conditioning equipment include any equipment that transform the o/p of transducer to the desired form acceptable by the next stage of the data acquisition system. Examples of signal conditioning equipment includes zero bridge balance device from strain gauge circuit, voltage amplifier and servomotor system.

(c) Multiplexer:- multiplexing is the process of sharing a single channel with more than one i/p An emf obtained from the transducer proportion to the quantity being measured is used as a i/p to Analog data-acquisition.. Thus a multiplexer accepts multiple analog i/p and connects them sequentially to one measuring instrument. Another name from a multiplexer is scanner.

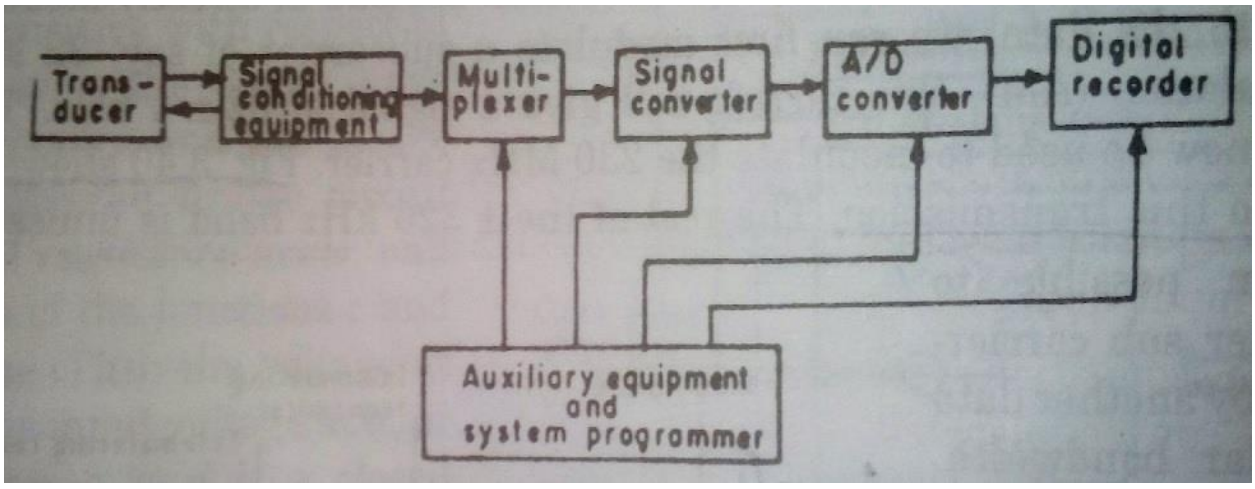
(d) Calibrating equipment: - before each test there is a pre-calibration and often each test there is a position calibration.

(e) Integrating equipment:- These equipment are used to know the integral or summation of a quantity . There are several ways of determining the time integral of a quantity but normally digital techniques are used for integration purposes.

(f) Visual display devices :- visual display devices are required for continuous monitoring of the i/p signals. These include numerical display, CRO etc.

(g) Analog recorders:- analog recorders are used to record the analog quantity . these include strip chart recorders , magnetic tape recorders, CRO with photographic equipment etc.

Digital data acquisition system :- A digital acquisition system is shown below-



The various components are described below:-

(a) They convert a physical quantity in to an electrical signal which is acceptable by the data acquisition system.

(b) Signal conditioning equipment:- Signal conditioning equipment include any equipment that transform the o/p of transducer to the desired form acceptable by the next stage of the data acquisition system. Examples of signal conditioning equipment includes zero bridge balance device from strain gauge circuit, voltage amplifier and servomotor system.

(c) Multiplexer:- multiplexing is the process of sharing a single channel with more than one i/p . Thus a multiplexer accepts multiple analog i/p and connects them sequentially to one measuring instrument. Another name from a multiplexer is scanner.

(d) **Signal converter**:- A signal convertor transducers the analog signal to a form acceptable by the analog to digital (A/D) converter.

(e) **A/D converter** :- an analog to digital converter converts the analog voltage to its equivalent digital form . The o/p of the A/D convertor may be fed to digital display devices for visual display or to digitals recorder for recording.

(f) **Auxiliary Equipment**:- this contain devices for system programming functions and digitals data processing. Some of the typical functions done by auxiliary equipment are linearization and limit comparison of signals which is performed by a digitals computer.

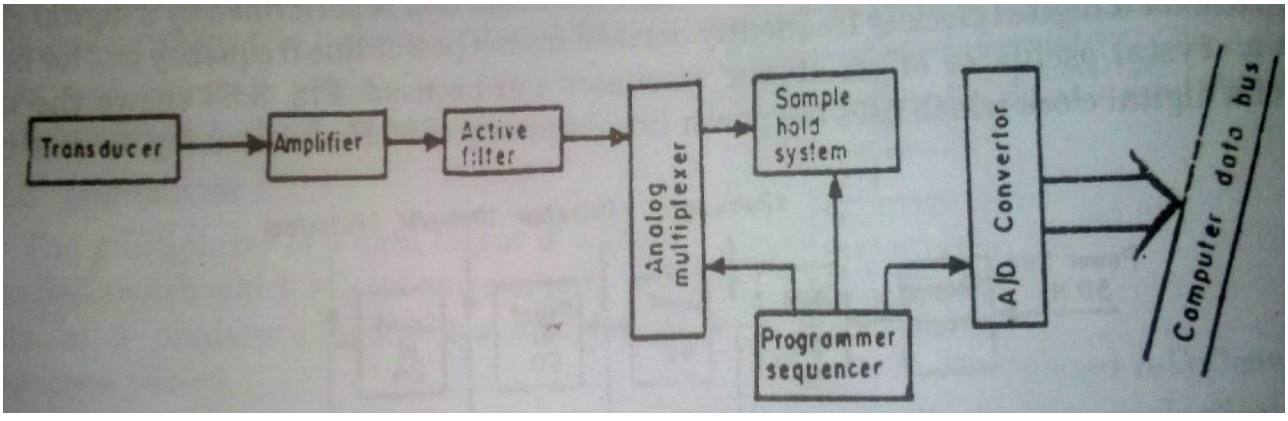
(g) **Digial Recorder** :- Digitals recorders are required to recorded of information on digital form.

(h) **Digitals printers** :- A digitals printers can be specified to interface with an electronics instrumentation system in order to provided a high quality hard copy for recoreds.

- The essential functional operations of a digital data acquisition system are:-
  Handling of analog signals.
  Making the measurement.
  Converting the data to digital from and handling it.
  Internal programing and control.

Modern Digital Data Acquisition System:-

A generalized diagram of the data acquisition system is shown below-



The various component are described as fallows:

(a) **Transducers**:- An emf obtained from the transducer proportion to the quantity being measured is used as a i/p to Analog data-acquisition.

(b) **Amplifier**:- An amplifier or signal conditioner equipment boosts the amplitude of the transducer o/p signal to useful level for further processing .Amplifier converts a high impedance signal, a differential signal with common-mode noise, a signal superimposed on a higher voltage or a combination in to a high level voltage.

(c) **Active filter**: - the o/p of an amplifier is fed in to a low pass active filter , which reduces high frequency signal

(d) **Analog Multiplexer**:-Anlog multiplexing is the process of sharing a single channel with more than one i/p . Thus a multiplexer accepts multiple analog i/p and connects them sequentially to one measuring instrument. Another name from a multiplexer is scanner.