CMR INSTITUTE OF TECHNOLOGY

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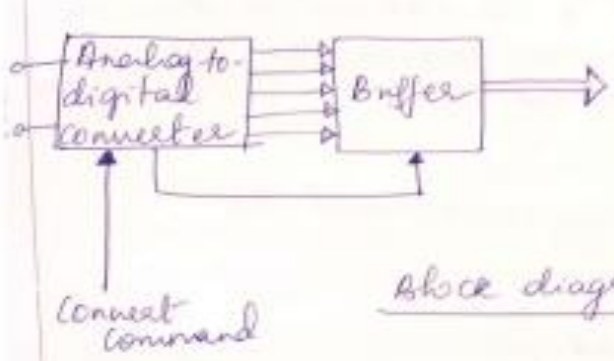
Internal Assesment Test - I									
Sub:	SENSORS & TRANSDUCERS							Code:	15EE662
Date:	15/05/2019	Duration:	90 mins	Max Marks:	50	Sem:	6	Branch:	EEE
Answer FIVE FULL Questions. Mention units wherever necessary.									

	Marks	OBE CO	OBE RBT
1. Explain single channel data acquisition system & multichannel analog multiplexed data acquisition system with a neat diagram	[10]	CO3	L4
2. Explain briefly the followings (i) Successive approximation analog to digital converter (ii) R-2R loaded digital to analog converter	[10]	CO3	L4
3. (a) Describe briefly the operation of Flash A/D Converter	[06]	CO4	L2
(b) Write a short note on MODEM	[04]	CO4	L1
4. With a neat diagram explain the operation voltage telemetry system & mention its advantages & disadvantages	[10]	CO4	L5
5. Explain the following with neat diagram i) Weighted resistor D/A Converter. ii) Pulse Modulation	[10]	CO4	L4
6. With a neat diagram explain the operation current telemetry system & mention its advantages & disadvantages	[10]	CO4	L5
7. Define data transmission. Explain in brief the different types of transmission.	[10]	CO4	L1
8. Describe a general data acquisition system with neat block diagram & mention its objectives.	[10]	CO3	L2

Single channel DAS



Block diagram of signal channel

- The s/m consists of a "signal conditioner" followed by an "ADC converter" performing repetitive conversions at a free running, internally determined rate.
- The digital o/p from the "buffer" are fed to a storage or printout device or to a digital computer for Analysis Eg:- Digital Panel meter (DPM)
- → ADC converters used in this s/m are usually provided to receive external commands to convert & hold.
- → Preamplifiers are coupled with the active filters before the process of Data acquisition to strengthen the signal, minimize the effect of noise, eliminate interfering high frequency components & for avoiding aliasing or conversion.
- → Analog data can perform data reduction if reliable & economically & should be considered as an alternative for reducing the no of transmission channels, if complex

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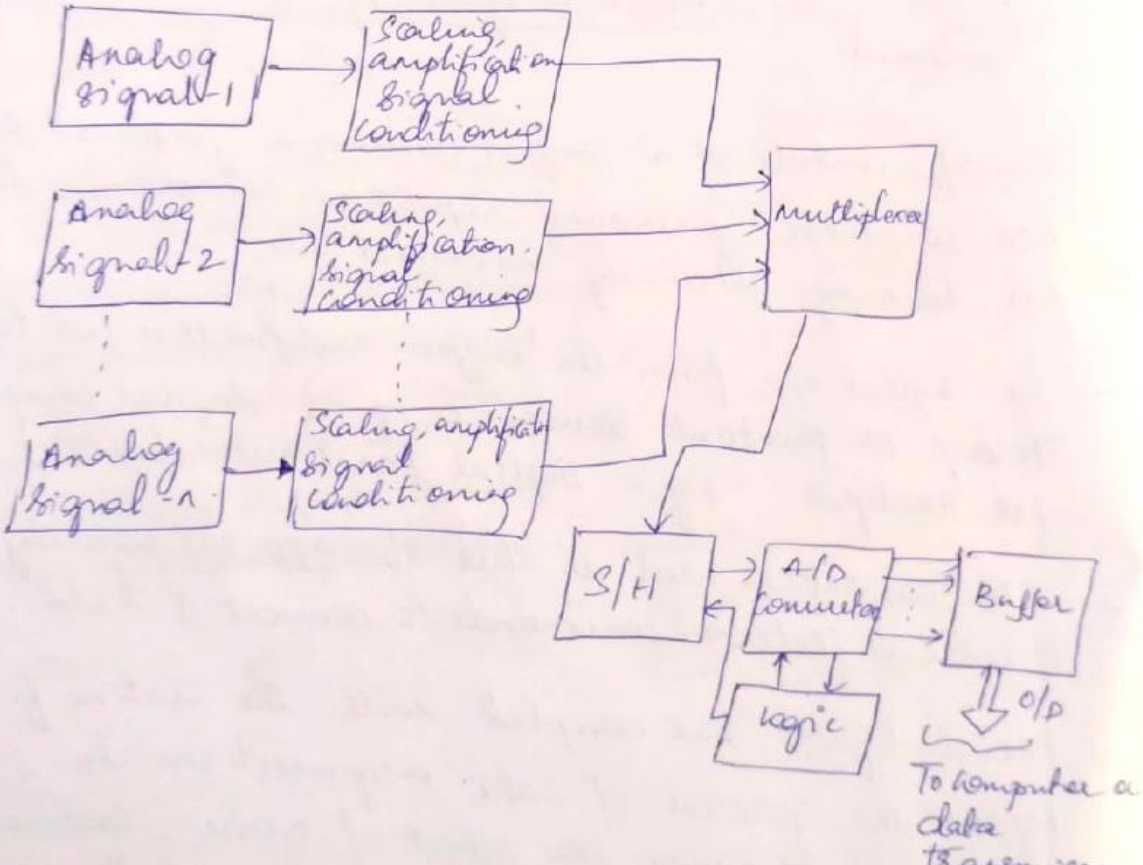
Multi-channel data Acquisition s/m

The different sub s/m of the DAS can be time-shared by two or more i/p sources. Based on the desired properties of the multiplexed s/m a no of techniques are employed.

1. multi-channel analog multiplexed s/m.

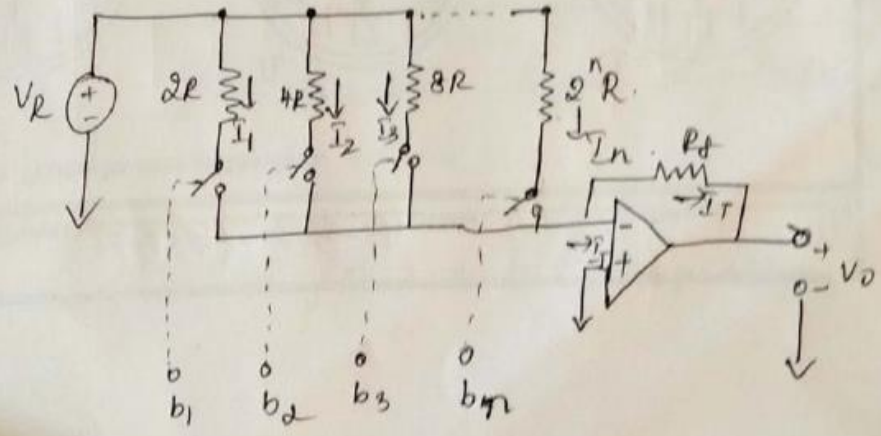


- The individual signals are applied directly, or after preamplification and/or signal conditioning whereas to the multiplexer
- These analog signals are applied directly or after preamplification and/or signal conditioning

2.i)

1. Weighted resistor digital-analog converters.

The binary weighted resistor DAC uses an op-amp to sum n binary weighted currents derived from a reference voltage V_R via current scaling resistors 2R, 4R, 8R, ... 2^nR. This ckt arrangement is as shown.



Switch positions are controlled by the digital input. when the digital input is logic 1, it connects the corresponding resistance to the reference vlg V_R.

when S/w is ON, $I = \frac{V_R}{R}$

when S/w is OFF, $I = 0$.

Here operational amplifier is used as a summing amplifier. Due to the high impedance of op-amp, summing current will flow through R_f.

Hence the total current through R_f can be,

$$I_T = I_1 + I_2 + I_3 + \dots + I_n$$

The output vlg a/c R_f

$$V_0 = -I_T R_f$$

$$= -(I_1 + I_2 + I_3 + \dots + I_n) R_f$$

$$= -\left(b_1 \cdot \frac{V_R}{2R} + b_2 \cdot \frac{V_R}{4R} + b_3 \cdot \frac{V_R}{8R} + \dots + b_n \frac{V_R}{2^n R}\right) R_f$$

$$= -\frac{V_R}{R} R_f \left(b_1 2^{-1} + b_2 2^{-2} + b_3 \cdot 2^{-3} + \dots + 2^{-n} \cdot b_n\right)$$

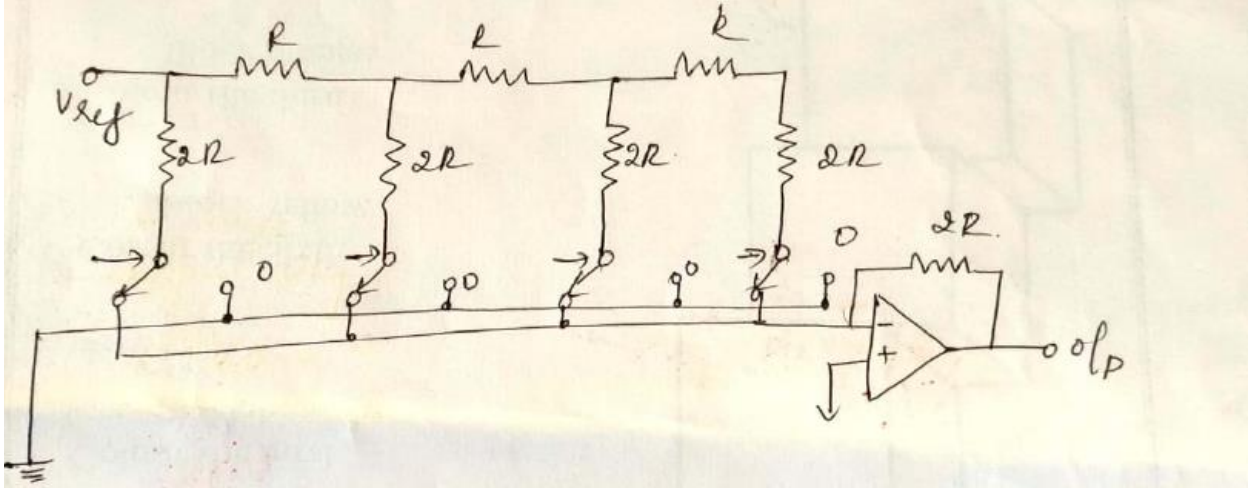
when $R_f = R$.

$$\boxed{V_0 = -V_R\left(b_1 2^{-1} + b_2 \cdot 2^{-2} + b_3 2^{-3} + \dots + b_n 2^{-n}\right)}$$

2. R-2R ladder network.

→ This overcomes the problem of obtaining accurate resistances over a wide range of values, only two values being required.

→ The o/p v/g is generated by g/n'g sections of the ladder to either the reference v/g or 0V acc to whether there is a 1 or 0 in the digital i/p.



3i)

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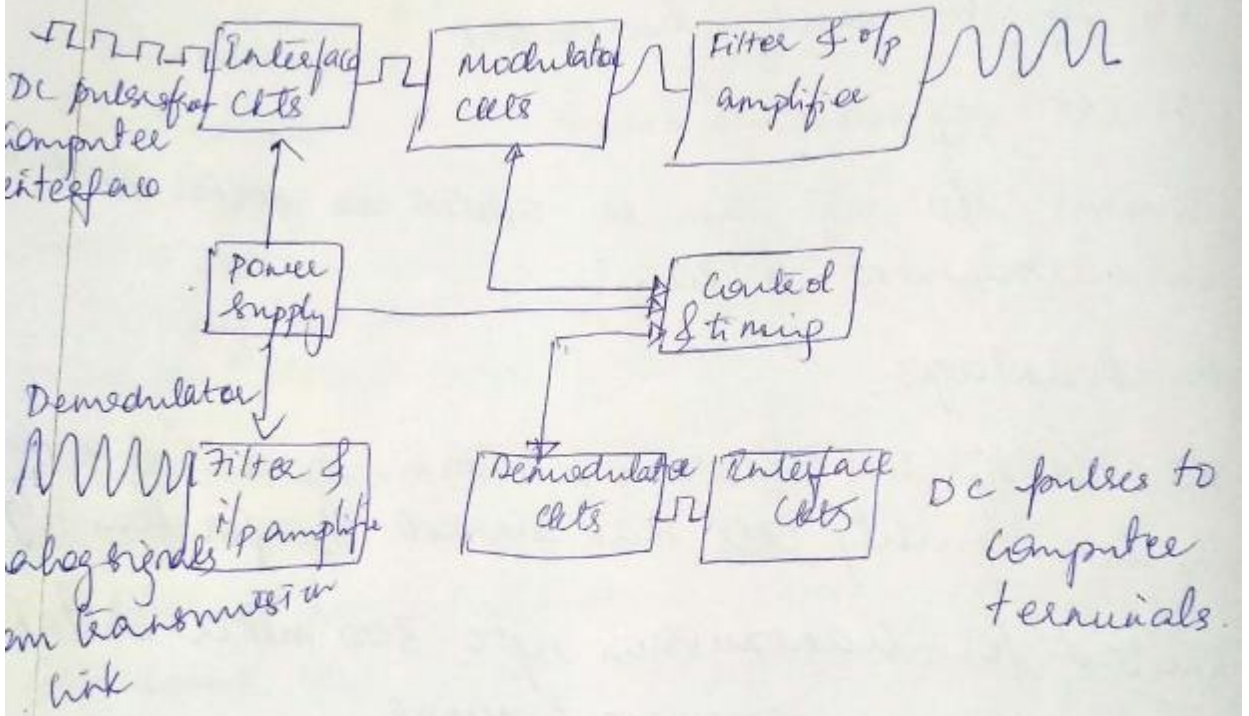
Modems :-

- is a acronym for MODulator DEModulator
- A MODEM is a device that converts data from the computer signals to analog signals which can be sent over a phone line. This is known as Modulation. The analog signals are then converted back into digital data by the receiving modem. This is known as Demodulation.



current telemetry S/m

Construction:-

1. It consists of a slide-wire potentiometer in series with a battery.
2. The slide is connected to the bourdon tube which measures pressure.
3. At the receiving terminal, a multimeter is connected in series, which is calibrated in terms of pressure scale (KN/m^2)

working

1. When the pressure changes the bourdon moves the sliding contact thereby changing the current at the transmitting terminal.
2. This current passes to the receiving terminal through the pair of wires & at the receiving terminal is measured by the milliammeter.

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Advantages

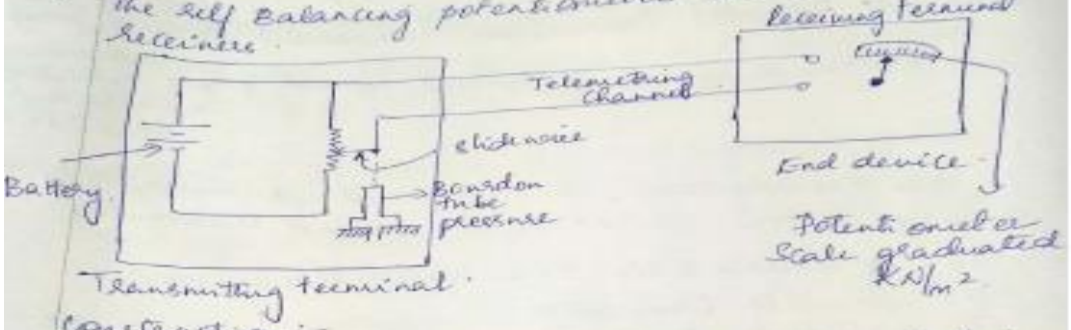
1. Simple milliammeters can be used with special calibration for line resistance.
2. Several receivers can be operated simultaneously
3. The received signals can be added or subtracted directly.
4. Change in line resistance are compensated by basic SIb method.
5. The response of the s/m to an i/p change is almost instantaneous o/p.

Disadvantages:

1. Not suitable for long distance because the o/p current is varied by means of an adjustable resistance in line.
2. Expensive

Voltage - Telemetry S/m

- The measurand is connected to A.C or D.C o/p
- The self balancing potentiometer are the usual receivers.



Construction :-

- It consists of a slide-wire potentiometer connected in series with a battery at the transmitting terminal. The sliding contact is connected to the bourdon tube used for pressure measurement.

At the receiving terminal a null balance D.C potentiometer or a recorder is used.

A pair of wires from a telemeter channel which is connected b/w transmitting & receiving terminal.

Working Principles

- with the change in pressure in the S/m, the bourdon tube actuates the slider of the potentiometer and the Vlg changes at the transmitting terminal
- This Vlg is carried to the receiving terminal, which is measured by a null deflection D.C potentiometer indicator in terms of pressure scale KN/m^2.

Advantages:-

1. Effective for short distance measurement
2. Vlg can be easily transmitted
3. The ckt required is simple
4. Several dp vlg can be added in series so that the measurement is linear

Disadvantages:-

1. Affected by line resistance, leakage, noise & require higher-quality cots than current S/m for low Vlg
2. Limited for transmission upto 300 meter distance
3. more expensive receiving terminal.

Data Acquisition Systems & Conversion

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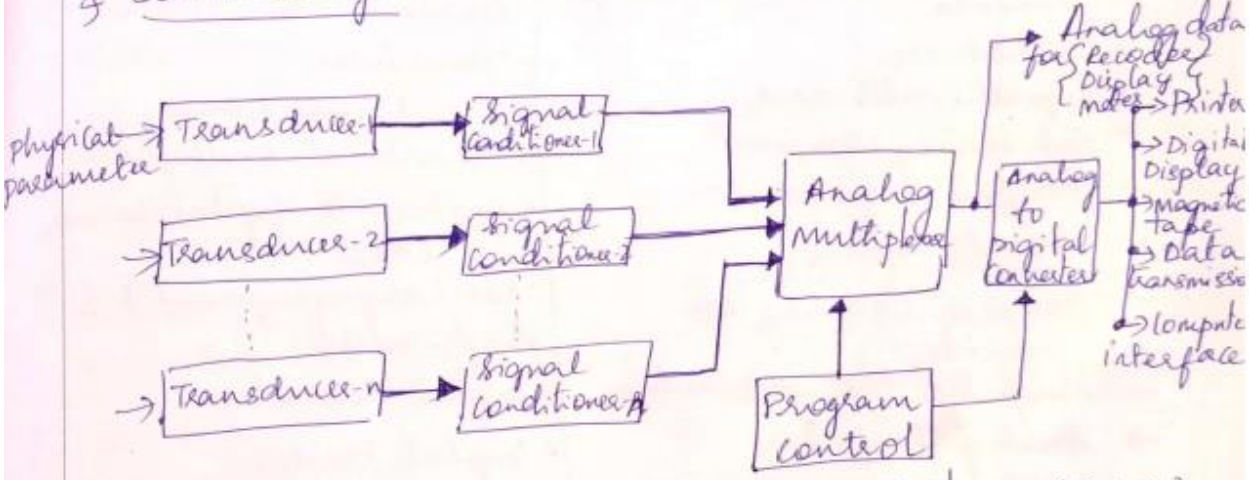
Data acquisition system (DAS) may be defined as a system used for data processing, data conversion & data storage.



Generalized data Acquisition system (DAS).

The block diagram for DAS is as shown above.

- The analog data is usually acquired & converted into digital form for the purpose of processing, transmission, display & storage.

Data may be transmitted in two forms.

→ long distance (from one location to another)
→ Short distance (from a test centre to nearby computer)

- The data may be displayed on a digital panel meter.
- The data may be stored temporarily for

objectives of DAS

1. To be reliable, flexible & capable of being expanded for future requirements.
2. To acquire the necessary data, at correct speed & at correct time.
3. Down time not be more than 0-1%.
4. To be able to compute unit performance indices using on-line, real-time data.
5. To maintain on-line optimum & safe operations, it must monitor the complete plant operation.
6. To be able to collect, summarize & store data for diagnosis of operation & record purposes.
7. To make use of all data efficiently to inform the operator about the state of the plant.
8. To provide an effective human

a considerable distance from the primary element for a data to be transmitted.

Telemetars:- If the data transmittion is to be carried over long distances.

The selection of transmission device depends upon the natwee of the variable & the distance the signal to be sent

Types of Transmission :-

1. Mechanical Transmission
   - The "rack & pinion arrangement" & the "gear trains" are used in Bourdon tube pressure gauge & dial indicator gauge constitute mechanical transmission
   - They amplify the displacement & also transmit the signal to a pointer which moves a/c a calibrated dial.

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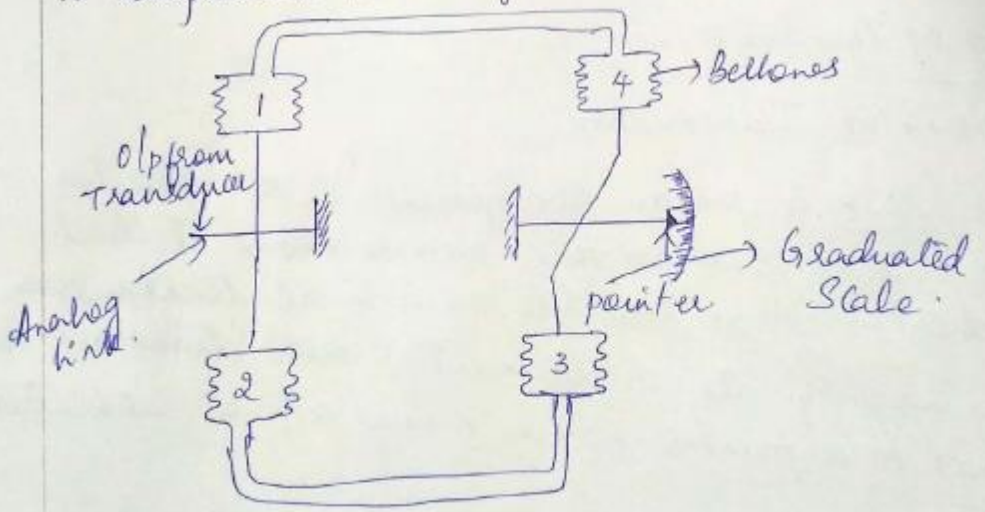
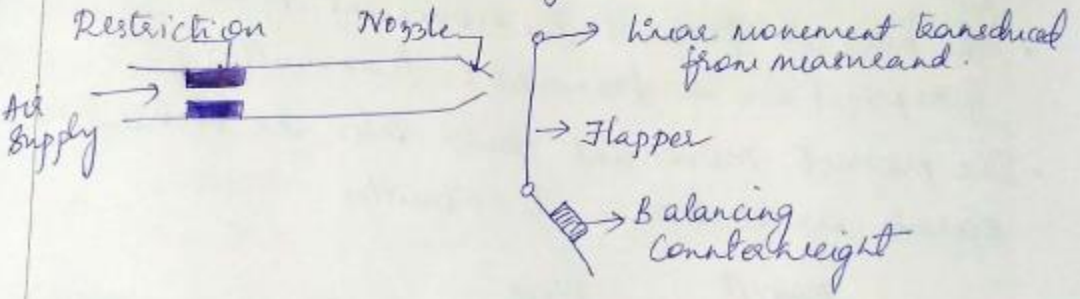
Hydraulic Transmission

- Four bellows are employed, two at the transmission end & two at the receiving end.
- The four bellows are connected by an impulse pipeline & the whole s/m is filled with liquid.
- When the actuating link, on the transmission end is operated by the measurand, then one bellow is expanded & other is contracted.
- This expansion & contraction is communicated to receiving end which moves the receiving pointer a equal amount.
- The purpose of using two bellows on either side is to compensate to changes in ambient temperature



Pneumatic Transmission :-

- It consists of an open nozzle which is supplied with air through a restriction/ orifice.
- Flapper is positioned by the measuring element in front of the nozzle.
- The force on the flapper is produced by a transducer which converts the measurand into linear displacement.
- The flapper is pivoted about a point & the other end it contains some balancing counter weight.



- When the flapper is moved against, the nozzle, the air cannot escape & max air passes to the amplifier
- When the flapped is moved away from the nozzle. Min air passes to the amplifier as most of the air escapes to the atmosphere.
- The movement of flapper from one extreme positi to another serves to control the amplifier, which produces an air pressure ∝ to the measurand of adequate strength for transmission over the required distance.

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4. Magnetic Transmission

- An armature is attached at the end of the mechanical moving part whose movement is to be transmitted outside the armature moving inside a non-magnetic tube.
- A magnet is placed around the armature outside the tube.
- The magnet follows the movement of the armature. It represents a pneumatic transmitter.
- The magnet movement could also be utilised to operate an electronic transmitter.