Minor Assignment

1. Explain the generalised measurement system and its functional elements?

A. A generalised "Measurement System" consists of the following:

1. Basic Functional Elements, and
2. Auxiliary Functional Elements.

1. Basic Functional Elements are those that form the integral parts of all instruments. They are the following:

a) Transducer Element that senses and converts the desired input to a more convenient and practicable form to be handled by the measurement system.

b) Signal conditioning or Intermediate modifying Element for manipulating /processing the output of the transducer in a suitable form.

c) Data Presentation Element for giving the information about the measurand or measured variable in the quantitative form.

2. Auxiliary functional elements are those which may be incorporated in a particular system depending on the type of requirement, the nature of measurement technique, etc. They are:

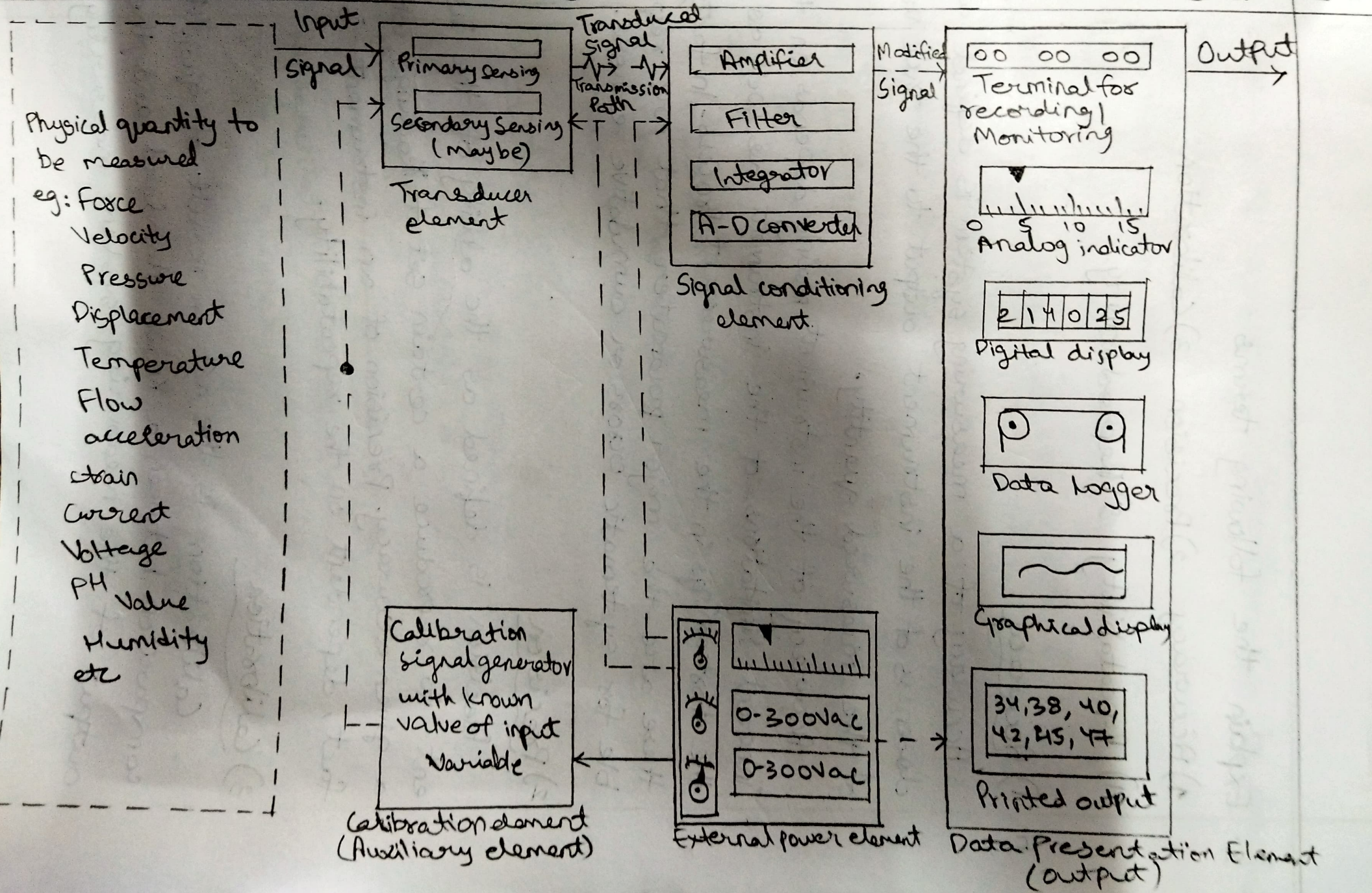
a) Calibration Element to provide a built-in calibration facility.

b) External power element to facilitate the working of one or more of the elements like the transducer element, the signal conditioning element, the data processing element or the feed back element.

c) Feed back Element to control the variation of the physical quantity that is being measured. In addition, feedback element is provided in the null-seeking potentiometric or wheatstone bridge devices to make them automatic or self-balancing.

d) Microprocessor Element to facilitate the manipulation of data for the purpose of simplifying or accelerating the data interpretation.

Basic and Auxiliary functional Elements of a measurement system



2. Explain the following terms

1) Accuracy 2) Precision 3) Calibration

4) Repeatability 5) Reproductivity.

A. 1) Accuracy

Accuracy of a measuring system is defined as the closeness of the instrument output to the true value of the measured quantity.

Accuracy of the instrument mainly depends on the inherent limitations of the instrument as well as on the shortcomings in the measurement Process. In fact, these are the major parameter that are responsible for systematic errors or cumulative errors.

2) Precision

Precision is defined as the ability of the instrument to reproduce a certain set of readings within a given accuracy. Precision of an instrument is in fact, dependent on the repeatability.

3) Calibration

Calibration is the act or result of quantitative comparison between a known standard and the output of the measuring system measuring

the same quantity. Calibration can be classified as follows:

Primary calibration
Secondary calibration
Direct calibration with known input source
Indirect calibration
Routine calibration.

4) Repeatability

The term repeatability can be defined as the ability of the instrument to reproduce a group of measurements of the same measured quantity, made by the same observer, using the same instrument, under the same conditions.

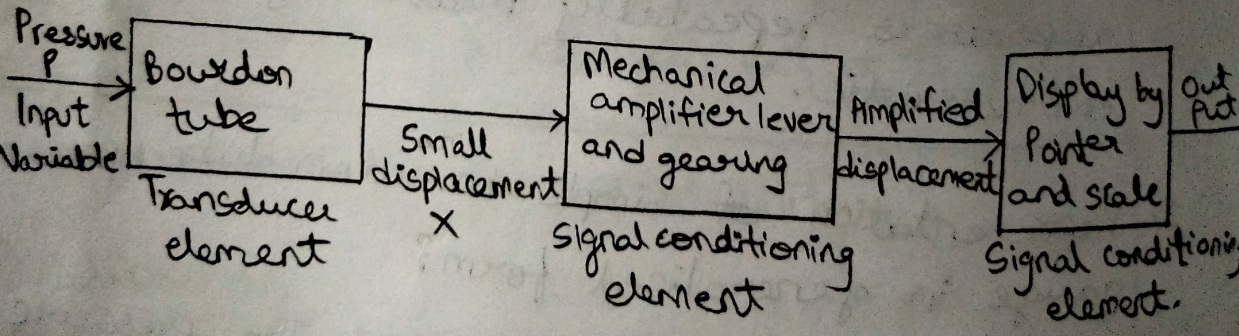
5) Reproductivity

Variation in the averages among different appraisers repeatedly measuring the same part characteristic.

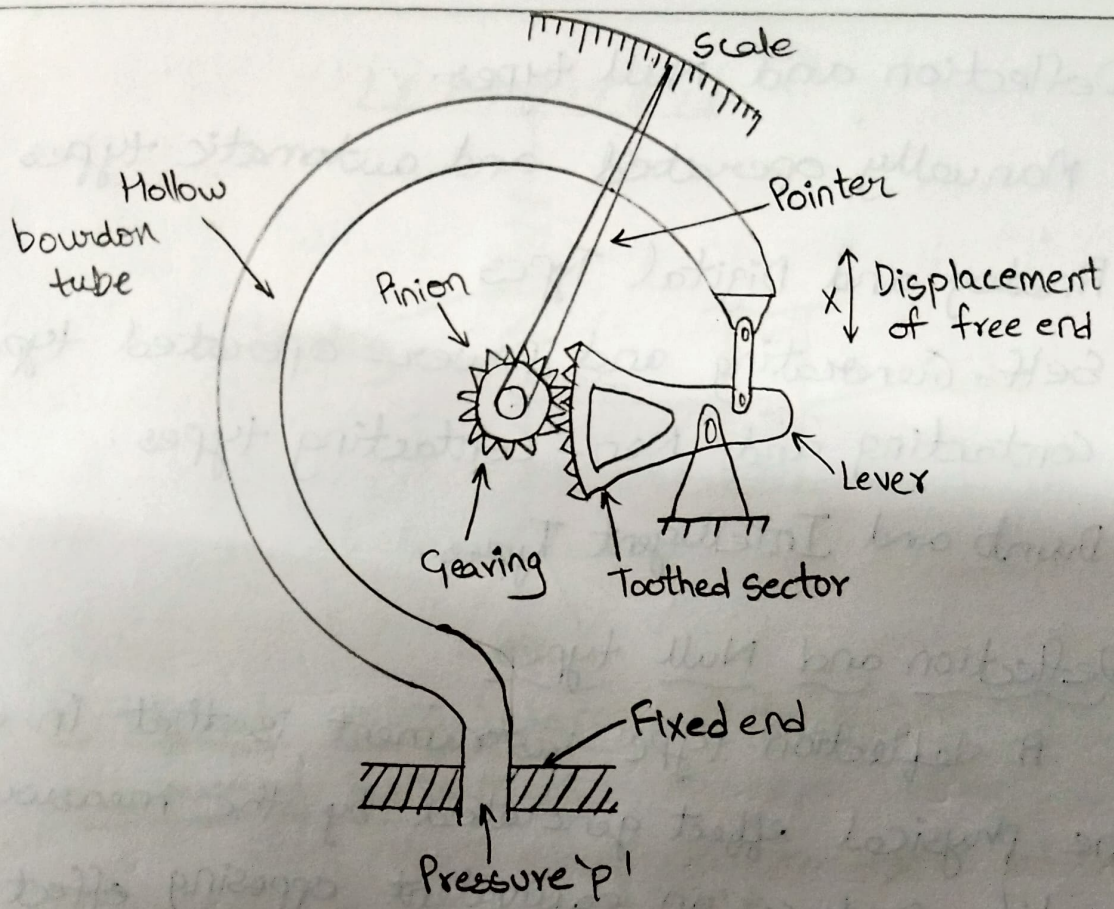
3. Representation of simple bourdon tube pressure gauge in generalised form?

A. Bourdon tube pressure gauge: The pressure applied to the hollow oval-shaped bent tube known as the bourdon tube, deforms the

cross-section of the tube as well as causes a relative motion, proportional to the applied pressure of the free end of the tube with respect to its fixed end. Thus, this tube acts as a transducer element as it converts the desired input, i.e pressure into a displacement x at its free end. This displacement is amplified by the combined lever and the gearing arrangement which may be referred to as the signal conditioning elements. Finally, the movement of the pointer attached to the gear on a scale gives an indication of the pressure and thus the pointer and the scale constitute the data presentation elements of the bourdon tube pressure gauge.



Functional elements of the Bourdon tube pressure gauge



Bourdon tube pressure gauge

4. Classification of Instruments and explain any two types briefly.

A. Classification of Instruments

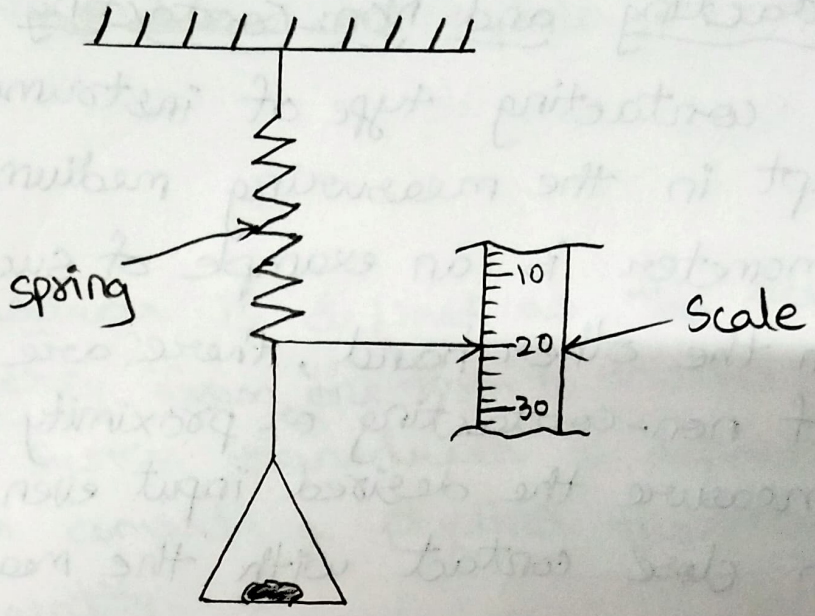
Instruments may be classified according to their application, mode of operation, manner of energy conversion, nature of output signal and so on. All these classifications usually result in overlapping areas. However, the instruments commonly used in practice may be categorised as follows:

1. Deflection and Null types.
2. Manually operated and automatic types
3. Analog and Digital Types
4. Self-Generating and power-operated types.
5. Contacting and Non-Contacting types.
6. Dumb and Intelligent Types.

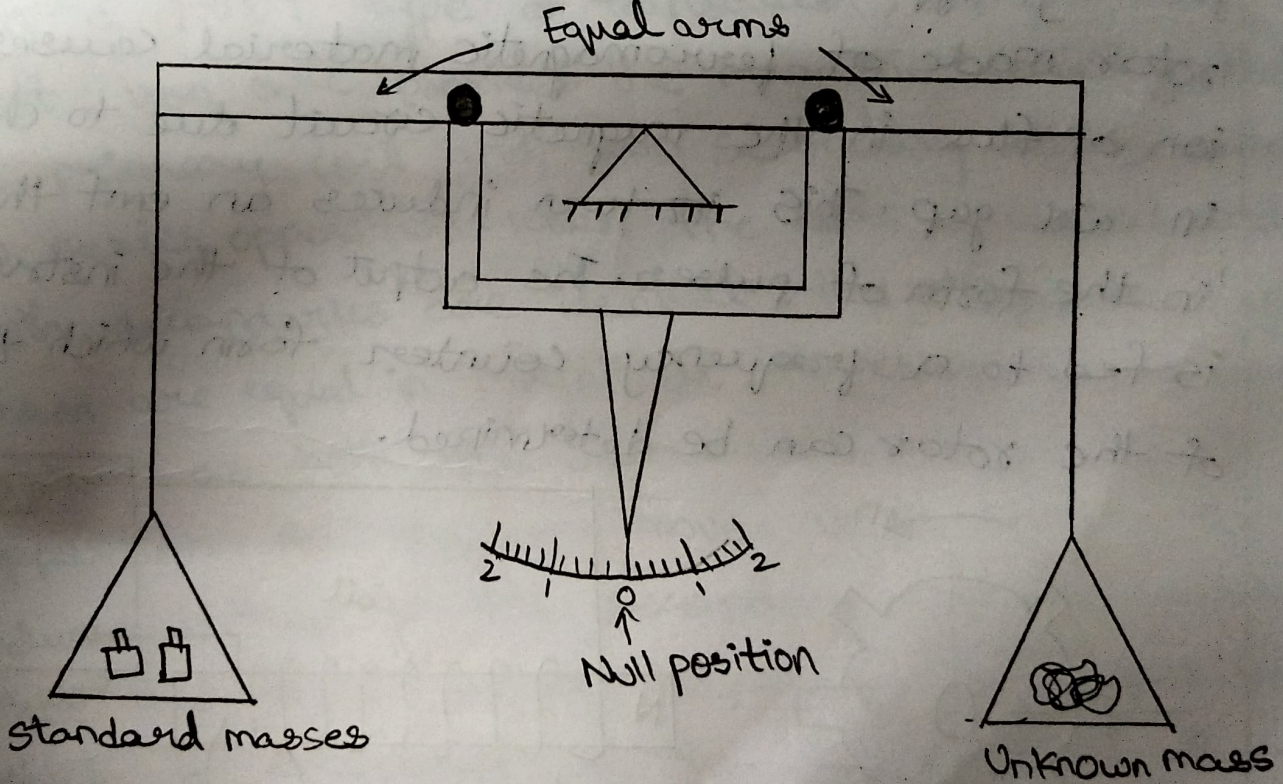
1. Deflection and Null types

A deflection type instrument is that in which the physical effect generated by the measuring quantity produces an equivalent opposing effect in some part of the instrument which in turn is closely related to some variable like mechanical displacement or deflection in the instrument.

A null type instrument is the one that is provided with either a manually operated or automatic balancing device that generators an equivalent opposing effect to nullify the physical effect caused by the quantity to be measured. The equivalent null-causing effect in turn provides the measure of the quantity.



A typical spring balance - A deflection type weight measuring instrument

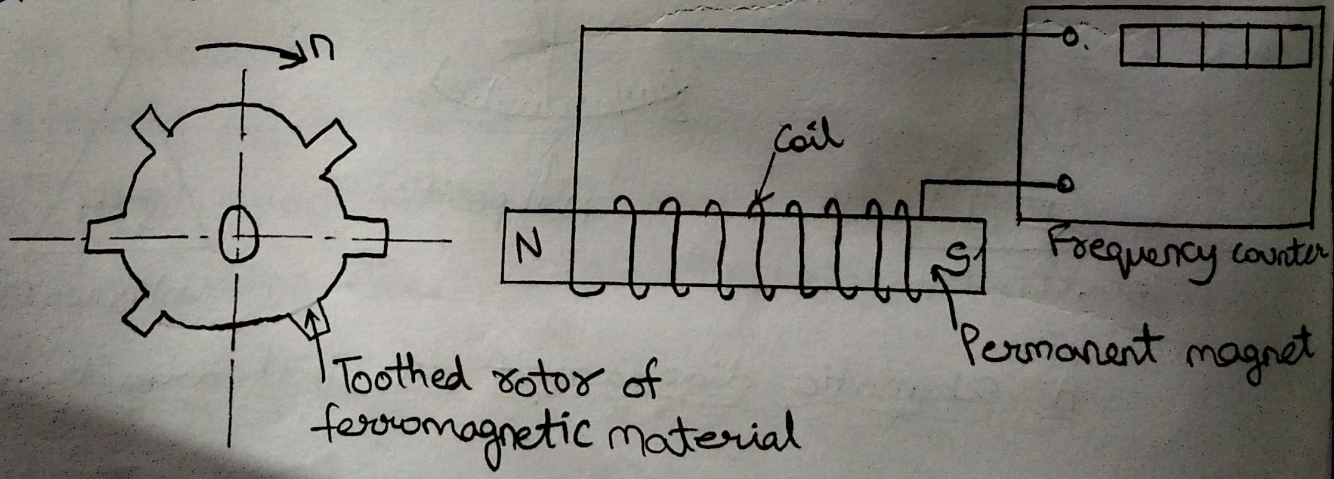


A schematic diagram of an equal arm beam balance

2. Contacting and Non-Contacting types

A contacting type of instrument is one that is kept in the measuring medium itself. A clinical thermometer is an example of such instruments.

On the other hand, there are instruments that are of non-contacting or proximity type. These instruments measure the desired input even though they are not in close contact with the measuring medium. For example, a variable reluctance tachometer, which measures the rpm of a rotating body, is also a proximity type of instrument. In this, the toothed rotor made of ferromagnetic material causes variation of flux in the magnetic circuit due to changes in air gap. This in turn induces an emf that is in the form of pulses. The output of the instrument is fed to a frequency counter form which the rpm of the rotor can be determined.



Variable reluctance tachometer

5. What is a transducer and explain the working of an LVDT

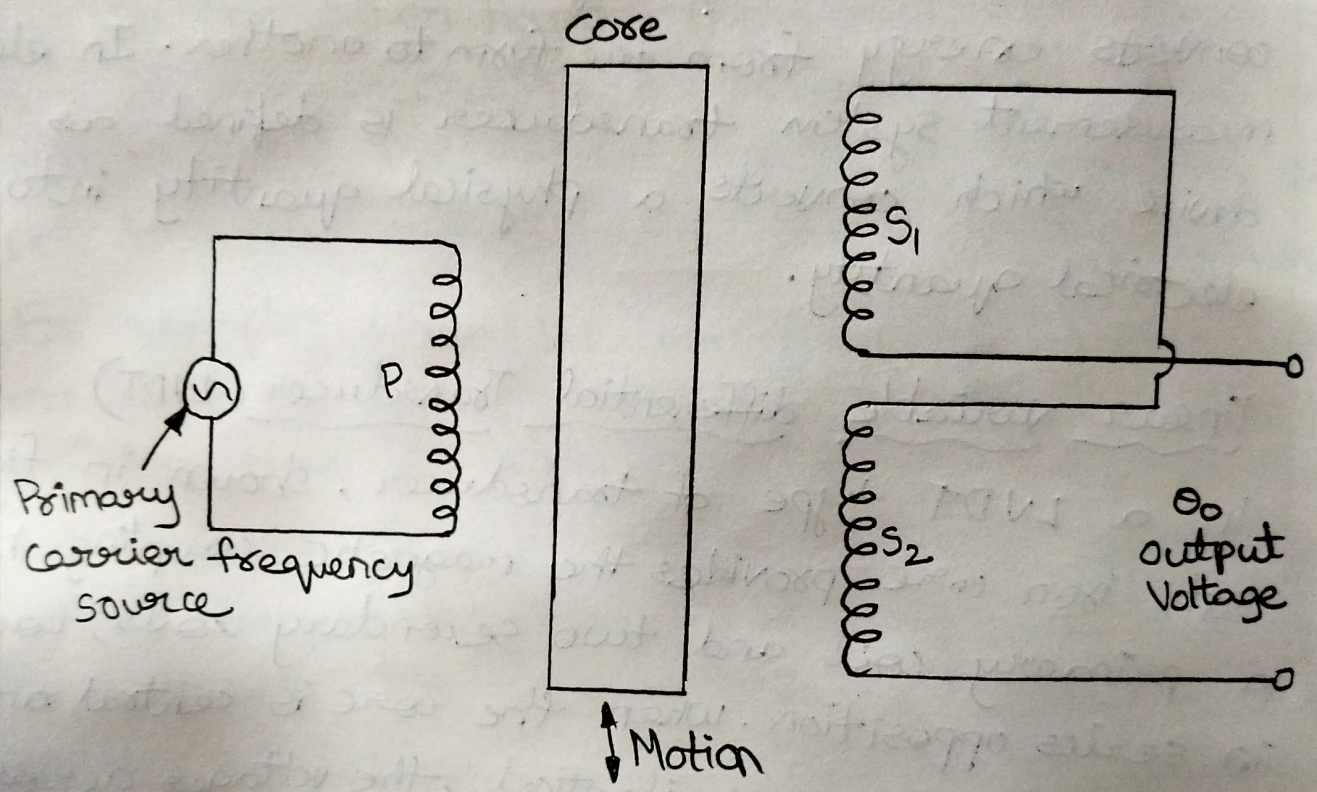
A. Transducer

A transducer is defined as the device which converts energy from one form to another. In electrical measurement system transducer is defined as a device which converts a physical quantity into electrical quantity.

Linear variable differential Transducer (LVDT)

In a LVDT type of transducer, shown in fig, a soft iron core provides the magnetic coupling between a primary coil and two secondary coils, connected in series opposition. When the core is central and both secondaries are identical, the voltages across them are equal in magnitude. However, the output is zero as both the secondaries are in series opposition. As the core moves up or down, the induced voltage of one secondary coil increases while that of the other decreases. The output voltage, which is modulated, is the difference of the two, since secondaries are in opposition. The ~~associated~~ ~~circuit~~ is ~~similar~~ to that ~~of~~. The output is proportional to the displacement of the iron core. The

device is very sensitive and is linear over a wide range of motion.



Linear Variable Differential Transducer