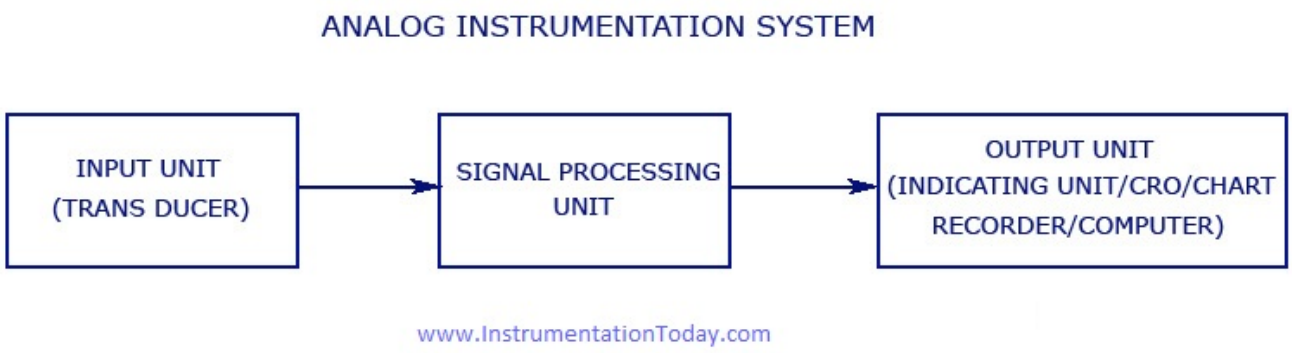
Basic block diagram of electronic measuring instrument

An analog instrumentation system includes three functional units. They are



1. **The Primary Element/Transducer**

The input receives the quantity whose value is to be measured and is converted into its proportional incremental electrical signal such as voltage, current, resistance change, inductance or even capacitance. Thus, the changed variable contains the information of the measured variable. Such a functional element or device is called a **transducer**.

2. **The Secondary Element/Signal Processing Unit**

The output of the **transducer** is provided to the input of the signal processing unit. This unit amplifies the weak transducer output and is filtered and modified to a form that is acceptable by the output unit. Thus this unit may have devices like: amplifiers, filters, analog to digital converters, and so on.

3. **The Final Element/Output Unit**

The output from the signal processing unit is fed to the input of the output unit. The output unit measures the signal and indicates the value to the reader. The indication may be either through: an indicating instrument, a CRO, digital computer, and so on.

Sensitivity

1. **Sensitivity** is an absolute quantity, the smallest absolute amount of change that can be detected by a measurement.

Resolution

Resolution can be expressed in two ways:

1. It is the ratio between the maximum signal measured to the smallest part that can be resolved - usually with an analog-to-digital (A/D) converter.

2. It is the degree to which a change can be theoretically detected, usually expressed as a number of bits. This relates the number of bits of resolution to the actual voltage measurements.

Accuracy

Accuracy can be defined as the amount of uncertainty in a measurement with respect to an absolute standard. Accuracy specifications usually contain the effect of errors due to gain and offset parameters. Offset errors can be given as a unit of measurement such as volts or ohms and are independent of the magnitude of the input signal being measured.

Attenuator

An attenuator is an electronic device that reduces the power of a signal without appreciably distorting its waveform.

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Block diagram of operational amplifier

The operation amplifier

An operational amplifier is a direct coupled high gain amplifier consisting of one or more differential (OPAMP) amplifiers and followed by a level translator and an output stage. An operational amplifier is available as a single integrated circuit package.

The block diagram of OPAMP is shown in **fig. 1**.

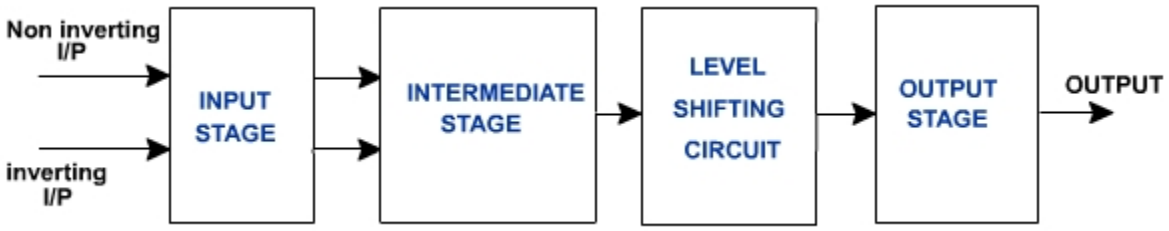

Fig. 1

The input stage is a dual input balanced output differential amplifier. This stage provides most of the voltage gain of the amplifier and also establishes the input resistance of the OPAMP. The intermediate stage of OPAMP is another differential amplifier which is driven by the output of the first stage. This is usually dual input unbalanced output.

Because direct coupling is used, the dc voltage level at the output of intermediate stage is well above ground potential. Therefore level shifting circuit is used to shift the dc level at the output downward to zero with respect to ground. The output stage is generally a push pull complementary amplifier. The output stage increases the output voltage swing and raises the current supplying capability of the OPAMP. It also provides low output resistance.

Trace time: - it is a time required by the electron beam to start from the origin to reach to the last point on the CRT to cover one side distance.

Retrace Time: - it is a time required by the electron beam to return to its original position on a CRT screen after being deflected to the right by or saw tooth wave form.