

Al-Rasheed University
College
Medical Instrumentation
Tech. Eng.



Measurements & medical Transducers

2nd Stage

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Lecture One

Basic Concepts of Measurement

1.1 Introduction

- **Measurement:** the process of comparing an unknown quantity with an accepted standard quantity.
- **Instrument:** A device or mechanism used to determine the present value of the quantity under measurement.
- The simplest measuring system consists of four function units as illustrated in the block diagram shown in Fig. (1.1);

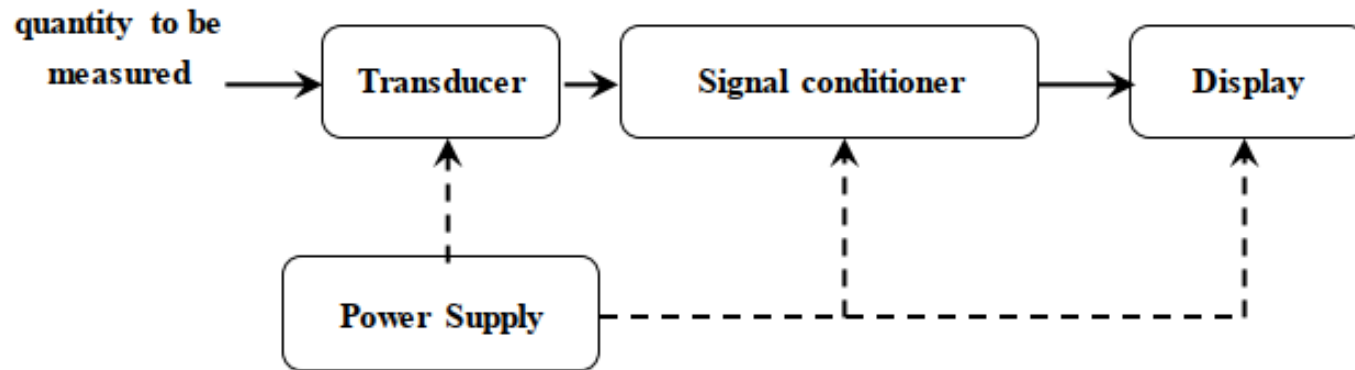


Fig (1.1). Block diagram of measurement system

- **The physical quantity to be measured** (measurand) may be electric quantity, force, pressure, level, strain, displacement, temperature, ...etc.
- **transducer** is defined as a device which converts the energy (quantity) from one form to another.
- **The signal conditioner** includes all system elements that are used to perform the necessary and distinct operations in the measurement sequence between the transducer unit and the output devices .
- **The display device** are used to display the required information about the measurements. The display device may be analogue panel meter, graphic recorder, magnetic tape recorder, cathode ray oscilloscope, or a digital display.
- **The power supply** provides the required excitation to the transducer and the necessary electrical power to the signal conditioner and the display device .

1.3 Methods of Measurements

Basically, there are two types of measurements:

1- Direct method

In direct method of measurement, the quantity to be measured is compared directly against a standard of some kind of quantity.

disadvantage:

- (i) It is not always possible, feasible and practicable.
- (ii) The involvement of human in this method makes it inaccurate and less sensitive.



2- Indirect Method

Indirect method of measurement is used only when the direct measurement is either impractical or impossible.

It is less desirable and often less accurate than direct measurement. It is important to select the suitable method of measurement according to the following points:

- (i) Device available.
- (ii) Accuracy desired.
- (iii) Time required.
- (iv) Difficulties in measurements.
- (v) Conditions of measurements.



1.4 Types of Instruments

The history of development of instruments encompasses three phases:

1- Mechanical Instruments

Mechanical instruments are very reliable for static and stable conditions, but they are unable for respond rapidly to measurement of dynamic and transient conditions.



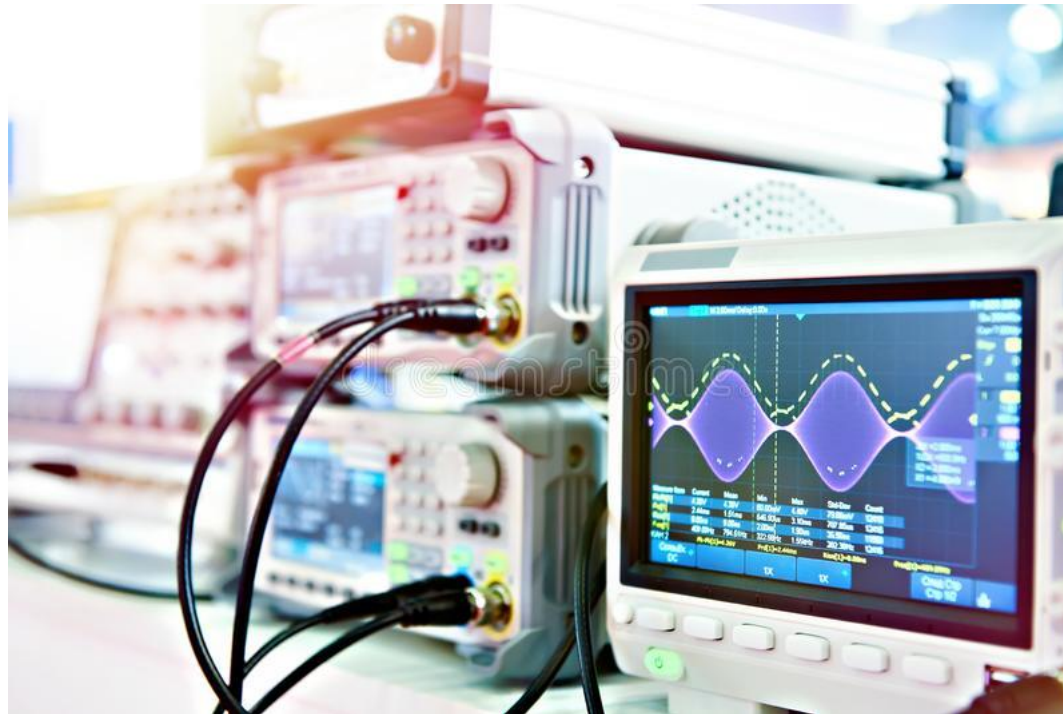
2- Electrical Instruments

Electrical methods of indicating the output of transducers are more rapid than the mechanical methods.



3- Electronic and digital Instruments

Electronic and digital instruments are becoming more reliable on account of the improvements in the design and manufacturing processes of semiconductor devices.



1.5 Factors Effecting Instrument selection

1- Accuracy: represents the closeness with which an instrument reading approaches the true value of the variable being measured.

2- Precision : a measure of the reproducibility of the measurements.

3- Sensitivity: the ratio of output signal or response of the instrument to a change of input or measured variable.

4- Resolution represents the smallest change in measured value to which the instrument will respond.



5- Error: represents the deviation from the true value of the measured variable.