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### Sensors used in Biomedical Applications

Sensors are widely used in biomedical applications. Measuring patients' vitals are now very quick, easy, fast, accurate because of advancements of electrical application of sensors. There are various kinds of sensors used to monitor various aspects of human health. Below are few examples.

1. Heart rate sensor, stethoscope senses the heart beats and sound is transmitted through pipe and heart rate is measured.
2. Oxygen level sensor, we put our finger in oxygen level measurement device which detects oxygen levels using light.
3. Blood pressure sensor.
4. Blood glucose sensor, an example of chemical sensor.
5. ECG (electrocardiography) machine sensor.

### Actuators used in Biomedical Applications

- 1) Actuators are used to perform certain action which can be performed by robots without human intervention.
- 2) Controlled medicine supply, mixing medicines in right quantity to make medicines tablets.
- 3) Ventilators, which supply oxygen to patient using actuators to continuously supply right quantity of oxygen.
- 4) Dialysis machines.
- 5) Drugs testing require specialised machines to rotate test tubes at regular intervals requires actuators.

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Components of a basic measuring instrument

It is possible & desirable to describe the operation of a measuring instrument or a system in a generalized manner without resorting to intricate details of the physical aspect of a specific instrument or a system

most contain 3 components

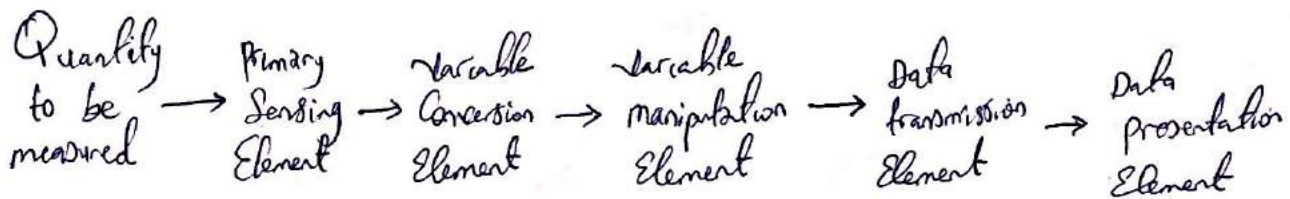
- Primary Sensing Element
- Variable Conversion Element
- Data presentation Element

(i) Primary Sensing Element

The measurement is first detected by primary sensor. The transducer converts the measurand into an analogous electrical signal.

(ii) Variable Conversion Element

It manipulates the signal presented to it preserving the original nature of the signal.



Data Conditioning element

Signal Conditioning then data transmission takes place.

## Data presentation Element.

The function of data presentation element is to convey the information about the quantity under measurement to the personnel reading the instrument or the system for monitoring, control, or analysis purposes. The information conveyed must be in a convenient form. In case data is to be monitored, visual display devices are needed. These devices may be analogue or digital indicating instruments like ammeters, voltmeters, etc. In case the data is to be recorded, recorders like magnetic tapes, high speed camera and T.V. equipment; storage type C.R.T., printers, analogue and digital computers may be used.

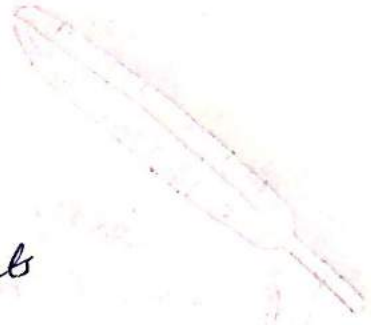
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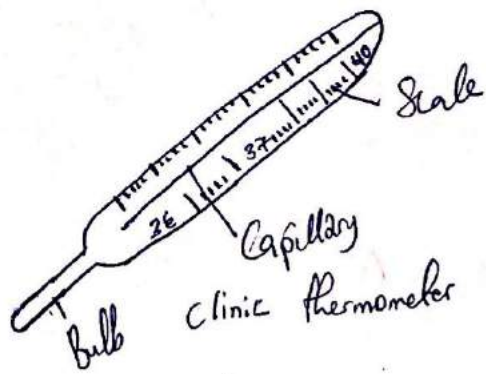
### Case Studies of medical measurement instruments



#### 1) Clinical Thermometer

In this thermometer bulb containing mercury acts as the primary sensing element as well as a variable conversion element.

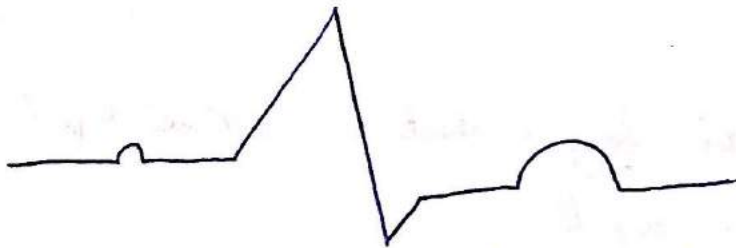
- It senses the input quantity, the temperature on account of the increase in temperature on ~~attendant~~ of the mercury in bulb expands and its volume is increased.
- The temperature signal is converted into volume displacement.
- As the mercury expands it moves through the capillary tube in the thermometer system integrated to the bulb.
- The cross section area of the capillary being constant, the volume signal is now converted into linear distance signal.
- Thus capillary has the role of signal manipulation and data transportation elements.
- The final data presentation stage consists of the scale on the thermometer stem, which is calibrated to give the indication of the temperature signal applied to the thermometer bulb.
- A restriction band is provided in the clinical thermometers at the junction of the bulb at the capillary which does not allow the back flow of mercury to the bulb once it has expanded to the capillary.
- Thus the restriction in the capillary acts as the data storage function of the instrument.



⊕ ECG (Electrocardiography) is the process of producing an electrocardiogram (ECG or

→ It is a graph of voltage versus time of the electrical activity of the heart using electrodes placed on the skin.

→ These electrodes detect the small electrical charges that are a consequence of cardiac muscle depolarization followed by repolarization during each cardiac cycle (heart beat).



ECG of a heart in normal sinus rhythm.