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DEPT: ELECTRICAL/ELECTRONICS 300L

NO (1)

### Actuators for biomedical applications

In the biomedical field when performing surgery on very small parts of the human body, the doctor in the past would've followed a habitual process of which the accuracy of the results could be very low. Periodic advancements have brought increased accuracy with the help of smart actuators & sensors.

The smart actuators are comprised of various elements such as sensors, processors & communication which allows the continuous interaction of the actuator within the complete system.

Smart actuators should be

- damage resistant
- work in the human bodily fluids
- meticulous
- lightweight

### Applications of actuators

- drug delivery
- Microgrippers to remove tumors
- Piezo electrical for making incisions
- detection
- analysis

### Examples of biomedical inclined actuators

- Nitinol
- catheter control (using shape memory materials)
- Laser techniques to remove stenosis
- Micropumps (controlled drug supply)
- Smart pill
- Vertical nano-particle filtration module

- Dialysis machines
- Ventilators

### Sensors for biomed

Sensors are ~~critically~~ critical components in all devices & measurement systems. Defining the term sensor is tough so instead we use the definition of an electrical transducer. A device which provides a usable output in response to a specified measured. Sensors consist of sensing component, converting device & electronic circuit.

Sensor characteristics include: measurement range, sensitivity, accuracy, precision, resolution, reproducibility, offset, linearity etc.

#### Examples

- Oxygen & CO<sub>2</sub> sensor for blood
- Heart sound sensor
- Blood flow sensor
- Respiratory sensor
- Electrochemical electrode
- E M G & E E G electrodes

### No (2)

#### 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 its physical aspect of a specific instrument or a system.

Most contain 3 components

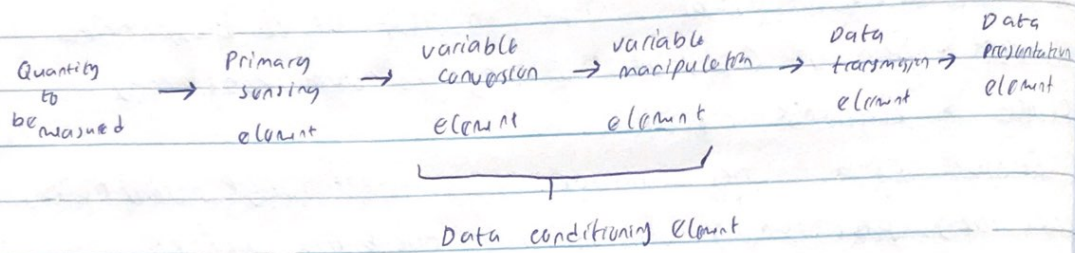
- Primary sensing Element
- Variable conversion Element
- Data Presentation Element.

### 1) Primary Sensing Element

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

### ii) Variable Conversion Element

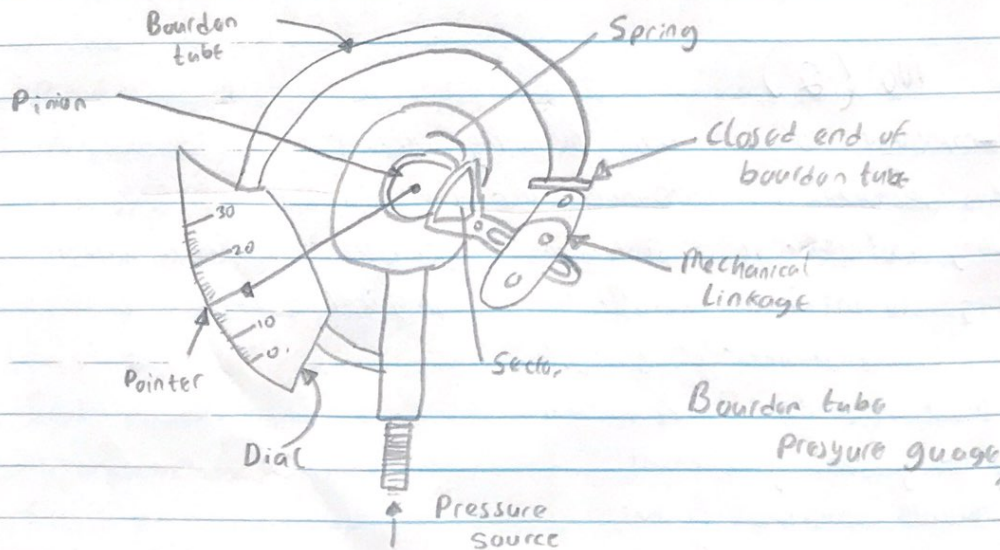
It manipulates the signal prepared to it preserving the original nature of the signal.



Signal conditioning then data transmission take place. (intermediate stage)

### 3) Data presentation Element

The information conveyed must be in a form intelligible to the personnel, this is the function of the data presentation element. Digital devices are needed for display. e.g. ammeter, voltmeter. The final stage is the terminating stage.

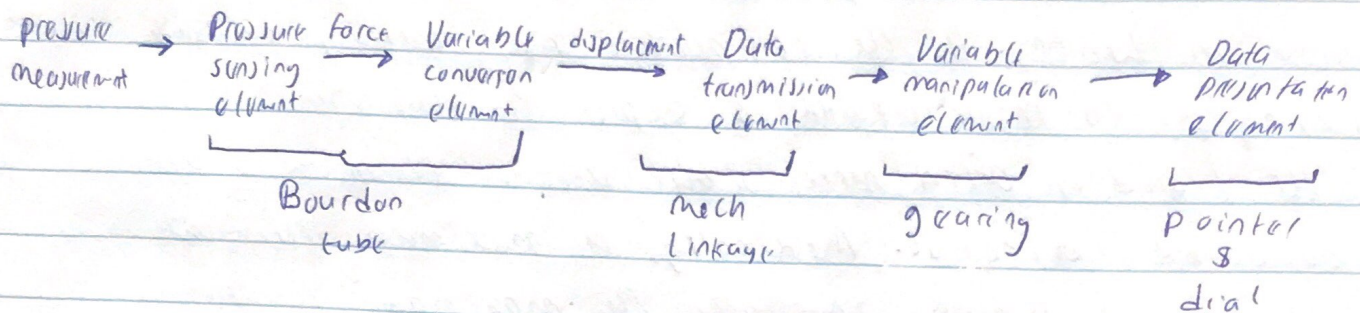


the bourdon tube = primary sensing element & variable conversion element

mechanical linkage = data transmission element

gearing arrangement = data manipulation element

Schematic diagram of bourdon tube



3)

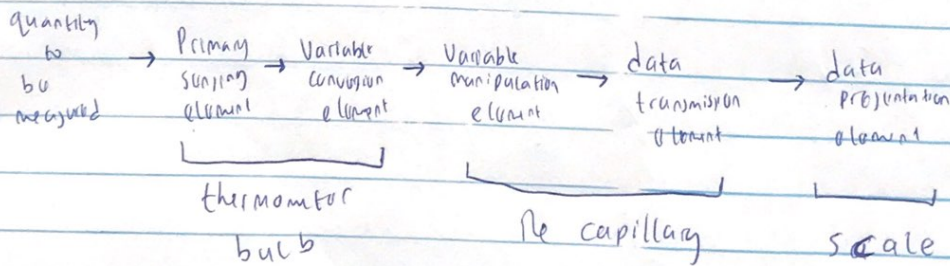
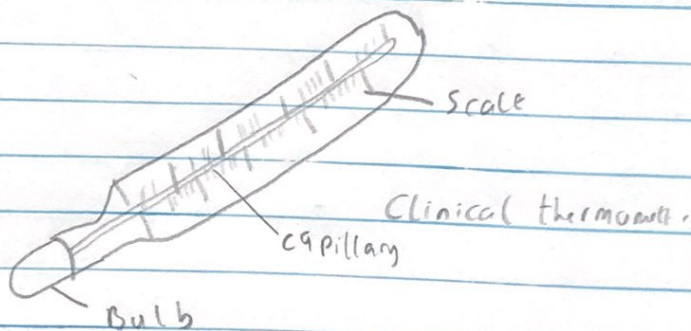
### 3) Brief case study of a medical thermometer:

It is used for measuring human or animal body temperature.

The tip of the thermometer is inserted into the mouth under the tongue, armpit, anus or ear.

It works on the principle that solids & liquids expand on heating. As the temperature rises, mercury expands causing it to move upwards & depict the temperature.

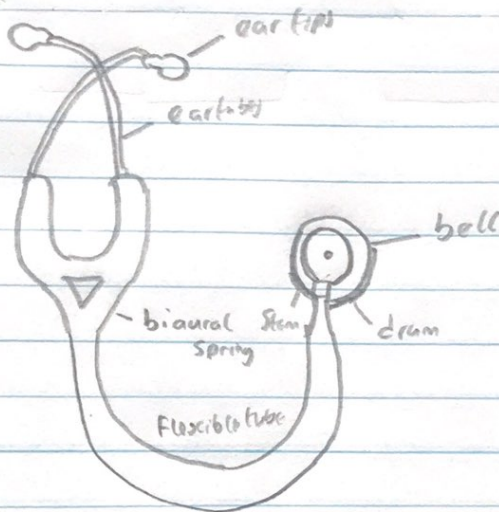
The liquid is often mercury, but alcohol thermometers use a coloured alcohol. Medically, a maximum thermometer is often used, which indicates the maximum temperature reached even after it is removed from the body. As the temperature of the bulb rises, the liquid expands up the tube through the constriction.



Schematic diagram of components of a  
Stethoscope

## Brief case study of a stethoscope

It is an acoustic medical device for auscultation, or listening to internal sounds of an animal or human body. It has a small disc-shaped resonator connected to two earpieces.



Whenever the doctors place the stethoscope on the chest of the patient, a vibration will occur because of sound waves from the patient's body. The diaphragm picks the vibrations and it is sent through the tube. The doctor picks up the sound

