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181ENG041007

ELECTRICAL ELECTRONICS ENGINEERING

① Describe briefly (with examples) sensors & actuators for Biomedical Applications.

Biomedical sensors are used to gain information on the body and its pathology. or it is a device which provides a usable output in response to a specified measurand of chemical, biological or physical properties. They are classified into Physical & Chemical sensors

Applications

- It helps doctor's quickly detect body temperature & blood pressure of patients
- It is used to monitor the heart frequency continuously
- In the military Biosensors are employed to detect the situation of the battle field to adjust the strategy of spying or attacking the enemy.
- It is used by Geographers as a PH sensor to detect our atmosphere's condition.

Examples

Oxygen and Carbon dioxide sensor for blood

Oxygen sensor for blood

Heart sound sensor

Actuators:

An Actuator is an electrical device that takes an electrical signal and combines it with an energy source to create physical motion.

An actuator may be pneumatic, hydraulic, electric, thermal or Magnetic.

- Manual Actuators: - These actuators require an employee to control gears, levers or wheels. Although they are inexpensive and simple to use, they have limited applicability.
- Pneumatic Actuators: - These actuators use gas pressure to power valves. The pressure pushes a piston to affect the valve system.
- Hydraulic Actuators: - These actuators use fluid to generate pressure. Instead of gas pressure, hydraulic actuators use fluid pressure to operate valves.
- Electric Actuators: - Electric actuators employ an electric motor to operate a valve. Although these actuators are quiet & efficient, they require batteries or electricity, which may not always be available in particular locations.
- Spring Actuators: - These actuators hold spring back until a trigger occurs. Once a particular threshold is reached, the spring releases and operates the valve. These are typically used in one-time emergency applications.

Biomedical Applications of Actuators

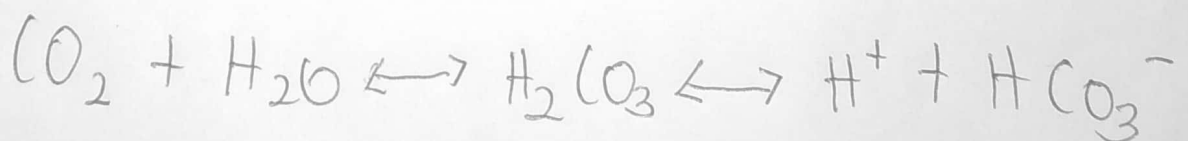
- Catheter control :- Using shape memory materials
- Laser techniques to remove stenosis
- Micropumps :- deliver very accurate amount of things where it is required.
- Smartpill :- Implanted under the skin and released when necessary
- Electrical stimulation :- Used to treat Parkinson's disease, epilepsy, cochlear implant, retinal implant, muscle stimulation.

③ Describe, with sketches & examples, of the components of a basic measuring instrument.

- Carbon dioxide sensor for Blood

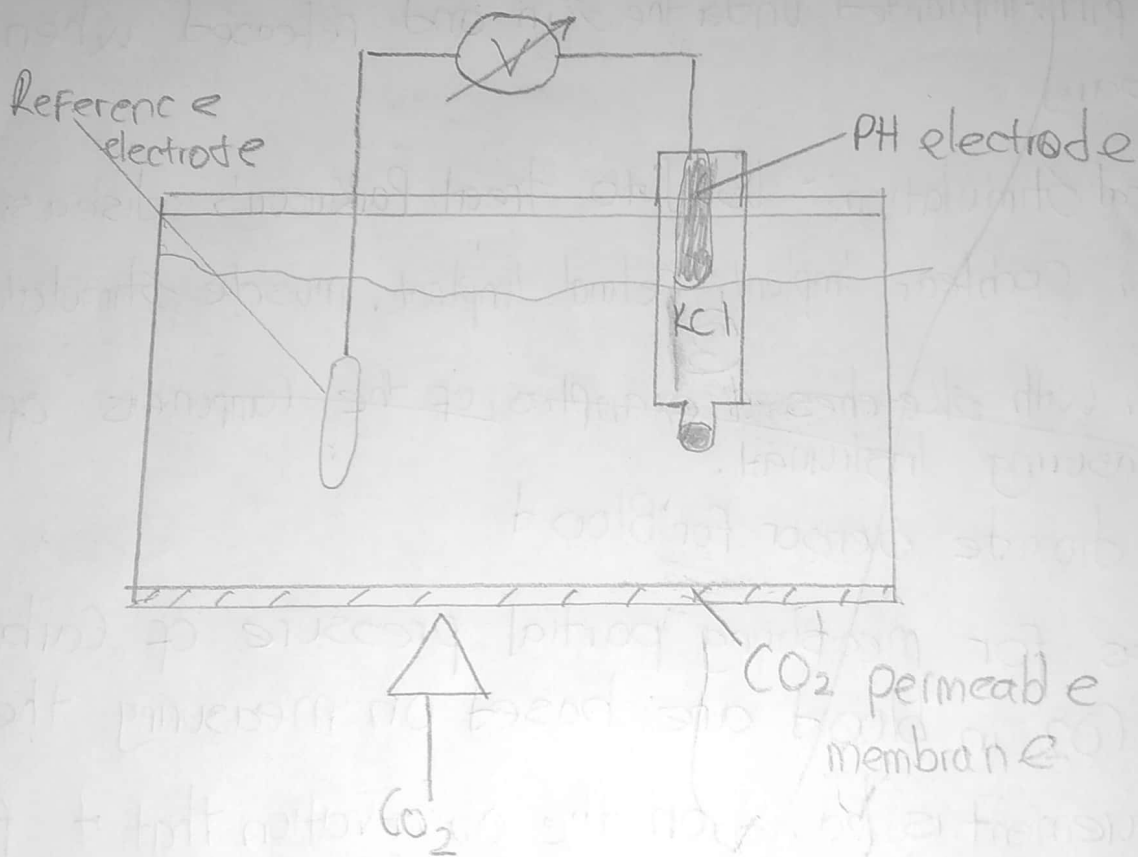
Electrodes for measuring partial pressure of Carbon dioxide CO_2 in blood are based on measuring the pH.

The measurement is based on the observation that it forms a weakly dissociated carbonic acid (H_2CO_3) and bicarbonate ions when CO_2 is dissolved in water according to the following reaction!



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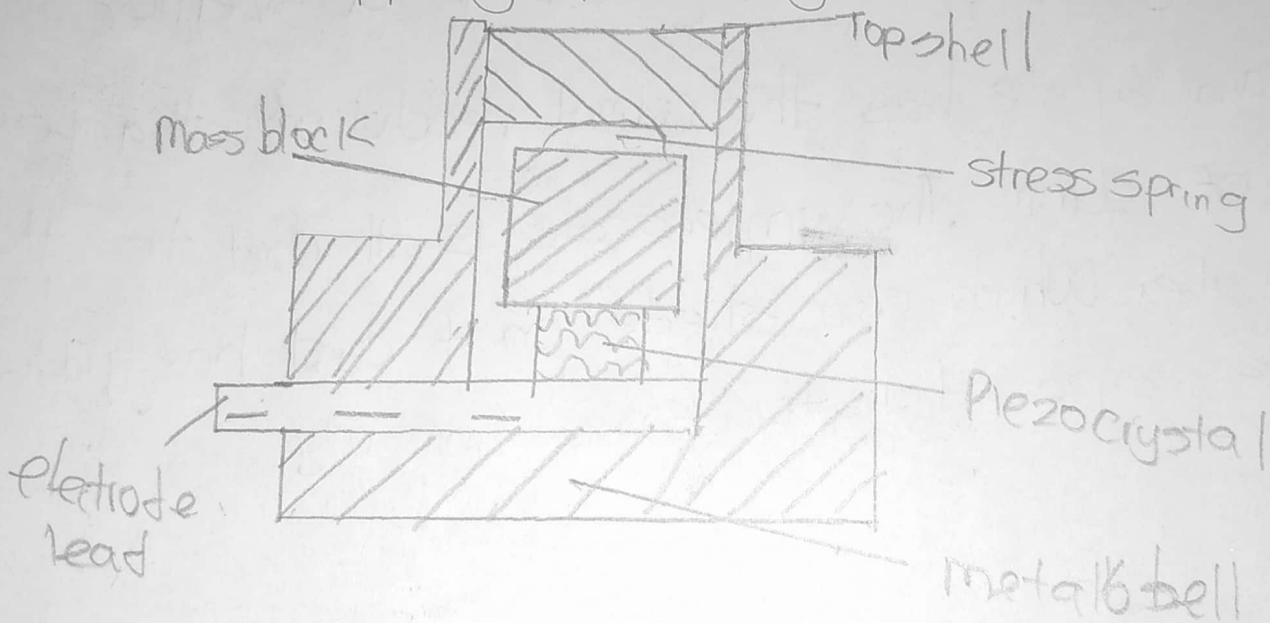
As a result of this chemical reaction, the pH of the solution is changed. This change generates a potential between the glass pH and a reference electrode that is proportional to the negative logarithm of the concentration of the carbon dioxide pCO_2 in the plasma.



Sensing principle of a pCO_2 electrode

① Piezoelectric

The sensing structure of piezoelectric acceleration sensor is illustrated below. Such sensor is used to measure heart sound. Its structure is very simple, which consists of vibration mass block & piezoelectric crystal. A stress spring is utilized to exert a certain stress on vibration mass block between top shell & mass block. Such method could timely adjust the linear characteristic of sensing component. This sensor's gravity is less than 30g, and is used to detect heart sound and buffeting from body organisms.

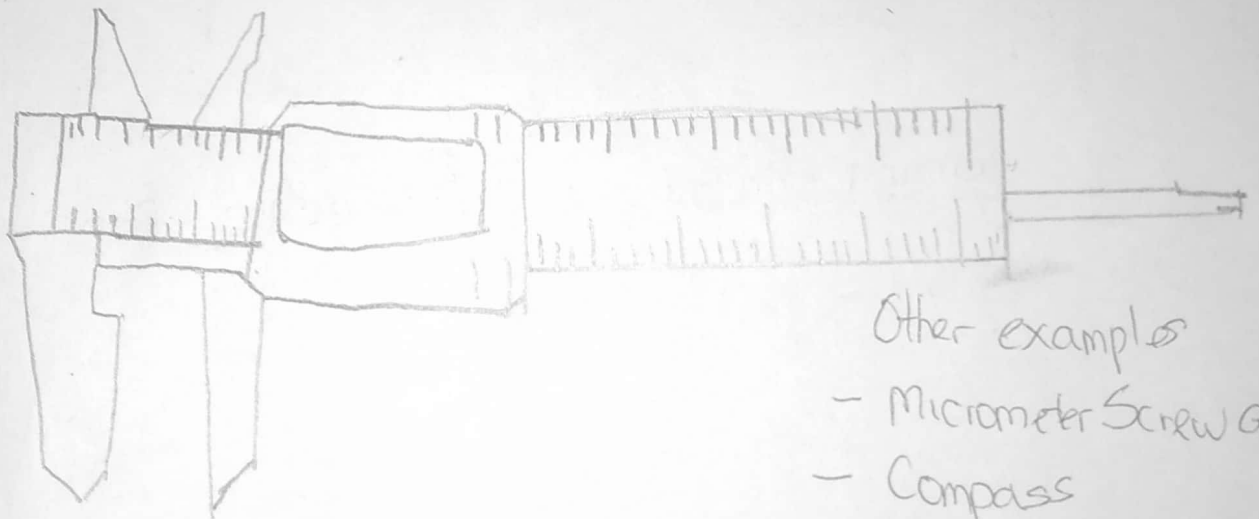


Sensing Structure of piezoelectric acceleration sensor

②

• Vernier Callipers:- These are widely used linear measurement instrument with a least count of 0.02mm . It works on the principle of using the alignment of line segments displaced by a small amount to make fine measurements. The human eye can easily detect this alignment of lines which is the main fact that drives a Vernier.

A Vernier scale has a main scale & a Vernier scale. The main scale has the normal resolution with a least count of 1mm . The Vernier scale is attached to the main scale, which can slide on it and has graduations that are spaced by the same 1mm only.



Vernier Calliper

- Other examples
- Micrometer Screw Gauge
 - Compass
 - ~~Divider~~ Protractor