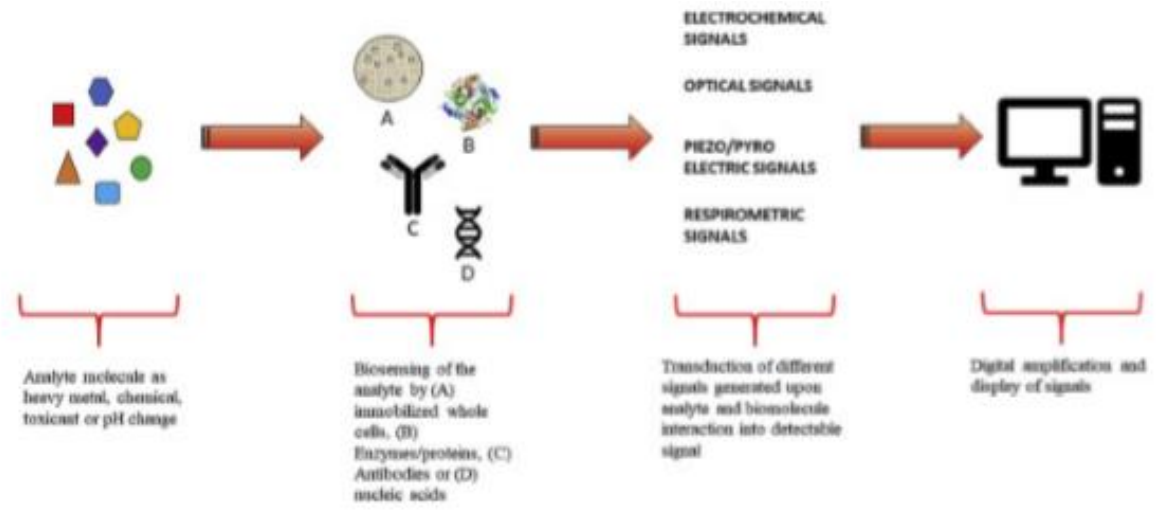
Biosensors and its Applications:

Introduction:

What is a Biosensor? The most widely accepted definition of a biosensor is: “an analytical device which incorporates a biologically active element with an appropriate physical transducer to generate a measurable signal proportional to the concentration of chemical species in any type of sample”.

Type of Biosensors:

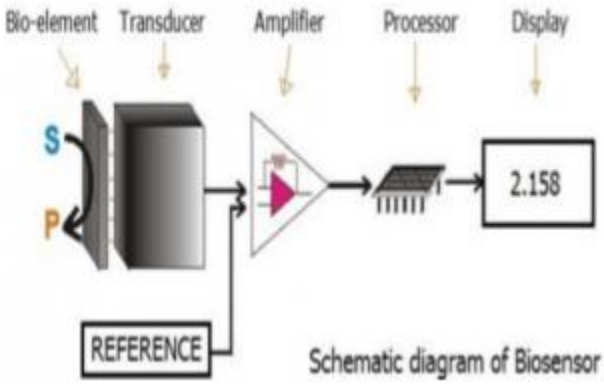
Biosensors can be categorized according to the basic principles of signal transduction and biorecognition elements. In the general scheme of a biosensor



the bio recognition element responds to the target compound and the transducer converts the biological response to a detectable signal, which can be measured electrochemically, optically, acoustically, mechanically, calorimetrically, or electronically, and then correlated with the analyte concentration. Biological elements include enzymes, antibodies, microorganisms, biological tissue, and organelles. When the binding of the sensing element and the analyte is the detected event, the instrument is described as an affinity sensor. When the interaction between the biological element and the analyte is accompanied or

followed by a chemical change in which the concentration of one of the substrates or products is measured the instrument is described as a metabolism sensor.

Finally, when the signal is produced after binding the analyte without chemically changing it but by converting an auxiliary substrate, the biosensor is called a catalytic sensor. The method of transduction depends on the type of physicochemical change resulting from the sensing event. Often, an important ancillary part of a biosensor is a membrane that covers the biological sensing element and has the main functions of selective permeation and diffusion control of analyte, protection against mechanical stresses, and support for the biological element.



Schematic diagram of Biosensor

Types of biosensors:

DNA biosensors: The DNA biosensors were devised on the property that single-strand nucleic acid molecule is able to recognize and bind to its complementary strand in a sample. The interaction is due to the formation of stable hydrogen bonds between the two nucleic acid strands.

Magnetic biosensors: miniaturized biosensors detecting magnetic micro- and nanoparticles in microfluidic channels using the magnetoresistance effect have great potential in terms of sensitivity and size.

Thermal biosensors: or calorimetric biosensors are developed by assimilating biosensor materials as mentioned before into a physical transducer.

Piezoelectric biosensors: are of two types: the quartz crystal microbalance and the surface acoustic wave device. They are based on the measurement of changes in resonance frequency of a piezoelectric crystal due to mass changes on the crystal structure.

Optical biosensors: consist of a light source, as well as numerous optical components to generate a light beam with specific characteristics and to beeline this light to a modulating agent, a modified sensing head along with a photodetector.

Applications of biosensors:

Some examples of the fields that use biosensor technology include:

- General healthcare monitoring
- Screening for disease
- Clinical analysis and diagnosis of disease
- Veterinary and agricultural applications
- Industrial processing and monitoring
- Environmental pollution control

Biosensors have been applied in many fields namely food industry, medical field, marine sector etc., and they provide better stability and sensitivity as compared with the traditional methods.

Distinctive capabilities of biosensors in healthcare services:

Biosensors found their best applications in the different manufacturing sector in which medical or healthcare, or clinical services are the prime ones. explores the several distinct capabilities of biosensors that fall under the umbrella of healthcare and allied services. Disease detection, retinal prostheses, contrast imaging during MRIs, heart diagnosis, medical mycology, health monitoring, etc., are the

significant features or broadly categorised domains well served with biosensors applications. These broad capabilities further uplift healthcare to a new height with excellent societal services. The latest COVID-19 pandemic is highly infectious and is caused by a newly discovered coronavirus that has impacted the world. Also, various other infectious diseases such as avian influenza, SARS, Hendra, Nipah, etc., have generated significant interest in recent years. Thus, Biosensors have immense potential and capabilities to detect the outbreak of a virus and/or any disease. Another big capability of the biosensor is in the heart diagnosis. Cardiovascular diseases are considered the highest cause of death worldwide, taking over 17 million lives each year. Biosensor using biomarkers is playing a crucial role in the diagnostic revolution of cardiovascular diseases. The design and development of highly sensitive & specific biosensor using convenient surface chemistries and nonmaterials are vital for the precise diagnosis of heart diseases.