ROHINI
COLLEGE OF ENGINEERING AND TECHNOLOGY
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DEPARTMENT OF BIOMEDICAL ENGINEERING

III Semester

BM3301 SENSORS AND MEASUREMENTS

UNIT – 5

5.10 Biosensors:

Transduction mechanism in a biosensor and Classification

5.10.1 Biosensors:

A biosensor is a device that combines a biological component with a physicochemical detector to detect, monitor, or quantify specific biological substances. These devices are designed to convert a biological response into an electrical, optical, or other measurable signal.

Here are the key components of a typical biosensor:

Biological Recognition Element (Bio element): This is the biological component of the biosensor that interacts selectively with the target analyte. Examples include enzymes, antibodies, nucleic acids, or whole cells.

Transducer: The transducer converts the biological response generated by the interaction of the bio element with the target analyte into a measurable signal. This can be an electrical, optical, or thermal signal, depending on the type of biosensor.

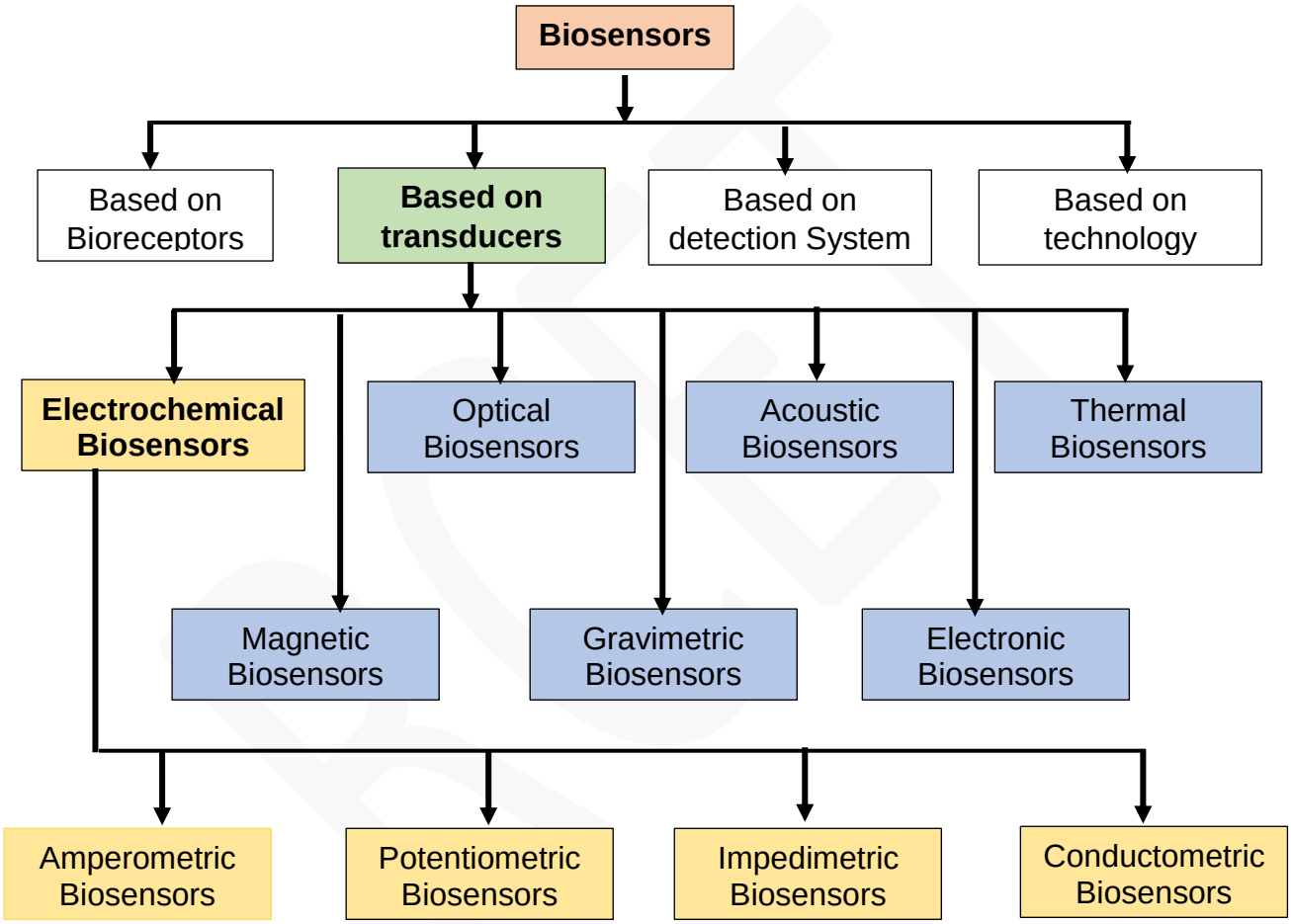
Detector/Signal Processor: This component processes the signal generated by the transducer and provides a measurable output that can be interpreted by the user or a connected device.

"Biosensors are the analytical devices composed of a biological recognition element directly interfaced to a signal transducer which together relate the concentration of an analyte (or group of related analytes) to a measurable response."

5.10.2 Transduction mechanism in a Biosensor :

The transduction mechanism in a biosensor refers to the process by which the biological response generated upon interaction with the target analyte is converted into a measurable signal. Different biosensors employ various transduction mechanisms based on the type of sensor and the nature of the target analyte.

Classification of biosensors based on various bioreceptors and transducers used.



5.10.3 Classification of Biosensors Based on Transduction mechanism:

1. **Electrochemical Transduction:**

   An electrochemical biosensor is a device that combines a biological sensing element with an electrochemical transducer to detect and quantify a specific biological molecule or analyte. These sensors are widely used in various fields, including medical diagnostics, environmental monitoring, and food safety.

1.1 Amperometric: This method measures the current resulting from a redox reaction occurring at an electrode surface. The bioelement (e.g., enzyme) catalyzes a reaction that produces or consumes electrons, leading to a change in current, which is proportional to the analyte concentration.

1.2 Potentiometric: This method measures the voltage or potential difference resulting from a chemical reaction. Changes in ion concentration due to the bioelement's activity cause variations in the electrode potential.

1.3 Impedimetric: An impedimetric biosensor is a type of biosensor that utilizes impedance measurement as the transduction principle for detecting and quantifying a specific biological analyte. Impedance is the opposition that a circuit presents to the flow of alternating current (AC).

1.4 Conductometric: A conductometric biosensor is a type of biosensor that relies on the measurement of changes in electrical conductivity for the detection and quantification of a specific biological analyte

2. Optical Biosensor::

2.1 Fluorescence: In fluorescence-based biosensors, the bioelement induces changes in fluorescence properties (emission intensity, wavelength) of a fluorophore. The changes are detected and correlated with the analyte concentration.

2.2 Absorbance/Transmission/Reflection: These methods involve measuring changes in light absorption, transmission, or reflection caused by the interaction between the bio element and the analyte.

3. Acoustic/Piezoelectric Biosensor:

A piezoelectric biosensor is a type of biosensor that employs the piezoelectric effect to detect and quantify the binding of a specific biological molecule or analyte. The piezoelectric effect refers to the generation of an electric charge in response to mechanical stress or deformation. In the context of biosensors, the mechanical changes associated with the binding events on the sensor surface are converted into electrical signals.

4. Thermal Biosensors:

Thermal biosensors measure changes in temperature resulting from biochemical reactions. The heat generated or absorbed during the bioelement-analyte interaction is detected and correlated with the analyte concentration.

5. Magnetic Transduction:

Magnetic biosensors use magnetic nanoparticles or other magnetic materials. Changes in magnetic properties due to the binding of the analyte to the bioelement are detected and quantified.

6. Gravimetric Biosensors:

A gravimetric biosensor is a type of biosensor that operates based on the principle of monitoring changes in mass associated with a biochemical reaction or the binding of a specific biological molecule. These sensors are designed to measure the mass changes on the sensor surface resulting from the interaction between a biological recognition element and the target analyte.

7. Electronic Biosensors:

An electronic biosensor is a type of biosensor that utilizes electronic components for the detection and quantification of specific biological molecules or analytes. These biosensors typically integrate a biological recognition element with an electronic transducer to convert the biological response into an electrical signal, which can then be measured and analyzed.

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