SENSORS IN SMART WEARABLE DEVICE:

There are specific requirements in selecting and using sensors for wearable devices. Wearability implies that they must be non-invasive, having the added advantage of offering painless measurement, comfort, and prevention from infections and contamination. The sensor should give an electrical signal so the data can be processed digitally. These conditions limit the types of sensors we can use. After meeting these basic needs, the sensor is chosen based on the device's purpose, considering size, cost, power use, strength, and reliability. The working conditions also affect the choice; for example, piezoelectric sensors are not suitable when the person is moving. Sensors in wearable devices are placed on the body to measure body functions like heart activity, muscle activity, breathing, skin temperature, blood pressure, posture, movement, and acceleration. Wearable devices can also have other sensors that collect information from the surroundings, such as cameras, microphones, touch sensors, environmental sensors, GPS, and GIS. Common wearable medical sensors are noninvasive, which means they do not hurt the body or go inside it.

It includes:

- **Skin surface electrodes**—Used for detecting surface potentials in bioelectric signal monitoring such as for ECG, electroencephalography (EEG), and electromyography (EMG).
- **Temperature thermistors**—For detecting skin surface temperature.
- **Piezoelectric sensors**—Often used for monitoring heart rate and respiratory effort.
- **Photoplethysmography (PPG):** It is a method used to measure changes in blood volume under the skin.
- **Pulse oximetry**—A technique for detecting blood oxygen saturation and heart rate from a PPG signal.
- **Galvanic skin response**—Detecting skin conductance in relation to skin hydration

In addition, many types of sensors take advantage of microelectronics technology. These include some applications of micro electromechanical systems (MEMS) and microelectronic biosensors. The most commonly used MEMS in medical sensing applications are based on the Wheatstone bridge, piezoresistive silicon pressure sensor, which is used in various forms to measure blood pressure, respiration, and acceleration.

- **Microelectronic biosensors:** Monitor biological processes and are either calorimetric (measuring heat) or electro-chemical.
- **Calorimetric biosensors:** Are based on the detection of the heat of biological reactions, by using conventional thermistors, thermopile sensors (an array of thermocouples), silicon, or thermopiles integrated on thin micromachined silicon membranes. They are used for monitoring enzymatic reactions (Reaction that happens with the help of enzymes)

Electrochemical biosensors are subdivided into:

- (1) **Conductometric biosensors** measuring the impedance between planar electrodes that have found limited applications.
- (2) **Potentiometric transducers** determining the electrical potential between two electrodes at zero current flow.
- (3) **Amperometric biosensors** detect and monitor enzymes such as glucose, lactate, and urea.