Al-Mustaqbal University
Department of Medical Instrumentation Techniques
2ⁿᵈ year
Biomedical Transducers and Sensors
Dr. Zeyad Taha Yaseen
2ⁿᵈ term – Introduction to Biomedical Sensors

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Units of Measurements:

The base measurement system is known as SI, which stands for Le Syste´me International d'Unite´s in French

SI basic units

Quantity	Name	Symbol	Defined by... (year established)
Length	Meter	m	...the length of the path traveled by light in vacuum in 1/299,792,458 of a second... (1983)
Mass	Kilogram	kg	...after a platinum-iridium prototype (1889)
Time	Second	s	...the duration of 9,192,631,770 periods of the radiation corresponding to the transition between the two hyperfine levels of the ground state of the cesium-133 atom (1967)
Electric current	Ampere	A	Force equal to 2×10^{-7} newton per meter of length exerted on two parallel conductors in vacuum when they carry the current (1946)
Thermodynamic temperature	Kelvin	K	The fraction 1/273.16 of the thermodynamic temperature of the triple point of water (1967)
Amount of substance	Mole	mol	...the amount of substance which contains as many elementary entities as there are atoms in 0.012 kg of carbon 12 (1971)
Luminous intensity	Candela	cd	...intensity in the perpendicular direction of a surface of 1/600,000 m^2 of a blackbody at temperature of freezing Pt under pressure of 101,325 newton per m^2 (1967)
Plane angle	Radian	rad	(supplemental unit)
Solid angle	Steradian	sr	(supplemental unit)

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Sensor characteristics:

Static characteristics:

The properties of the system after all transient effects have settled to their final or steady state:

- ✓ Accuracy
- ✓ Discrimination
- ✓ Precision
- ✓ Errors
- ✓ Drift
- ✓ Sensitivity
- ✓ Linearity
- ✓ Hystheresis (backslash)

Dynamic characteristics:

The properties of the system transient response to an input:

- ➢ Zero order systems
- ➢ First order systems
- ➢ Second order systems

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Accuracy and Resolution:

Accuracy: is the capacity of a measuring instrument to give RESULTS close to the TRUE VALUE of the measured quantity.

➢ Accuracy is related to the bias of a set of measurements

➢ Accuracy is measured by the absolute and relative errors

$$\text{ABSOLUTE ERROR} = \text{RESULT} - \text{TRUE VALUE}$$
$$\text{RELATIVE ERROR} = \frac{\text{ABSOLUTE ERROR}}{\text{TRUE VALUE}}$$

Resolution (Discrimination): is the minimal change of the input necessary to produce a detectable change at the output.

➢ When the increment is from zero, it is called **Threshold**.

Precision:

Precision: is the capacity of a measuring instrument to give the same reading when repetitively measuring the same quantity under the same prescribed conditions.

➢ Precision implies agreement between successive readings, NOT closeness to the true value

➢ Precision is related to the variance of a set of measurements.

➢ Precision is a necessary but not sufficient condition for accuracy.

Two terms closely related to precision Repeatability and Reproducibility.
Repeatability: is the precision of a set of measurements taken over a short time

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interval **Reproducibility:** is the precision of a set of measurements BUT:

✓ taken over a long time interval or

✓ Performed by different operators or

✓ with different instruments or

✓ in different laboratories

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