MEDICAL INSTRUMENTATION
SECOND YEAR
2021-2022
LECTURE NO.(3)

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ELECTRONIC BALANCES WORK

The quickest way to understand the principle of how electronic balances work, is to first understand how they are constructed. There are two basic types of electronic balance designs.

A. Electromagnetic balancing type.

B. Electrical resistance wire type (load cell type)

These are based on completely different principles, but what they both have in common is that neither directly measures mass. They measure the force that acts downward on the pan.

This force is converted to an electrical signal and displayed on a digital display. As a means of measuring force, the electromagnetic balance method utilizes the electromagnetic force generated from a magnet and coil, whereas the electrical resistance wire method utilizes the change in resistance value of a strain gauge attached to a piece of metal that bends in response to a force

So why do electronic balances display mass values when that is not what they measure? It is because the reference standards for mass are weights, which are placed on a pan to inform the electronic balance that a given force is equivalent to a given number of grams, which is used for conversion. Consequently, electronic balances that do not perform this conversion accurately cannot display accurate mass values.

Various principles are used for measuring the weight of objects. The following briefly describes the operating principles and features of the two most popular methods, "electromagnetic type" and "load cell type.“

A. Electromagnetic Type

This is also called the "electromagnetic balance method." With mechanical balances, the sample is placed at one end of the beam and the weight is placed at the other end, and the value of the weight when both are perfectly balanced becomes the mass of the sample. With electromagnetic type balances, an electrical force (electromagnetic force) is applied instead of a placed weight to balance the beam.

The amount of electricity required for balancing the beam changes according to the weight of the sample that is placed. The amount of current when the beam is perfectly balanced is detected, and the mass is obtained from that detected value.

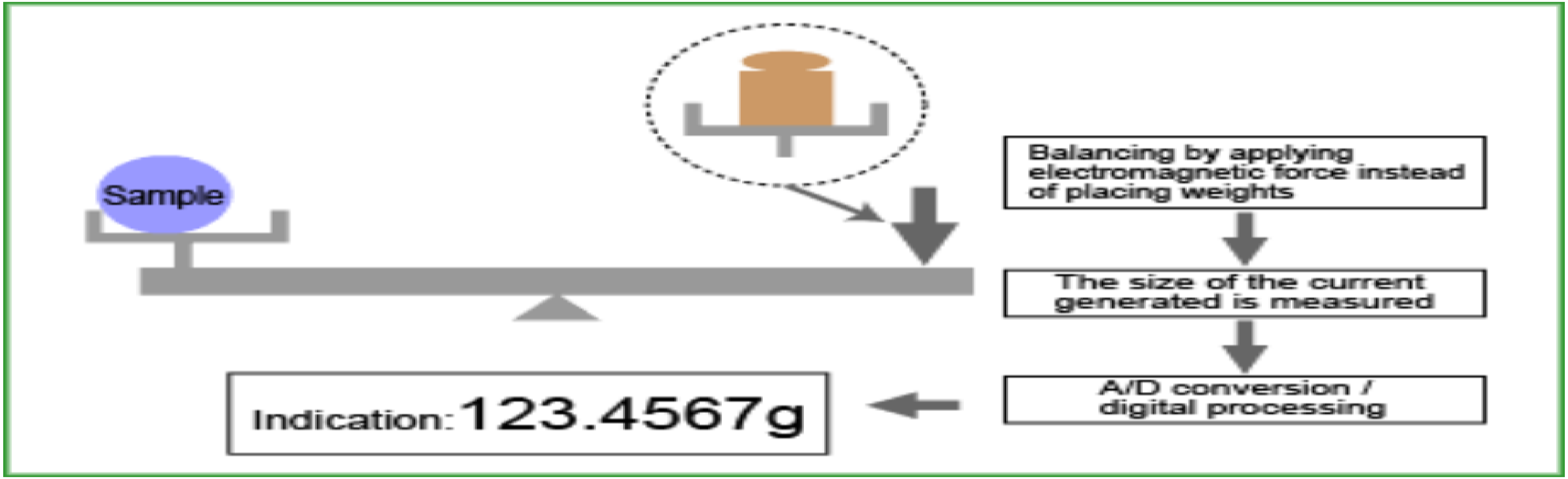

Figure 2: The electromagnetic balance

B. LOAD CELL TYPE (ELECTRICAL RESISTANCE WIRE METHOD)

One end of an object (elastic body) made of Aluminium and shaped as shown in the figure is fixed in place, and the sample is placed on the other end. The weight of the sample causes the elastic body to flex.
The amount of flex causes the strain gauges attached to the elastic body to expand and contract, changing the amount of electricity that is output (strictly speaking, the resistance value). The mass is then obtained from that amount of electricity.

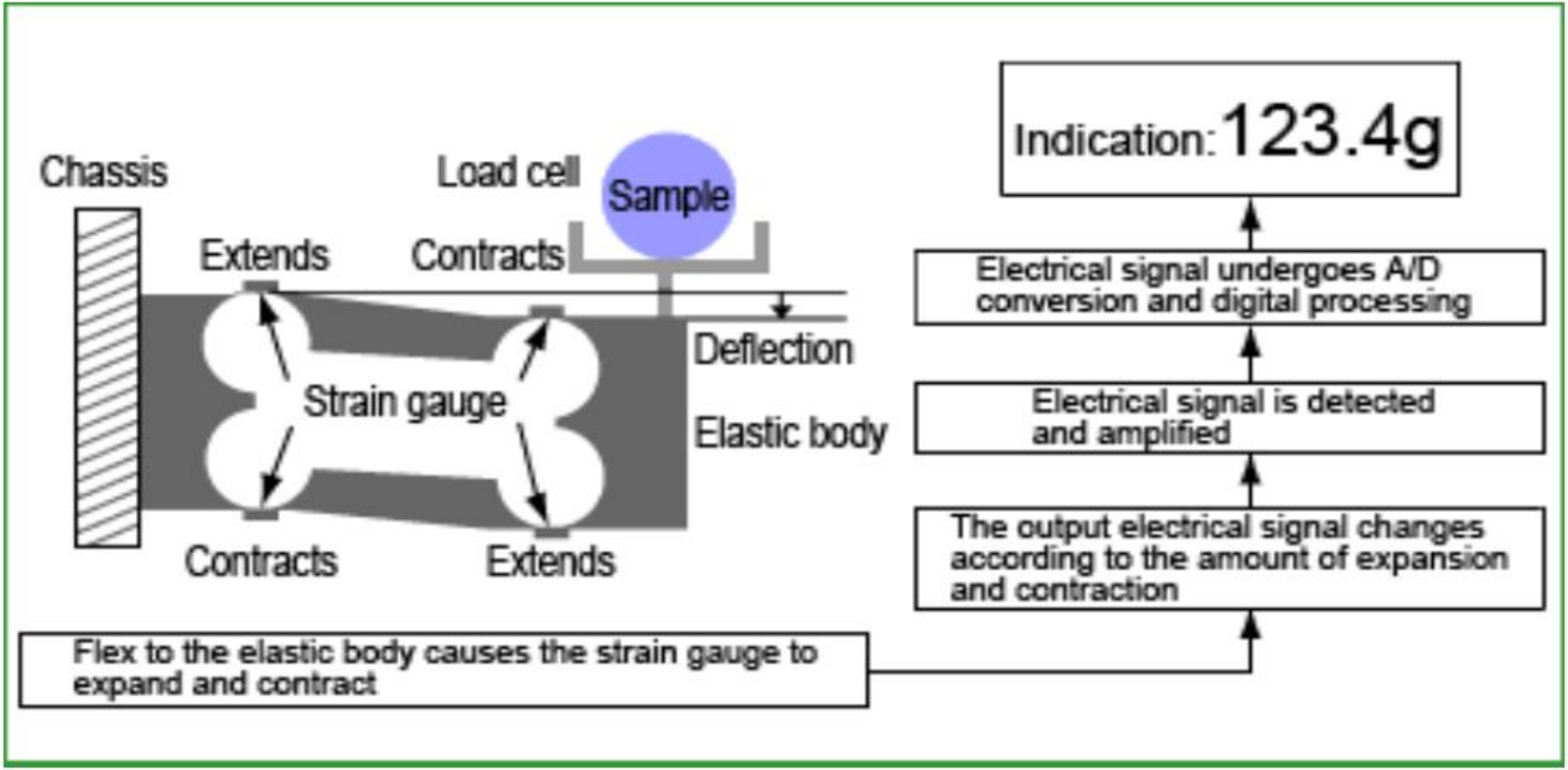

Figure 3: The electrical balance

The table below explains the comparison between electromagnetic type and load cell type

	Electromagnetic Type	Load Cell Type
Advantages	High accuracy	• Simple structure • Even large models are easy to make
Disadvantages	• Complex structure • Difficult to downsize	Accuracy is limited
Applications	Ultra-precision balances such as analytical balances	• Small, cheap balances that require only moderate accuracy • Large balances

3. Balance and scale terms

there are many balance and scale terms have to understand as explain :

- accuracy: the ability of a scale to provide a result that is as close as possible to the actual value. The best modern balances have an accuracy of better than one part in 100 million when one-kilogram masses are compared.
- Calibration: the comparison between the output of a scale or balance against a standard value. Usually done with a standard known weight and adjusted so the instrument gives a reading in agreement
- Capacity: the heaviest load that can be measured on the instrument.
- Precision: amount of agreement between repeated measurements of the same quantity; also known as **repeatability.** Note: A scale can be extremely precise but not necessarily be accurate.
- Readability: this is the smallest division at which the scale or balance can be read. It can vary as much as 0.1g to 0.0000001g. Readability designates the number of places after the decimal point that the scale can be read.

Numerical Decimal	Number of Decimal	Fraction
0.1g	1 place	1/10 gram
.01	2 places	1/100 gram
.001	3 places	1/1000 gram
.0001	4 places	1/10,000 gram (1/10)
.0001	5 places	1/100,000 gram (1/100)

Tare: the act of removing a known weight of an object, usually the weighing container, to zero a scale. This means that the final reading will be of the material to be weighed and will not reflect the weight of the container. Most balances allow taring to 100% of capacity.