



**AL- MUSTAQBAL UNIVERSITY COLLEGE**  
**DEPARTMENT OF BIOMEDICAL ENGINEERING**

# **Laboratory Instrumentation**

**BME 422**

**Lecture 5**

**- Pulse Oximeter -**

Dr. Zaidoon AL-Shammari

Lecturer / Researcher

[zaidoon.waleed@mustaqbal-college.edu.iq](mailto:zaidoon.waleed@mustaqbal-college.edu.iq)

# Pulse oximeter

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- Pulse oximeter is a device used to measure the oxygen saturation level of the arterial blood.
- Oximeters are widely used in hospitals, medical clinics, operating rooms, and homes and can be used any time, at home, at work, or during exercise or recreation.



- Oximeters can give an accurate reading within seconds and therefore are especially useful in an emergency situation.
- Pulse oximeters also measure and display pulse rate as both oxygen saturation level and pulse rate are considered vital signs of a patient.

# Techniques of pulse oximetry

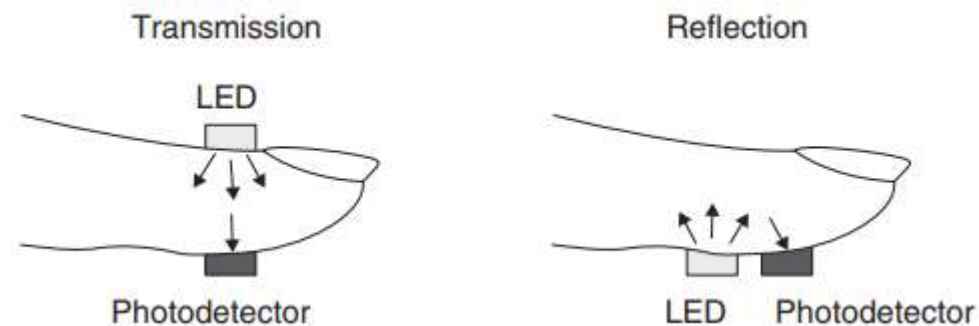


There are two methods of sending light through the measuring site:

- Transmission method: In this method,
  - The emitter and photodetector are opposite of each other with the measuring site in between.
  - The light can then pass through the site.



- Reflectance method: In this method,
- The emitter and photodetector are next to each other on the measuring site.
  - The light bounces from the emitter to the detector across the site.
  - The transmission method is the most commonly used.



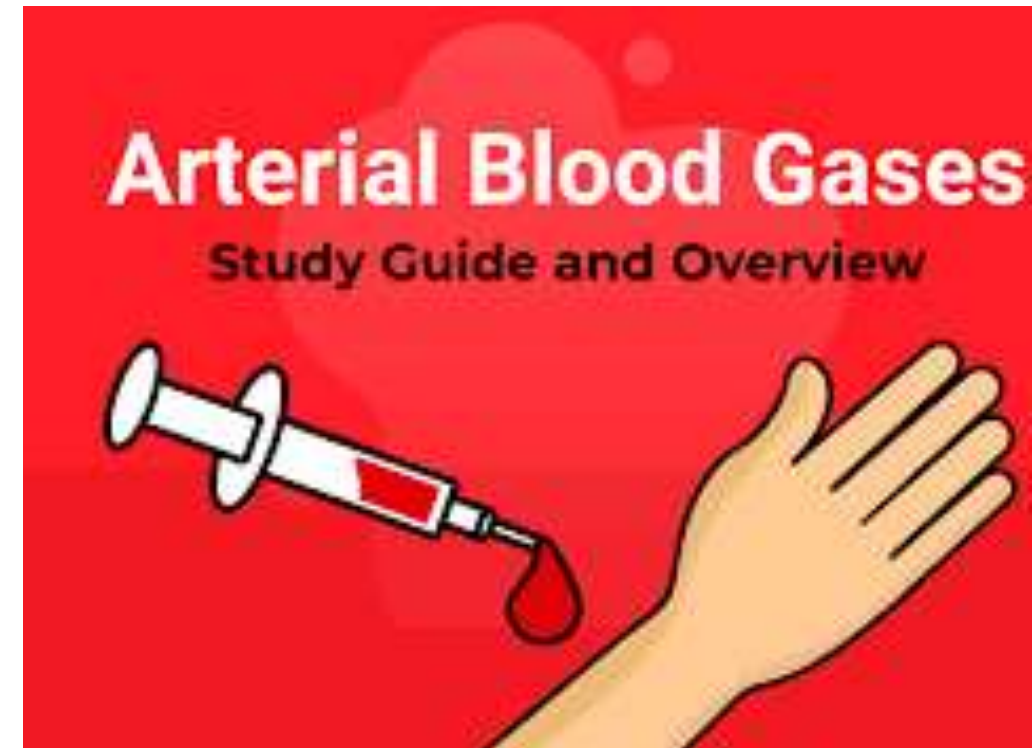
Pulse oximetry techniques

# How to measure the oxygen saturation



1- Invasive procedure (arterial blood gas analysis)

- Not real time measurement.
- Infection problem.
- Pain.



# How to measure the oxygen saturation



2- Pulse oximeter is a noninvasive method for monitoring a person's oxygen saturation.

Consists of :

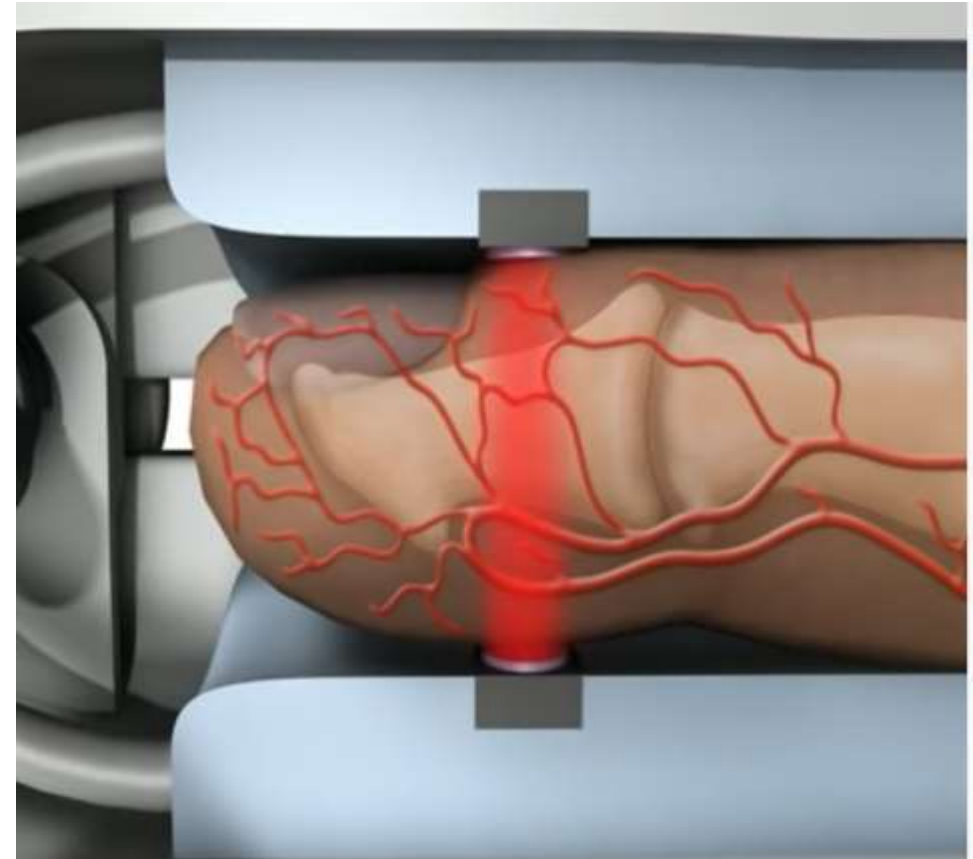
- I. Peripheral probe.
  - A. Two light emitting diodes.
  - B. Light detector.





## II. Microprocessor.

- The light emitted several hundreds times per second by diodes is absorbed by tissues.
- The amount of the absorption is measured by the detector.

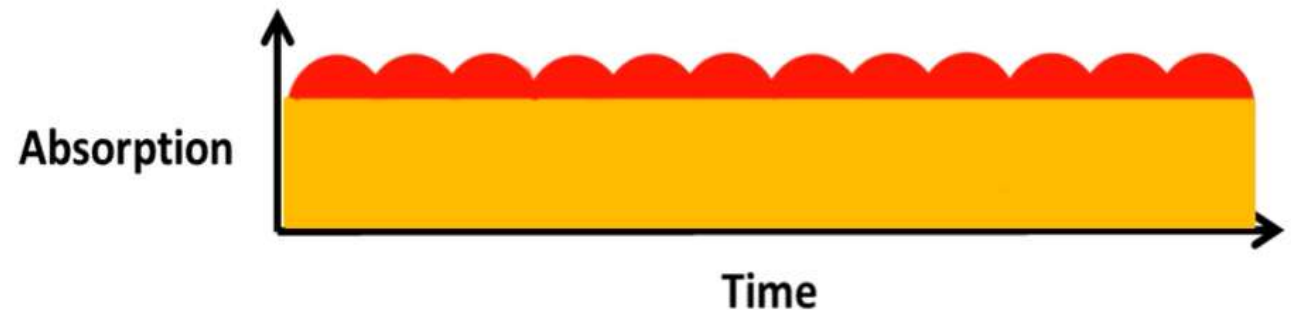




- The red light at wavelength of 660 nm which the absorption of deoxyhemoglobin is greater than the oxyhemoglobin.
- The infrared light emits light at wavelength of 940 nm where the absorption of oxyhemoglobin is greater than the deoxyhemoglobin



- The pulse oximeter measure the pulsatile arterial blood that means, the static or the constant absorptions must be subtracted.
- Anything except the arterial blood is considered DC or constant such as skin, venous blood, bones, nail, etc.



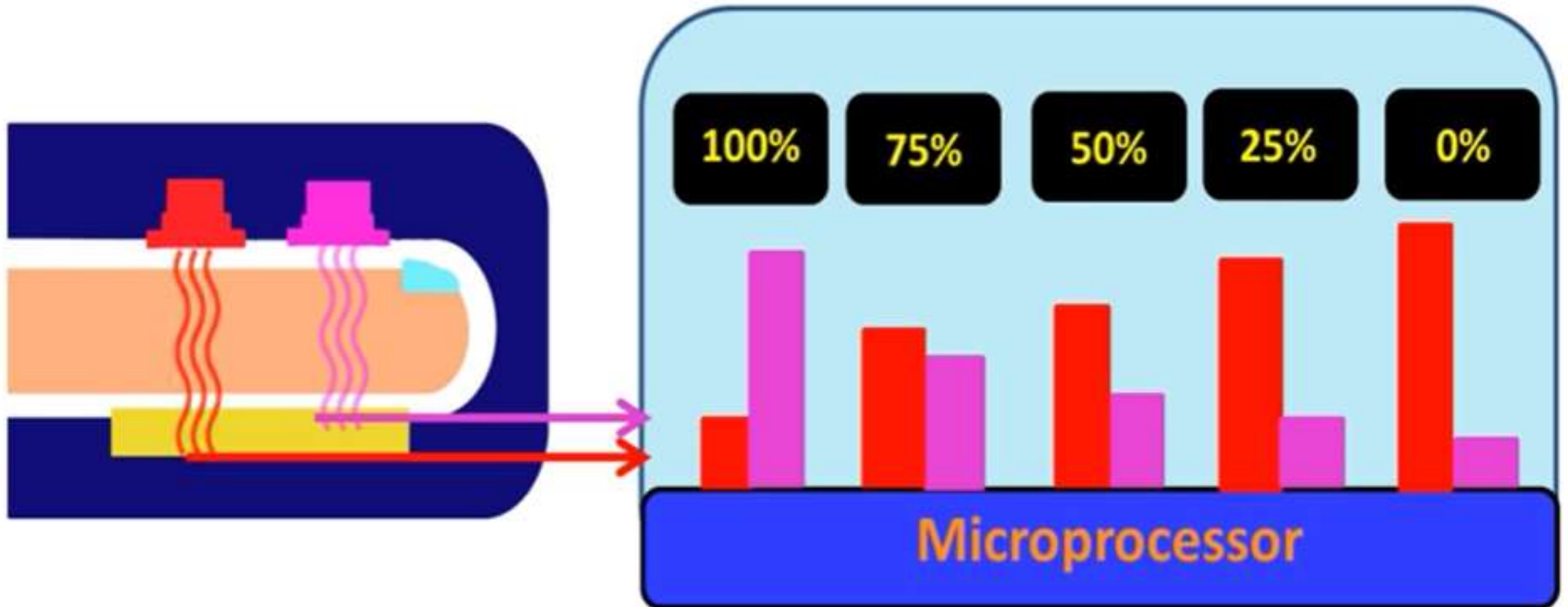


- The microprocessor calculate the concentration of the oxyhemoglobin and deoxyhemoglobin and then determine the oxygen saturation or SpO<sub>2</sub>.

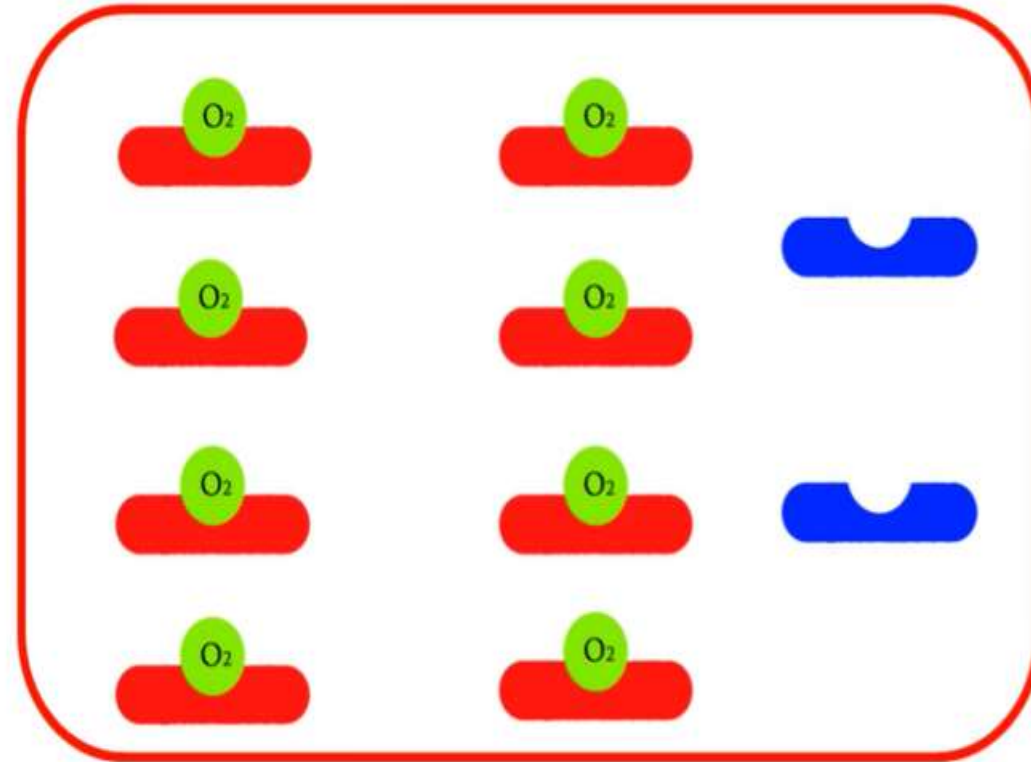
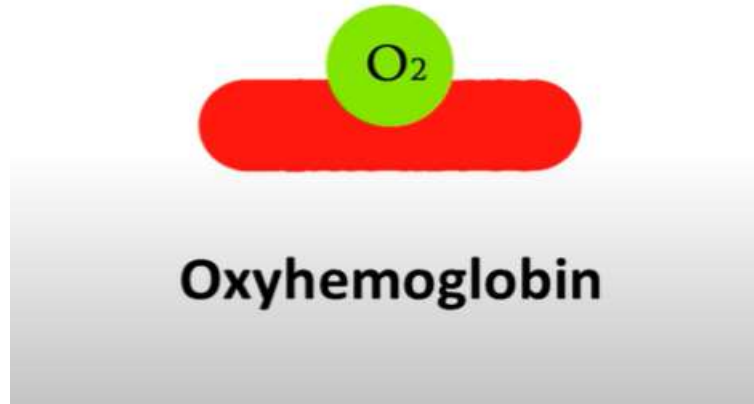
$$SpO_2 = \frac{HbO_2}{HbO_2 + Hb}$$

where  $HbO_2$  is the oxyhemoglobin and  $Hb$  is the deoxyhemoglobin

# Principles of operations



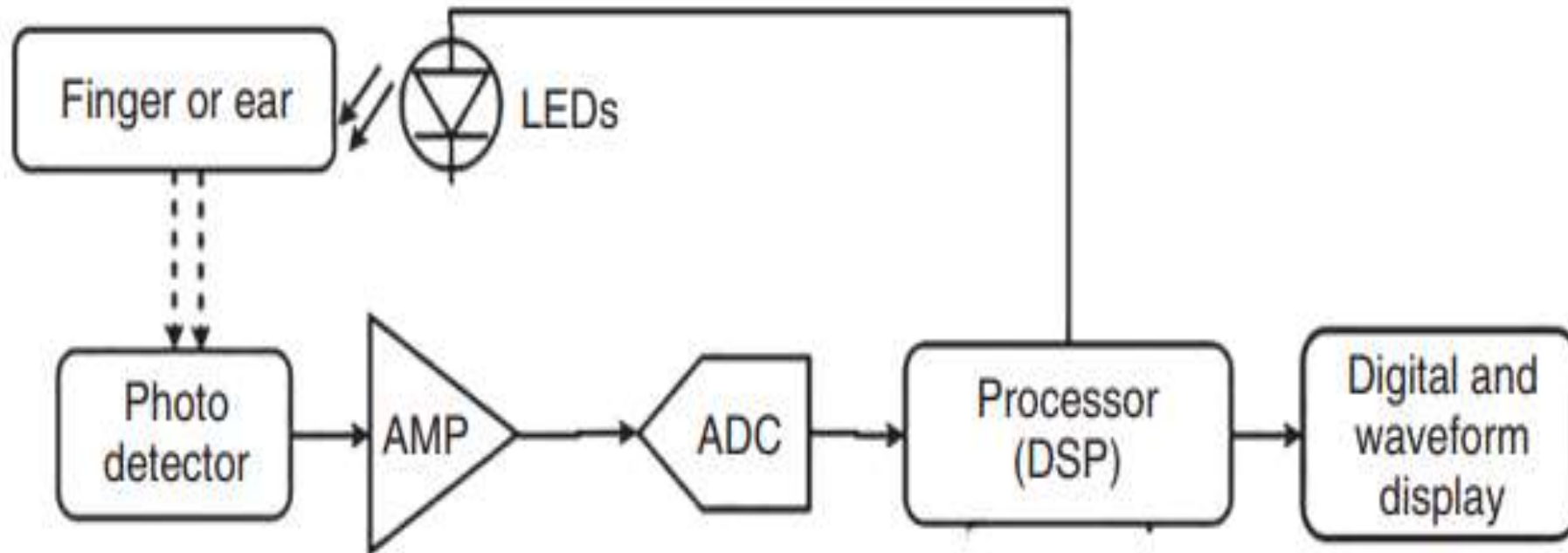
# SpO<sub>2</sub>



80%

SpO<sub>2</sub>

# The analog signal processing technique



# The analog signal processing technique



- The signal from the sensor is a current.
- Amplifiers to further amplify the signal.
- Noise filters to remove different kinds of interference.
- Bandpass filters to separate the low frequency (dc) component from the pulsatile, higher frequency (ac) component.
- an analog – digital converter to convert the continuously varying signal to a digital representation.



# Where pulse oximeter located is

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- Intensive care units.
- Inpatient/outpatient wards.
- Operating rooms.
- General clinics.
- Even at home.

# The main application areas of oximetry



- During or after surgery.
- To study how well lung medicines are working.
- To check a person's ability to handle increased activity levels.
- To see if a ventilator is needed to help breathing.



Choosing the ideal place for the oximeter is based on :

- I. Well perfused
- II. Comfortable for the patient
- III. Accessible

# Places of the oximeter



Therefore, there are many places the probe could be placed:

- A. Ear
- B. Nose
- C. Tongue
- D. Cheeks
- E. Feet

