BASICS OF BIOMEDICAL INSTRUMENTATION

UNIT V BIO-CHEMICAL MEASUREMENT

UNIT V

UNIT V BIO-CHEMICAL MEASUREMENT

Blood gas analyzers and Non-Invasive monitoring, colorimeter, Sodium Potassium Analyser, spectrophotometer, blood cell counter, auto analyzer (simplified schematic description).ifiers, Power line interference, Right leg driven ECG amplifier, Band pass filtering

blood gas

- A **blood gas** test measures the amount of oxygen and carbon dioxide in the **blood**. It may also be used to determine the pH of the **blood**, or how acidic it is. The test is commonly known as a **blood gas analysis** or **arterial blood gas** (**ABG**) test.

Blood gas analyzers

- **Blood gas analyzers** consist of three electrodes measuring pH, PCO2, and PO2 at 37°C. They were introduced in about 1960 following inventions by R Stow

Analyzers used to measure **blood gas**, pH, electrolytes, and some metabolites in whole **blood** specimens. They **can** measure pH, partial pressure of carbon dioxide and oxygen, and concentrations of many ions (sodium, potassium, chloride, bicarbonate) and metabolites (calcium, magnesium, glucose, lactate).

NORMAL RANGES

- Partial pressure of oxygen (PaO2) - 75 - 100 mmHg. Partial pressure of carbon dioxide (PaCO2) - 38 - 42 mmHg. Arterial **blood** pH of 7.38 - 7.42. Oxygen saturation (SaO2) - 94 - 100%

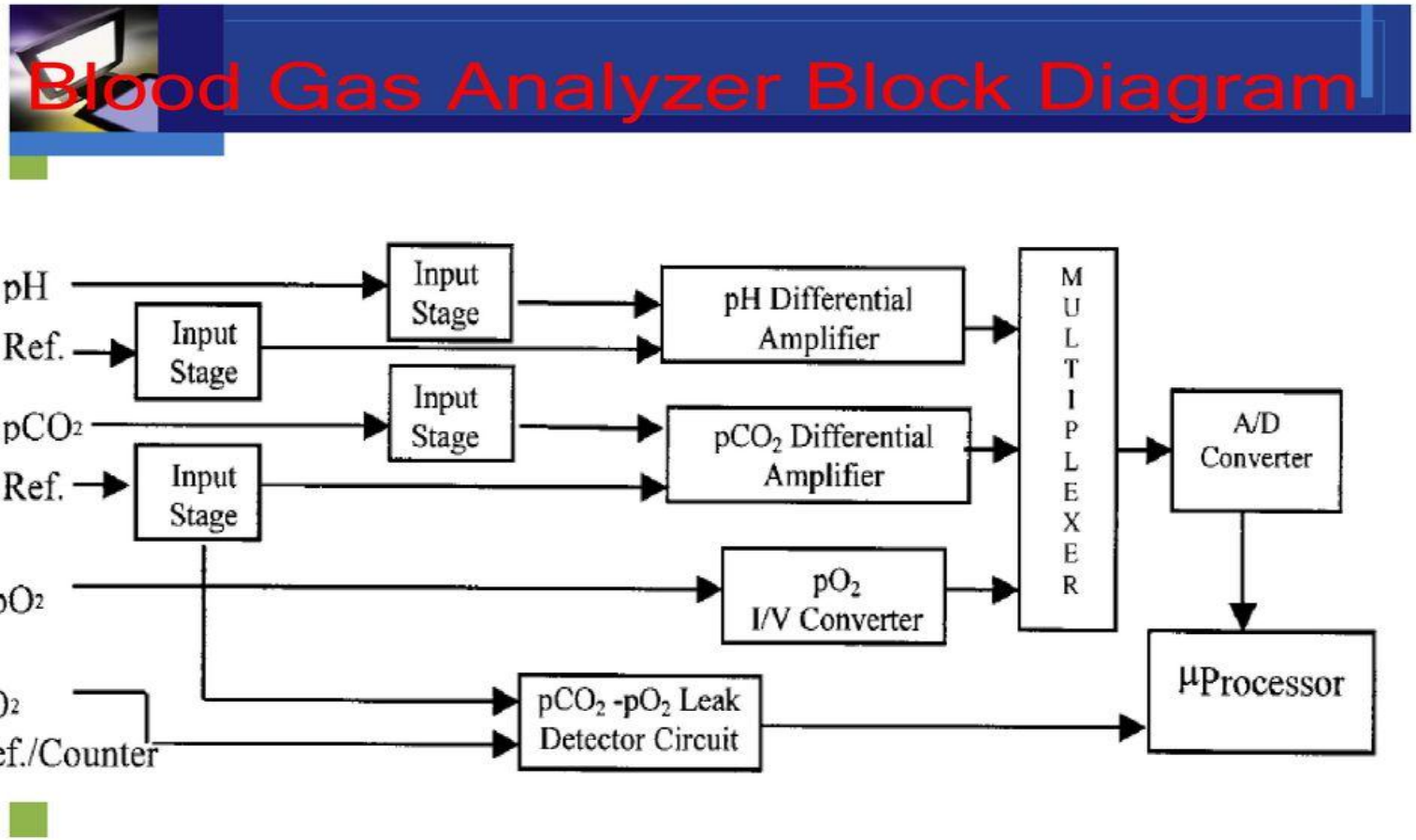
Tube USED TO BLOODGAS

- Red-Top **Tube**: This **tube** is a VACUTAINER® containing no anticoagulant – **used** for drawing serum for selected tests. Royal Blue-Top **Tube**: There are two types of royal blue-top Monoject® **tubes** – one with the anticoagulant EDTA and the other plain. These are **used** in drawing whole **blood** or serum for trace element **analysis**.

ACID-BASE BALNCE

- PH
- DEFINITION

BLOCK DIAGRAM



WORKING

- **Blood gas**/pH **analyzers** use electrodes to determine pH, partial pressure of carbon dioxide, and partial pressure of oxygen in the **blood**. Chemistry **analyzers** use a dry reagent pad system in which a filter pad impregnated with all reagents required for a particular reaction is placed on a thin plastic strip.

Noninvasive monitoring

- **Noninvasive monitoring** should include a standard five-lead electrocardiogram, **noninvasive** BP measurement, pulse oximetry, capnography, and nasopharyngeal and bladder temperature. **Invasive monitoring** should include systemic arterial, central venous, and PA pressure measurements

invasive monitoring

- This helps to ensure adequate tissue perfusion, prevents organ dysfunction and death. It is especially important in high-risk patients, patients undergoing cardiac, neurosurgical or lengthy surgical procedures, or when major blood loss during surgery is anticipated.

difference

- **Non-invasive** cancers stay within the milk ducts or lobules **in the** breast. They do not grow into or invade normal tissues within or beyond the breast. **Non-invasive** cancers are sometimes called carcinoma in situ (“**in the** same place”) or pre-cancers. **Invasive** cancers do grow into normal, healthy tissues

UNIT V

UNIT V BIO-CHEMICAL MEASUREMENT

Blood gas analyzers and Non-Invasive monitoring, colorimeter, Sodium Potassium Analyser, spectrophotometer, blood cell counter, auto analyzer (simplified schematic description).ifiers, Power line interference, Right leg driven ECG amplifier, Band pass filtering

colorimeter,

- he working **principle** of the **colorimeter** is based on Beer-Lambert's law which states that the amount of light absorbed by a color solution is directly proportional to the concentration of the solution and the length of a light path through the solution.

application

Colorimetry, measurement of the wavelength and the intensity of electromagnetic radiation in the visible region of the spectrum. It is **used** extensively for identification and determination of concentrations of substances that absorb light.

definition

- an instrument or device for determining and specifying colors specifically : one used for chemical analysis by comparison of a liquid's color with standard colors. Other Words from **colorimeter** Example Sentences Learn More about **colorimeter**.

parts of a colorimeter

- **The essential parts of a colorimeter are:**
- a **light** source (often an ordinary low-voltage filament lamp);
- an adjustable **aperture**;
- a set of colored **filters**;
- a cuvette to hold the working solution;
- a detector (usually a photoresistor) to measure the transmitted **light**;
- a meter to display the **output** from the detector.

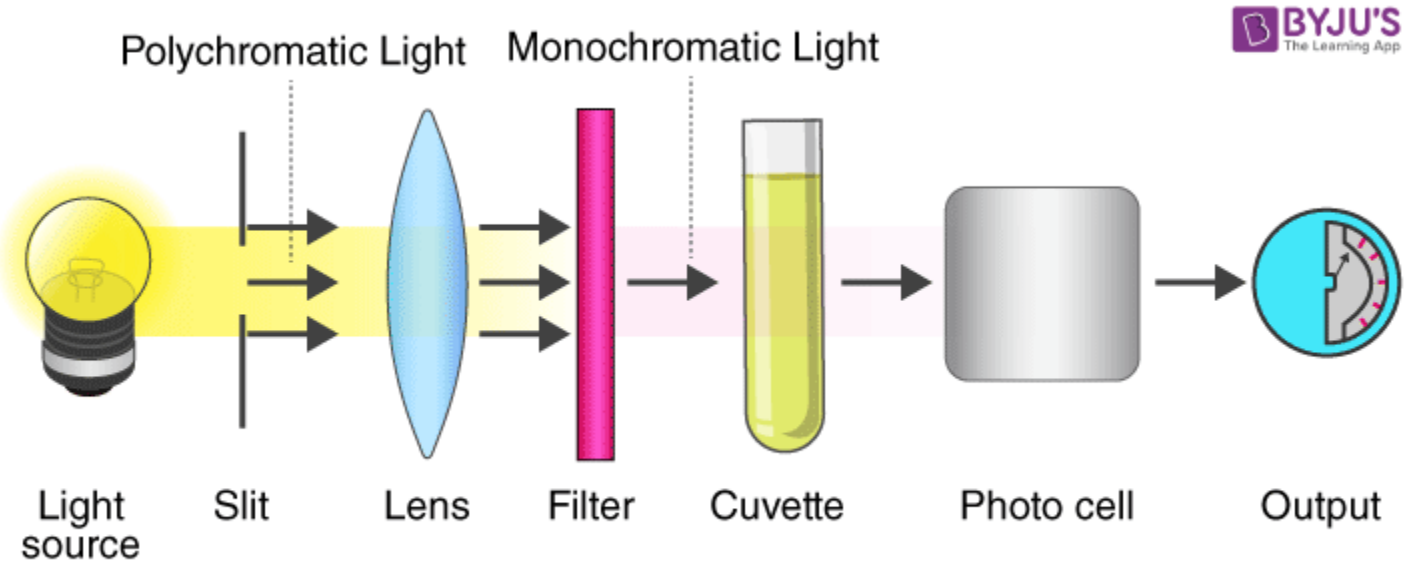
Colorimeter unit

- **Colorimeters** generally measure transmittance (a linear scale from 0-100%) as well as absorbance (a logarithmic scale from zero to infinity). The displayed value, however, is usually either mg/L or ppm which are calculated from measured values.

Principle of Colorimeter

- It is a photometric technique which states that when a beam of incident light of intensity I_o passes through a solution, the following occur:
- A part of it is reflected which is denoted as I_r
- A part of it is absorbed which is denoted as I_a
- Rest of the light is transmitted and is denoted as I_t
- Therefore, $I_o = I_r + I_a + I_t$
- To determine I_a the measurement of I_o and I_t is sufficient therefore, I_r is eliminated. The amount of light reflected is kept constant to measure I_o and I_t.
- Colorimeter is based on two fundamental laws of photometry. We have discussed them below:

diagram


Polychromatic Light
Monochromatic Light
BYJU'S
The Learning App
Light source
Slit
Lens
Filter
Cuvette
Photo cell
Output

Flame Photometer

- A photoelectric **flame photometer** is a device used in inorganic chemical analysis to determine the concentration of certain metal ions, among them sodium, potassium, lithium, and calcium. Group 1 and Group 2 metals are quite sensitive to **Flame Photometry** due to their low excitation energies

working

- The principle of flame photometer is based on the measurement of the emitted light **intensity** when a metal is introduced into the flame. The wavelength of the **colour** gives information about the element and the **colour** of the flame gives information about the amount of the element present in the sample.

applications

- Flame photometer applications. Determining the concentration of sodium and potassium ions in infusion solutions, such as NaCl **solution**, Ringer **solution** or others. Product control and indirect quality testing of various substances over sodium, potassium or lithium. Concentration determination in pharmaceutical reagents

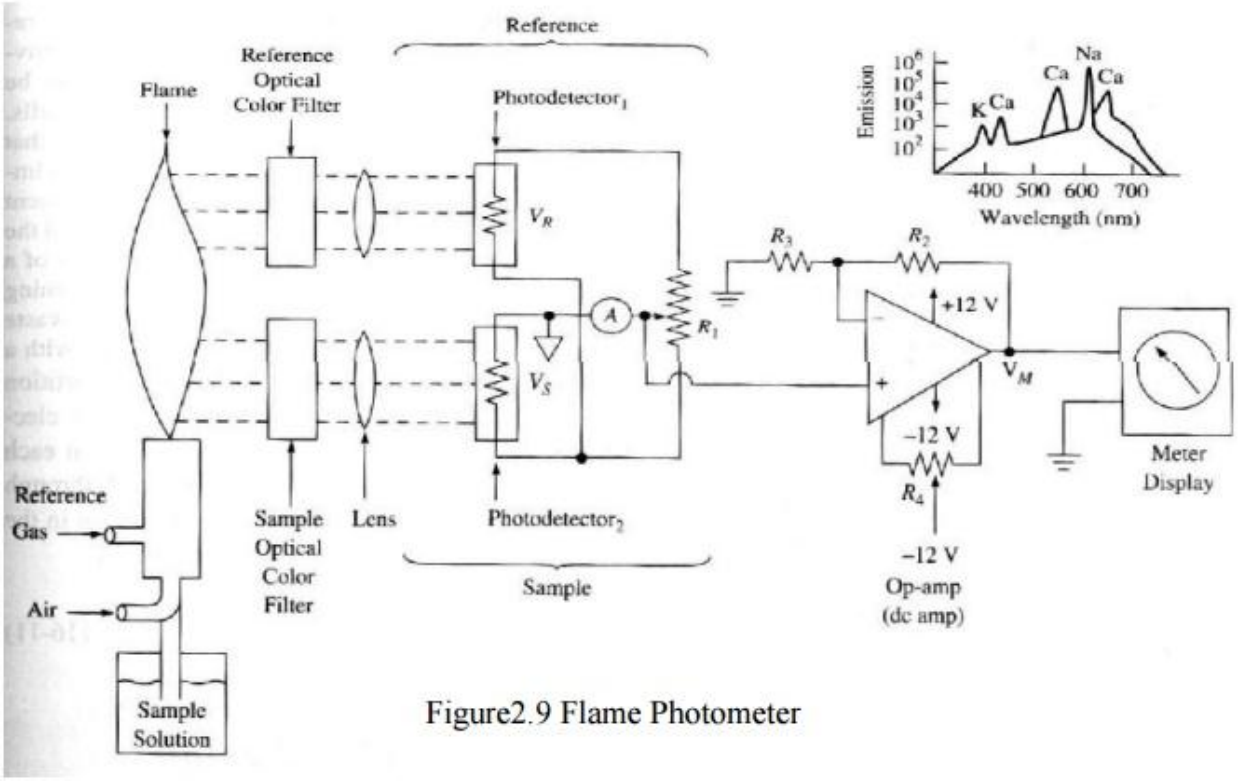


Figure2.9 Flame Photometer

Filter Photometer

- A **filter photometer** is a colorimeter in which the length of light is selected by the use of appropriate glass **filters**. A UV-Vis Spectrophotometer may use **filters** or a variable scanning sensor.

Filter Photometer

- A **filter photometer** has a single optical path between the source and detector, and is called a single-beam instrument. The instrument is calibrated to 0% T while using a shutter to block the source radiation from the detector. After opening the shutter, the instrument is calibrated to 100% T using an appropriate blank

Sodium Potassium Analyser

- The electrolyte **analyser** is a device for measuring the electrolytes in the human body. They are primarily used in the quantitative measurement of **sodium**, **potassium**, and chloride in whole blood, serum, or plasma. ... Some electrolyte **analysers** employ miniaturized ISE, which are fabricated in planar type

Sodium Potassium Analyser

- **Principle**: The electrolyte **analyzer** has different electrodes, specific for different ions of interest. ... A difference in **sodium** ion concentration between the **sodium** solution inside the electrode and the sample causes an electrochemical potential to form across the membrane of the active electrode.

spectrophotometer

- Spectrophotometry is a branch of electromagnetic spectroscopy concerned with the quantitative measurement of the reflection or transmission properties of a material as a function of wavelength

- **Spectrophotometry** is a branch of electromagnetic spectroscopy concerned with the quantitative measurement of the reflection or transmission properties of a material as a function of wavelength.[2] Spectrophotometry uses photometers, known as spectrophotometers, that can measure the intensity of a light beam at different wavelengths. Although spectrophotometry is most commonly applied to ultraviolet, visible, and infrared radiation, modern spectrophotometers can interrogate wide swaths of the electromagnetic spectrum, including x-ray, ultraviolet, visible, infrared, and/or microwave wavelengths.

applications

- **Some of the major applications of spectrophotometers includ e the following:**
- Detection of concentration of substances.
- Detection of impurities.
- Structure elucidation of organic compounds.
- Monitoring dissolved oxygen content in freshwater and marine ecosystems.
- Characterization of proteins.
- Detection of functional groups.

- **Spectrophotometers** measure light intensity as a **function** of wavelength and are commonly used to measure the concentration of a compound in an aqueous solution. Depending on the type of **spectrophotometer**, different wavelengths of light can be analyzed.

UNIT V

UNIT V BIO-CHEMICAL MEASUREMENT

Blood gas analyzers and Non-Invasive monitoring, colorimeter, Sodium Potassium Analyser, spectrophotometer, blood cell counter, auto analyzer (simplified schematic description).ifiers, Power line interference, Right leg driven ECG amplifier, Band pass filtering

blood cell counter

- A **blood cell**, also called a hematopoietic **cell**, hemocyte, or hematocyte, is a **cell** produced through hematopoiesis and found mainly in the **blood**. Major types of **blood cells** include red **blood cells** (erythrocytes), white **blood cells** (leukocytes), and platelets (thrombocytes)

types

- It has **four** main components: plasma, red **blood cells**, white **blood cells**, and platelets. **Blood** has many **different** functions, including: transporting oxygen and nutrients to the lungs and tissues. forming **blood** clots to prevent excess **blood** loss

function

- **lood is made mostly of plasma, but 3 main types of blood cells circulate with the plasma:**
- **Platelets** help the blood to clot. Clotting stops the blood from flowing out of the **body** when a vein or artery is broken. ...
- **Red blood cells** carry oxygen. ...
- **White blood cells** ward off infection.

Types

- All of the cells found in the blood come from bone marrow. They begin their life as stem cells, and they mature into three main types of cells— RBCs, **WBCs**, and **platelets**.

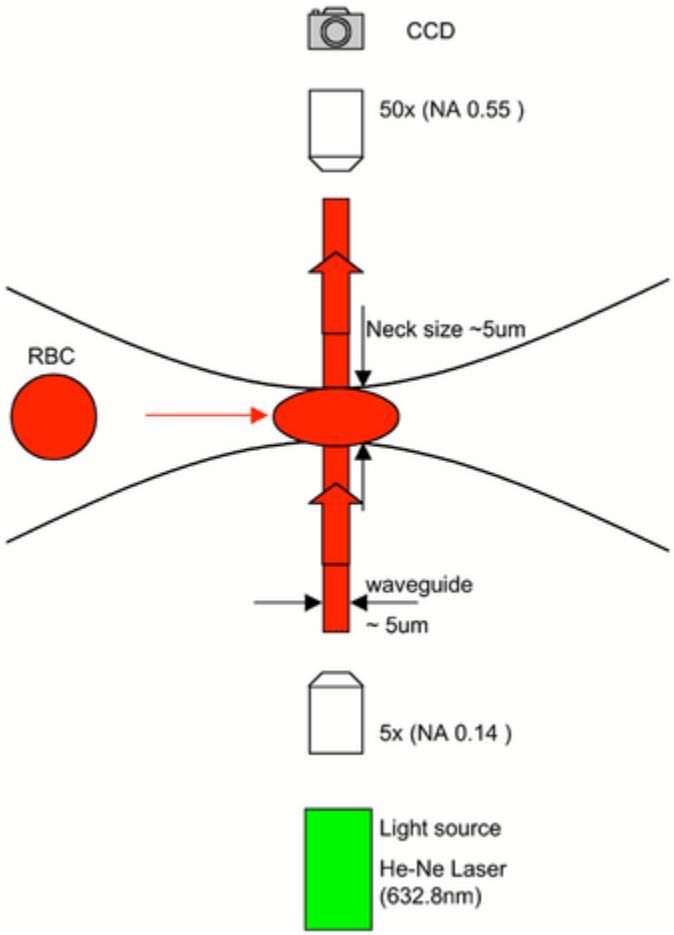
- RBC
- WBC
- BLOOD PLATLETS

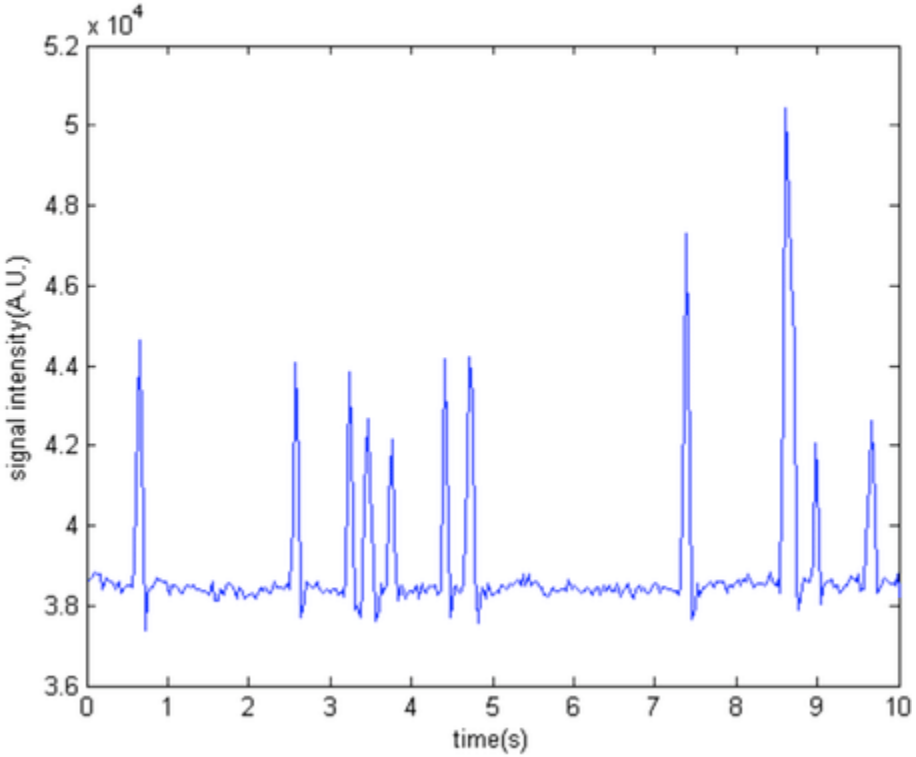
METHODES

- 1.HEMATOCRIT DETERMINATION
- 2.MANUAL METHOD
- 3.COULTER METHOD
- 4.LASER BASED CELL COUNTING

blood cell counter-Methodes

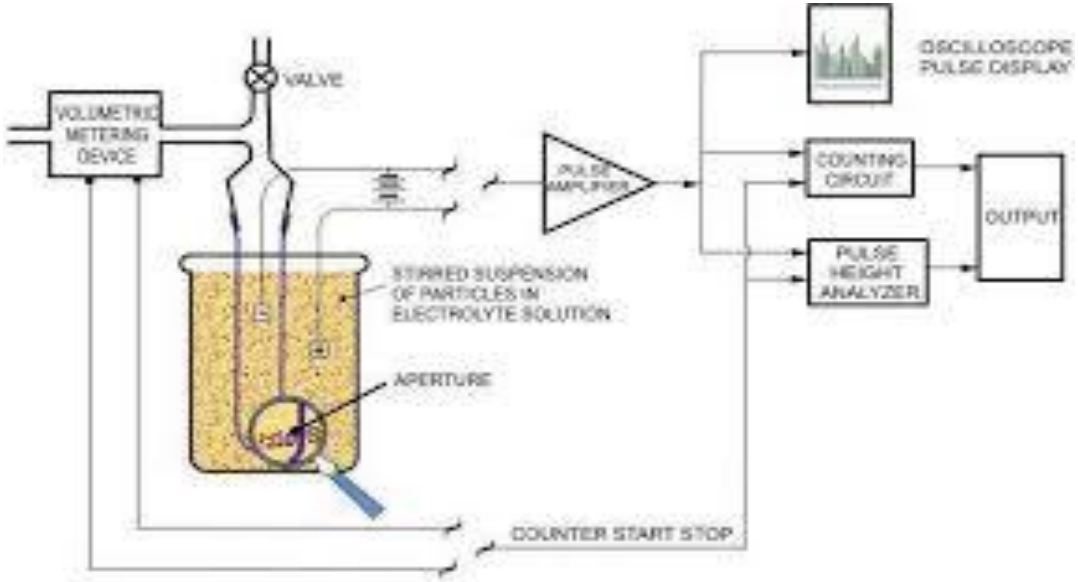
- **Laser-based** hematologic analyzers allow platelets to pass through in single file through a flow **cell** containing a **laser**. As the **platelet** passes through the **laser**, it is **counted** as an event (providing a **platelet count**) but it also scatters the **laser** light. Two detectors can measure the scattered light.


CCD
50x (NA 0.55)
Neck size ~5um
RBC
waveguide
~ 5um
5x (NA 0.14)
Light source
He-Ne Laser
(632.8nm)


x 10^4
5.2
5
4.8
4.6
4.4
4.2
4
3.8
3.6
signal intensity(A.U.)
0
1
2
3
4
5
6
7
8
9
10
time(s)

COULTER METHOD

- **Coulter** developed a technology for **counting** and sizing particles using impedance measurements. The technology was principally developed to **count blood cells** quickly by measuring the changes in electrical conductance as **cells** suspended in a conductive fluid passed through a small orifice.


VALVE
VOLUMETRIC METERING DEVICE
PULSE AMPLIFIER
OSCILLOSCOPE PULSE DISPLAY
COUNTING CIRCUIT
OUTPUT
PULSE HEIGHT ANALYZER
STIRRED SUSPENSION OF PARTICLES IN ELECTROLYTE SOLUTION
APERTURE
COUNTER START STOP

auto analyzer

- The **AutoAnalyzer** is an **automated analyzer** using a flow technique called continuous flow analysis (CFA), or more correctly Segmented Flow Analysis (SFA) first made by the Technicon Corporation. The instrument was invented in 1957 by Leonard Skeggs, PhD and commercialized by Jack Whitehead's Technicon Corporation.

auto analyzer

- he Clinical Biochemistry Analyzer is an instrument that uses the pale yellow supernatant portion (serum) of centrifuged blood sample or a urine sample, and induces reactions using reagents to measure various components, such as
  sugar, **cholesterol**, **protein**, enzyme, etc.

auto analyzer

- An **automated analyser** is a medical laboratory instrument designed to measure different chemicals and other characteristics in a number of biological samples quickly, with minimal human assistance. These measured properties of blood and other fluids may be useful in the diagnosis of disease.

auto analyzer

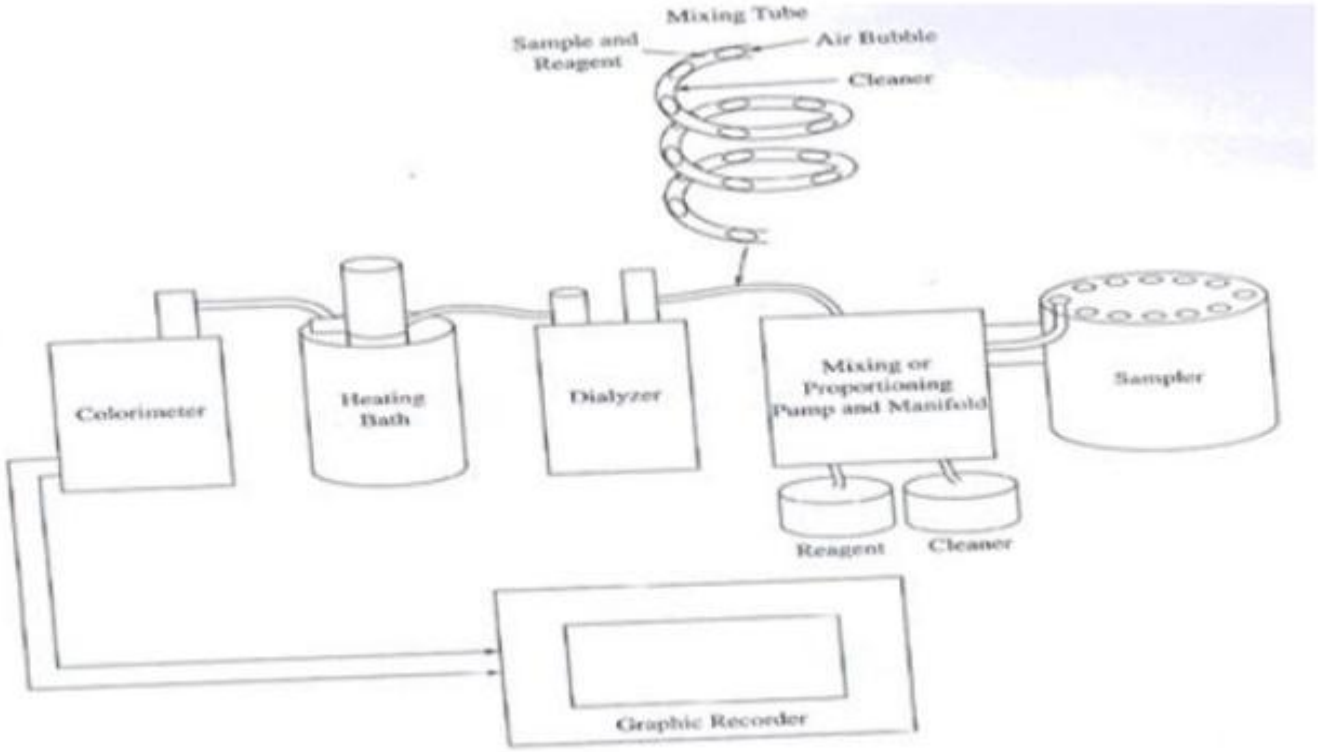


Figure 2.11 Block diagram of Autoanalyzer