WELCOME

Mymensingh Polytechnic Institute, Mymensingh.
Institute Code: *57067*
Technology: *ElectroMedical*
Technology Code: 86

Teacher's information

Md. Mahamudul Hasan Sumon
Junior Instructor (ElectroMedical)
Mymensingh Polytechnic Institute, Mymensingh.

Subject's Information

Subject Name: *Diagnostic and Laboratory Equipment.*

Subject Code: *28661*

Semester: *6th*

LESSION : 01

Lession Name: **Understand the concept of diagnostic and laboratory device.**

1.1 Define medical diagnostic and laboratory device.
1.2 Distinguish between the glassware and plastic ware.
1.3 List the diagnostic and lab instruments used in medical lab.
1.4 Define Water bath.
1.5 Describe thermostatic Water bath.
1.6 State the purpose of Incubator and Hot air Oven.
1.7 Describe Microprocessor based Ion Analyzer.

1.1 Define medical diagnostic and laboratory device.

A medical laboratory or clinical laboratory is a laboratory where tests are carried out on patients' or clients' or subjects' specimens to obtain information about the health status of the affected individual to aid in diagnosis, treatment, research and prevention of disease.

1.2 Distinguish between the glassware and plastic ware.

Glassware:

Slide, Test tube, Lens, Prism, Pipette, Buratte, Flask, Jar etc.

Plasticware:

Syringe, Test tube stand. Corck, Funel, Glaves, Rac, Jar etc.

1.3 List the diagnostic and lab instruments used in medical lab.

List the diagnostic and lab instruments :

- ✓Microscope.
- ✓Centifusw machine.
- ✓Spectrophotometer.
- ✓Colorimeter.
- ✓Flame photometer.
- ✓Bio-Chemistry Analyzer.
- ✓Blood Cell counter.
- ✓P^H Meter.
- ✓Water Bath.
- ✓Incubator. Etc.

1.4 Define water bath.

Water Bath: A water bath is laboratory equipment made from a container filled with heated water. It is used to incubate samples in water at a constant temperature over a long period of time. Most water baths have a digital or an analogue interface to allow users to set a desired temperature, but some water baths have their temperature controlled by a current passing through a reader. Utilizations include warming of reagents, melting of substrates or incubation of cell cultures. It is also used to enable certain chemical reactions to occur at high temperature.

1.4 Define water bath.

1.5 Describe Thermostatic Water bath.

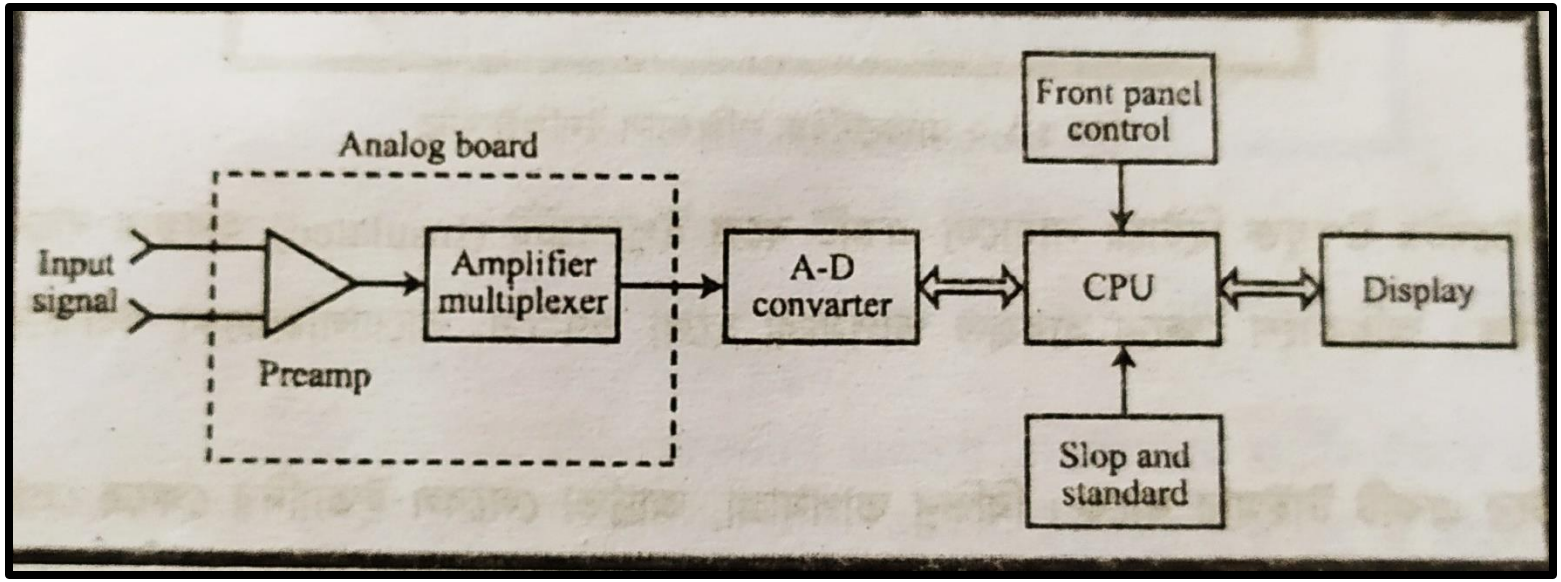
1.6 State the purpose of Incubator and Hot air Oven.

Incubator: Incubator is a device used to grow and maintain microbiological cultures or cell cultures. The incubator maintains optimal temperature, humidity and other conditions such as the CO (CO_2) and oxygen content of the atmosphere inside. Incubators are essential for a lot of experimental work in cell biology, microbiology and molecular biology and are used to culture both bacterial as well as eukaryotic cells.

1.6 State the purpose of Incubator and Hot air Oven.

Hot air Oven: Hot air ovens are electrical devices which use dry heat to sterilize. Generally, they use a thermostat to control the temperature. Their double walled insulation keeps the heat in and conserves energy, the inner layer being a poor conductor and outer layer being metallic. Its Temparature limit is 50°C to 300°C.

1.7 Describe Microprocessor based Ion Analyzer.



Learning Outcomes

1. Students can know about medical diagnostic and laboratory device.
2. Students can know about distinguish between the glassware and plastic ware.
3. Students can know about list the diagnostic and lab instruments used in medical lab.
4. Students can know about define Water bath.
5. Students can know about describe thermostatic Water bath.
6. Students can know about state the purpose of Incubator and Hot air Oven.
7. Students can know about describe Microprocessor based Ion Analyzer.

Questions?

LESSION : 02

Lession Name: **Understand the analytical instruments & photosensitive devices.**

2.1 Define analytical instruments.
2.2 Describe analytical and electronic balance.
2.3 Define Monochromator and Photosensitive detectors.
2.4 Describe Photovoltaic cell, Photo emissive cell and Photomultiplier tube.
2.5 Mention different types of Optical filters.

2.1 Define analytical instruments.

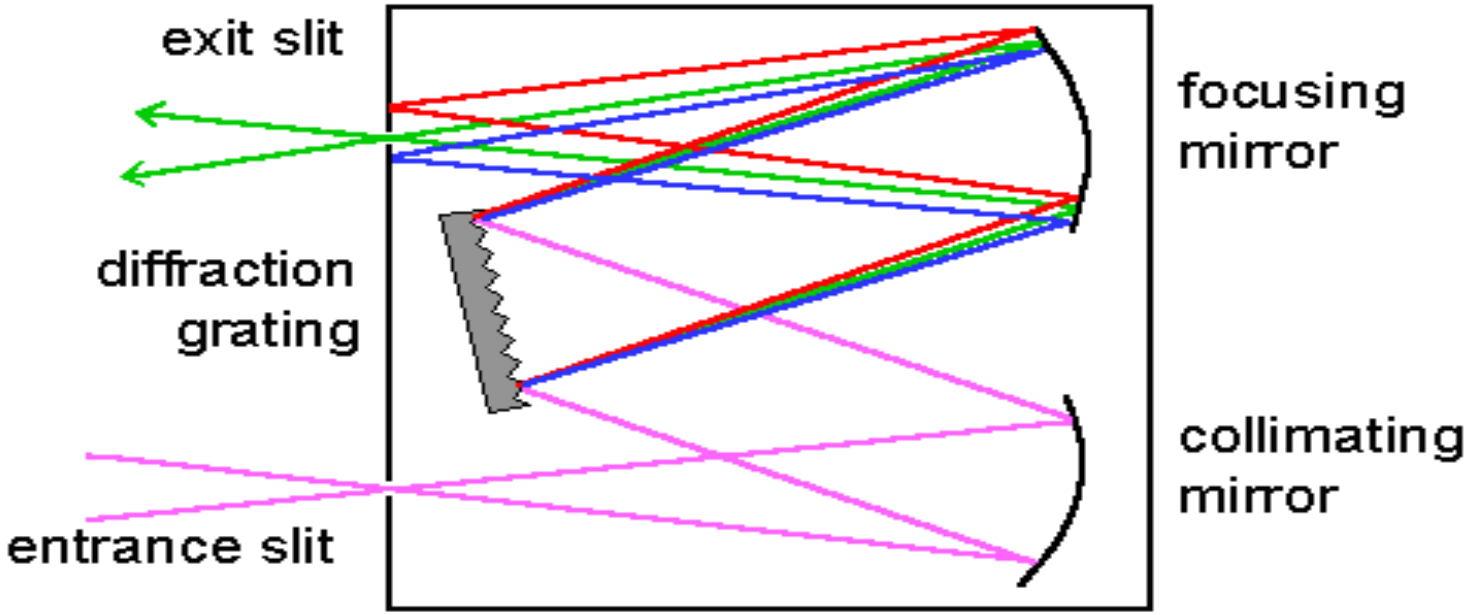
Analytical instruments: Analytical lab instruments encompass a wide range of instrumentation whose principle purpose is to qualitatively and quantitatively analyze samples; the chemical makeup of a sample and the quantity of each component within a sample. The wide range of available equipment also allows for a wide range of testing methods and their respective applications.

2.2 Describe analytical and Electronic Balance.

Electronic Balance: An analytical balance is a class of balance designed to measure small mass in the sub-milligram range. The measuring pan of an analytical balance is inside a transparent enclosure with doors so that dust does not collect and so any air currents in the room do not affect the balance's operation.

2.3 Define Monochromator and Photosensitive detectors.

Monochromator: A monochromator is an optical device that transmits a mechanically selectable narrow band of wavelengths of light or other radiation chosen from a wider range of wavelengths available at the input.



2.3 Define Monochromator and Photosensitive detectors.

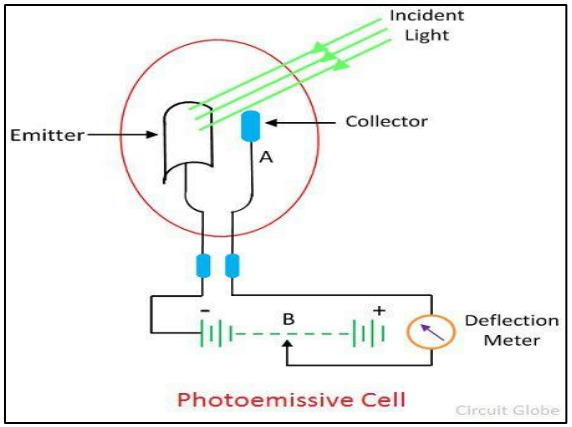
Photosensitive detectors: Photodetectors, also called photosensors, are sensors of light or other electromagnetic radiation. A photo detector has a p–n junction that converts light photons into current. The absorbed photons make electron–hole pairs in the depletion region. Photodiodes and photo transistors are a few examples of photo detectors. Solar cells convert some of the light energy absorbed into electrical energy.

2.4 Describe Photovoltaic cell, Photo emissive cell and Photomultiplier tube.

Photovoltaic cell: A solar cell, or photovoltaic cell, is an electrical device that converts the energy of light directly into electricity by the photovoltaic effect, which is a physical and chemical phenomenon. It is a form of photoelectric cell, defined as a device whose electrical characteristics, such as current, voltage, or resistance, vary when exposed to light. Individual solar cell devices can be combined to form modules, otherwise known as solar panels. The common single junction silicon solar cell can produce a maximum open-circuit voltage of approximately 0.5 to 0.6 volts.

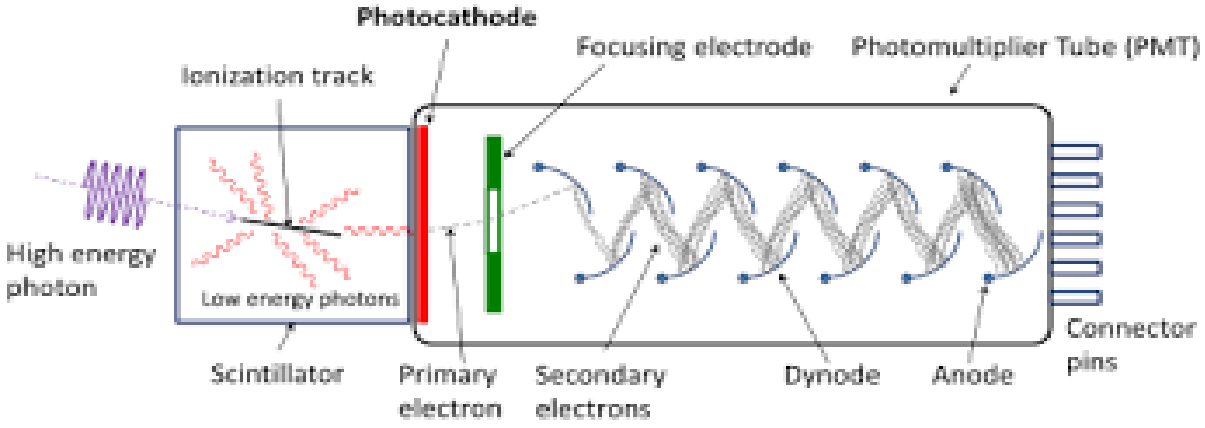
2.4 Describe Photovoltaic cell, Photo emissive cell and Photomultiplier tube.

Photo emissive cell: A phototube or photoelectric cell is a type of gas-filled or vacuum tube that is sensitive to light. Such a tube is more correctly called a 'photoemissive cell' to distinguish it from photovoltaic or photoconductive cells. Phototubes were previously more widely used but are now replaced in many applications by solid state photodetectors. The photomultiplier tube is one of the most sensitive light detectors, and is still widely used in physics research.



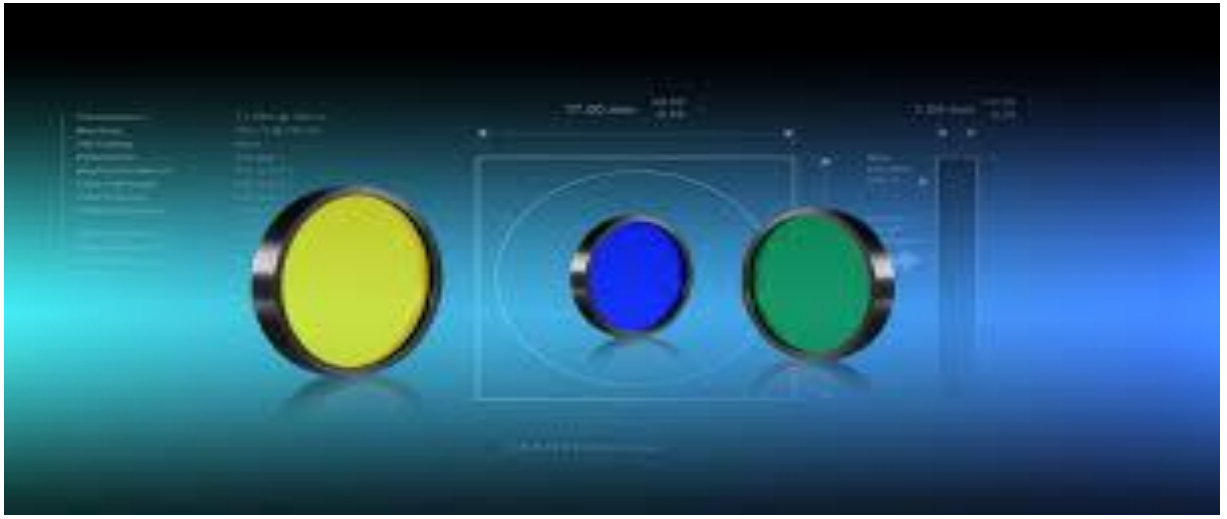
2.4 Describe Photovoltaic cell, Photo emissive cell and Photomultiplier tube.

Photomultiplier tube: Photomultiplier tubes members of the class of vacuum tubes, and more specifically vacuum phototubes, are extremely sensitive detectors of light in the ultraviolet, visible, and near-infrared ranges of the electromagnetic spectrum. These detectors multiply the current produced by incident light by as much as 100 million times or 10^8, in multiple dynode stages, enabling individual photons to be detected when the incident flux of light is low.



2.5 Mention different types of Optical filters.

Optical filter: An optical filter is a device that selectively transmits light of different wavelengths, usually implemented as a glass plane or plastic device in the optical path, which are either dyed in the bulk or have interference coatings. The optical properties of filters are completely described by their frequency response, which specifies how the magnitude and phase of each frequency component of an incoming signal is modified by the filter.



Learning Outcomes

- Students can know about define analytical instruments.
- Students can know about describe analytical and electronic balance.
- Students can know about define Monochromator and Photosensitive detectors.
- Students can know about describe Photovoltaic cell, Photo emissive cell and Photomultiplier tube.
- Students can know about mention different types of Optical filters.

Questions?

LESSION : 03

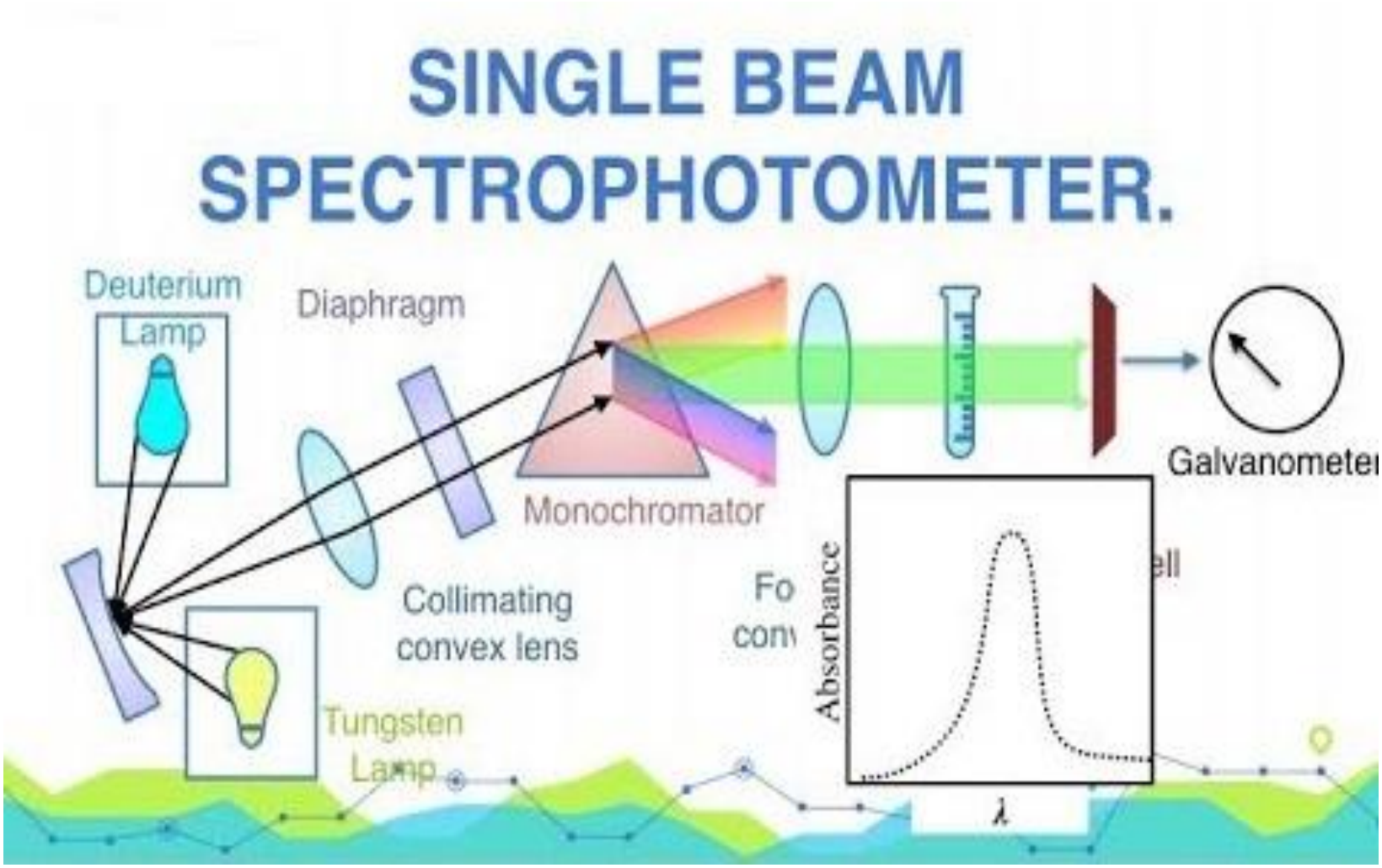
Lession Name: Understand the Spectrophotometer.

3.1 Define Spectrophotometer.
3.2 Explain the optical diagram of single beam null type Spectrophotometer.
3.3 Explain the optical diagram of double beam spectrophotometer.
3.4 Describe the operation of a microprocessor based Spectrophotometer with block diagram.
3.5 Mention the basic components of infrared Spectrophotometer.
3.6 Mention different types of Infrared Spectrophotometers.
3.7 Describe the recording type double beam optical null type Infrared Spectrophotometer with block diagram.

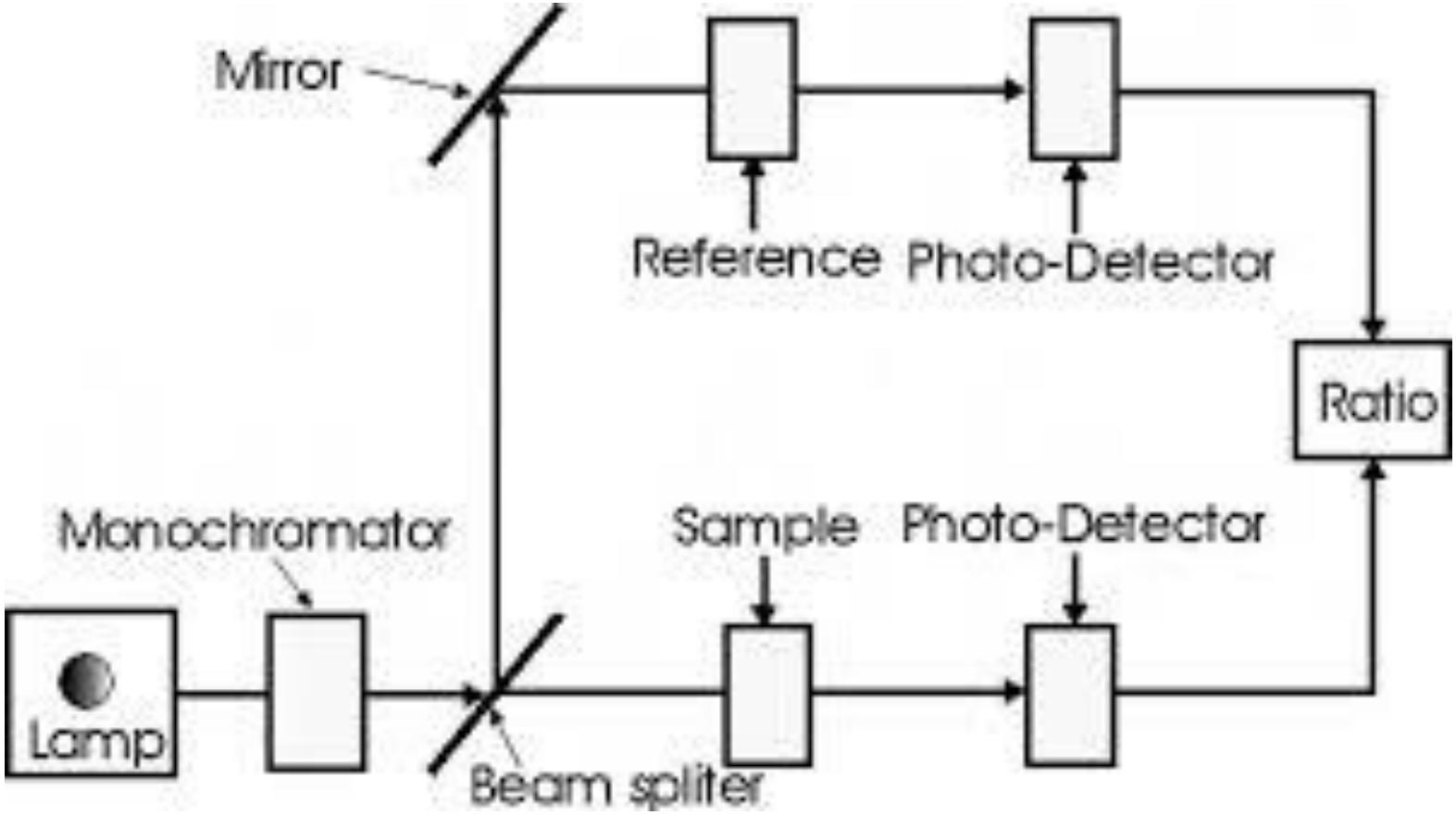
3.1 Define Spectrophotometer.

Spectrophotometer: A spectrophotometer is an instrument that measures the amount of light absorbed by a sample. Spectrophotometer techniques are used to measure the concentration of solutes in solution by measuring the amount of the light that is absorbed by the solution in a cuvette placed in the spectrophotometer .

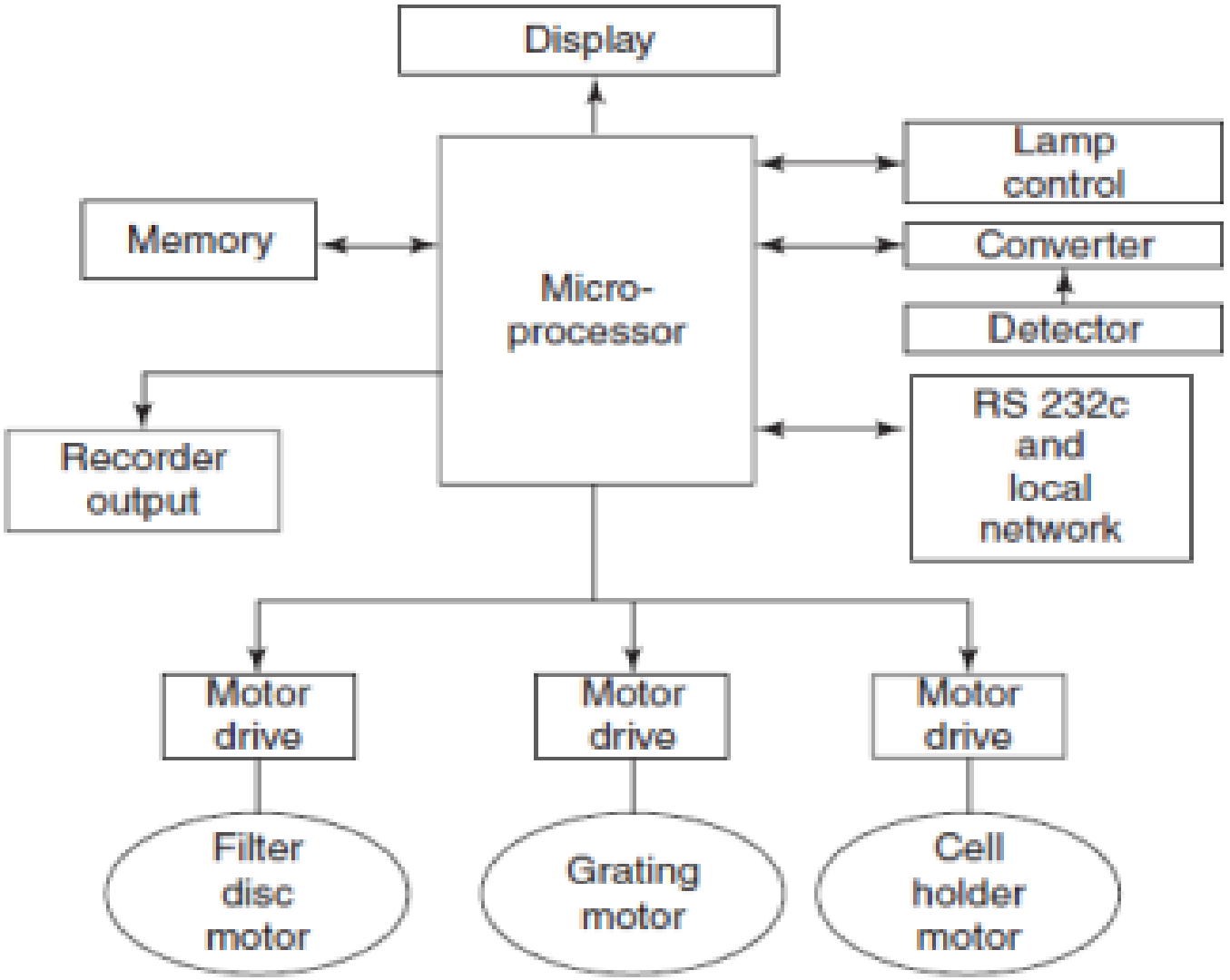
3.2 Explain the optical diagram of single beam null type Spectrophotometer.



3.3 Explain the optical diagram of double beam spectrophotometer.



3.4 Describe the operation of a microprocessor based Spectrophotometer with block diagram.



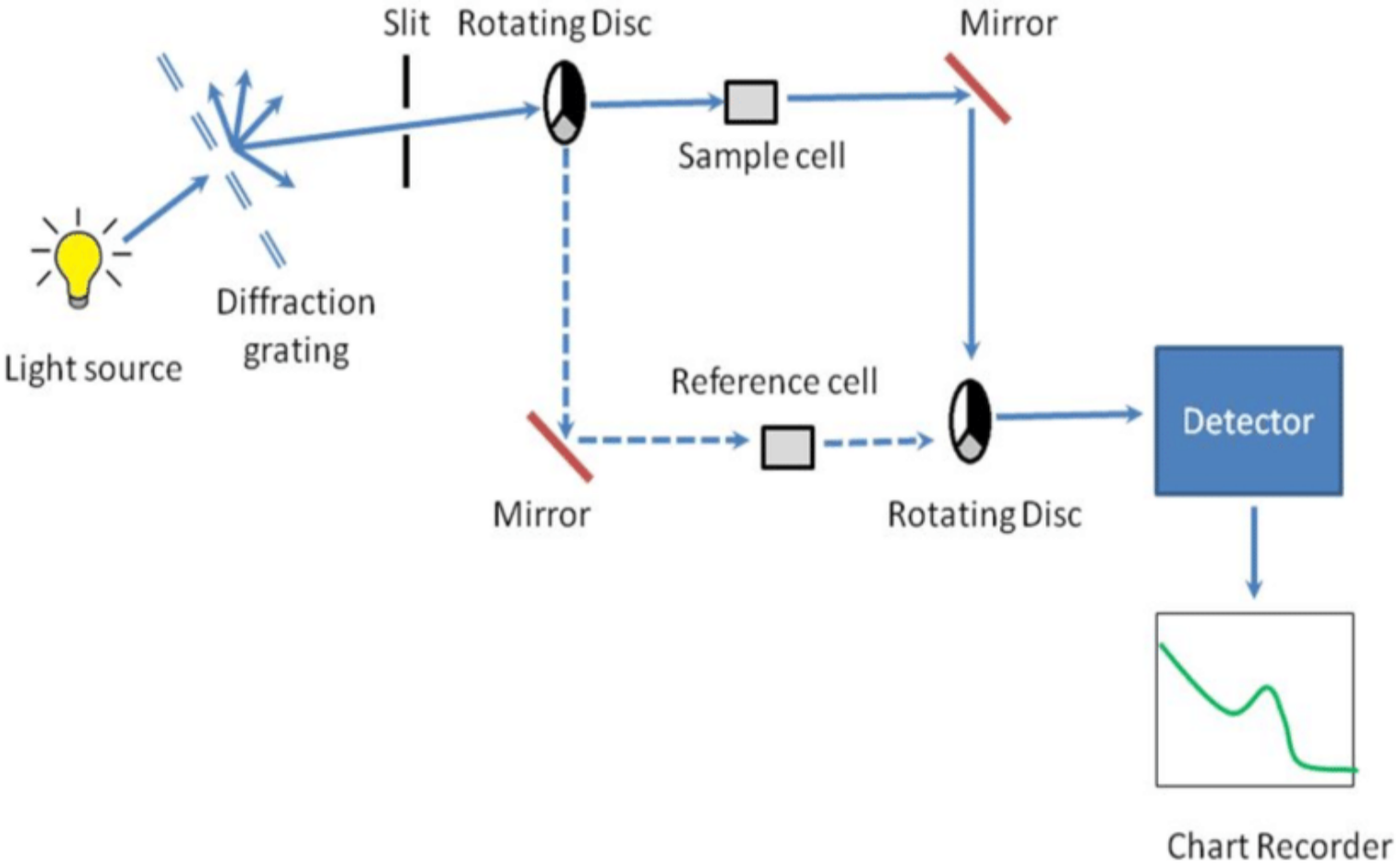
3.5 Mention the basic components of infrared Spectrophotometer.

Infrared spectroscopy: Infrared spectroscopy involves the interaction of infrared radiation with matter. It covers a range of techniques, mostly based on absorption spectroscopy. As with all spectroscopic techniques, it can be used to identify and study chemical substances. Samples may be solid, liquid, or gas. The method or technique of infrared spectroscopy is conducted with an instrument called an infrared spectrometer to produce an infrared spectrum.

3.6 Mention different types of Infrared Spectrophotometers.

1. Dispersive IR (DIR) spectrometers
2. Fourier transform IR (FTIR) spectrometers.

3.7 Describe the recording type double beam optical null type Infrared Spectrophotometer with block diagram.



Learning Outcomes

- Students can know about Spectrophotometer.
- Students can know about the optical diagram of single beam null type Spectrophotometer.
- Students can know about the optical diagram of double beam spectrophotometer.
- Students can know about describe the operation of a microprocessor based Spectrophotometer with block diagram.
- Students can know about the basic components of infrared Spectrophotometer.
- Students can know about different types of Infrared Spectrophotometers.
- Students can know about the recording type double beam optical null type Infrared Spectrophotometer with block diagram.

Questions?

LESSION : 04

Lession Name: **Understand the Microscope.**

4.1 Define Microscope.
4.2 Mention different types of Microscopes.
4.3 Describe simple Microscope.
4.4 Describe a high power Compound Microscope.
4.5 Define Electron Microscope.
4.6 Describe the construction and working principle of Electron Microscope.

4.1 Define Microscope.

Microscope: A **microscope** is an instrument used to see objects that are too small to be seen by the naked eye. Microscopy is the science of investigating small objects and structures using such an instrument. Microscopic means invisible to the eye unless aided by a microscope.

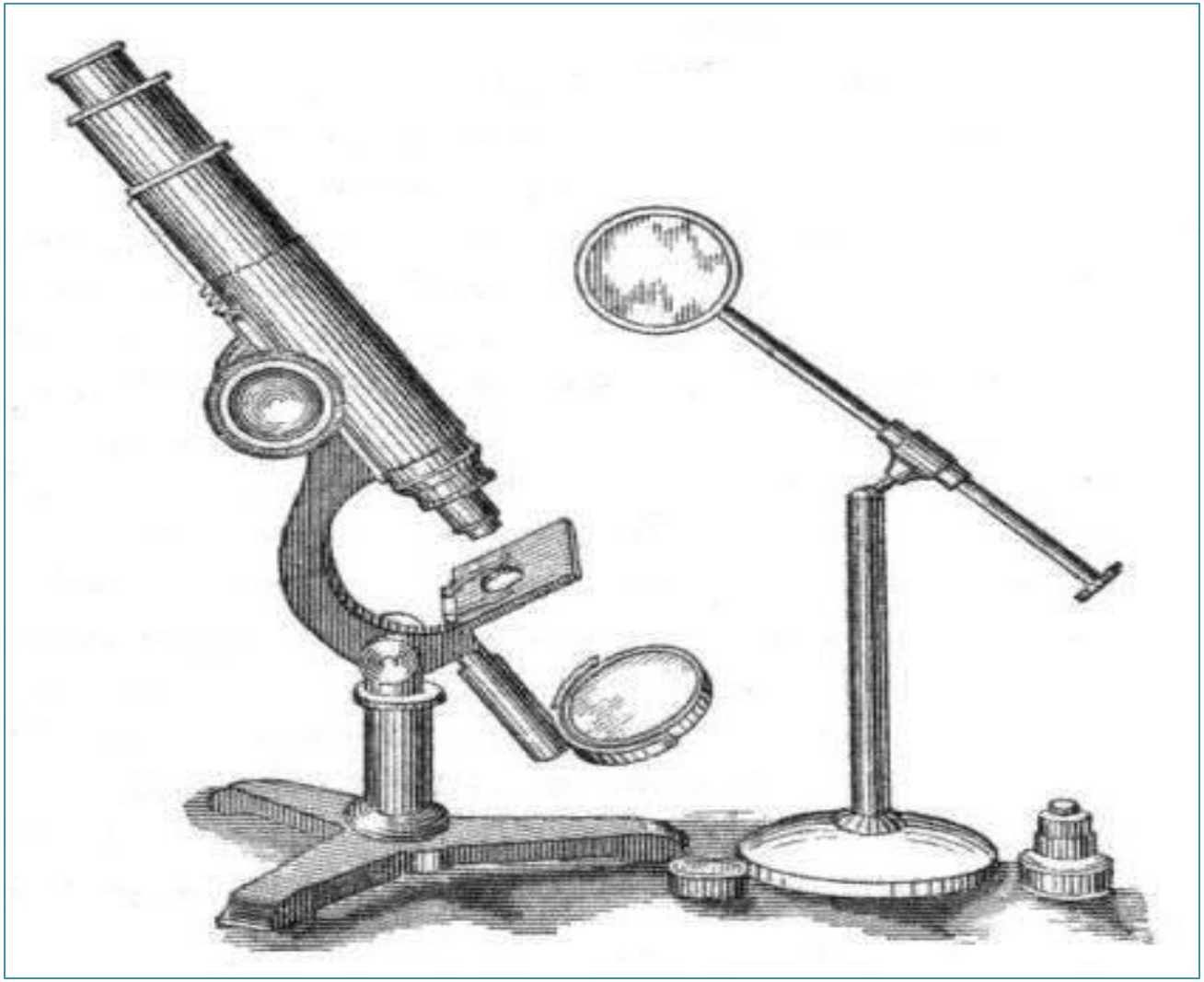
4.2 Different types of Microscope.

1. Optical Microscope.
2. Simple Optical Microscope.
3. Compound Optical Microscope.
4. Stereo Microscope.
5. Inverted Microscope.
6. Petrographic Microscope.
7. Electron Microscope.
8. Scanning Probe Microscope.

4.3 Describe simple Microscope.

A simple microscope is a magnifying glass that has a double convex lens with a short focal length. The examples of this kind of instrument include the hand lens and reading lens. When an object is kept near the lens, then its principal focus with an image is produced which is erect and bigger than the original object. The formed image is virtual and cannot be projected on a screen like a real image.

4.3 Describe simple Microscope.



4.4 Describe a high power Compound Microscope.

Parts Of Compound Microscope

Parts can be categorized into two:

Mechanical parts

Optical parts

(A) Mechanical Parts of a Compound Microscope

1. Foot or base

It is a U-shaped structure and supports the entire weight of the compound microscope.

2. Pillar

It is a vertical projection. This stand rests on the base and supports the stage.

3. Arm

The entire microscope is handled by a strong and curved structure known as the arm.

4.4 Describe a high power Compound Microscope.

4. Stage

The flat and rectangular plate that is connected to the arm's lower end. The specimen is placed on the stage for studying and examining. The center of the stage shows a hole through which light can pass.

5. Inclination joint

It is a joint wherein the arm is fastened to the compound microscope's pillar. The microscope can be tilted using the inclination joint.

6. Clips

The upper part of the stage is connected to two clips. The slide can be held in its position with the help of the clips.

4.4 Describe a high power Compound Microscope.

7. Diaphragm

The diaphragm is fastened below the stage. It controls and adjusts the intensity of light that passes into the microscope. The diaphragm can be of two types:

Disc diaphragm

Iris diaphragm

8. Nose piece

The nose piece is circular and a rotating metallic part that is connected to the body tube's lower end. The nose piece has three holes wherein the objective lenses are embedded.

4.4 Describe a high power Compound Microscope.

9. Body tube

The upper part of the arm of the microscope has a hollow and tubular structure known as the body tube. The body tube can be shifted down and up using the adjustment knobs.

10. Fine adjustment knob

It is the small knob which is used for sharp and fine focusing of the object. For accurate and sharp focusing, this knob can be used.

11. Coarse adjustment knob

It is a large knob that is used for moving the body tube down and up for bringing the object to be examined under exact focus.

4.4 Describe a high power Compound Microscope.

(B) Optical Parts of Compound Microscope

1. Eyepiece lens or Ocular

At the top of the body tube, a lens is planted which is known as the eyepiece. On the rim of the eyepiece, there are certain markings such as 5X, 10X, 15X, etc which indicates the magnification power. The object's magnified image can be observed with the help of an eyepiece.

2. Mirror

A mirror is found attached wither to the pillar or the lower end of the arm. It consists of a concave mirror on one side and a plain mirror on the other. It can be used for reflection of light rays into the microscope.

3. Objective lenses

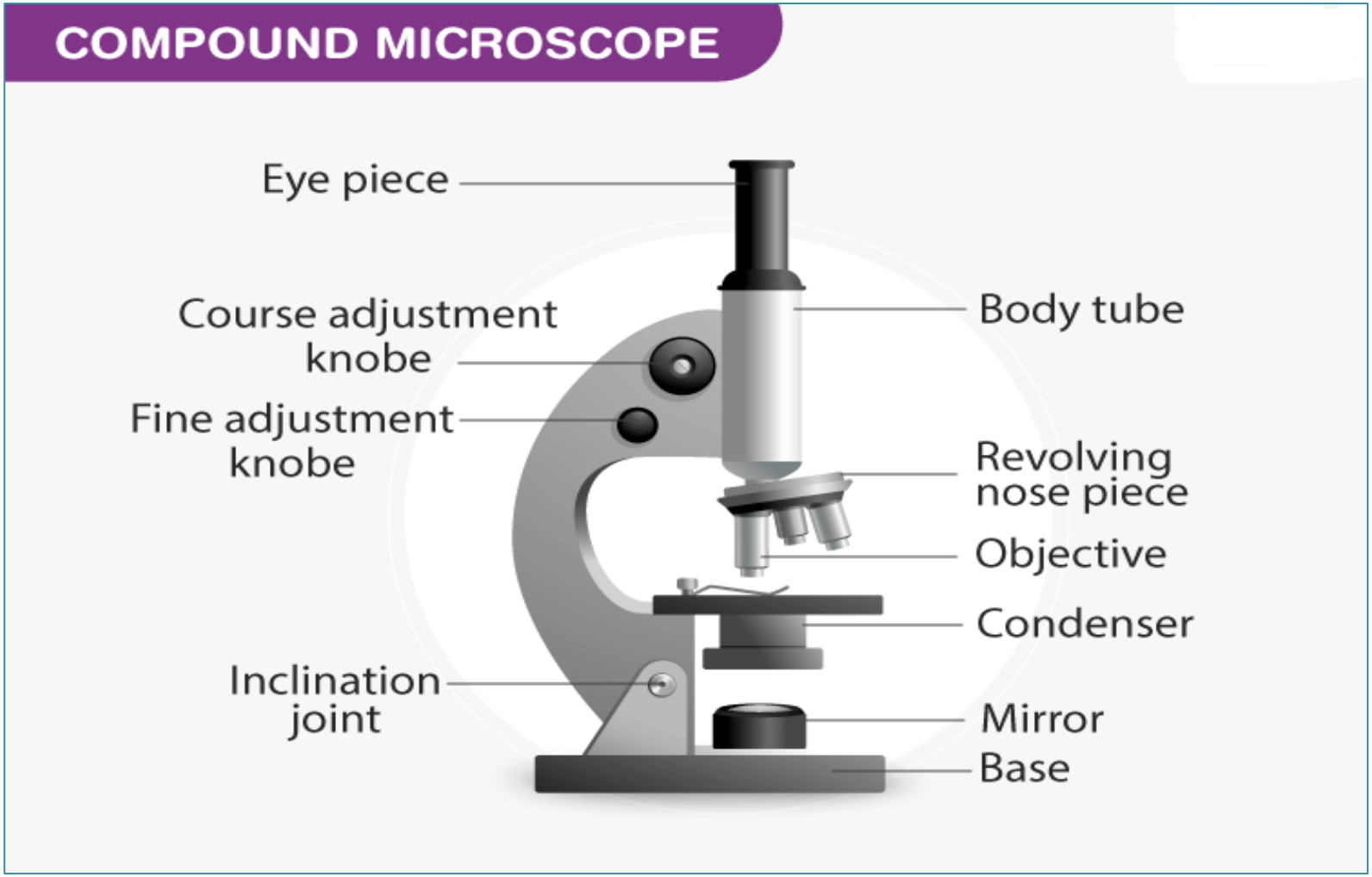
At the bottom of the body tube, there are two objective lenses that are connected to the revolving nose piece. The three objective lenses are as follows:

Oil immersion objective – 100X

High power objective – 45X

Low power objective – 10X

4.4 Describe a high power Compound Microscope.



4.5 Define Electron Microscope.

An **electron microscope** is a microscope that uses a beam of accelerated electrons as a source of illumination. As the wavelength of an electron can be up to 100,000 times shorter than that of visible light photons, electron microscopes have a higher resolving power than light microscopes and can reveal the structure of smaller objects. A scanning transmission electron microscope has achieved better than 50 pm resolution in annular dark-field imaging mode and magnifications of up to about 10,000,000× whereas most light microscopes are limited by diffraction to about 200 nm resolution and useful magnifications below 2000×.

4.6 Describe the construction and working principle of Electron Microscope.

Electron gun

Electron gun is a heated tungsten filament, which generates electrons.

Electromagnetic lenses

Condenser lens focuses the electron beam on the specimen. A second condenser lens forms the electrons into a thin tight beam.

The electron beam coming out of the specimen passes down the second of magnetic coils called **objective lens**, which has high power and forms the intermediate magnified image.

A third set of magnetic lenses called **projector (ocular) lenses** produce the final further magnified image.

Each of these lenses acts as image magnifier all the while maintaining an incredible level of details and resolution.

Specimen Holder

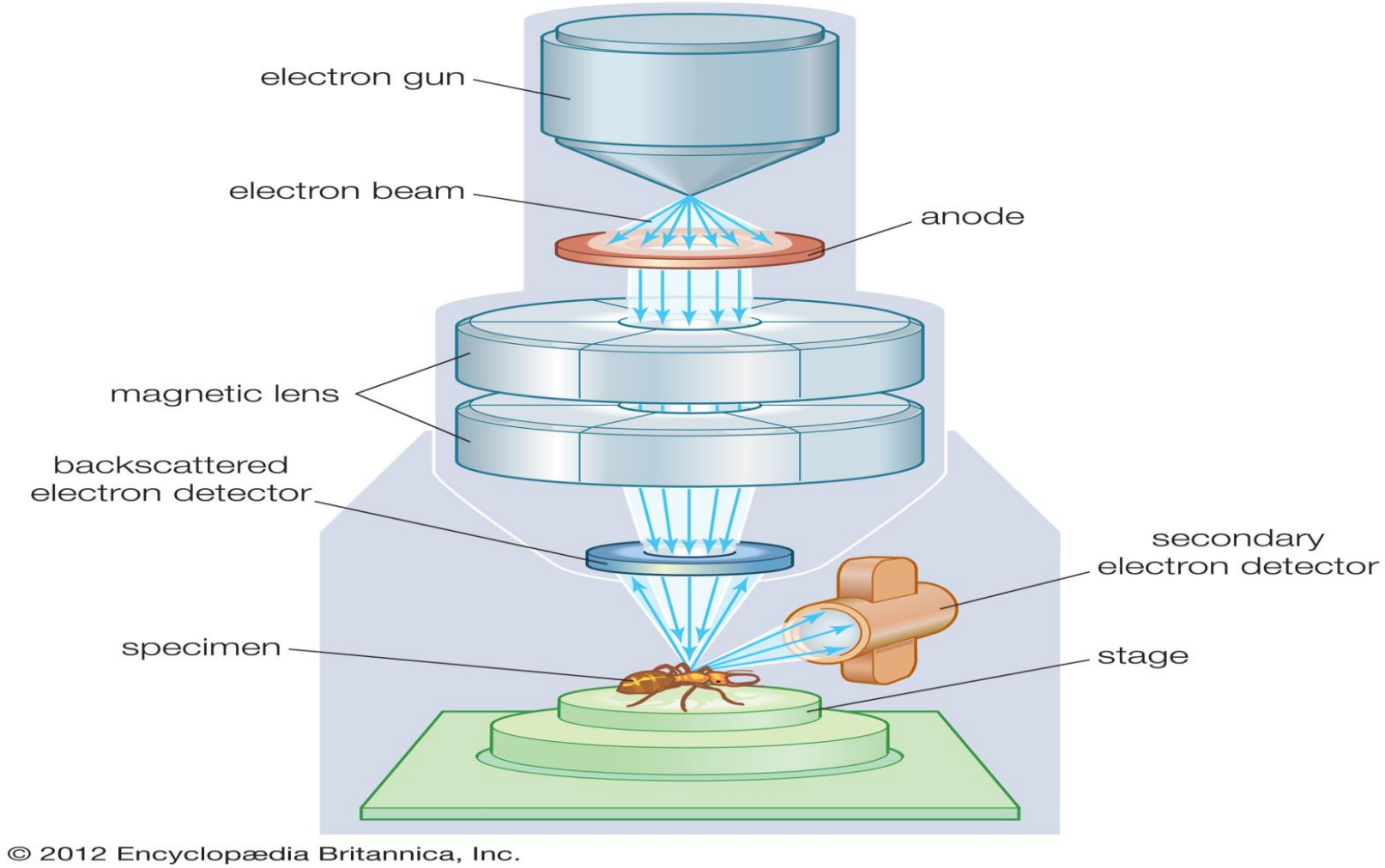
The specimen holder is an extremely thin film of carbon or collodion held by a metal grid.

Image viewing and Recording System.

The final image is projected on a fluorescent screen.

Below the fluorescent screen is a camera for recording the image.

4.6 Describe the construction and working principle of Electron Microscope.



Learning Outcomes

- ✓ Students can define Microscope.
- ✓ Students can know about different types of Microscopes.
- ✓ Students can know about simple Microscope.
- ✓ Students can know about a high power Compound Microscope.
- ✓ Students can know about define Electron Microscope.
- ✓ Students can know about the construction and working principle of Electron Microscope.

Questions?

LESSION : 05

Lession Name: Understand PH meter.

5.1 Define PH meter
5.2 Explain the principle of PH measurement.
5.3 Mention different types of electrodes for PH measurement.
5.4 Explain the PH measurement of blood.
5.5 Describe the construction and principle of operation of null-detector type PH meter
5.6 Describe the construction and operation of digital PH meter.
5.7 Discuss glass electrode and ion-selective electrode.
5.8 Explain acid base balance in blood.
5.9 Define buffer solution.
5.10 Describe PCO2 and PO2 measurement of blood.

5.1 Define PH meter

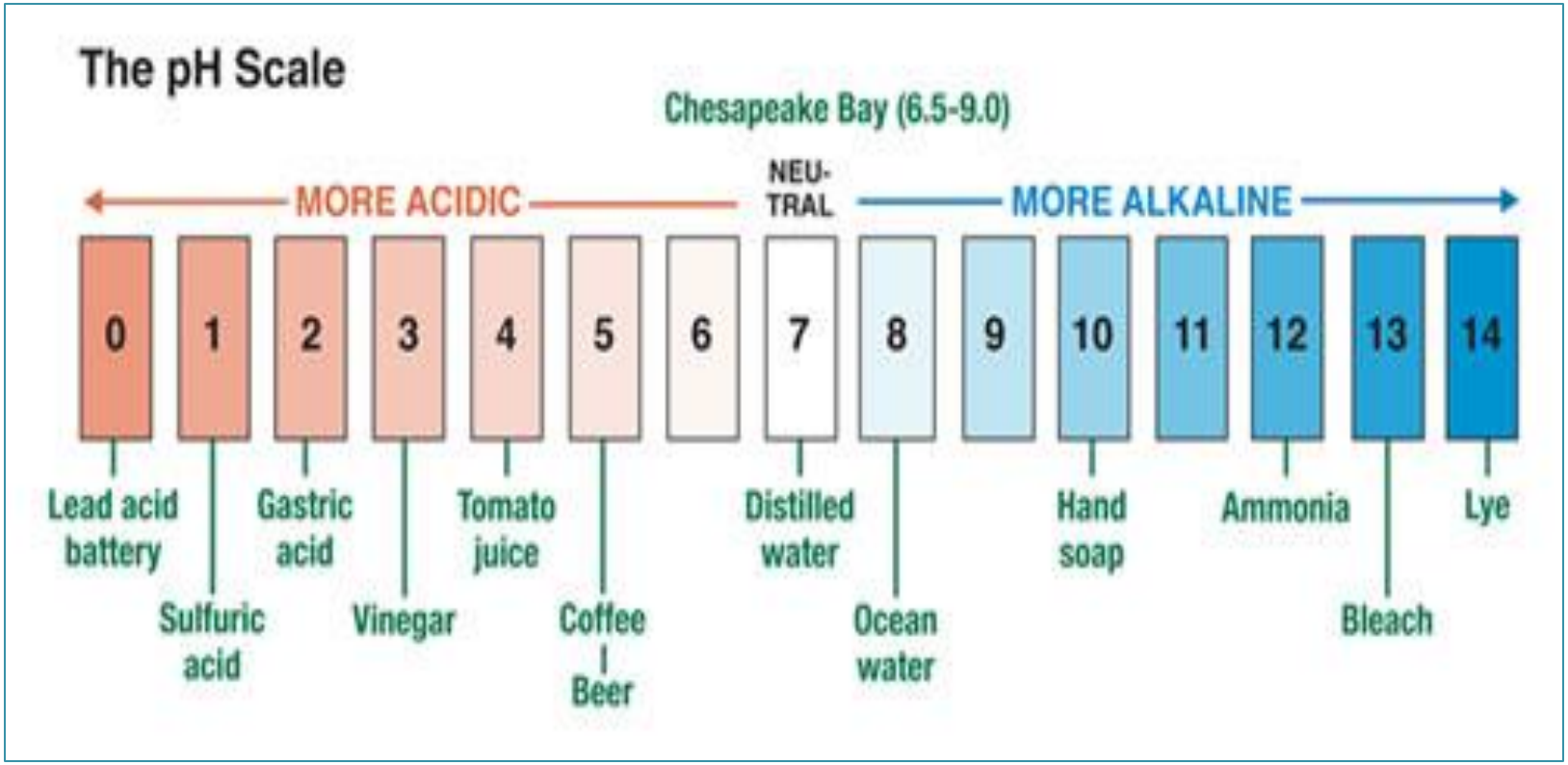
A **pH meter** is a scientific instrument that measures the hydrogen-ion activity in water-based solutions, indicating its acidity or alkalinity expressed as pH. The pH meter measures the difference in electrical potential between a pH electrode and a reference electrode, and so the pH meter is sometimes referred to as a "potentiometric pH meter". The difference in electrical potential relates to the acidity or pH of the solution. The pH meter is used in many applications ranging from laboratory experimentation to quality control.

5.2 Explain the principle of PH measurement.

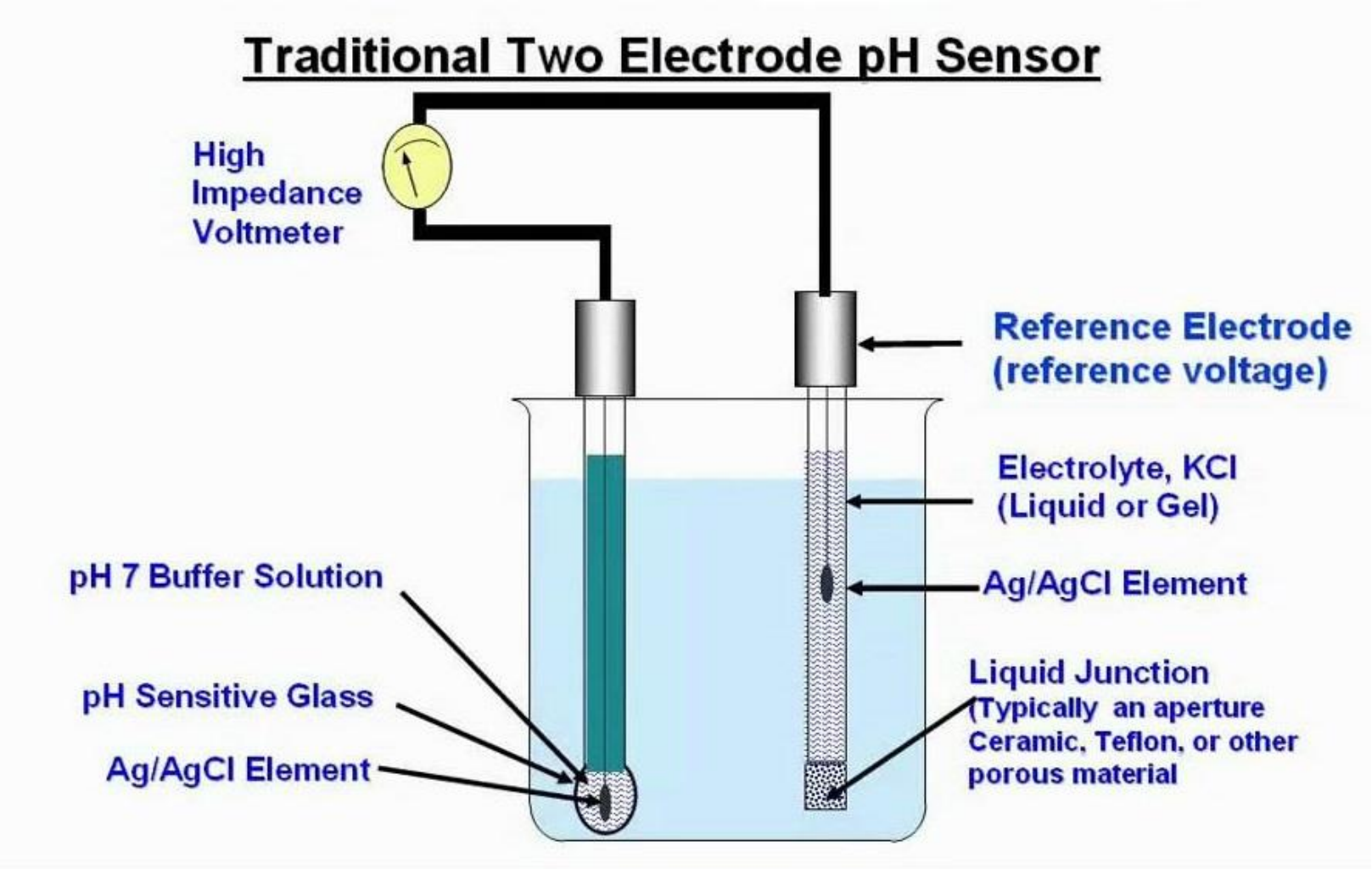
Knowing the pH value of a solution or fluid is very important for many chemical and analytical tasks and its measurement determines any follow up measurements.
Taking a pH measurement often seems to be trivial, which is the reason why pH measurements are frequently not questioned. But to make a useful pH measurement close attention must be paid to the measurement's details. To make a proper pH measurement and avoid errors you must first be familiar with the basics of pH measurement.
The elementary questions are:
What defines the pH-value?
How do I measure the pH-value?
Where and why are pH measurements made?

The water molecule has the property of dissociating into two ionic components in aqueous solutions. $H_2O <-> H^+ + OH^-$
The H^+ ion is termed hydrogen ion or proton, the OH^- ion hydroxide ion.
The pH value describes the activity of hydrogen ions in aqueous solutions typically on a scale of 0 to 14. Based on this pH scale, liquids are characterized as being acidic, alkaline or neutral: a solution which is neither acidic nor alkaline is neutral. This corresponds to a value of 7 on the pH scale. Acidity indicates a higher activity of hydrogen ions and a pH measurement value lower than 7. Alkaline solutions are characterized by a lower hydrogen ion activity or higher hydroxide ion activity, respectively and a pH measurement value above 7. The graph below uses examples to illustrate the pH scale.

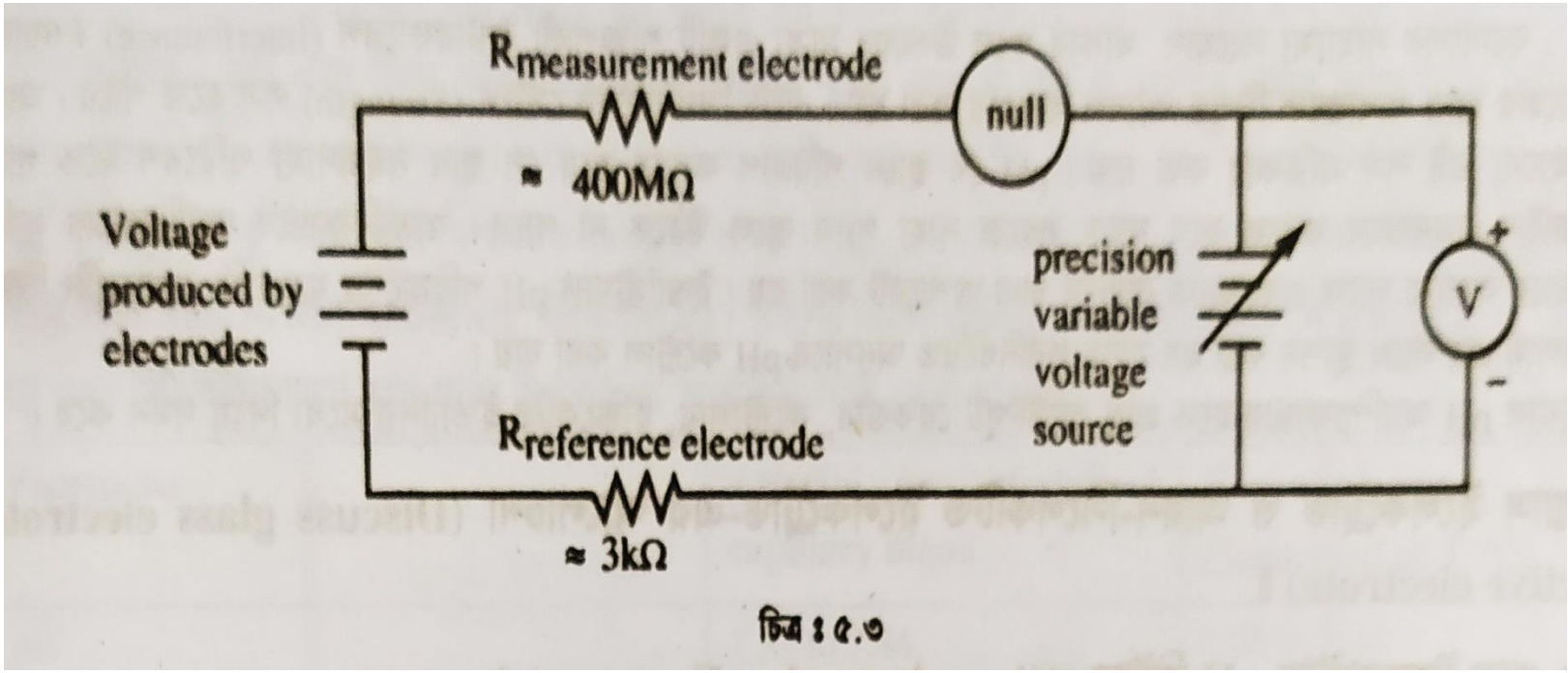
5.2 Explain the principle of PH measurement.



5.3 Mention different types of electrodes for PH measurement.



5.5 Null-detector type PH meter



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5.6 Describe the construction and operation of digital PH meter.