UV-Visible Spectroscopy

- Ultraviolet and Visible spectra arise from the transition of valance electrons within a molecule or ion from a lower electronic energy level to higher electronic energy level.
- This transition occurs due to the absorption of UV or Visible light by a molecule or ion.
- The wave length region of ultraviolet (UV) and visible radiations **are 200 – 400 and 400 – 750** nm respectively.
- When a monochromatic light is passed through a solution, the electrons present in the outermost shell of atoms or molecules or ions (valence electrons) absorb radiant energy and undergo transitions from lower energy level (G.S.) to higher energy state (E.S.).
- The actual amount of energy required for transition depends on the energy difference between the ground state energy level (E_1) and the excited state energy level (E_2).
- $\Delta E = E_2 - E_1 = h\nu$
- The two groups, chromophore and auxochrome are responsible for absorption and position of absorption in UV -Vis. spectra respectively.

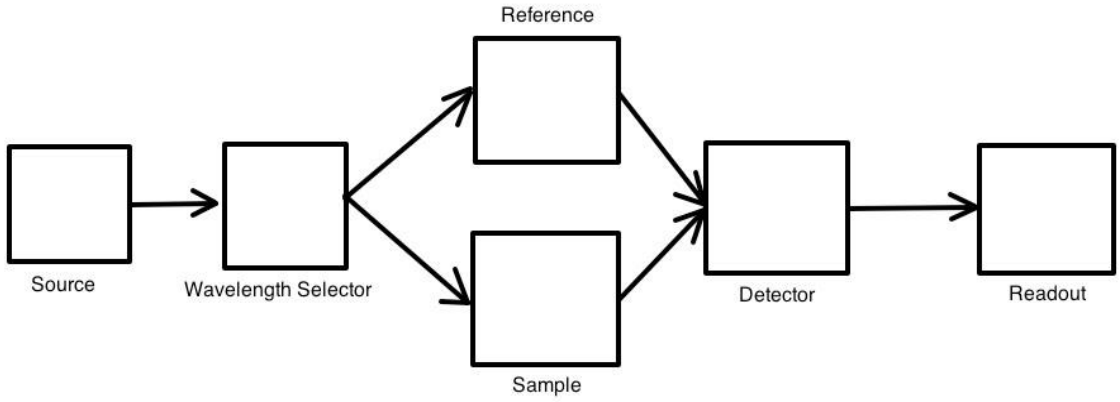
CHROMOPHORE

- The presence of one or more unsaturated linkages (π -electrons) in a compound are responsible for the absorption of UV-Visible radiation.
- These linkages are referred as chromophores. Chromophores undergo $\pi \rightarrow \pi^*$ transitions in the short wavelength regions of UV-radiations.
- Examples:
- C= C, – C ≡ C– , C ≡ N, –N =N , –C =O–

AUXOCHROME

- **It refers to an** atom or group of atoms which does not give rise to absorption band on its own.
- But, when they are attached to chromophoric group, it alters the position of the peak.
- Examples:
- –OH, $–NH_2$, –Cl, Br, –I, –SH, etc.

BLOCK DIAGRAM



Instrumentation

1. Radiation source

The most commonly used radiation source is hydrogen (or) deuterium lamps

Requirements of a radiation source

It must be stable and supply continuous radiation.

It must be of sufficient intensity.

2. Monochromators (or) filters

The monochromator is used to separate the radiation according to the wavelength.

The essential elements of a monochromator are an entrance slit, a dispersing element and an exit slit.

The dispersing element may be a prism or grating.

3. Cells (Sample cell and Reference cell)

The cells containing sample/reference for analysis should fulfil the following conditions

They must be uniform in construction.

The material used for construction should be inert to solvents.

It must transmit the light of the wavelength used.

4.Detectors

Photomultiplier tube or Photocell is used as detector

The detector converts the radiation falling on it into electric current.

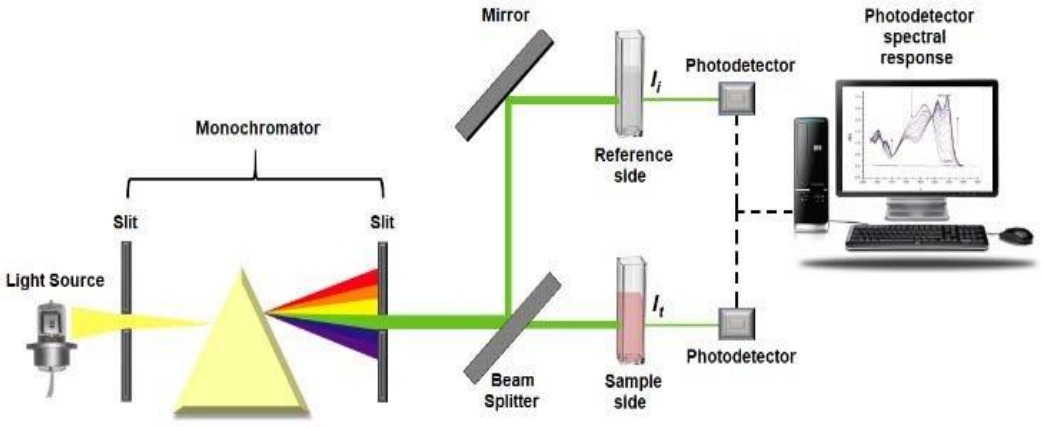
The current is directly proportional to the concentration of the solution.

5. Recording system

The signal from the detector is finally received by the recording system.

The recording is done by Digital read out device**.**

Working



- The radiation from the source is allowed to pass through the Monochromatic or filter.
- It allows a narrow range of wavelength to pass through an exit slit.
- The beam of radiation coming out from the mono chromator is split into two equal half beams.
- One-half of the beam (the sample beam) is directed to pass through a sample cell containing a solution of the compound to be analyzed.
- Another half (the reference beam) is directed to pass through an reference cell that contains only the solvent.
- The instrument is designed in such a way that it can compare the intensities of the two beams.

If the compound absorbs light at a particular wavelength, then intensity of the sample beam (I_S) will be less than that of the reference beam (I_R).

The instrument gives output graph, which is a plot of wavelength Vs absorbance of the light. This graph is known as absorption spectrum.