2.2 INSTRUMENTATION

Instruments for making molecular absorption measurements in the UV, visible, and near-IR regions are produced by dozens of companies.

There are hundreds of instrument makes and models from which to choose. Some are simple and inexpensive (a few hundred dollars); others are complex, computer- controlled, scanning instruments costing $30,000 or more.

The simpler instruments are often useful only in the visible region for quantitative measurements at a single wavelength.

The more complex instruments can provide spectral scanning at selectable resolution, measurements in the UV as well as the visible regions, compensation for source intensity fluctuations, and Several other features.

Instrument Components :

Instruments for measuring the absorption of UV, visible, and near-IR radiation are made up of one or more

a) Sources,
b) Wavelength selectors,
c) Sample containers,
d) Radiation transducers, and
e) Signal processors and readout devices.

Sources:

For the purposes of molecular absorption measurements, a continuum source is required whose radiant power does not change sharply over a considerable range of wavelengths.

The different types of sources are :

- ✓ Deuterium and Hydrogen Lamps
- ✓ Tungsten Filament Lamps
- ✓ Light-Emitting Diodes
- ✓ Xenon Arc Lamps.

Deuterium and Hydrogen Lamps :

Working Principle :

- A continuum spectrum in the UV region is produced by electrical excitation of deuterium or hydrogen at low pressure.

- The continuum spectrum is produced by initial formation of an excited molecules followed by dissociation of the excited molecule to give two atomic species plus a UV photon.

A deuterium lamp of the type used in spectrophotometers and (b) its spectrum. The plot is of irradiance Ed (proportional to radiant power) versus wavelength. Note that the maximum intensity occurs at -225 nm. Typically, instruments switch from deuterium to tungsten at -350 nm.

Working:

- An arc is formed between a heated, oxide-coated filament and a metal electrode.
- About 40 V is applied between the filament and the electrode.
- The heated filament provides electrons to maintain a direct current.
- A regulated power supply is required for constant intensities.
- Most modern lamps of this type contain hydrogen instead of deuterium and are of a low- voltage type.
- An important feature of deuterium and hydrogen discharge lamps is the shape of the aperture between the two electrodes.
- The aperture which constricts the discharge to a narrow path.
- As a result, an intense ball of radiation about 1 to 1.5 mm in diameter is produced.
- Both deuterium and hydrogen lamps produce outputs in the range of 160–800 nm.
- In the UV region (190–400 nm), a continuum spectrum exists as can be seen in Figure (b).