

## \* Spectroscopy :-

This is the most useful and modern branch of chemistry in which we study the spectra of a substance and by the analytical and theoretical study of the simple spectra.

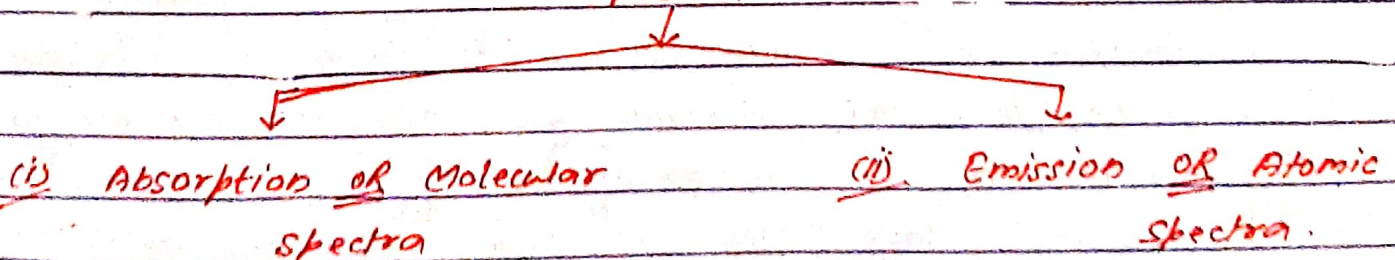
Spectroscopy gives following information about atoms, molecules and ions. such as -

- Bond length.
- Bond angle.
- Nature of the bond
- Molecular structure
- Bond strength. etc.

Molecular structure is derived indirectly from the technique known as spectroscopy, which deals with the transitions that a molecule undergoes between its energy from lower to higher upon adsorption of suitable radiation which determine by quantum mechanical selection rule.

Molecular spectroscopy may be defined as the study of the interaction of electromagnetic waves and matter.

### Spectra



### (i) Absorption Spectra :-

When a beam of light is allowed to pass through a molecule. The molecule undergoes a transition from the lower energy level to



the higher energy level with the absorption of a photon of energy  $h\nu$ . Thus we get a spectra known as absorption spectra.

### (ii) Emission spectra :-

when a molecule falls from the higher energy (excited state) level to lower energy level (ground state) with emission of photon of energy  $h\nu$ . The spectrum thus obtained known as Emission spectra.

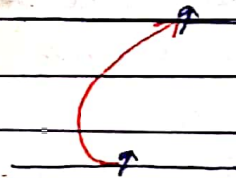
### NOTE :-

$$\text{Energy } \Delta E = h\nu.$$

change in energy is discontinuous.

### Discontinuous :-

Sudden jumps of electron from one shells to another shells.



### \* Electromagnetic Radiation :-

Electromagnetic radiations are associated with both electrical and magnetic properties. Arrangement of these electromagnetic radiation a/c to increasing frequency (Energy) and decreasing wave length is called electromagnetic spectrum.

\* Region of the spectrum:—

<u>Regions</u>	<u>Frequency (<math>\nu</math>)</u>	<u>wave length (<math>\lambda</math>)</u>	<u>Energy (E)</u>
(1) Radio frequency NMR } ESR } [spectroscopy]	$3 \times 10^6 - 3 \times 10^{10}$ Hz. or $\text{sec}^{-1}$	10m - 1cm	0.001 - 10 J/mole
(2) Microwave Rotational Spectroscopy	$3 \times 10^{10} - 3 \times 10^{12}$ Hz.	1cm - 100 $\mu\text{m}$	In order of 100 of J/mole.
(3) Infrared Vibrational Spectroscopy	$3 \times 10^{12} - 3 \times 10^{14}$ Hz.	100 $\mu\text{m}$ - 1 $\mu\text{m}$	In order of $10^4$ J/mole
(4) UV and Visible Electronic Spectroscopy	$3 \times 10^{14} - 3 \times 10^{16}$ Hz.	1 $\mu\text{m}$ - 10nm	100 of kJ/mole.
(5) X-ray (PES/XPES)	$3 \times 10^{16} - 3 \times 10^{18}$ Hz.	10nm - 100 pm	10,000 kJ/mole.
(6) $\gamma$ -ray	$3 \times 10^{18} - 3 \times 10^{20}$ Hz.	100 pm - 1 pm.	$10^9 - 10^{11}$ J/gm-atom.

1cm =  $10^{-2}$  m

1 $\text{\AA}$  =  $10^{-10}$  m

1  $\mu\text{m}$  =  $10^{-6}$  m

1nm = 10  $\text{\AA}$

1nm =  $10^{-9}$  m

1 pm =  $10^{-12}$  m