* 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 theoritical 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 techenique known as spectroscopy. which deals with the transitions that a molecule undergoes between it's 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 OR Molecular Spectra

(ii) Emission OR Atomic 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.

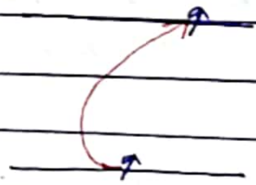
NOTE :–

Energy $\Delta E = h\nu$.

change in energy is discontineous.

Discontineous :–

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:—

Regions	Frequency (ν)	Wave length (λ)	Energy (E)
(1). Radio frequency NMR } spectroscopy ESR }	$3\times10^6 - 3\times10^{10}$ Hz. or sec^{-1}	10m — 1 cm	0.001 — 10 J/mole
(2). Microwave Rotational Spectroscopy	$3\times10^{10} - 3\times10^{12}$ Hz.	1cm — 100 μm	In order of 100 of J/mole.
(3). Infrared Vibrational Spectroscopy	$3\times10^{12} - 3\times10^{14}$ Hz.	100 μm — 1 μm	In order of 10^4 J/mole
(4). UV and visible Electronic Spectroscopy	$3\times10^{14} - 3\times10^{16}$ Hz.	1 μm — 10nm	100 of KJ/mole.
(5). X-ray (PES/XPES)	$3\times10^{16} - 3\times10^{18}$ Hz.	10nm — 100 Pm	10,000 KJ/mole.
(6). γ-ray	$3\times10^{18} - 3\times10^{20}$ Hz.	100 Pm — 1 Pm.	$10^9 - 10^{11}$ J/gm-atom.

$1cm = 10^{-2} m$ $\quad$ $1 Å = 10^{-10} m$

$1 \mu m = 10^{-6} m$ $\quad$ $1 nm = 10 Å$

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

$1 Pm = 10^{-12} m.$

* Some difinition:-

* wave length (λ) :-

The distance between two consecutive crests and troughs of a wave is called wave length of that wave.

A wave is a disturbance which travelles in a medium with out changes its forms.

UNIT – Meter (m), centimeter (cm), Angostrom ($\mathring{A}$), nanometre (nm), Picometre (Pm), Micrometer or micron (μm).

* Frequency (ν) :-

The no. of waves passing a given point in one second is called frequency.

UNIT – Hz (Hertz), Sec^{-1} (per second), t^{-1} (per time)

* wave number ($\bar{\nu}$) :-

The number of waves per centimetre is called the wave number.

UNIT – cm^{-1}.

* Relationship between Energy (E), wave length (λ), wave number ($\bar{\nu}$) and frequency (ν) :-

A/c to Plank's Equation –

$E = h\nu$

$E = \frac{hc}{\lambda}$ —— (I)

$E = hc\bar{\nu}$ —— (II)