a) $\sigma \rightarrow \sigma^*$ transitions:

- Shown by saturated hydrocarbons, like methane, propane, etc... Absorption occurs near 150 mμ.

$$\rangle C:C\langle \xrightarrow{\sigma\rightarrow\sigma^*} \rangle C\cdot C\langle$$

- Excitation of σ bond $e^-$ to $\sigma^*$ (antibonding) level occurs with net retention of $e^-$ spin → excited singlet state, which may in turn, gets converted to excited triplet state.

b) $n \longrightarrow \sigma^*$ transition:

- Occurs in saturated compounds containing one hetero atom with unshared pair of $e^-$ (n$e^-$). eg: saturated halides, alcohols, ethers, aldehydes, ketones, amines etc...
- Requires less energy than $\sigma \rightarrow \sigma^*$ transition.
- In case of saturated alkyl halides, the energy required for such transition ↓ with ↑ in size of halogen atom. (or ↓ in electronegativity of atom)

$$-\overset{|}{C}-\ddot{X}: \xrightarrow{n\rightarrow\sigma^*} -\overset{|}{C}-\dot{X}:$$

- Similarly, amines absorb at higher wavelengths as compared to alcohols.
- $n \rightarrow \sigma^*$ transitions are very senstive to H-bonding. H-bonding shifts the UV absorption to shorter wavelengths.

c) $\pi \longrightarrow \pi^*$ transition:

- Occurs in unsaturated centres of molecule i.e., in compounds containing double or triple bonds and also in aromatics. eg: alkenes, alkynes, carbonyl compounds, cyanides, azo compounds etc..

$$>C::C< \xrightarrow{\pi \rightarrow \pi^*} >C:.\dot{C}<$$

- This transition requires still lesser energy as compared to $n \rightarrow \sigma^*$ transition, ∴ absorption occurs at longer wavelengths.

d) $n \longrightarrow \pi^*$ transition:

- In this type, $e^-$ of unshared $e^-$ pair on hetero atom gets excited to $\pi^*$ antibonding orbital
  eg:- Saturated aldehydes → $R_2C=\ddot{O}:$
- Requires least amount of energy out of all transitions and hence occurs at longer wavelengths.

* Chromophore:

- All those compounds which absorb light of $\lambda$ b/w 400-800 mμ appear coloured to Human eye
- Originally, chromophore was considered any system which is responsible for imparting colour to the compound
  eg: Nitro group which imparts yellow colour to nitro compounds

"CHROMOPHORE is defined as any isolated covalently bonded group that shows a characteristic absorption in the UV or Visible region."

: ethylenic, acetylenic, carbonyls, acids, esters, nitrile group, etc...

Types of Chromophores-

a) Chromophores in which the group contain π ele*

and they undergo $\pi \rightarrow \pi^*$ transition.
eg: ethylenes, acetylenes, etc...

b) chromophores which contain both $\pi$ electrons and n (non bonding) electrons, and undergo two types of transitions i.e. $\pi \rightarrow \pi^*$ and $n \rightarrow \pi^*$. eg: carbonyls, nitriles, azo compounds, nitro compounds, etc

Note: In compounds of type $\geq C - C \leq$ and $\geq C - H$ absorption occurs around 150 mμ as a result of $\sigma \rightarrow \sigma^*$ transition and in compounds containing -Ö-, -S̈-, >N̈ atoms at 190 mμ due to $n \rightarrow \sigma^*$ transition.

* Auxochrome:

- An auxochrome can be defined as any group which does not itself act as a chromophore but whose presence brings about a shift of the absorption band towards the red end of the spectrum (longer wavelength).
- It increases the intensity of colour. "colour enhancing group".
- Examples of auxochromes: $-OH$, $-OR$, $-NH_2$, $-NHR$, $-NR_2$, $-SH$, etc...

Mechanism- All auxochromic groups contain non-bonding electrons. Due to this, there is extension of conjugation of the chromophore by sharing the non-bonding electrons.

eg: $CH_2=CH-\ddot{N}-(CH_3)_2 \longleftrightarrow \bar{C}H_2-CH=\overset{+}{N}(CH_3)_2$