



19CH103- ENGINEERING CHEMISTRY

Unit-5 INSTRUMENTAL METHODS OF ANALYSIS

SPECTROSCOPIC TECHNIQUE

It is the study of interaction of electromagnetic radiation with matter consisting of atoms and molecules. When a substance is irradiated with electromagnetic radiation, the energy of the incident photons may be transferred to atoms and molecules raising their energy from ground state level to excited state. This process is known as absorption and the resultant spectrum is known as absorption spectrum.

The process of absorption can occur only when the energy difference between the two levels E is exactly matched by the energy of the incident photons as given by the equation $E = h\nu = hc/\lambda$ where h is Planck's constant (6.63×10^{-34} Js), ν is the frequency of incident radiation, c is the velocity of light and λ is the wavelength of the incident radiation. The excited state atoms and molecules then relax to the ground state by spontaneous emission of radiation. The frequency of the radiation emitted depends on E .

The energy changes that occur in atoms and molecules during interaction with different regions of electromagnetic radiation are given below. Radiation absorbed Energy of the radiation (J/mole) Effect on the atoms/molecules Applications Introduction, absorption of radiation, UV-Visible Spectrophotometer: Instrumentation and application, IR Spectrophotometer: Instrumentation and application, Thermal methods of analysis TGA, DTA, DSC, Sensors: Oxygen and Glucose sensor, Cyclic Voltammetry for redox system. γ -radiation > 109 Change in nuclear configuration Used for cancer radiotherapy.

X- radiation 107 - 109 Change in core electron distribution Chemical crystallography, qualitative and quantitative analysis. Ultraviolet and Visible radiation 105 -107 Change in valence shell electron distribution. In qualitative and quantitative analysis. Infra red rays 103 -105 Change in the vibrational and rotational energy levels Detection of functional groups in compounds, calculation of force constant, bond length, etc., and in quantitative analysis Microwave radiation 10-103 Change in rotational energy levels Calculation of force constant, bond length, bond angle, etc. Radio frequency 10-3 - 10 Changes in nuclear and electron spin in the presence of external magnetic field. Detection of proton environment and paramagnetic ions. 3.2.1 UV-Visible spectroscopy The UV -Visible spectroscopy is also known as electronic absorption spectroscopy as molecules absorb radiation resulting in transitions between electronic energy levels. Absorption of radiation in the UV (wavelength range 190-400nm) and visible (wavelength 400-800nm) regions result in transitions between electronic energy levels. The principle of electronic