Chapter 14

Analytical Chemistry

Analytical chemistry is the study of the separation, identification, and quantification of the chemical components of natural and artificial materials. Qualitative analysis gives an indication of the identity of the chemical species in the sample, and quantitative analysis determines the amount of certain components in the substance.

Analytical chemistry is often described as the area of chemistry responsible for characterizing the composition of matter, both qualitatively and quantitatively. This description is misleading. The argument has been made that analytical chemistry is not a separate branch of chemistry, but simply the application of chemical knowledge. It finds numerous applications in various disciplines of chemistry such as inorganic, organic, physical, biochemistry, environmental science, agricultural science, biomedical, clinical chemistry, solid state research, electronics, oceanography, forensic science and space research.

Importance of Analytical Chemistry:

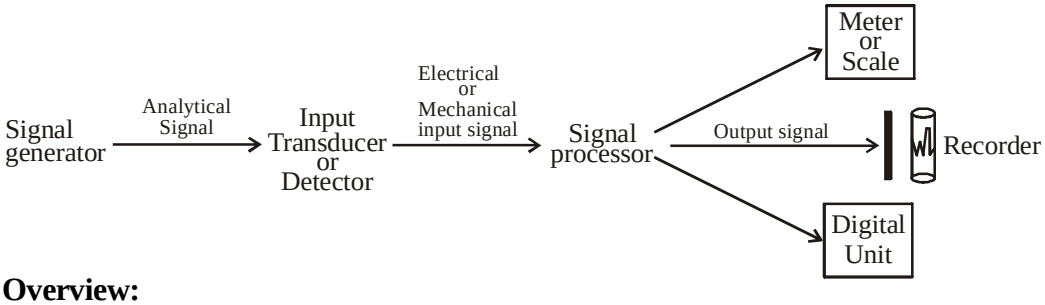
In environmental science the monitoring of SO_2, CO and CO_2 can be done by fluorescence or infrared spectroscopy while analysis of dissolved oxygen or chlorine from water can be carried out by potentiometry or calorimetry. The analysis of pesticides or insecticides from crops can be carried out by gas chromatography or HPLC.

The analysis of micronutrients such as iron, Cu, Zn, Mb, B and Mg can be carried out by spectrophotometry. In the field of bio-medical research and clinical chemistry, several example like spectral analysis of food poisons, presence of vanadium and arsenic in hair and nails. The spectra of cobalt in vitamin B_{12}, Fe in hemoglobin of blood after their isolation by gel permeation. In the field of electronics, oceanography, earth sciences and planetary sciences, analytical chemistry is extensively used.

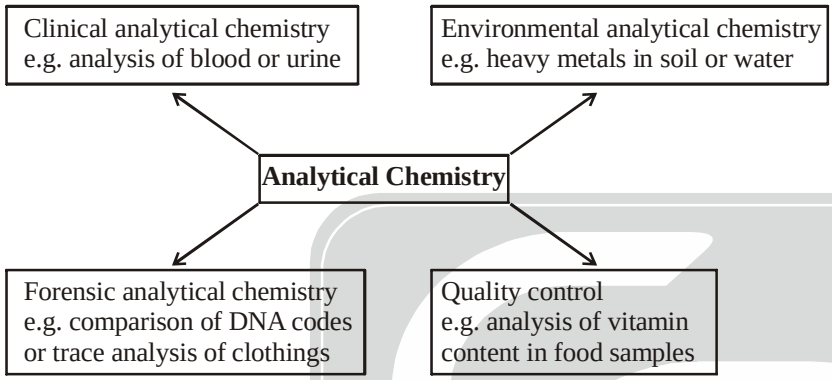
Role of Instrumentation:

It is essential to distinguish between instrumentation for analytical techniques and operation of instruments. The former is of atmost importance to the analytical chemist. During analysis methods which demand the least skill from the analytical chemist are preferred. However, knowledge of the chemical reactions in a particular system is most essential, when chemist resorts to the use of instruments, he should not end up as a black box operator. It is absolutely essential that he is able to interpret data obtained and arrive at the logical conclusion regarding the composition or structure of the analyte.

Components of a Typical Instrument:



Overview:



Separation Technique:

In chemistry a separation process, or a separation technique, or a simply a separation, is a method to achieve any mass transfer phenomenon that converts a mixture of substances into two or more distinct product mixtures, at least one of which is enriched in one or more of the mixture's constituents. In some cases, a separation may fully divide the mixture into its pure constituents. Separation are carried out based on differences in chemical properties or physical properties such as size, shape, mass, density or chemical affinity between constituents of mixture.

The purpose of separation may be analytical, i.e., to help analyze components in the original mixture without any attempt to save the fractions, or may be preparative, i.e., to prepare fractions or samples of the components that can be saved.

Some List of the Separation Techniques:

- Adsorption
- Chromatography
- Crystallization
- Electrophoresis
- Extraction
- Evaporation
- Analytical methods
- Precipitation
- Filtration
- Decantation
- Simple distillation