CHAPTER – 3 Non-aqueous Titration

3.1 INTRODUCTION

Non-aqueous titration refers to a type of titration in which the analyte substance is dissolved in a solvent which does not contain water. This procedure is a very important one in pharmacopoeial assays.

3.2 Principle of Non-aqueous Titration

Non-aqueous titration's principle is similar to that of acid-base titration, which states that if an acid donates a proton to another substance, a base accepts a proton. Various solvents, such as **protogenic solvents, protophilic solvents, aprotic solvents,** and **amphiprotic solvents** are used in non-aqueous titration.

3.3 Theory

The need for non-aqueous titration arises because water can behave as a weak base and a weak acid as well, and can hence compete in proton acceptance or proton donation with other weak acids and bases dissolved in it.

The procedure of non-aqueous titration is very useful because it satisfies two different requirements, namely – suitable titration of very weak acids or bases along with providing a solvent with an ability to dissolve organic compounds.

An **example** of a reaction in which water is not a suitable solvent is the reaction given by:

$R\text{-}NH_2 + H^+ \rightleftharpoons R\text{-}NH_3^+$

which is competed with in an aqueous solvent by the reaction given by:

$H_2O + H^+ \rightleftharpoons H_3O^+$

- This type of competition provided by water towards weak bases or weak acids makes it difficult to detect the end point of the titration. Therefore, these substances which have very sharp end points when titrated in aqueous solutions due to their weakly basic or weakly acidic nature generally need to be titrated in non-aqueous solvents.
- Many reactions which occur in non-aqueous titration procedures can be explained via the **Bronsted-Lowry Theory** and its definition of acids and bases. Basically, acids can be thought of as proton donors, whereas bases can be thought of as proton acceptors.

- It can also be noted that potentially acidic substances can behave as acids only when a base (to which a proton can be donated) is present. The converse of this statement also holds true, i.e. potentially basic substances can behave as bases only when an acid (from which a proton can be accepted) is present.

3.4	Types of Non-Aqueous Solvents

Typically, there exist four types of solvents used in the non-aqueous titration of a given analyte. These are:

1. Aprotic Solvents: these solvents are neutral in charge and are chemically inert. They also generally have a low dielectric constant. **Examples** of these types of solvents include chloroform and benzene.

2. Protophilic Solvents: these solvents have a basic character and tend to react with the acids they come in contact with, leading to the formation of solvated protons. **Examples** of protophilic solvents are ammonia and pyridine.

3. Protogenic Solvents: these solvents have a more acidic character and tend to have a levelling effect on the bases they come in contact with. **Examples** of protogenic solvents used in non-aqueous titration are sulphuric acid and acetic acid.

4. Amphiprotic Solvents: these solvents have properties which are protophilic as well as protogenic. **Examples** of these types of solvents are acetic acid and alcohols.

Thus, the solvents typically used in non-aqueous titrations are described above. The end points of these titrations can also be accurately measured using potentiometric titration procedures.