Coordination Compounds Overview

Ligands in coordination chemistry can be classified based on various factors such as the number of donor atoms, charge, and the type of bonding they form with the central metal atom. Here is a summary of the key types of ligands, their examples, and relevant terms:

1. Types of Ligands Based on the Number of Donor Atoms

- **Monodentate Ligands**: Ligands that donate one electron pair to the central atom.
  Examples:
  - NH_3 (ammine)
  - Cl^- (chlorido)
  - H_2O (aqua)
- **Bidentate Ligands**: Ligands with two donor atoms that form two bonds to the central atom.
  Examples:
  - Ethylenediamine (en), which has two nitrogen atoms that donate electrons.
  - Oxalate $(C_2O_4^{2-})$.
- **Polydentate Ligands**: Ligands that can attach to the central atom through multiple donor atoms.
  Example:
  - Ethylenediaminetetraacetate (EDTA), a hexadentate ligand, binds through six sites.

2. Types of Ligands Based on Charge

- **Neutral Ligands**: These do not carry any charge.
  Examples:
  - NH_3 (ammine)
  - CO (carbonyl).
- **Anionic Ligands**: These ligands carry a negative charge.
  Examples:
  - Cl^- (chlorido)
  - CN^- (cyanido)
  - OH^- (hydroxido).
- **Cationic Ligands**: Rare, but some are positively charged.
  Examples:
  - Nitronium ion NO_2^+ (nitronium).

3. Ambidentate Ligands

These ligands can coordinate to the central metal through two different atoms.
Examples:

- Thiocyanate SCN^-, which can bind through sulfur or nitrogen.
- Nitrite NO_2^-, which can bind through nitrogen or oxygen.

4. Ligands in Biological Systems

- **Porphyrin**: Found in chlorophyll and hemoglobin, it binds metal ions like Mg^{2+} and Fe^{2+}.
- **Cyanocobalamin (Vitamin B12)**: Contains cobalt in a complex with a modified porphyrin-like ligand.