In the present work, 2-hydroxy-4-chloro-5-methylacetophenone oxime and 2-hydroxy-4-chloro-5-methylpropiophenone oxime have been prepared. These ligands possess the effective chelating system C=C=C=N-OH. They have been examined as ligands for several metal ions: Cu$^{2+}$, Ni$^{2+}$, Pd$^{2+}$, Co$^{2+}$, Fe$^{2+}$, Fe$^{3+}$, Pb$^{2+}$, Cd$^{2+}$, Cr$^{3+}$, Al$^{3+}$, Mn$^{2+}$, Zn$^{2+}$, Ba$^{2+}$, Be$^{2+}$ and Mg$^{2+}$ and their analytical applications have been studied.

The Part-I of the thesis describes the reaction between ligands and the above mentioned metal ions and their analytical applications. Among the above metal ions Cu$^{2+}$, Ni$^{2+}$, Pd$^{2+}$, Co$^{2+}$ and Fe$^{2+}$ have been found to give precipitates while Fe$^{3+}$ gives colour reaction with these reagents at appropriate pH. The sensitivity of the ligands at various dilutions of the metal ion solutions has been studied. The specificity of the ligands for precipitation or colour reaction with the metal ions has also been examined by determining the pH range. The ligands have been investigated for gravimetric determination of Cu$^{2+}$, Ni$^{2+}$, Pd$^{2+}$, Co$^{2+}$ and Fe$^{2+}$. The interference by other metal ions has also been examined. The use of these ligands for colorimetric determination of the metal ions in dilute solution has also been studied.
The Part - II of the thesis deals with the study of the composition of the chelates of the ligands with Cu\(^{2+}\), Ni\(^{2+}\), Co\(^{2+}\), Pd\(^{2+}\) and Fe\(^{2+}\). In the complexes of Cu\(^{2+}\), Ni\(^{2+}\) and Pd\(^{2+}\) the metal percentage has been determined by conversion to the corresponding oxides. In the case of Co\(^{2+}\) chelates the cobalt was determined as cobalt anthranilate. In the complexes of palladium, the metal percentage has been determined by conversion to the jewelry metal. The metal-ligand ratio has been determined using Job's method of continuous variation. The absorption spectra in the ultraviolet, visible and infra-red regions and the magnetic susceptibility determination of the chelates have also been carried out to get some supporting evidences for the structure of chelates.