CHAPTER 5  SUMMARY AND CONCLUSION

The work described in the thesis concerns with the reactions of some of the 
Cu(II), Ni(II), Co(II) and Mn(II) complexes with 2- thiophenecarboxaldehyde, ortho/
4-chloro/ 4-nitro/ 4-methoxy-phenylenediamine, furfuraldehyde and 2,2’-bipyridyl. The
new heterocyclic Schiff base complexes are formed with N₄OS donor sets. The
structures of these new synthesised complexes have been investigated by using various
physico chemical methods. The complexes have been effectively used as DNA cleavage
and antibacterial studies. The antibacterial properties of the complexes have also been
screened against some pathogenic bacteria.

Chapter I

Chapter I deals with the general introduction to Schiff base, biological
importance of the copper, nickel, cobalt and manganese metal ions and brief discussion
of their applications in various methods. The literature survey of heterocyclic
Mononuclear Schiff base metal complexes is given in the first chapter.

Chapter-II

The aim and scope of the present work is presented in this chapter.

Chapter-III

Chapter III deals with the details on various experimental and characterization
techniques employed in the present study and also provides the information about the
spectral characterization of heterocyclic Schiff base metal complexes. These metal
complexes were synthesized by using 2- thiophenecarboxaldehyde, ortho/ 4-chloro/ 4-nitro/ 4-methoxy-phenylenediamine, furfuraldehyde and 2,2'-bipyridyl.

Chapter-IV

A Chapter 4.1- The new mononuclear heterocyclic Schiff base complexes were synthesized from 2- thiophenecarboxaldehyde, o-phenylenediamine, furfuraldehyde and 2, 2'- bipyridyl containing N₄OS donors set in different environments. The IR, electronic, ESR, magnetic and molar conductivity studies of the metal complexes were used to determine the type of coordination and geometries of the mononuclear complexes. The IR spectra of the complexes were compared with that of the free ligand to determine the changes that might have taken place during the complexation. Lowering of (C=\text{N}) in the complexes as compared to the ligand \( (1620 \text{ cm}^{-1}) \) is due to reduction of double bond character of carbon-nitrogen bond of the azomethine group. The electronic and magnetic susceptibility studies reveal that the geometry of the central metal ion is distorted octahedral. The \( ^1\text{H} \) NMR spectra of Schiff base \( \text{C}_{16}\text{H}_{12}\text{N}_{2}\text{O}_{2} \) ligand is used to determine the structure of the ligand. The interaction between newly synthesised \( \text{Cu(\text{C}_{30}\text{H}_{26}\text{N}_{4}\text{O}_{2}\text{S})}, \text{Ni(\text{C}_{30}\text{H}_{26}\text{N}_{4}\text{O}_{2}\text{S})}, \text{Co(\text{C}_{30}\text{H}_{26}\text{N}_{4}\text{O}_{2}\text{S})} \) and \( \text{Mn(\text{C}_{30}\text{H}_{26}\text{N}_{4}\text{O}_{2}\text{S})} \) complexes with DNA was investigated by gel electrophoresis technique. The result indicates that the \( \text{Cu(\text{C}_{30}\text{H}_{26}\text{N}_{4}\text{O}_{2}\text{S})} \) complexes cleave DNA more efficiently when compared to other complexes. The antibacterial activity of the metal complexes was found to be higher than the parent Schiff base ligands. Among the metal complexes \( \text{Cu(\text{C}_{30}\text{H}_{26}\text{N}_{4}\text{O}_{2}\text{S})} \) complex was found to be the most potent antibacterial activity and was observed against all the tested strains. It is due to difference in the number of protons in the mononuclear
Cu(II), Co(II), Ni(II) and Mn(II) metal complexes probably points the difference in the sizes of the +2 oxidation state of these metal ions, with the different polarizing due to its different sizes. Gram positive bacteria were found to be more susceptible than Gram negative bacteria.

A Chapter 4.2- The design and synthesis of mononuclear Cu(II), Ni(II), Co(II) and Mn(II) Schiff base complexes have been demonstrated in this report. All the four complexes were synthesized from 2- thiophenecarboxaldehyde, 4-chlorophenylene diamine, furfuraldehyde and 2, 2'- bipyridyl containing N₄OS donors set in different environments. They were characterized by spectral and analytical data. The molar conductance values indicate that the complexes were electrolytic in nature. FT-IR spectra reveal that the Heterocyclic Schiff base tetradenate ligand coordinating through nitrogen of azomethine and furfural oxygen, thiophene sulphur and pyridine nitrogen respectively and azomethine stretching frequency observed for all the complexes suggesting the complex formation. The UV-Vis, magnetic susceptibility and EPR spectral data of the complexes suggest a distorted octahedral geometry. The DNA cleavage studies reveal that the copper(II) and Cobalt(II) complexes cleaved DNA more effectively as compared other complexes and ligand. The antibacterial activity of the Cu(II) complexes are higher than the ligand Ni(II), Co(II) and Mn(II) complexes. It may be due to the Cu(II) ion which is smaller in size with high electronegativity when compared to other metal ions. Also chelation which subsequently favours its permeation through the lipid layer of the cell membrane.
Chapter 4.3 - All the four complexes were synthesized from 2- thiophenecarboxaldehyde, 4-methoxyphenylenediamine, furfuraldehyde and 2, 2’ bipyridyl containing N₄OS donors set in different environments were and discussed. They were characterized by spectral and analytical data. The molar conductance values indicate that the complexes were electrolytic in nature. FT-IR spectra reveal that the azomethine nitrogen stretching frequency observed for all the complexes suggesting the complex formation and far IR spectra indicate that the chloride ion bonded to the metal ion. The UV-Vis, magnetic susceptibility and EPR spectral data of the complexes suggest a distorted octahedral geometry. The DNA cleavage studies reveal that the Cu(C₃₉H₂₅N₅O₇S) complex cleaved DNA more effectively as compared other complexes and ligand. The antibacterial activity of the Cu(C₃₀H₂₅N₅O₇S) complex are higher than the ligand and other complexes.

Chapter 4.4 - The synthesis and characterization of mononuclear Cu(II), Ni(II), Co(II) and Mn(II) Schiff base complexes have been established. They were characterized by spectral and analytical data. The molar conductance values indicate that the complexes were electrolytic in nature. The IR spectrum shows the presence of metal-nitrogen, metal-oxygen, metal -sulphur and the presence of ionic acetate for the complexes. The UV-Vis, magnetic susceptibility and EPR spectral data of the complexes suggest a distorted octahedral geometry. The DNA cleavage studies reveal that the Copper(II) and Cobalt(II) complexes cleaved DNA more effectively as compared other complexes and ligand. It is suggested that the Cu(C₃₁H₂₈N₄O₆S), Ni(C₃₁H₂₈N₄O₆S), Co(C₃₁H₂₈N₄O₆S) and Mn(C₃₁H₂₈N₄O₆S) complexes having
antimicrobial activity may act either by killing the microbe or by inhibiting multiplication of the microbe by blocking their active sites. The antibacterial activity of the Cu(II) complexes are higher than the ligand and other metal complexes.

A Chapter 4.5 - The investigated compounds were tested for in vitro antibacterial activity against bacteria Staphylococcus aureus (Gram +ve), Bacillus subtilus (Gram +ve), Escherichia coli (Gram -ve) and Klebsiella pneumonia (Gram -ve) by well diffusion method using nutrient agar as the medium. Streptomycin was used as standard component.

The comparative study of the heterocyclic Schiff base ligands, chloro, methoxy and nitro substituted Schiff base ligands act as more antibacterial agents than the free heterocyclic Schiff base.

The overall increasing antibacterial activity order is as follows Chloro substituted heterocyclic Schiff base > Methoxy substituted heterocyclic Schiff base > Nitro substituted heterocyclic Schiff base > free heterocyclic Schiff base.