4.1 DISCUSSION
In the present investigation, eighteen Schiff base complexes of the three metals Co (II), Ni(II) and Cu(II) have been synthesized and studied. These complexes were prepared by using different ligands (Schiff bases) and metal chlorides. In some complexes the chloride ion remained outside the coordination sphere, however in others it is within the sphere. In several cases water molecules were found present either in the lattice of complex compound or in coordination sphere or both. In general the donor atoms of the coordinating ligands are nitrogen, oxygen or sulphur. The synthesized Schiff bases acted as bidentate ligand in majority of complexes. On the basis of characterization, findings and structural arrangements, the following possible general formulae for these complexes have been suggested.

1. \([ML(H_2O)_2Cl_2].nH_2O\)
2. \([ML(H_2O)_2].Cl_2.nH_2O\)
3. \([ML(H_2O)_2].Cl_2\)
4. \([ML_2Cl_2]\)
5. \([ML_2]\)
6. \([ML_2Cl_2].nH_2O\)
7. \([ML_2(H_2O)_2]\)
8. \([ML_2].nH_2O\)

The Schiff base-ligand L= Furfurylidene-thioacetamide (FTA), Furfurylidene-4-aminoacetanilide (FAA), 4-Chlorobenzylidene-thioacetamide (CTA), 4-Chlorobenzylidene-2-amino-4-chlorophenol (CAP), 3-Nitrobenzylidene-2-aminothiazole (NAT) and 3-Nitrobenzylidene-2-amino-4-chlorophenol (NAP). The
complexes are of different colours. Analytical data, colour, molar conductance, spectral and magnetic moment data of the complexes have been summarized in (Table 1-6) of Chapter-III. Graphs and plots of only representative cases have been given in Chapter-III (with a view to keep the bulk of the thesis reduced). The molar conductance of the complexes have been measured after dissolving them in the suitable organic solvents viz. methanol and ethanol. The molar conductance (Ohm$^{-1}$ cm$^{2}$mol.$^{-1}$) have been measured by preparing the millimolar solution of complexes in methanol or ethanol.$^{1-2}$

The molar conductance value of a complex may deviate from the prescribed range because of the dissociation of the complex ion or some solvolysis kind of reactions $^{3-5}$. The very low molar conductance value suggests the non-electrolytic nature of a complex compound.

4.1.1. COMPLEXES OF COBALT (II), NICKEL (II) AND COPPER (II)

WITH FURFURYLIDENE-THIOACETAMIDE:

The analytical data of the complexes show that the metal to ligand stoichiometry is 1:1. The value of molar conductance in methanol of cobalt(II)-complex ($10^{-3}$M) shows the non-electrolytic nature while the nickel(II) and copper(II) complexes show 1:2 electrolytic nature. The $\mu_{eff}$ values of Co(II), Ni(II) and Cu(II) are 5.06, diamagnetic and 1.94 B.M.$^{6-10}$ respectively Table-1.

A sharp band at 1650 cm$^{-1}$ in the IR spectrum of the ligand is owing to $>$C=N group (Schiff base). This band shifts towards lower frequency side ($1610 \pm 10$ cm$^{-1}$) on coordination through azomethine nitrogen$^{11-15}$. A medium intensity ligand band is observed at $1210$ cm$^{-1}$ (C-O-C). As a result of coordination of ring oxygen with the
metal ion, this band position shifts to 1180±10 cm⁻¹ 16-20,27,65,90-96. A band due to C=S stretching vibrations which appears at 1525 cm⁻¹, remains unshifted in the spectra of complexes. Thus ruling out the participation of C=S group in coordination. The presence of water molecules in the coordination sphere is supported by the appearance of bands at 3430±10 cm⁻¹ and 760±10 cm⁻¹, which are attributable to stretching and rocking mode respectively 28,50. The new bands at 510±10 cm⁻¹ and 410±10 cm⁻¹ in the corresponding metal complexes have been assigned to νₘ₋₀ and νₘ₋ₙ mode respectively 11,13,21,32,96-100.

The electronic spectrum of Co(II)-complex exhibits two bands at 15340 and 20430 cm⁻¹ assignable to ⁴T₁g(F)→⁴A₂g(F) (ν₂) and ⁴T₁g(F)→⁴T₁g(P) (ν₃) transitions, respectively. The values of ligand field parameters, 10 Dq, B, β, λ, and LFSE are : 8221 cm⁻¹, 961 cm⁻¹, 0.85, (-)618 cm⁻¹ and 78.43 KJmol⁻¹ respectively. This favours an octahedral geometry for this complex. The Ni(II)-complex gives two bands at 18610 and 27320 cm⁻¹, these are tentatively assigned to ¹A₁g→¹B₂g (ν₂) and ¹A₁g→¹B₁g (ν₃) transitions. This in association with diamagnetic nature of the complex, suggest the geometry to be square planar. The Cu(II)-complex gives two bands at 12480 and 19265 cm⁻¹ tentatively assignable to ²B₁g→²B₂g and ²B₁g→²Eg transitions. This is in favour of square planar geometry 6,8,16-19,22-23,33.

4.1.2. COMPLEXES OF COBALT(II), NICKEL(II) AND COPPER(II) WITH FURFURYLIDENE-4-AMINOACETANILIDE :

The analytical data of the complexes indicate that the metal to Schiff base ligand stoichiometry is 1:1. The molar conductance in methanol of the complexes
(10^{-3}M) of Co(II), Ni(II) and Cu(II) are 140, 135 and 150 Ohm^{-1}cm^{-2}mol^{-1} respectively. This suggest the unibivalent electrolytic nature of all the complexes. The magnetic moment of Co(II) is 4.54 B. M., Ni(II) is diamagnetic and Cu(II) is 1.91B.M. A sharp band at 1590 cm^{-1} in the IR spectrum of the ligand is owing to >C=N group. This band shifts downward by 15-20 cm^{-1} in complexes, indicating coordination through azomethine nitrogen. A medium intensity band at 1125 cm^{-1} in ligand has been assigned to ν_C-O-C of furan ring. On coordination of ring oxygen with the metal ion, the band position of ν_C-O-C shifts to higher frequency (30-40 cm^{-1}) side. Carbonyl frequency remains unaltered in the complexes ruling out the possibility of coordination of carbonyl group. The spectra of complexes exhibited new bands around 3440±10 cm^{-1} and 760±10 cm^{-1}(rocking), assignable to coordinated water molecules. The new bands at 543±10 cm^{-1} and 470±10 cm^{-1} in the complexes are due to ν_M-O and ν_M-N respectively.

The electronic spectrum of Co(II)-complex shows one band at 16200 cm^{-1} (ν_3) which has been assigned to ^4A_2→^4T_1(P) transition. On the basis of magnetic and electronic spectral data, the tetrahedral geometry has been suggested for this complex. Nickel(II)-complex exhibits three bands at 15240, 18210 and 21120 cm^{-1}; these are tentatively assigned to ^1A_1g→^1Eg (ν_1), ^1A_1g→^1B_2g (ν_2) and ^1A_1g→^1B_1g (ν_3) transitions respectively. It is a diamagnetic complex, therefore square planar geometry has been suggested. Copper(II)-complex gives bands at 14040 and 18450 cm^{-1}. These may tentatively assigned to ^2B_1g, ^2B_2g and ^2B_2g→^2Eg transitions. This favours the square planar stereoarrangements.
4.1.3. COMPLEXES OF COBAL'T(II), NICKEL(II) AND COPPER(II) WITH 4-CHLOROBENZYLIDENE-THIOACETAMIDE:

The analytical data of the complexes suggest that the complexes have metal to ligand stoichiometry in 1:2. The molar conductance value (in methanol) of the complexes (10^{-3}M) falls in the range of 24.0-35.0 Ohm^{-1} cm^{2} mol^{-1} suggesting the non-electrolytic nature for all the three complexes^{1-5}. The observed magnetic moment for the complexes of Co(II) is 5.04 B.M; Ni(II) is 3.06 B.M. and Cu(II) is 2.04 B.M^{6,9,34} Table-3.

The IR band due to >C=N (azomethine) appears at 1630 cm^{-1} in the free ligand. This shifts to the lower side i.e. 1610±10 cm^{-1}, due to the reduction in electron density as a result of coordination through azomethine nitrogen^{11-15,24}. A band due to the ν_{C=S} group in free ligand appears at 1520 cm^{-1}. On complexation this shifts towards lower frequency side by 20-30 cm^{-1} with reduced intensity. This suggest the involvement of S-atom in complexation^{13,35,44-45}. The new band at 470±10 cm^{-1} in the complex is due to in the ν_{M-N}^{6,13,32,34,46-48}.

The electronic spectrum of Co(II)-complex shows two bands at 17800 and 19680 cm^{-1}, which are assignable to ^{4}T_{1g}(F)-^{4}A_{2g}(F) (ν_{2}) and ^{4}T_{1g}(F)-^{4}T_{1g}(P) (ν_{3}) respectively. The various ligand field parameters, 10 Dq, B, β, λ and LFSE have been calculated and the values are as : 9468 cm^{-1}, 833 cm^{-1}, 0.74, (-)699 cm^{-1} and 90.33 KJmol^{-1} respectively. This favours the geometry to be octahedral. The three bands at 11140, 16940 and 25430 cm^{-1} in the spectrum of Ni(II)-complex have been assigned to ^{3}A_{2g}(F)-^{3}T_{2g}(F) (ν_{1}), ^{3}A_{2g}(F)-^{3}T_{1g}(F) (ν_{2}) and ^{3}A_{2g}(F)-^{3}T_{1g}(P) (ν_{3})
respectively. The various ligand field parameters viz. 10Dq, B, β, \(\nu_2/\nu_1\), \(\lambda\) and LFSE have been calculated and their values are as: 11140 cm\(^{-1}\), 725 cm\(^{-1}\), 0.67, 1.61, (-) 213 cm\(^{-1}\) and 150.26 KJ mol\(^{-1}\) respectively. These findings favour the complex geometry to be octahedral. The Cu(II)-complex gives a broad band expanded between 12600-16310 cm\(^{-1}\). The nature of the band corresponds to transition \(^2\)Eg-\(^2\)T\(_{2g}\). The value of ligand field parameters 10 Dq, \(\lambda\) and LFSE comes to be 13836 cm\(^{-1}\), (-)1239 cm\(^{-1}\) and 99.00 KJmol\(^{-1}\), favouring an octahedral geometry for this complex\(^6\)\(^{10}\)\(^{34}\)\(^{48}\)\(^{87}\)\(^{89}\).

4.1.4 COMPLEXES OF COBALT(II), NICKEL(II) AND COPPER(II)

WITH 4-CHLOROBENZYLIDENE-2-AMINO-4-CHLOROPHENOL

The analytical data of the complexes show that the metal to Schiff base ligand stoichiometry is 1:2. The molar conductance in methanol of the complexes (10\(^{-3}\)M) of Co(II), Ni(II) and Cu(II) are 32.2, 27.1 and 38.3 Ohm\(^{-1}\)cm\(^2\)mol\(^{-1}\) respectively, suggesting the non-electrolytic nature for all the three complexes\(^1\)\(^\text{-}^5\). The observed magnetic moment for the complexes of Co(II), Ni(II) and Cu(II) are 4.10, diamagnetic and 1.70 B.M. respectively\(^6\)\(^\text{-}^10\) Table-4.

The CAP ligand band at 1620 cm\(^{-1}\) due to \(\nu_{\text{C=N}}\) (azomethine) group which suffers a down shift (1600\(\pm\)10 cm\(^{-1}\)) in complexes. This negative shift in the band position of \(\nu_{\text{C=N}}\) indicates the participation of azomethine nitrogen on coordination\(^1\)\(^\text{-}^15\)\(^,\)\(^24\). The ligand spectrum shows bands at 3350 cm\(^{-1}\) and 1380 cm\(^{-1}\) due to the stretching vibration and phenolic-OH deformation. These are absent in the spectra of the complexes. An intense ligand band at 1270 cm\(^{-1}\) due to the phenolic C-O
vibration shifts to higher frequency 1280±10 cm⁻¹ in the complexes. These suggest the deprotonation of the phenolic OH group after its chelation with the metal ion 35-42. The new bands at 560±10 cm⁻¹ and 435±10 cm⁻¹ in the complexes are due to νM-O and νM-N respectively 11,13,21,29-30,32,43.

The electronic spectrum of Co(II)-complex shows one band at 15900 cm⁻¹ (ν₃), assignable to ⁴A₂ → ⁴T₁ (P) transition. On the basis of magnetic moment and electronic spectral data, the tetrahedral geometry has been suggested for this complex 31. The Ni(II)-complex exhibits two bands at 13122 cm⁻¹ (ν₁) and 18682 cm⁻¹ (ν₂); these are tentatively assigned to ¹A₁g-¹Eg and ¹A₁g-¹B₂g transitions respectively. These transitions and the diamagnetic nature of the Ni(II)-complex suggest the geometry to be square planar. Two absorption bands at 12210 cm⁻¹ and 18340 cm⁻¹ in the Cu(II)-complex are assignable to ²B₁g-²B₂g and ²B₁g-²Eg transitions. This favours the square planar geometry 5-8,10-11,34.

4.1.5 COMPLEXES OF COBALT(II), NICKEL(II) AND COPPER(II) WITH 3-NITROBENZYLIDENE-2-AMINOTHIAZOLE:

The analytical data indicate that the metal to ligand stoichiometry is 1:2. The values of molar conductance in methanol of the complexes (10⁻³M) falls in the range 24.0-41.0 Ohm⁻¹cm²mol⁻¹. This suggest the non-electrolytic nature of the complexes 5-8. The magnetic moment values are 5.04, 3.19 and 1.92 B.M. respectively for Co(II), Ni(II) and Cu(II) complexes 8,9,34 Table-5.

The free ligand exhibits a band due to >C=N(azomethine group) at 1610cm⁻¹ which on complexation suffers a negative shift by about 25-30 cm⁻¹, suggesting
the coordination through nitrogen atom of azomethine group\textsuperscript{13,51-52}. IR spectrum of
the ligand exhibited a sharp band at 830 cm\textsuperscript{-1} due to C-S-C group. Its position in the
complexes has been observed at 810±5 cm\textsuperscript{-1} indicating the involvement of ring
sulphur atom in coordination\textsuperscript{53-55}. An intense band at 1570 cm\textsuperscript{-1} due to C=N cyclic
does not alter in the spectra of complexes. This rule out the participation of (C=N cyclic) group in coordination\textsuperscript{56-57}. A hump at around 3448±10 cm\textsuperscript{-1} is due to
associated lattice water in complexes. A new band at 478±10 cm\textsuperscript{-1} has been
assigned to ν\textsubscript{M-N} vibration in the complexes\textsuperscript{11,13,21,58-59}.

The electronic spectrum of Co(II)-complex shows two bands at 14500 and
19435 cm\textsuperscript{-1} which have tentatively been assigned to \textsuperscript{4}T\textsubscript{1g}(F)-\textsuperscript{4}A\textsubscript{2g}(F) (ν\textsubscript{2}) and
\textsuperscript{4}T\textsubscript{1g}(F)-\textsuperscript{4}T\textsubscript{2g}(P) (ν\textsubscript{3}) respectively. The various ligand field parameters, 10Dq, B, β, λ
and LFSE have been calculated and values are as : 7772 cm\textsuperscript{-1}, 917 cm\textsuperscript{-1}, 0.81, (-)
574 cm\textsuperscript{-1} and 74.2 KJmol\textsuperscript{-1}. These findings are in favour of an octahedral geometry
for the Co(II)-complex. Nickel(II)-complex exhibits three bands at 11340,19364 and
23135 cm\textsuperscript{-1} corresponding to transitions \textsuperscript{3}A\textsubscript{2g}(F)-\textsuperscript{3}T\textsubscript{2g}(F) (ν\textsubscript{1}), \textsuperscript{3}A\textsubscript{2g}(F)-\textsuperscript{3}T\textsubscript{1g}(F) (ν\textsubscript{2})
and \textsuperscript{3}A\textsubscript{2g}(F)-\textsuperscript{3}T\textsubscript{1g}(P) (ν\textsubscript{3}), respectively. The electronic spectra and magnetic moment
data suggest the octahedral geometry for this complex. The values of various ligand
field parameters, 10Dq, B, β, ν\textsubscript{2}/ν\textsubscript{1}, λ and LFSE are as : 11340 cm\textsuperscript{-1}, 565 cm\textsuperscript{-1},
0.52, 1.70, (-361 cm\textsuperscript{-1} and 162.3 KJmol\textsuperscript{-1} respectively. This also support the above
view. For the Cu(II)-complex a single broad band at 13300 cm\textsuperscript{-1} has been observed;
this attributes to \textsuperscript{2}E\textsubscript{g}-\textsuperscript{2}T\textsubscript{2g} transition. The broadness of the band infers the distorted
octahedral geometry of the complex. The various ligand field parameters viz., 10Dq,
λ and LFSE have been calculated and values are : 13300 cm\(^{-1}\), (-)730 cm\(^{-1}\) and 95.16 KJmol\(^{-1}\) respectively. Ligand field parameters and magnetic moment data substantiate the same view\(^6\)-\(^{10,34,87-89}\).

4.1.6 COMPLEXES OF COBALT (II), NICKEL (II) AND COPPER (II) WITH 3-NITROBENZYLIDENE-2-AMINO-4-CHLOROPHENOL

The analytical data of the complexes show that the complexes have metal to Schiff base (ligand) stoichiometry in 1:2. The molar conductance in methanol of the complexes (10\(^{-3}\)M) falls in the range 26.0-39.0 Ohm\(^{-1}\)cm\(^2\)mol\(^{-1}\). This suggest the non-electrolytic nature of the complexes\(^1\)-\(^5\). The magnetic moment values are 5.10, 3.10 and 1.87 B.M., respectively for Co(II), Ni(II) and Cu(II) complexes\(^9\)-\(^9,34\) Table-6.

The IR spectrum of the ligand showed band at 1623 cm\(^{-1}\). The band has shifted to 1590±10 cm\(^{-1}\) in the spectra of complexes. This indicates the participation of azomethine group in complexation\(^13\)-\(^15\). The IR spectrum of the ligand exhibited a broad band around 3413 cm\(^{-1}\), which may be assigned to the stretching vibration of the phenolic-OH group. A sharp band at 1390 cm\(^{-1}\) appears in ligand due to phenolic-OH deformation. These bands are disappeared in the spectra of complexes. An intense band at 1278 cm\(^{-1}\) in the ligand due to the phenolic C-O vibration shifts higher 1290±5 cm\(^{-1}\) in the complexes\(^41\)-\(^42,60\). The higher shift of C-O stretching vibration and the disappearance of –OH band suggested the deprotonation of the phenolic–OH after its chelation. A broad band around 3380±10 cm\(^{-1}\) in the spectra of complexes is assignable to ν\(_{\text{stret}}\) of water. Another band of medium intensity at 780±10 cm\(^{-1}\) (ν-OH rocking), suggests the presence of
coordinated water in the Co(II) and Ni(II) complexes. This band is absent in the spectra of Cu(II)-complex suggest the absence of coordinated water. The \( \nu_{\text{M-O}} \) and \( \nu_{\text{M-N}} \) vibrations are verified to exist by the appearance of new bands in the spectra of complexes at 478±10 cm\(^{-1}\) and 428±10 cm\(^{-1}\) respectively\(^{32,46,48,61-64}\).

The electronic spectrum of Co(II)-complex exhibits two bands at 15200 and 20412 cm\(^{-1}\) assignable to \( ^4T_{1g}(F)-^4A_{2g}(F) \) (\( \nu_2 \)) and \( ^4T_{1g}(F)-^4T_{1g}(P) \) (\( \nu_3 \)) transitions, respectively. The value of ligand field parameters, 10 Dq, B, \( \beta \), \( \lambda \) and LFSE are 8148 cm\(^{-1}\), 964 cm\(^{-1}\), 0.86, (-)634 cm\(^{-1}\) and 77.73 KJmol\(^{-1}\) respectively. These findings are in favour of an octahedral geometry for the Co(II)-complex. In Ni(II)-complex, the absorption bands at 11128, 17224 and 23610 cm\(^{-1}\) have tentatively been assigned to \( ^3A_{2g}(F)-^3T_{2g} \) (\( \nu_1 \)), \( ^3A_{2g}(F)-^3T_{1g}(F) \) (\( \nu_2 \)) and \( ^3A_{2g}(F)-^3T_{1g}(P) \) (\( \nu_3 \)), respectively. The electronic spectra and magnetic moment data suggest the octahedral geometry for this complex. The values of various ligand field parameters, 10 Dq B, \( \beta \), \( \nu_2/\nu_1 \), \( \lambda \) and LFSE are as : 11128 cm\(^{-1}\), 497 cm\(^{-1}\), 0.46, 1.54, (-)265 cm\(^{-1}\) and 159.30 KJmol\(^{-1}\) respectively, also support the same view. The Cu(II)-complex gives bands at 12110 and 18140 cm\(^{-1}\), attributable to \( ^2B_{1g}-^2B_{2g} \) and \( ^2B_{1g}-^2E_g \) transitions. This suggests the geometry to be square planar\(^{6,8,11,16,19,22,34,49}\).
STRUCTURE OF THE METAL COMPLEXES

(I) FTA-Metal Complex

\[ [M = \text{Co(II)}] \]

(II)

\[ [M = \text{Ni(II) / Cu(II)}] \]
(II) FAA-Metal Complex

\[
\begin{align*}
\text{[M = Co(II) / Ni(II) / Cu(II)]}
\end{align*}
\]

(III) CTA-Metal Complex

\[
\begin{align*}
\text{[M = Co(II) / Ni(II) / Cu(II)]}
\end{align*}
\]
(IV) CAP-Metal Complex

\[ M = \text{Co(II)} / \text{Ni(II)} / \text{Cu(II)} \]

(V) NAT-Metal Complex

\[ M = \text{Co(II)} / \text{Ni(II)} / \text{Cu(II)} \]
(VI) NAP-Metal Complex

([M = Co(II) / Ni(II)])

(II)

([M = Cu(II)])
4.2 ESR STUDIES
4.2 ELECTRON SPIN RESONANCE SPECTROSCOPY\textsuperscript{6,8,34,66-86}:

The copper (II) ion, with a d\textsuperscript{9} configuration, has an effective spin of S = 1/2, the associated spin angular momentum Ms = ± 1/2 leads to a doubly degenerate spin state in the absence of a magnetic field. In a magnetic field this degeneracy is removed and the energy difference between these two states is given by the equation: E=\hbar\nu= g\beta H, where \hbar is planks constant, \nu is the frequency g is the lande splitting factor (equal to 2.002 for the free electron), \beta is the electronic Bohr magneton and H is the magnetic field. For normal magnetic field, the resonance frequency in the X-band microwave region is 10\textsuperscript{4} MHz and hence the absorption is performed using microwave radiation\textsuperscript{77-78}.

For the free copper(II), their is also an interaction with the magnetic field due to the orbital angular momentum L of the electron and the total interaction becomes E=(2.00235+L) H. The orbital degeneracy is removed by the crystal field and the orbital angular momentum is said to be quenched for the ground state of copper(II) complexes.\textsuperscript{67-68}

Although the E. S. R. spectra of transition metal species can be very difficult to interpret. They may be very important, first simply as an aid to identification, particularly using hyperfine splitting pattern, and secondly as a means of studying the electron distortion values of g\textsuperscript{II} and g\textsuperscript{I} can show which 'd' orbitals are occupied and which one is not. Thus the g values indicate the direction in which John Teller distortion has occurred. The hyperfine coupling constants can be used to determine the spin densities on nuclei, and to distinguish the components in (s) orbital (isotropic) from those in 'p' and 'd' orbital (anisotropic). In axial copper(II) ion
environment, the 'g' factors, is no longer isotropic. In axial systems the 'g' factors are different depending on whether a $dx^2.y^2$ or a $dz^2$ ground state is present, $g^\parallel > g > 2.0$ and $g > g^\perp > 2.0$ respectively. Nuclear hyperfine splitting $(2I+1)$ for copper where $I = 3/2$ makes it splitted into four lines, separated by the nuclear hyperfine splitting constant $A^{8.79}$. Commonly the X-band frequency is kept at 9500 MHz or 9.5 GHz with field strength of about 3000 - 6000 gauss; while working on Q-band, the frequency is raised to 35 GHz with field strength of about 12500 gauss. Water, alcohol's and other high dielectric constant solvents are not the solvent of choice for EPR because they strongly absorb microwave power. They can be used when the sample has a strong resonance and is contained in a specially designed cell. EPR measurements on gases, solution, powder, single crystals and frozen solution, (or lower temperature) can be carried out. The best frozen solution results are obtained when the solvent freezes to form a glass$^{6,88,73,79}$. The ESR spectra and related parameters of the five Cu(II) Schiff base complexes viz:

(Furfurylidene-thioacetamide) - copper(II) complex,

(4-Chlorobenzylidene-2-amino-4-chlorophenol) - copper(II) complex,

(4-Chlorobenzylidene-thioacetamide) - copper(II) complex

(3-Nitrobenzylidene-2-aminothiazole) - copper(II) complex

(3-Nitrobenzylidene-2-amino-4-chlorophenol) - copper(II) complex

ESR parameters for these complexes are presented in Table - I. ESR parameters suggest that all the compounds, which are having the $g^\parallel$ values less than 2.3 indicate the prevalence of covalent character in the metal ligand bond. The axial symmetry parameter $G$ has its value sufficiently less than 4 i.e. < 2 in all the complexes; this suggest the medium or strong field nature of the used ligands$^{6,8,34}$. 
The measure of the difference between $g^\parallel$ and $g^\perp$ has been taken as an anisotropy parameter. All the five complexes have got some value for the same. However, the compound $C_3$ exhibits the maximum value while $C_2$ gives the minimum value of $\Delta g$ i.e. $g^\parallel - g^\perp$. The correlation $g^\parallel > g^\perp$ has theoretically been meant for tetragonal elongated copper(II) complexes with a ground state $dx^2-y^2$. In present studies of copper(II) Schiff base complexes, the same relation appears true for all the five complexes. A slight higher value of $g^\parallel$ than $g^\perp$ suggest $dx^2-y^2$ to be the ground state rather than a $dz^2$ which further is a condition for square planar Cu(II) complexes or tetragonally elongated Cu(II) octahedral complexes. ESR spectra of complex give lorentzian type of peaks.
### TABLE – 1. ELECTRON SPIN RESONANCE PARAMETERS OF THE COPPER(II) COMPLEXES:

<table>
<thead>
<tr>
<th>Comp. No.</th>
<th>Metal Complexes</th>
<th>$g^{\parallel}$</th>
<th>$g^{\perp}$</th>
<th>$g_{av}$</th>
<th>G</th>
<th>Antisotropy $g^{\parallel}-g^{\perp} = \Delta g$</th>
</tr>
</thead>
<tbody>
<tr>
<td>C₁</td>
<td>(FTA)-Cu(II) Complex</td>
<td>2.2367</td>
<td>2.1805</td>
<td>2.1992</td>
<td>1.3113</td>
<td>0.0562</td>
</tr>
<tr>
<td>C₂</td>
<td>(CTA)-Cu(II) Complex</td>
<td>2.2329</td>
<td>2.1768</td>
<td>2.1955</td>
<td>1.3167</td>
<td>0.0561</td>
</tr>
<tr>
<td>C₃</td>
<td>(CAP)-Cu(II) Complex</td>
<td>2.1989</td>
<td>2.1064</td>
<td>2.1372</td>
<td>1.8694</td>
<td>0.0925</td>
</tr>
<tr>
<td>C₄</td>
<td>(NAT)-Cu(II) Complex</td>
<td>2.2214</td>
<td>2.1552</td>
<td>2.1773</td>
<td>1.4265</td>
<td>0.0662</td>
</tr>
<tr>
<td>C₅</td>
<td>(NAP)-Cu(II) Complex</td>
<td>2.2139</td>
<td>2.1410</td>
<td>2.1653</td>
<td>1.5170</td>
<td>0.0729</td>
</tr>
</tbody>
</table>

(FTA) = Furfurylidene-thioacetamide

(CTA) = 4-Chlorobenzylidene-thioacetamide

(CAP) = 4-Chlorobenzylidene-2-amino-4-chlorophenol

(NAT) = 3-Nitrobenzylidene-2-aminothiazole.

(NAP) = 3-Nitrobenzylidene-2-amino-4-chlorophenol
REFERENCES:


