CHAPTER-2

Literature Review
2.1 Survey of relevant literature

In the present investigation, the literature of some transition metal complexes with antibiotics has been surveyed.

In periodic table, the elements are classified into four blocks; namely s, p, d and f after the name of the atomic orbital which receives the last elections. The d-block elements are called transition elements and lying between s and p blocks starting from fourth period and onwards. Transition metals occupy the sub groups IB, IIB, IIIB, IVB, VB, VIB, VIIB and VIII form four transition series. The first series (3d) starts from $^{21}$Sc to $^{30}$Zn and the second (4d) from $^{39}$Y to $^{48}$Cd. The third series (5d) begins with $^{57}$La to $^{71}$Lu followed by $^{72}$Hf to $^{80}$Hg and the fourth series starts from $^{89}$Ac to $^{103}$Lw followed by $^{104}$Ku, $^{105}$Ha to the elements of atomic number 112 (to be discovered).

These elements serve as a bridge between the highly electropositive ‘s’ and highly electronegative ‘p’ block elements, therefore, they show the properties that are intermediate between ‘s’ and ‘p’ block elements. These elements show many properties in common, for instance, melting and boiling points, density, metallic character, ionisation potential, reactivity, colour, variable valency, magnetic and catalytic properties and ability to form complexes.

The role of metal ions and their complexes in biochemistry has been related through coordination chemistry, which reviewed extensively $^1$-$^4$.

The solution studies of binary and ternary complexes recently become an interesting area of researches as these includes some important areas of chemistry$^5$-$^8$ like medicine, industry, environment and analytical field.
A brief account of literature surveyed on some recent publications having relevance to the present investigation has been given in the following paragraph.

Polarographic analysis of streptomycin has been done by Sackett et al\(^9\).

The order of stability of metal complexes has been determined\(^10\).

The antimicrobial activity of tetracyclines have been reported by Finlay\(^11\).

Amperometric determination of Fe(II) and Co(II) binary complexes of oxytetracycline and neomycin have been reported\(^12\)-\(^16\).

The isolation and general properties of tetracycline and terramycin salts and dissociation constants of the acid and base functions of terramycin have also been determined by potentiometric titration\(^17\).

Some literature\(^18\)-\(^22\) is also available related to amperometric and biampereometric analysis of methicillin in aqueous medium.

A. Albert\(^23\) have determined the formation constants of Fe, Cu, Ni, Zn and Mn with terramycin and aureomycin.

Woodward et al\(^24\) have determined the structure of terramycin.

Devries and Kroon\(^25\) have studied a millicoulometer method for the determination of polarographic-n-values.

Some work on streptomycin and terramycin have also been reported in the literature\(^26,27\).

Bothe\(^28\) and coworkers have reported structural elucidation of tetracycline.
A polarographic investigation of the alkaline decomposition of streptomycin has been made by Bricker and vail²⁹.

Spectrophotometric determination of humulone and lupulone in hops have been studied by Alderton and his coworkers³⁰.

The polarographic oxidation potential of ascorbic acid has been studied by Kern³¹ and complexes of penicillin-G with Ag(I), Zn(II) and Pb(II) were studied by Irving and Rossotti³² using Calvin-Bjerrum pH titration technique.

Some metal chelates of streptomycin have been reported by Guarini and coworkers³³.

Doershak and coworkers³⁴ have studied the reversible isomerisation of tetracycline.

The stability constants and the avidity of the tetracycline for metal cations of metals has been studied by Albert and Ress³⁵.

Weiss and others³⁶ investigated the interactions of cupric ions and penicillin-G potassium and found log K to be 4.8. Gans and Higuchi³⁷ reported the solubility and complexing properties of oxytetracycline and tetracycline in aqueous solution. They also reported the tetracycline interaction were greater than those with oxytetracycline.

Menteus Ventura³⁸ has been shown effect of magnesium, manganese and cobalt ions on phyto toxic action of terramycin and aureomycin.

Higuchi and Bottom³⁹ have reported the solubility and complexing properties of oxytetracycline and tetracycline in the solution states by using different techniques.
Co antibiotic complexes\textsuperscript{40} and mixed ligand complexes\textsuperscript{41} of tetracycline have also been reported.

The influence of some mettalline ions on the stability of streptomycin and penicillin have been reported in aqueous solutions by Unterman and Schwarz\textsuperscript{42}.

Some vitamin antibiotic compounds have been prepared by Guttman\textsuperscript{43}. The phytogenic copper complexes of streptomycin antibiotics have studied by Koles\textsuperscript{44}.

Taguchi\textsuperscript{45} has been reported chlortetracycline metal chelate with penicillin-G. The metal complexes of tetracaine hydrochloride and related local anesthetic have also been reported\textsuperscript{46}.

The mediation of divalent metal ions in the binding of tetracycline of macromolecules have been reported\textsuperscript{47}.

Lumb et at\textsuperscript{48} have reported antibiotic complexes, A. 4788 containing streptomycin and having activity against powdery mildew.

Mironeanu and coworker\textsuperscript{49} have reported the influence of some antibiotic on the chromatographic or electrochromatographic migration of cations.

The influence of some heavy metal ions micronutrients and macronutrients on the phytotoxicity of streptomycin have also been reported\textsuperscript{50}.

Some addition compounds of cationic antibiotics with special consideration of neomycin and bacitracin have also been studied\textsuperscript{51}.

Garrett\textsuperscript{52} has reported variation of $p$Ka values of tetracyclines in dimethyl formamide water solvents. The in-vitro binding of tetracycline to calcium has also been studied\textsuperscript{53}. 
Webster and coworkers\textsuperscript{54} have determined the crystal structure of aureomycin (chlortetracycline) hydrochloride configuration, bond distance and conformation.

The work on polarographic determination of chloramphenical have been done\textsuperscript{55}. The complexes of streptomycin with metal such as Ca, Mg and Zn has been reported by Zahn\textsuperscript{56}.

Mexwell et al\textsuperscript{57} reported the stabilities of some alkaline earth chelates of tetracyclines.

The polarographic behaviour of oxytetracyclines have been reported by Hetman\textsuperscript{58}.

The role of calcium ions in the toxic action of neomycin has been reported by Have et al\textsuperscript{59}.

Steinman\textsuperscript{60} has reported correlation of chemical structure of penicillins and biological activity.

Higuchi and Pisano\textsuperscript{61} have reported influence of halogen, nitro and other substituents and correlation of binding tendencies towards prednisolone, theophylline and phenacetin.

Singh and Dutta\textsuperscript{62} have studied the polarography of copper-8-aminoquinoline complex.

Remmers et al\textsuperscript{63} reported complexes of tetracycline antibiotic.

R.A. Condrade\textsuperscript{64} and J. Natingawa\textsuperscript{65} have studied the spectra of Fe(II), Co(II), Ni(II), Zn(II) and Cu(II) complexes of streptomycin sulphate.

Ziemske et al\textsuperscript{66} reported the experimental studies on the autotoxicity of certain antibiotics.
Cieleszky and Sebessy\textsuperscript{67} have studied the polarographic behaviour of oxytetracycline and their acid degradation products.

Narasimhachari and Rao\textsuperscript{68} have reported the physicochemical studies on the stability of penicillin salts and newer penicillins.

Grabowska et al\textsuperscript{69} have studied the hydrolysis of aspirin in the presence of accompanying substances in solid mixtures.

The stability constants of tetracycline complexes have been reported by Benet and Goyan\textsuperscript{70}.

Martin et al\textsuperscript{71} reported the biophysical study of the mode of action of the tetracycline antibiotics.

Roth and Kargerova\textsuperscript{72} have been reported the action of epinephrectomy on the toxicity of neomycin.

Some transition metal complexes of 8-aminoquinoline were observed by Fanning and Taylor\textsuperscript{73}.

Strelnikova et al\textsuperscript{74} have reported complex formation of some anilides including phenacetin and benzanilides.

Crosse and coworkers\textsuperscript{75} have reported antibacterial action of streptomycin copper- chelate against phytophthora infectants on tomato.

The relative stabilities of different penicillins at pH=4-5 using spectrophotometric method have been studied by Joshi et al\textsuperscript{76}.

The effect of Zn-bacitracin complex in poultry nutrition have also been reported by Brown et al\textsuperscript{77}.

Binding in metal complexes of tetracyclines and its derivatives were also reported in the literature\textsuperscript{78}.

Kalina and coworkers\textsuperscript{79,80} have reported the preparation of complex compounds of bacitracin.
The biological activity of the gentamycin complex have been reported by Weinstein\textsuperscript{81}.

Kassem et al\textsuperscript{82} have reported the stability of tetracycline hydrochloride and effect of aliphatic and aromatic hydroxy acids in aqueous solution.

Metal binding techniques for various antibiotics were seen by Doluisio et al\textsuperscript{83}.

Co and Ni complexes of tetracycline have been prepared by Brown et al\textsuperscript{84}.

Manojlovic\textsuperscript{85} has reported copper(II) acetyl salicylate.

The antibacterial effect of neomycin quaternary substances on pseudomonas auregnosa was seen by Toborsky\textsuperscript{86}.

The interaction of divalent and trivalent cations with antibiotics U-20, 661, 9DNA binding agent have been investigated by Reusser\textsuperscript{87}.

The stability of oxacilline and phenoxyethyl penicillin in aqueous solutions at various pH values and temperature has been determined by Kondrateva and coworker\textsuperscript{88}.

Biswaas and Mukherjee\textsuperscript{89} have shown the action of some antibiotics on cholera vibrious.

Gour and Palrecha\textsuperscript{90} have studied the polarographic behaviour of aspirin complexes with cadmium, lead and copper.

The effect of zinc bacitracin in feedings broilers have been investigated by Tortuero and Faixa\textsuperscript{91}.

Grech\textsuperscript{92} have studied the thermodynamics of metal complex formation.
The 1:1 complexes of Zn with bacitracin have been reported by Burachik et al.\cite{93} by using spectrophotometric technique.

Tereshin\cite{94} have reported oscillopolarographic behaviour of some antibiotics and Pilet et al.\cite{95} determined the heat stability of some antibiotics.

Woodson and Smith\cite{96} have studied the polarography of aspirin.

James and R.H. Leach\cite{97} have reported the chloramphenical complex with borax in aqueous solutions.

The stability of aqueous solutions of streptomycin have been investigated by Kondrateva and coworkers\cite{98}.

The formation of bacitracin-Zn(II) complexes have been reported by Neal and Donald\cite{99} by using spectrophotometric titrations, ORD and NMR studies.

Vartak and Menon\cite{100} have studied the stability constants of some substituted salicylic acid and their complexes.

Mixed ligand anionic complexes of Mn(II) have been studied by Das and coworker\cite{101}.

An improved technique for determination of stability constants using polarographic method was given by Fillipovic et al.\cite{102}.

The stability constants from polarographic data of irreversible systems have been reported by Sundareson\cite{103}.

The complexes of Mn(II), Cu(II) and Co(II) with some antibiotics have been determined amperometrically by Suit and Pelizz\cite{104}.

The polarographic study of complexes of Pb(II) and Zn(II) in sodium formate and formic acid system has been done by Yadav and coworkers\cite{105}. 
Manojlovic\textsuperscript{106} have studied the crystal structure of copper (II) aspirinate.

Chandra and Kumar\textsuperscript{107} have reported the polarographic studies of Zn(II) and Mn(II) in ethanol-water, methanol-water and acetone-water mixtures.

Siegerman\textsuperscript{108} were reported the differential pulse polarography of antibiotics.

Sharma and Nigam\textsuperscript{109} have determined the kinetic parameters of totally irreversible electroreduction of some Zn(II) complexes of thiomalic acid, thiosalicylic acid and thiovanol.

Haavik\textsuperscript{110} have studied the effect of bacitracin and Mn(II) upon producer strain bacillus licheni formis.

Linkov and Zhuloskya\textsuperscript{111} have studied the oxytetracycline solubility in aqueous media.

The mixed ligand complexes of Zn(II) with ammonia and pyridine have been reported by polarographically by Sundaresan and Sundaram\textsuperscript{112}.

Agrawal and Vijayawargiya\textsuperscript{113} have reported the Ni and Co complexes with streptomycin using conductometric method. They also determined the acid dissociation constants of streptomycin perchlorate and stability constants of its complexes with copper(II) by potentiometric pH titration\textsuperscript{114}.

Bal and Khan\textsuperscript{115} have reported interference of oral iron with gastrointestinal absorption of tetracyclines.

Wasylishen and Graham\textsuperscript{116} have reported the nmr of the metal binding sites in bacitracin.
The binding of penicillin antibiotics to a human liver protein have been studied by Kornguth et al\textsuperscript{17}.

Greech\textsuperscript{18} reported the estimation of the degree of binding of tetracycline in human plasma.

Jackson and Fazakerley\textsuperscript{19} reported the kinetic study of penicillin with Ni.

The toxicity of some antibiotics have been reported by Patel and coworkers\textsuperscript{20}.

The effect of Triton X-100 on the kinetics of irreversible electrode processes and polarographic behaviour of Ni(II), Co(II), Zn(II) and Mn(II) have been reported by Sharma, Jha and Singh\textsuperscript{21}.

Patel et al\textsuperscript{22} have determined proton ligand stability constants using polarographic method.

Brudelt\textsuperscript{23} has reported a new look at structure and bonding in transition metal complexes.

Pb, Ag, and Zn complexes with penicillin-V were reported by Sharma et al\textsuperscript{24}.

The thermodynamic studies of Be(II), Mg(II), and Cu(II) with penicillin complexes have been done by Chakrawarti, Tiwari and Sharma\textsuperscript{25}.

The evaluation of variable periods of antibiotic therapy in treatment of cholera have been determined by Ray and coworkers\textsuperscript{26}.

Lee et al\textsuperscript{27} have reported the complexation of aspirin by caffeine Fe, Co, Ni and Cu complexes of penicillins were reported in literature by Chakrawarti and coworkers\textsuperscript{28}.  

Chakrawarti and Sharma\textsuperscript{129} have also studied the penicillin complexes with Be(II), Mg(II), and Cu(II).

The clinical observation with oral chloramphenical streptomycin in infactive diarrhoea have been done by Ghosh and Acharya\textsuperscript{130}.

The conductometric and spectrophotometric study of Co(II), Ni(II) and Cu(II) metals with dopamine and isoprenaline, and the stability constants and thermodynamic parameters at 0°, 25° and 35° and a fixed ionic strength of 0.1 M with KCl have been determined by Vijayawargiya and coworkers\textsuperscript{131}.

Mishra and Bera\textsuperscript{132} have been reported neurootological profile of streptomycin toxicity.

The Ag(I) Zn(II) and Pb(II) complexes of penicillins have been studied by Tiwari et al\textsuperscript{133}.

Nunezvergara and Luis\textsuperscript{134} have reported electrochemical study of some penicillin antibiotics by rapid A.C. polarography.

Anne and Lien\textsuperscript{135} have reported antibacterial activity of acetyl salicylic acid.

The microscopic dissociation constants of some tetracyclines have been investigated by Gupta et al\textsuperscript{136}.

Tiwari and coworkers\textsuperscript{137} were reported thermodynamic parameters of [Mn(II)-penicillin] complexes. Polarographic study of metal ligand complexes has been reported by Gupta and Bhat\textsuperscript{138}.

Wlodzimier\textsuperscript{139} have reported alternating current polarographic detection for reverse phase-ion pair high performance liquid chromatography of some benzoic acids.
Das and coworkers\textsuperscript{140} have reported the determination of stability constants of copper (II) complexes with ethylene diamine and acetyl salicylates (aspirinate) by electrochemical method.

Ortiz, Borras and Jimenez\textsuperscript{141} have reported chemical study of the copper (II) acetyl salicylic acid complex.

The polarographic study of composition and stability of complexes of some tetracyclines with UO\textsubscript{2}(II) in aqueous medium have been done by Sachan et al\textsuperscript{142}.

Some solid compounds of Cu and Zn with tetracycline hydrochloride and doxycycline - hydrochloride have been synthesized by Katakwar and Kacchawaha\textsuperscript{143}.

Shankland et al\textsuperscript{144} have reported influence of sifnovial fluid (SF) and a protein- containing medium on the polarographic detection of aspirin.

Martinez et al\textsuperscript{145} have reported spectrophotometric and potentiometric study of β-lactum penicillins and Cu(II) chelates in solution and site of complex formation which was observed as a function of pH.

Saux et al\textsuperscript{146} have reported comparative study of pharmacokinetic profiles of four tetracycline formulation.

Chakrawarti et al\textsuperscript{147} have reported electrochemical study of metal drug system in aqueous solution.

Neilands\textsuperscript{148} reported Cu complexes with cycloserine. The results obtained agreed with those obtained by Neuzill and Breton\textsuperscript{149}.

The electrochemical behaviour of Co(II) complexes of some life saving drugs have been reported by Narr et al\textsuperscript{150}.
Keniston and coworkers\textsuperscript{151} have determined pyridoxal s'-phosphate as an antidotes for cyanide, spermine, gentamycin and dopamine toxicity in vivo rat status.

Some references regarding the paracetamol and indomethacin have also been available in the literature\textsuperscript{152,153}.

Krimpen et al\textsuperscript{154} have reported the complexation behavior of some penicillins, cephalosprins and their derivatives.

Stankor\textsuperscript{155} have reported formation of complexes of oxytetracycline and MoO$_4^{2-}$ ions using pH metric determination.

The antibacterial activity of complexes of ampicilline have been determined by Vairamani et al\textsuperscript{156}.

The formation of charge transfer for complexes of penicillins with iodine have been reported by Salech et al\textsuperscript{157}.

Zhan and coworkers\textsuperscript{158} have determined some salicylates (salicylic acid and aspirin) by alternating current oscilopolarographic titration.

The polarographic method for the determination of manganese in air have been studied by Burenko et al\textsuperscript{159}.

Patel et al\textsuperscript{160} have determined the stability constants of Cr (II), Mn(II), Co(II), Ni(II) and Cu(II) chelates of monobasic tridentate ligands possessing O-N-O moiety.

Shukla et al\textsuperscript{161} have determined tetracyclines in pure form using vanadium reagent.

Mukharjee et al\textsuperscript{162} have reported the ampicillin ligand species in the [Cu(amp)]$^+$ and [Cu(amp)$_2$] complexes.
Nagar and Kumar\textsuperscript{163} have studied physicochemical composition and stability constants of some transition metal complexes.

The polarographic study of Ni(II) and Mn(II) at a dropping mercury electrode using 3-hydroxy pyridine-2-thiols as complexing agent have been done by Sharma et al\textsuperscript{164}.

Petrenko\textsuperscript{165} have reported the mechanism of action of the tetracycline series.

The mixed ligand complex formation of Co, Ni, Cu and Zn with 6-aminopenicillanic acid and some nucleic bases in aqueous solution have been reported by Mukharjee et al\textsuperscript{166}.

Stability constants and kinetic parameters of a reversible system have been reported by Sreenivas and coworkers\textsuperscript{167}.

Desiqueira et al\textsuperscript{168} have reported the metal complexes of anhydrotetracycline I-A spectrometric study of the Cu(II) and Ni(II) complexes.

The mixed ligand complexes of Cu(II) and Co(II) have been reported by Chakrawarti and Patel\textsuperscript{169}.

Warowna et al\textsuperscript{170,171} have reported the electrochemical studies of some quinoline antibiotics, by direct current polarography and differential pulse polarography.

McDonald and coworker\textsuperscript{172} have studied the phosphoinositide hydrolysis by phospholipase C modulated by multivalent cations La (III), Al(III), neomycin, polyamines and melittin.

The polarographic estimation of Cu(II), Pb(II) and Zn(II) in presence of 2-amino-3-hydroxy pyridine as complexing agent have been reported by Singh et al\textsuperscript{173}. 
The binding of purified multiple antibiotic resistance repressor protein (marR) to mar operator sequences have been reported by Martin and coworker\textsuperscript{174}.

Hillen et al\textsuperscript{175} reported the thermodynamic analysis of tetracycline-mediated induction of tetracycline repressor by a quantitative methylation protection assay.

Varshney and coworkers\textsuperscript{176} have studied the mixed ligand complexes of Mn(II) in N-methyl formamide by using polarographic technique.

The tetracycline repressor-tetracycline interaction have been done by Kaszycky et al\textsuperscript{177}.

Leaderer et al\textsuperscript{178} have observed tetracycline analogs affecting binding to Tn 10- encoded tet. repressor trigger the same mechanism of induction.

Mukharjee and Ghosh\textsuperscript{179} have reported the mixed ligand complex formation of Co, Ni, Cu and Zn with ampicillin in the presence of bipyridine and imidazole.

Ravisankar et al\textsuperscript{180} have reported reversed phase HPLC method for the estimation of paracetamol, chlorozoxazine and diclofenac sodium in formulation.

Liao and Hancock\textsuperscript{181} have reported a penicillin-binding protein 3 homolog, PBPZX in pseudomonas aeruginosa gene cloning and growth phase dependent expression.

Liao\textsuperscript{182} have also reported susceptibility to β-lactam antibiotics of pseudomonas aeruginosa overproducing penicillin -binding protein 3.
Lepage et al\textsuperscript{183} have reported multimodular class A penicillin-binding proteins in mycobacterium leprae.

The cloning and characterization of the pon A gene encoding penicillin-binding protein-I from neisseria gonorrhoeae and neisseria meningitidis have been reported by Ropp et al\textsuperscript{184}.

Kupka\textsuperscript{185} reported the IR studies of complexation in penicillin-transition metal ion systems and semi-empirical PM3 calculation on simple model compounds.

The topographical and functional investigation of escherichia coli penicillin-binding protein 1b by alanine stretch scanning matogenesis have been reported by Lefevere et al\textsuperscript{186}.

Argekar and Shah\textsuperscript{187} have reported a fast accurate HPLC method for the simultaneous determination of paracetamol and diclofanac sodium in tablets.

Gangwal and Trivadi\textsuperscript{188} have reported simultaneous analysis of indomethacin and paracetamol in combined dosage form.

Done et al\textsuperscript{189} have reported ligand induced conformational change in penicillin acylase.

Novak et al\textsuperscript{190} have studied the penicillin tolerance genes of streptococcus pneumoniae.

The overall equilibrium constants for the complexes of Co, Fe, Zn and Mn with halidixic acid antibiotic have been determined by Sharma et al\textsuperscript{191} using pH-metric.

The transcriptional analysis of the staphylococcus oureus penicillin binding protein Z gene have been studied by Pinho and coworkers\textsuperscript{192}.
Fiallo et al\textsuperscript{193} have reinvestigated the interaction of Fe(III) with several anthracycline antitumour antibiotics.

The experimental design and multivariate calibration in the development, setup and validation of a differential pulse polarographic and uv spectrophotometric method for the simultaneous plasmatic determination of therapeutic metranidazole pefloxacin have been determined by Gratteri and Cruciani\textsuperscript{194}.

Complex formation between neomycin B and RNA aptamer\textsuperscript{195} dolking of cationic antibiotics to negatively charged pockets in RNA folds\textsuperscript{196,197} have also been determined.

Epperson et al\textsuperscript{198} have reported proton nmr studies for Co(Ill) complexes of the peptide antibiotic bacitracin and analoges insight in to structure activity relationship.

L. Tantuvay and F. Khan\textsuperscript{199} have reported the thermodynamics of [Zn-antibiotics-streptomycin] system by polarographically.

Electrode kinetics of polarographic reduction of Zn(II) with some antibiotics have been reported by Khan et al\textsuperscript{200}.

Laxmi Tantuvay\textsuperscript{201} have also studied the kinetics of electrode reaction for [Zn(II)-antibiotics-ampicillin] system.

Some work on polarographic study of mixed ligand complexes of Zn(II) with some selected antibiotics have done by L. Tantuvay and F. Khan\textsuperscript{202,204}. Some work related to thermodynamics of [Mn(II)-antibiotics-bacitracin] mixed system have also done by L. Tantuvay\textsuperscript{203}.

Above survey of literature revealed that the work on the antibiotics complexes is in progress and no work has so for been done on the complexation of Mn and Zn with neomycin, chlortetracycline,
oxytetracycline, tetracycline, penicillin-V and penicillin-G as primary ligands and phenacetin, aspirin and paracetamol as secondary ligands. Since the binary complexes of Mn and Zn with selected antibiotics viz. neomycin, chlortetracycline, oxytetracycline, tetracycline, penicillin-V and penicillin-G have been reported by Khan et al. \(^{204}\) polarographically, therefore, we have decided to study the ternary complex formation of Mn and Zn with these selected antibiotics as primary ligands and phenacetin, aspirin, paracetamol as secondary ligands polarographically for which no reference has been traced out so far in the literature.

### 2.2 Aim of present study

The above survey of literature showed that no reference could be traced out so far regarding ternary complex formations between Mn and Zn with neomycin, chlortetracycline, oxytetracycline, tetracycline, penicillin-V and penicillin-G as primary ligands and phenacetin, aspirin and paracetamol as secondary ligands polarographically. Hence it is thought worthwhile to undertake the system study of complex formation between these metals and ligands.

The kinetic parameters viz. transfer coefficient (\(\alpha\)), degree of irreversibility (\(\lambda\)) & standard rate constant (\(k\)) and the stability constants (\(\log \beta\)) and thermodynamic parameters such as enthalpy change (\(\Delta H\)), free energy change (\(\Delta G\)) and entropy change (\(\Delta S\)) of these complexes are to be determined. The stability of complexes is affected by the bonding between the metal and ligands, basicity and steric hindrance of ligands, therefore, these aspects have been discussed in detail and finally some conclusions will be drawn.
From this study, the valuable informations about chemical reactions, complex formation, basicity, equilibria, bonding, nature of various groups in the ligands, effect of size, steric hindrance of ligands will be available that would be very much useful in electrochemistry, analytical chemistry, coordination chemistry, inorganic chemistry and technology of nonferrous and rare metals.
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