M. Sc. - II Inorganic Chemistry
Semester – III
CHI-5301: Organometallic Chemistry & Homogeneous catalysis
(48 L+ 12 T) (4 credit)

Section I- Organometallic Chemistry (24 L+ 06 T) (2 credit)

1. Introduction and Recapitulation
   Sigma complexes and π complexes: Synthesis, bonding, properties and applications. (3 L)
2. Metal-Carbon multiple bonded compounds
   Carbene and Carbynes: Synthesis, bonding, properties and applications. (3 L)

3. n^nCnRn: Carbocyclic Polyenes: Synthesis, bonding, properties and applications. Allyls, Pentadienyls, Cyclobutadienes, Cyclopentadienyl, Cycloheptatrienyls, Arenes, Cyclooctatetraenes. (6 L)

4. Fluxional Behavior of organometallic compounds and study of organometallic compound by NMR, IR. (3 L)

5. Phosphine complexes: Synthesis, bonding, properties, and applications. (2 L)

6. Metal-Metal Bonds: Transition metal atom clusters and cages. (2 L)

7. Roll of transition metal organometallics in organic synthesis:
   As electrophiles and nucleophiles, Activating agents and protecting agents (3 L)

8. Applications Organometallic Chemistry in pharmaceutical, medical, agriculture and horticulture. (2 L)

Section II- Homogeneous Catalysis (24 L+ 06 T) (2 credit)

1. Introduction to catalysis: Basic principle, Definition of activity and selectivity in catalysis, Homogeneous vs. Heterogeneous catalysis, Importance of Homogeneous catalysis in synthesis of high value chemicals (4 L)

2. Characteristics of central metal atom and influence of attached ligands on catalytic activity.
   Important properties of ligands: Elementary steps, important reaction types, Catalytic cycle, Catalytic intermediates and their identification. (4 L)

3. Hydrogenation of Olefin: Isomerization, Dimerization, Hydrocyanation and Metathesis reaction, Carbonylation reaction: Monsanto acetic acid process and its industrial importance. (4 L)

4. Hydroformylation reaction in Rhodium complexes, Role of phosphine ligand in regioselective formation of ligand aldehyde. (4 L)

5. Polymerization: Catalytic cycle for alkene Polymerization, Metallocene catalysts-structure and special features, advantages of Metallocene catalysis, Mechanism of polymerization and stereo control by Metallocene catalyst. (4 L)

6. C-C coupling : Cativa process, Heck reaction, Suzuki cross coupling reaction, Negeshi reaction, Sonogashira reaction, Kumada coupling reaction (4 L)

Reference Books:

1. Organotransition Metal Chemistry Anthony F. Hill, Royal Society of Chemistry, Tutorial Chemistry Text, 2002.Chapters1-7.
2. Organometallics: A concise Introduction, Ch. Elshebroicn and A. Salzer, VCH, chapters 12-16
3. Organotransition Metal Chemistry: Applications to Organic Synthesis, S.G. Davies, Permagaon 1982.
4. Inorganic Chemistry 3rd edn. D.F. Shriver and P.W. Atkins, Oxford University Press, 1999, Chapter 16.
5. Organometallic Chemistry –R.C. Mehrotra and A. Singh, 1992, Wiley
6. Principles of Organometallic Chemistry, P. Powell, Chapman & Hall
7. Organometallic Compounds, Morries, Sijlirn, IVY Publication House
8. Organometallics in Organic Synthesis – Swan & Black
9. Organometallic Chemistry - E.J. Elias and Gupta
10. Homogeneous Catalysis - G.W.Parshall

CHI-5302: Inorganic reaction mechanism and photochemistry
(48 L+ 12 T) (4 credit)

Section I- Inorganic reaction mechanism (24 L+ 06 T) (2 credit)

1. Types of Mechanisms: Basic concepts as stability and lability, stability constants; HSAB principle, Chelate effect, Macro cyclic effect; ligand transfer and electron transfer reaction in coordination compounds, intimate and stoichiometric mechanism of ligand substitution (8 L)
2. Substitution in square planar complexes- trans effect, trans series, applications of trans effect (2 L)
3. Substitution in octahedral complexes- SN^1, SN^2, SN^1CB mechanisms, Racemisation in coordination compounds, steric effects on substitution (6 L)
4. Electron transfer reactions- Potential energy diagrams as a conceptual tool, Marcus equation, types of electron transfer reactions and factors affecting on electron transfer reactions. (6 L)
5. Other reaction types- Oxidative addition, reductive elimination, methyl migration and CO insertion reactions (2 L)

Section II--Inorganic photochemistry, reaction types and magnetic properties (24 L+ 06 T) (2 credit)

1. Photochemical reactions- Prompt and Delayed reactions, Quantum yield, Recapitulation of fluorescence and Phosphorescence, Photochemical reactions by Irradiating at d-d and charge transfer bands, Transitions in metal-metal bonded systems, photochemical reactions involving chlorophyll, Kinetics of excited state processes (8 L)

2. Reactions of coordinated ligands
   i) Non-Chelate forming reactions-
   Reactions of donor atoms (Halogenations of coordinated N atoms, alkylation of coordinated S and N atoms, solvolysis of coordinated P atoms), Reactions of non-donor atoms, Nuclear behaviour of ligand, Electrophilic behaviour of the ligand.
   ii) Chelate ring forming reactions- Reactions predominantly involving thermodynamic template effects, reactions predominantly involving kinetic effects
   iii) Chelate modifying reactions (8 L)

3. Magnetic properties:
   i) Magnetic moments based on crystal field ground term, perturbation theory and its applications, anomalous magnetic moments in magnetically dilute and concentrated system in various symmetrical environments of coordination complexes (6 L)
   ii).Mixed valence compounds (2 L)

Reference Books:

1. Inorganic Chemistry- Principles of structure and reactivity, J.E. Huheey, E.A. Keiter and R.L. Keiter 4th Edn. Harper Collins publication New York.
2. Mechanism of Inorganic Reactions in solution- an introduction, D. Benson, McGraw-Hill publication
3. Basic inorganic Chemistry by F. A. cotton and G.Wilkinson, Wiley Eastern limited new Delhi.
4. Inorganic Chemistry by D. F. Shriver and P.W. Atkins
5. Mechanisms of Inorganic reactions by C. F. Basolo and R. G. Pearson Wiley New York.
6. Magnetochemistry by Shamal and Dutta.

CHI-5303: Physical Methods in Inorganic Chemistry
(48 L+ 12 T) (4 credit)

Principles, Instrumentation & Applications of the following techniques,

1. Thermal techniques (TG, DTA, DSC), DMA (dynamic mechanical analysis) Derivative thermo gravimetric and its advantages (14 L)
2. X-Ray Diffraction Powder &Single Crystal (8 L)
3. Cyclic Voltammetry (4 L)
4. Mossbauer spectroscopy (4 L)
5. Electron Spin resonance spectroscopy (10 L)
6. X-ray Photoelectron Spectroscopy (2 L)
7. Microscopy- Electron microscopy, Laser microscopy, X-ray microscopy (6 L)

Reference Books:

1. Structural methods in Inorganic Chemistry – E.A.V. Edsworth, D.W.H. Rankin & S. Cradock, Blackwell Scientific Publication, 1987.
2. Physical Methods for Chemists-R.S. Drago, (2nd edition, Saunders)
3. Instrumental methods of Chemical Analysis – Chatwal & Anand
4. Laboratory Techniques in Electro analytical Chemistry edited by P.T. Kissinger and W.R.Heinman (1984) M. Dekker vinc (USA)
5. Dennis H. Evans, Journal of Chemical Education, vol.60, pp290 (1983).
6. P.T. Kissinger and W.R. Heinmann, Journal of Chemical Education, vol.60, pp702 (1983).
7. J.J. Van Benschoten, Journal of Chemical Education, vol.60, pp772 (1983).

CHI-5304: Bioinorganic and Inorganic medicinal chemistry

(48 L+ 12 T) (4 credit)

Section I- Bioinorganic chemistry (24 L + 06 T) (2 credit)

1. Recapitulation of biological roles of metals and ligand structure, function and biochemistry of enzymes containing
   i) Zinc: Zinc finger, carboxypeptidase, carbonic anhydrase,
   ii) Nickel: Ni in proteins, Nickel transport and enzyme active site assembly, coordination of biological nickel.
   iii) Molybdenum: Cofactors, antagonism between copper and molybdenum hydroxylase
   iv) Copper: Type I, Type II, Type III, Blue copper proteins and non-blue copper proteins
   v) Manganese
   vi) Biochemistry of chromium and vanadium (16 L)
2. Transition metal complexes as chemical nucleases (4 L)
3. Radiopharmaceuticals and MRI contrast agents. (4 L)

Section II: Inorganic medicinal chemistry (24 L + 06 T) (2 credit)

1. Overview
   Introduction, metal ions in disease as chelating agents, metalloproteins as drug targets, matrix metalloproteinases, modulation of cellular responses by metal containing drugs, metal based chemotherapeutic drug, metal complexes as diagnostic agent (6 L)

2. Cis-platin based anticancer agents
   Mode of action, mechanism. (3 L)

3. Bismuth in medicine
   Chemistry of bismuth
   Bismuth in medicine- helicobacter, pylori bacterium methods for the study of bismuth, Bismuth citrate complex
   Bismuth complexes with biomolecules- bismuth binding to oxygen containing biomolecules, bismuth complexes with thiolate ligands, bismuth (III) complexes with metallothionine and transferring, enzyme inhibition (6 L)

4. Gold complexes with anti-arthritic, anti-tumour and anti-HIV activity
   Introduction, crysotherapy, history of medicinal uses
   Gold chemistry- oxidation state, Gold (I) complexes, Gold (III) complexes, oxidation-reduction potentials
   Gold biochemistry and pharmacology- in vivo metabolism and ligand displacement, antitumor, anti-HIV activity. (5 L)

5. Biomedical uses of lithium

Chemistry of lithium, Distribution in the body and cells, Biochemistry of lithium and lithium isotope. (4 L)

Reference books:

1. Bioinorganic chemistry - R. J. P. Williams
2. Bioinorganic chemistry: An Introduction, Robert Crichton, Elsevier Science, 2007.
3. Metal complexes as enzyme Inhibitors A.Y. Louiwe and Thomas Meade Chem.Rev. 1999,99,2711
4. Bioinorganic chemistry: Inorganic elements in the chemistry of life, An introduction and guide- wolfgangKaim, BrigilleSchwedrski, John Wiley and sons 1994.
5. Principle of Bioinorganic chemistry- S.J. lippard and J.M. Berg, University science Books 1994.
6. The Biological Chemistry of the elements: The Inorganic Chemistry of life- Silva, J.J.R. Fraustoda and R.J.P. Williams second E.d. oxford university press, 2012.
7. Uses of inorganic chemistry in medicine Ed. Nicholas, P. Farrel

Practical course I

CHI- 5305: Analysis, Estimations and computer applications (4 Credit)

A. Alloy analysis (any 2)

1 To determine the amount and percentage of Ni, Fe, Cr from Stainless steel alloy
2 To determine the amount and percentage of Ni, Fe, Cr from Nichrome alloy
3 To determine the amount and percentage of Cu and Ni from Monel metal

B. Ore analysis (any 2)

1 To determine amount and percentage of Fe, Ti, Al and silica from Illemenite ore
2 To determine amount and percentage of Ca, Mg, Si from Dolomite ore
3 To determine amount and percentage of Fe, Si, Ca from cement sample

C. Instrumental analysis (any 4)

1 To determine Zn/Cu/Fe/Mn from soil sample by AAS method
2 To determine P/S/B/Mo from soil sample by UV visible spectrophotometer
3 To determine moisture ash, acid insoluble ash, curcumin and starch from turmeric powder
4 Flame photometric estimation of each Na, K from given sample by working curve method
5 Flame photometric estimation of each Na, K from given sample of binary mixture by standard addition method
6 Determination of nitrogen by using nitrogen analyser from given sample.

D. Inorganic Estimations (any 8)

1 Estimation of Mn from tea leaves.
2 Estimation of Vitamin C from lemon juice.
3 Estimation of Cu from fungicide.
4 Estimation of calcium and silica from ash.
5 To determine amount and percentage of S/Mo/B from plant sample.
6 Determination of Chromium from zinc chrome.
7 Determination of Fe and Zn from Iron and Zinc supplementary capsule.
8 Determination of amount and percentage of nicotine from tobacco.
9 Determination of amount and percentage of caffeine from coffee.
10 Determination of amount and percentage of titanium and silica in tooth powder.
11 Determination of amount and percentage of copper from gas welding rods

E. Ion exchange chromatography

1 Separation and estimation of mixture of Zn(II) and Mg(II)
2 Separation and estimation of mixture of Al(III) and Mg(II)

(Note: Minimum 16 experiments should be completed in this course.)

Reference:

1. A textbook of qualitative inorganic analysis: A. I. Vogel
2. Inorganic synthesis – King
3. Synthetic inorganic chemistry: W.L.Jolly
4. Experimental Inorganic chemistry by W.G.Palmer
5. The analysis of minerals and ores of rare elements: W.R.Schoeller, A.R.Powell, Charles, Griffin and company limited

Practical course II

CHI- 5306: Inorganic preparations and Instrumental analysis (4 Credit)

A. Inorganic preparations (any 8)

1 Preparation of mercury tetrathiocyanatocobaltate (II)
2 Preparation of dichloro(triphenylphosphine)nickel(II) sulphate
3 Preparation of potassium hexathiocyanato chromate (III)
4 Preparation of trans-dichlorobisethylenediamminecobalt (III)chloride
5 Preparation of tris(acetylacetonato) manganese (III)
6 Preparation of chloroaquotetrammine cobalt sulphate
7 Preparation of chrome alum
8 Preparation of $Cu(o\text{-}phen)_2$
9 Preparation of potassium dihydroxodioxalato titanate (IV) and estimation of titania

B. Preparation of solid state material (any 5)

1 Nickel ferrite
2 zinc ferrite
3 $BaZrO_3$
4 MnO_2
5 Nickel oxide
6 TiO_2

C. Instrumentation (any 3)

1. Magnetic susceptibility of Co-ordination complexes by Gauy's method
   To determine number of unpaired electrons from given complex
2. Thermo gravimetric analysis
   TGA for analysis of $CuSO_4$ and NaCl find out the percentage of each constituent in mixture
   To determine the number of water molecules in a given hydrated complex using thermo gravimetric analysis
3 Photocatalytic degradation of dye using TiO_2 nanoparticles
4 To determine amount of chloride/ Sulphate / Phosphate from given sample solution by Turbidometric titration

E. Chemical Kinetics

1 To study rate of aquation of tris 1-10 phenanthrolein Fe (II) in acid solution by spectrophotometer.
2 To study rate of aquation of trans dichlorobisethylenediammine cobalt (III) chloride
3 To determine corrosion rate of metal strips (mild steel or aluminum) in different concentration of acidic or alkali medium
4 To study the effect of 1, 10 phenanthroline on corrosion inhibition of mild steel in H_2SO_4

(Note: Minimum 16 experiments should be completed in this course.)

Reference:

1. A textbook of qualitative inorganic analysis: A. I. Vogel
2. Inorganic synthesis – King
3. Synthetic inorganic chemistry: W.L.Jolly
4. Experimental Inorganic chemistry by W.G.Palmer
5. The analysis of minerals and ores of rare elements: W.R.Schoeller, A.R.Powell, Charles, Griffin and company limited

M. Sc. - II Inorganic Chemistry

Semester – IV

CHI-5401: Heterogeneous Catalysis and Inorganic polymers
(48 L+ 12 T) (4 credit)

Descriptive chemistry of Heterogeneous Catalysis

1. Definition of catalysis, Classification of Catalytic systems, adsorption of molecules on solid surfaces, PE curves for adsorption, descriptive chemistry of chemisorption on metals, chemisorption and catalysis by metals-semi quantitative aspects, catalysis by supported and unsupported bimetals, adsorption and catalysis on semiconducting oxides, selective oxidation of hydrocarbons, different types of reactors. (6 L)
2. Zeolite compounds and heterogeneous catalysis

   Introduction to meso-porous & micro porous materials: classification into micro meso and macroporous material the origin pore and its significance, distinction from condensed material

   Zeolites- Definition, types, natural and synthetic zeolites and aluminosilicate, primary and secondary building blocks, final framework structure, Lowensteine rule, sodalite and other structure, nomenclature , Atlas of zeolites structure distinction novel zeolites, example of small, medium, large and extra-large pore zeolites general properties and application of molecular sieve. (10 L)
3. Characterization of Zeolites:

   XRD, SEM and other spectral techniques, FT-IR, Solid state NMR, Surface area by BET method, pore volume& pore structure, origin of Brownsted acidity & basicity in zeolites, techniques for determination of acidity, temperature programmed desorption of bases.(8 L)
4. Photo catalysis using semiconducting oxides. (2 L)
5. Heterogeneous catalysis using intercalation compounds. (2 L)
6. Heterogeneous catalysis using Pervoskite related oxides (4 L)
7. Heterogeneous catalysis using oxides with Scheelite structure

   Ideal crystal structure, physical properties, oxidation of olefins, mechanism for catalysis by $BiMoO_4$, oxidation of propylene to acrolein, amino propylene to acrylonitrile, Role of bismuth in catalysis. (4 L)
8. Immobilization of transition metal complex catalyst on Inorganic support: Anchored catalysts. Industrial applications of heterogeneous catalysis. (6 L)
9. Inorganic polymers – Polysilylenes, SN and PN compounds. (6 L)

Reference Books:

1. Heterogeneous catalysts – principles and applications – G. C. Bond
2. Introduction to Zeolite Science and Practice – H. Van Bekkum, E. M. Flanigen, P. A.Jacobs and J. C. Jahnson, Elsevier, Amsterdam, 2001.
3. Catalysis – Principles and applications – B. Vishwanath, S. Shivshankar and A.V.Ramaswamy, Narosa Publishing House, New Delhi, 2004.
4. Advanced Materials in Catalysis -J.J. Burton, R.L.Garten, Acad. Press, New York, 1977

CHI: 5402 -Material science I: Inorganic materials & solid state chemistry

(48 L+ 12 T) (4 credit)

1. Structure of solids and crystal defect

a) The types of matter, classification of solids, structure of ionic crystals, Ionic crystals with stoichiometry MX, MX_2 , spinel structure, pervoskite structure

b) Crystal defect: Classification of defect, calculation of no. of defects and average energy required for defect, diffusion in solids: Fick's 1^{st} and 2^{nd} law of diffusion in solids. (8 L)

2. Magnetic materials: Magnetism in solids, hysteresis loop and their classification, soft and hard ferrites, spinels, garnets, applications of magnetic materials. (4 L)

3. Electronic and optical materials

a) Electronic materials and applications

Conductivity: conductors, insulators, semiconductors, superconductors, temperature dependent conductivity.

Applications of semiconducting devices: metal-metal junction i.e. Peltier effect and seebeck effect , diodes, transistors, metal-semiconductor junction

b) Optical materials and their properties

Photonic devices, photoluminescence, crystalline laser. (8 L)

4. Superconducting materials

Definition of superconductivity, critical temperature, BCS theory, properties and classification of superconducting materials, High Tc and Low Tc superconductivity, superconducting oxides, inter metallic superconductors and applications. (8 L)

5. Ceramic materials

Classification, dielectric properties, polarization properties, Piezo, Pyro, and ferroelectric effect of ceramics, sol-gel processing of ceramics, applications as oxides, carbides, borides and nitrides (5 L)

6. Composite materials

Definition, glass transition temperature, fibers for reinforced plastic composite materials, application as glass fiber, carbon fiber, aramid fibers, polymer composites (5 L)

7. Biomaterials

Definition, types, bioactive glasses, bioactive glasses and bioactive composites, application of biomaterials (5 L)

8. Meta materials

Introduction, Electromagnetic, meta materials, classification, elastic meta materials,

acquisition meta materials, structural meta materials, thermoelectric meta materials, Hall effect, applications. (5 L)

Reference books:

1. Solid state chemistry by L. V. Azaroff
2. Material science and engineering by V. Raghavan
3. Inorganic chemistry by J. E. Huheey
4. Solid state chemistry by L. Smart and E. Moore
5. Solid state chemistry by D. K. Chakraborty
6. Solid state chemistry and its applications by A. R. West, John willey and sons Singapore

CHI: 5403 - Material Science-II: Nanomaterials (48 L+ 12 T) (4 credit)

1. Introduction to Nanomaterials (2 L)
2. Synthesis of nanomaterials 1

   (Methods such as solvothermal, sonochemical, CVD, Arc discharge method, Hydrothermal, Co-precipitation, Microwave, Sol gel method, Ball milling)

   a. Oxide Nanoparticles

   b. Zero valent metal nanoparticles

   c. Zero valent bimetallic nanoparticles

   d. Semiconducting sulphides & Selenides, Nanotubes, nanowires. (12 L)
3. Properties and Structures

   a. Optical and electrical properties

   b. Electronic structure & spectral properties of semiconductor Nanocrystals.

   c. Nanotubes, synthesis, Properties and Application. (8 L)
4. Structural determination, application , morphology

   Raman spectroscopy, XRD, SEM, TEM, HRTEM, FESEM, Cryo-SEM, AFM, Scanning tunnelling microscopy (10 L)

5. Photochemistry and Electrochemistry of Nano assemblies (4 L)
6. Nano porous materials (2 L)
7. Applications as sensor (4 L)
8. Application of nanotechnology in medicinal chemistry, Biological Applications (targeted drug delivery) (6 L)

Reference Books:

1. The Chemistry of Nanomaterials edited by C.N.R.Rao, A.Muller, A.K.Cheetham Wiley-VCH Verlag GmbH & co. Volumes 1&2
2. WTEC Panel Report on Nanostructure Science and Technology edited by Richard Siegel, Evelin Hu7M.C.RoCo—Kluwer Academic Publishers, Boston/London.
3. Nanomaterials Dr. Sulbha Kulkarni.
4. Nanotechnology, G. Timp; Springer, AIP Press, 2012.
5. Nanoscopic Materials – Size Dependent Phenomenon, E. Roduner, RSC Publishing 2006.
6. Nanochemistry – A Chemical Approach to Nanomaterials, G. A. Ozim, A. C. Arsenault, L. Cadematiri, RSC Publishing 2009.

CHI: 5404 - Inorganic applications in industrial and environmental chemistry (48 L+ 12 T) (4 credit)

Section I- Inorganic applications in industry (24 L + 06 T) (2 credit)

1. Dyes and Pigments
   a) Dyes: Introduction, classification of dyes, applications in industry
   b) Pigments: Introduction, pigments in food, naturally occurring plants and animal pigments, synthetic food pigments such as sunset yellow, allura red AC, pigments in plants, raw materials for paints, physical properties of pigments in paints, brief description of manufacturing process of commonly used pigments as a white lead, ZnO, TiO_2 (8 L)

2. Electrochemical applications
   Introduction, electro deposition of metals, modification of electrode surface, surface modified electrodes, Nafion modified electrodes, Applications of surface modified electrode such as electro catalysis and ion selective electrodes. (8 L)

3. Inorganic chemicals as metallic corrosion inhibitors
   Introduction, principle of corrosion inhibitors, corrosion as an electrochemical process, practical aspects of corrosion inhibition, anion inhibitor properties in neutral electrolytes, some applications of corrosion inhibitor (cooling water circulation- once through the open system engine radiation and cooling system, central heating system), Refrigeration plants and high chloride system, water for steam raising, corrosion inhibitor for paint coating.(8 L)

Section II- Environmental chemistry (24 L + 06 T) (2 credit)

1. Introduction to waste water analysis and waste water engineering for biological treatment. (6 L)
2. Biotechnology and waste water management: Applications of biotechnology for the treatment of : high strength waste , primary and secondary sludge, Phenol and cyanide removal, solid phase extraction. (6 L)
3. Bioaccumulation of toxic metals Pb, Hg, Cd, As, energy sources for the future- Fuel cells and clean cars for the future (Power ball) Bioaccumulation of organic pollutants. (6 L)
4. Bioremediation
   Introduction and concept, Basic facts, Factors of bioremediation, Key features of bioremediation, methods of bioremediation (6 L)

Reference books

1. Handbook of industrial chemistry, K. H. Davis, F. S. Bernel, CBS Publishers Bangalore
2. Environmental chemistry, Girard
3. Textbook of environmental chemistry, Balram Pani
4. Insight into specialty inorganic chemicals, David Thomson
5. Environmental chemistry, Stanley Manahan 10^{th} edition.

Practical course III

CHI- 5405: Extended practical in inorganic chemistry (4 Credit)

A. Preparation and purity of complexes of:

1. DMG with Cu, Ni, Mn
2. 8-hydroxyquinoline with Cu, Ni, Mn
3. Salicylaldoxime with Cu, Ni, Mn
4. Thiourea with Cu, Ni, Mn
5. Salen with Cu, Ni, Mn

B. Structural determination of above complexes using following techniques:

1. UV-visible spectroscopy
2. Magnetic susceptibility
3. Thermo gravimetric analysis
4. IR spectroscopy
5. Conductivity

C. Report on industrial visit or study tour.

NOTE: Preparation and purity of minimum 08 complexes along with their structure determination using all possible techniques is to be carried out.

C. Introduction to literature survey

D. Case study: A particular specific topic of scientific temper can be selected concerning with practical instructor and study report is to be submitted.

Reference:

1. A textbook of qualitative inorganic analysis: A. I. Vogel
2. Inorganic synthesis – King
3. Synthetic inorganic chemistry: W.L.Jolly
4. Experimental Inorganic chemistry by W.G.Palmer
5. The analysis of minerals and ores of rare elements: W.R.Schoeller, A.R.Powell, Charles, Griffin and company limited

Practical course IV

CHI- 5406: Project work (4 Credit)

This is mandatory for every student to undertake the project work on selected area of study under the guidance of project coordinator. Student must carry out entire experimental work within the stipulated time and present it briefly in the form of the dissertation at the time evaluations.