Anekant Education Society's

Tuljaram Chaturchand College of Arts, Science, Commerce, Baramati

(Autonomous)

DEPARTMENT OF CHEMISTRY

(Faculty of Science and Technology)

Two Year MSc Degree Program Chemistry

MSc Inorganic Chemistry

(2019 Pattern)

Choice Based Credit System Structure and Syllabus

(To be implemented from June 2019)

M. Sc. - II Inorganic Chemistry

Semester–III

CHI-5301: Organometallic Chemistry & Homogeneous catalysis (48L+12 T) (4 credit)

Course Objective:

1. To understand basic principle and applications of organometallic chemistry
2. Students will be able to learn metal-metal bonds, clusters, cadge, fluxional behaviour.
3. Students will be able to synthesis of carbene, carbynes, sigma and pi complexes.
4. Students will be able to learn about C-C coupling reactions, applications.
5. Students will be able to understand magnetic behaviour.
6. To make students capable of studying chemistry in academic and industrial courses.
7. To develop problem solving skills in students.

Course outcomes:

After successfully completing this course, students will be able to:

CO1: get knowledge about Synthesis, bonding, & applications of sigma & Pi complexes as well as Carbene & Carbynes.

CO2: develop the Fluxional behavior of OMC.

CO3: able to apply research skills in OMC in pharmaceuticals, medical, agriculture & horticulture.

CO4: apply their knowledge to Differentiate in Homogeneous & Heterogeneous catalysis, Importance of Homogeneous catalysis in synthesis of Chemicals

CO5: To apply catalytic cycles of Hydrogenation of Olefins.

CO6: Get knowledge about Catalytic cycles for Polymerization, C-C coupling reactions.

CO7: Student apply their knowledge to solve problems based on 18 electron rules

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

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. (3L)
3. n^nCnRn: Carbocyclic Polyenes: Synthesis, bonding, properties and applications. Allyls, Pentadienyls, Cyclobutadienes, Cyclopentadienyl, Cycloheptatrienyls,Arenes,Cyclooctatetraenes. (6L)
4. Fluxional Behavior of organometallic compounds and study of organometallic compound by NMR, IR. (3L)
5. Phosphine complexes: Synthesis, bonding, properties, and applications. (2L)
6. Metal-Metal Bonds: Transition metal atom clusters and cages. (2L)
7. Roll of transition metal organometallic inorganic synthesis:
   As electrophiles and nucleophiles, Activating agents and protecting agents (3L)
8. Applications Organometallic Chemistry in pharmaceutical, medical, agriculture and horticulture. (2L)

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

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 (4L)

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. (4L)

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

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

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. (4L)

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

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,Permagaon1982.
4. Inorganic Chemistry 3rd edn. D.F. Shriver and P.W. Atkins, Oxford University Press,1999, Chapter16.
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. Organometallic in Organic Synthesis –Swan &Black
9. Organometallic Chemistry-E.J. Elias and Gupta
10. Homogeneous Catalysis-G.W.Parshall

Choice Based Credit System Syllabus (2019 Pattern)

Mapping of Program Outcomes with Course Outcomes

Class: M.Sc. (Sem III) **Subject**: Chemistry

Course: Organometallic chemistry and homogeneous catalysis **Course Code**: CHI: 5301

Weightage: 1=weak or low relation, 2=moderate or partial relation, 3=strong or direct relation

	Programme Outcomes(POs)								
Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	3	3	2	2	0	0	0	0	0
CO2	3	2	2	2	0	0	0	0	0
CO3	3	2	2	2	2	2	0	0	0
CO4	3	2	0	3	3	0	0	0	0
CO5	3	2	0	2	0	0	0	1	0
CO6	1	0	0	0	0	3	0	2	3
CO7	1	1	0	0	0	2	0	2	0

Justification for the mapping

PO1: Disciplinary Knowledge

CO1: get knowledge about Synthesis, bonding, & applications of sigma & Pi complexes as well as Carbene & Carbynes.

CO2: develop the Fluxional behavior of OMC.

CO3: able to apply research skills in OMC in pharmaceuticals, medical, agriculture & horticulture.

CO4: Apply their knowledge to Differentiate in Homogeneous & Heterogeneous catalysis, Importance of Homogeneous catalysis in synthesis of Chemicals

CO5: To apply catalytic cycles of Hydrogenation of Olefins.

CO6: Get knowledge about Catalytic cycles for Polymerization, C-C coupling reactions.

CO7: Student apply their knowledge to solve problems based on 18 electron rules

PO2: Critical Thinking and Problem Solving

CO1: get knowledge about Synthesis, bonding, & applications of sigma & Pi complexes as well as Carbene & Carbynes.

CO2: To develop knowledge of the Fluxional behavior of OMC.

CO3: able to apply research skills in OMC in pharmaceuticals, medical, agriculture & horticulture.

CO4: apply their knowledge to Differentiate in Homogeneous & Heterogeneous catalysis, Importance of Homogeneous catalysis in synthesis of Chemicals

CO5: To apply catalytic cycles of Hydrogenation of Olefins.

CO7: Student apply their knowledge to solve problems based on 18 electron rules

PO3: Social competence

CO1: get knowledge about Synthesis, bonding, & applications of sigma & Pi complexes as well as Carbene & Carbynes.

CO2: To develop knowledge of the Fluxional behavior of OMC.

CO3: able to apply research skills in OMC in pharmaceuticals, medical, agriculture & horticulture.

PO4: Research related skills and scientific temper

CO1: get knowledge about Synthesis, bonding, & applications of sigma & Pi complexes as well as Carbene & Carbynes.

CO2: develop the Fluxional behavior of OMC.

CO3: able to apply research skills in OMC in pharmaceuticals, medical, agriculture & horticulture.

CO4: apply their knowledge to Differentiate in Homogeneous & Heterogeneous catalysis, Importance of Homogeneous catalysis in synthesis of Chemicals

CO5: To apply catalytic cycles of Hydrogenation of Olefins.

PO5: Trans-disciplinary Knowledge

CO3: able to apply research skills in OMC in pharmaceuticals, medical, agriculture & horticulture.

CO4: Apply their knowledge to Differentiate in Homogeneous & Heterogeneous catalysis, Importance of Homogeneous catalysis in synthesis of Chemicals

PO6: Personal and Professional Competence

CO3: able to apply research skills in OMC in pharmaceuticals, medical, agriculture & horticulture.

CO6: Get knowledge about Catalytic cycles for Polymerization, C-C coupling reactions.

CO7: Student apply their knowledge to solve problems based on 18 electron rules

PO8: Environment and sustainability

CO5: To apply catalytic cycles of Hydrogenation of Olefins.

CO6: Get knowledge about Catalytic cycles for Polymerization, C-C coupling reactions.

CO7: Student apply their knowledge to solve problems based on 18 electron rules

PO9: Self-directed and Life-long Learning

CO6: Student understand the applications of heterogeneous catalysis in research field

CHI-5302: Inorganic reaction mechanism and photochemistry

(48L+12T)(4 credit)

Course outcome:

1. Student should able to understand different types of inorganic reactions.
2. Student should able to differentiate between SN^1 and SN^2 reaction mechanism.
3. Student should able to understand substitution reactions in square planer and octahedral complexes
4. Student should be able to understand different types of photochemical reactions
5. Student should be able to understand magnetic properties of compound
6. Student should able to understand Student inorganic reaction mechanism

Course objectives:

After successfully completing this course, students will be able to:

CO1: get knowledge about stability, lability, chelates effect, HSAB principle.

CO2: To understand about substitution reactions in square planar &octahedral complexes.

CO3: know applications about detail concepts in photochemical reactions like prompt, delayed, Quantum effect, Luminescence.

CO4: To get knowledge about reactions of co-ordinate ligands.

CO5: student thinks critically to find the application of magnetic materials.

CO6: Student get knowledge of mixed valence compound.

CO7: Student apply their knowledge of find suitable substitution reaction

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

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 (2L)
3. Substitution in octahedral complexes- SN^1, SN^2, SN^1CB mechanisms, Racemisation in coordination compounds, steric effects on substitution (6L)
4. Electron transfer reactions- Potential energy diagrams as a conceptual tool, Marcusequation, types of electron transfer reactions and factors affecting on electron transfer reactions. (6L)
5. Other reaction types- Oxidative addition, reductive elimination, methyl migration and CO insertion reactions (2L)

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 (8L)

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 behavior 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 (6L)
   ii).Mixed valence compounds (2L)

Reference Books:

1. Inorganic Chemistry-Principles of structure and reactivity, J.E.Huheey, E.A. Keiter and R.L.Keiter 4thEdn.Harper Collins publication New York.
2. Mechanism of Inorganic Reactions in solution- an introduction, D. Benson, McGraw-Hillpublication
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. Basoloand R. G. PearsonWileyNew York.
6. Magneto chemistry by Shamal and Dutta.

Choice Based Credit System Syllabus (2019 Pattern)

Mapping of Program Outcomes with Course Outcomes

Class: M.Sc. (Sem III) **Subject**: Chemistry

Course: Inorganic reaction mechanism and photochemistry **Course Code**: CHI 5302

Weightage: 1=weak or low relation, 2=moderate or partial relation, 3=strong or direct relation

	Programme Outcomes(POs)								
Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	3	1	0	0	2	0	0	0	0
CO2	3	0	0	0	0	0	0	0	0
CO3	3	2	2	2	2	0	0	2	2
CO4	3	2	0	0	0	0	0	0	1
CO5	3	3	2	2	2	1	0	0	1
CO6	3	3	0	0	0	0	0	0	0
CO7	3	0	0	2	2	1	0	0	0

Justification for the mapping

PO1: Disciplinary Knowledge

CO1: get knowledge about stability, lability, chelates effect, HSAB principle.

CO2: To understand about substitution reactions in square planar & octahedral complexes.

CO3: know applications about detail concepts in photochemical reactions like prompt, delayed, Quantum effect, Luminescence.

CO4: To get knowledge about reactions of co-ordinate ligands.

CO5: student think critically to find the application of magnetic materials.

CO6: Student get knowledge of mixed valence compound.

CO7: Student apply their knowledge of find suitable substitution reaction

PO2: Critical Thinking and Problem Solving

CO1: get knowledge about stability, lability, chelates effect, HSAB principle.

CO3: know applications about detail concepts in photochemical reactions like prompt, delayed, Quantum effect, Luminescence.

CO4: To get knowledge about reactions of co-ordinate ligands.

CO5: student think critically to find the application of magnetic materials.

CO6: Student get knowledge of mixed valence compound.

CO7: Student apply their knowledge of find suitable substitution reaction

PO3: Social Competence

CO3: know applications about detail concepts in photochemical reactions like prompt, delayed, Quantum effect, Luminescence.

CO5: student think critically to find the application of magnetic materials.

PO4: Research related skills and Scientific temper

CO3: know applications about detail concepts in photochemical reactions like prompt, delayed, Quantum effect, Luminescence.

CO5: student think critically to find the application of magnetic materials.

CO7: Student apply their knowledge of find suitable substitution reaction

PO5: Trans-disciplinary Knowledge

CO1: get knowledge about stability, lability, chelates effect, HSAB principle.

CO3: know applications about detail concepts in photochemical reactions like prompt, delayed, Quantum effect, Luminescence.

CO5: student think critically to find the application of magnetic materials.

CO7: Student apply their knowledge of find suitable substitution reaction

PO6: Personal and Professional Competence

CO5: student think critically to find the application of magnetic materials.

CO7: Student apply their knowledge of find suitable substitution reaction

PO8: Environment and sustainability

CO3: know applications about detail concepts in photochemical reactions like prompt, delayed, Quantum effect, Luminescence.

PO9: Self-directed and Life-long Learning

CO3: know applications about detail concepts in photochemical reactions like prompt, delayed, Quantum effect, Luminescence.

CO4: To get knowledge about reactions of co-ordinate ligands.

CO5: student thinks critically to find the application of magnetic materials.

CHI-5303: Physical Methods in Inorganic Chemistry

(48L+12 T)(4credit)

Course Objectives:

1. Students should be able to understand principle, instrumentation of various techniques.
2. Students should be able to handle various instruments and applied for characterization of various compounds.
3. Student should be able to understand ESR, XRD, XPS, Mossbauer spectroscopy.
4. Students will be able to identify and describe different approaches used in the treatment
5. Student will learn principle of different technique.
6. Student will understand basic concepts, principle and applications.
7. Student should be able to analyze ESR, XPS XRD, Mossbauer spectra.

Course outcomes:

After successfully completing this course, students will be able to:

CO1: To get Theoretical knowledge about Instrumental methods used in Inorganic Chemistry.

CO2: To understand Principle, Instrumentation & applications of thermal techniques.

CO3: will be able to solve problems based on Thermal techniques, ESR, XRD.

CO4: To study about X-ray diffraction, powder & single crystal, X-ray photoelectron Spectroscopy & enhance critical thinking by interpretating of instrumental technique.

CO5: To understand Principle, Instrumentation & applications of ESR.

CO6: Use the XRD, ESR, technique in their characterization of inorganic materials.

CO7: Student finds the applications of instrumental technique in various field like biology, physics, microbiology etc.

Principles, Instrumentation &Applications of the following techniques,

1. Thermal techniques (TG, DTA,DSC),DMA (dynamic mechanical analysis) Derivative thermogravimetric and its advantages (14 L)
2. X-RayDiffractionPowder&Single Crystal (8 L)
3. CyclicVoltammetry (4 L)
4. Mossbauerspectroscopy (4L)
5. Electron Spin resonance spectroscopy (10L)
6. X-ray Photoelectron Spectroscopy (2 L)
7. Microscopy- Electronmicroscopy, Lasermicroscopy, X-ray microscopy (6 L)

Reference Books:

1. Structural methods in Inorganic Chemistry – E.A.V. Eds worth, D.W.H. Rankin & S.Cradock, Blackwell Scientific Publication, 1987.
2. Physical Methods for Chemists-R.S. Drago, (2ndedition,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. Dekkervinc(USA)
5. Dennis H.Evans, Journalof 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. VanBenschoten, Journal of Chemical Education, vol.60, pp772 (1983).

Choice Based Credit System Syllabus (2019 Pattern)

Mapping of Program Outcomes with Course Outcomes

Class: M.Sc. (Sem III) **Subject**: Chemistry

Course: Physical methods in Inorganic chemistry **Course Code**: CHI 5303

Weightage: 1=weak or low relation, 2=moderate or partial relation, 3=strong or direct relation

	Programme Outcomes(POs)								
Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	3	0	0	0	0	0	0	0	0
CO2	2	3	3	0	0	0	0	0	3
CO3	3	3	0	3	0	0	0	0	0
CO4	3	3	0	2	0	0	0	0	2
CO5	3	3	0	2	0	0	0	0	3
CO6	1	3	0	0	0	0	0	0	2
CO7	3	2	3	1	3	3	0	2	2

Justification for the mapping

PO1: Disciplinary Knowledge

CO1: To get Theoretical knowledge about Instrumental methods used in Inorganic Chemistry.

CO2: To understand Principle, Instrumentation & applications of thermal techniques.

CO3: will be able to solve problems based on Thermal techniques, ESR, XRD.

CO4: To study about X-ray diffraction, powder & single crystal, X-ray photoelectron Spectroscopy & enhance critical thinking by interpretating of instrumental technique.

CO5: To understand Principle, Instrumentation & applications of ESR.

CO6: Use the XRD, ESR, technique in their characterization of inorganic materials.

CO7: Student finds the applications of instrumental technique in various field like biology, physics, microbiology etc.

PO2: Critical Thinking and Problem Solving

CO2: To understand Principle, Instrumentation & applications of thermal techniques.

CO3: will be able to solve problems based on Thermal techniques, ESR, XRD.

CO4: To study about X-ray diffraction, powder & single crystal, X-ray photoelectron Spectroscopy & enhance critical thinking by interpretating of instrumental technique.

CO5: To understand Principle, Instrumentation & applications of ESR.

CO6: Use the XRD, ESR, technique in their characterization of inorganic materials.

CO7: Student finds the applications of instrumental technique in various field like biology, physics, microbiology etc.

PO3: Social competence

CO2: To understand Principle, Instrumentation & applications of thermal techniques.

CO7: Student finds the applications of instrumental technique in various field like biology, physics, microbiology etc.

PO4: Research related skills and Scientific temper

CO3: will be able to solve problems based on Thermal techniques, ESR, XRD.

CO4: To study about X-ray diffraction, powder & single crystal, X-ray photoelectron Spectroscopy & enhance critical thinking by interpretating of instrumental technique.

CO5: To understand Principle, Instrumentation & applications of ESR.

CO7: Student finds the applications of instrumental technique in various field like biology, physics, microbiology etc.

PO5: Trans-disciplinary Knowledge

CO7: Student finds the applications of instrumental technique in various field like biology, physics, microbiology etc.

PO6: Personal and Professional Competence

CO7: Student finds the applications of instrumental technique in various field like biology, physics, microbiology etc.

PO8: Environment and sustainability

CO7: Student finds the applications of instrumental technique in various field like biology, physics, microbiology etc.

PO9: Self-directed and Life-long Learning

CO2: To understand Principle, Instrumentation & applications of thermal techniques.

CO4: To study about X-ray diffraction, powder & single crystal, X-ray photoelectron Spectroscopy & enhance critical thinking by interpretating of instrumental technique.

CO5: To understand Principle, Instrumentation & applications of ESR.

CO6: Use the XRD, ESR, technique in their characterization of inorganic materials.

CO7: Student finds the applications of instrumental technique in various field like biology, physics, microbiology etc.

CHI-5304: Bioinorganic and Inorganic medicinal chemistry

(48L+12 T)(4 credit)

Course Objective:

1. Students will able to recognize and explain the interaction of different metal ions with biological ligands
2. To understand various functions and biochemistry of enzyme containing metals.
3. To Understand the concept & to find out biological role
4. Students will able to understand inorganic metals in biology
5. Student should explain the functions of haemoglobin & myoglobin
6. Students should able to understand role of various metals in medicine
7. Students should able to understand Antitumour, anti-HIV , anti-anthritic activity
8. Student should be able to understand the mechanism about medicinal chemistry.

Course outcomes:

After successfully completing this course, students will be able to:

CO1: get knowledge about role of metals in Biology.

CO2: To study the function & biochemistry of Zinc, nickel, Molybdenum, Copper & Manganese.

CO3: get knowledge about Radiopharmaceuticals & their applications in biology.

CO4: get knowledge about application of inorganic elements in medicinal field.

CO5: To know about metalloproteins as a drug target.

CO6: To study about metal based chemotherapeutic drugs as well as diagnostic agents.

CO7: Students analyze the biological functions of metals in human body.

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

1. Recapitulation of biological roles of metals and ligand structure, function and biochemistry of enzymes containing
   i) Zinc: Zinc finger, carboxypeptidase, carbonicanhydrase,
   ii) Nickel: Ni in proteins, Nickel transport and enzyme active site assembly, coordination of biological nickel.
   iii) Molybdenum:Cofactors,antagonismbetweencopperandmolybdenumhydroxylase
   iv) Copper: TypeI, TypeII, TypeIII, 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 (4L)

3. Radiopharmaceuticals and MRI contrast agents. (4L)

Section II: Inorganic medicinal chemistry(24L+ 06T)(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 (6L)

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 bimolecular- 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, chrysotherapy, 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 andlithium isotope. (4L)

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-wolfgang Kaim, Brigille Schwedrski, John Wileyand sons 1994.
5. Principle of Bioinorganic chemistry- S.J. lippard and J.M. Berg, University science Books1994.
6. The Biological Chemistryof the elements: The Inorganic Chemistry of life- Silva, J.J.R.FraustodaandR.J.P.WilliamssecondE.d.oxforduniversitypress,2012.
7. Uses of inorganic chemistry in medicine Ed. Nicholas, P. Far

Choice Based Credit System Syllabus (2019 Pattern)

Mapping of Program Outcomes with Course Outcomes

Class: M.Sc. (Sem III) **Subject**: Chemistry

Course: Bioinorganic and inorganic medicinal chemistry **Course Code**: CHI 5304

Weightage: 1=weak or low relation, 2=moderate or partial relation, 3=strong or direct relation

	Programme Outcomes(POs)								
Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	3	0	0	0	0	0	0	0	2
CO2	0	3	0	0	0	3	0	0	2
CO3	3	3	2	3	0	0	0	3	0
CO4	3	2	2	3	3	0	0	2	2
CO5	0	0	0	0	0	0	0	0	1
CO6	0	0	0	0	2	0	0	0	0
CO7	0	2	2	3	2	2	2	0	1

Justification for the mapping

PO1: Disciplinary Knowledge

CO1: get knowledge about role of metals in Biology.

CO3: get knowledge about Radiopharmaceuticals & their applications in biology.

CO4: get knowledge about application of inorganic elements in medicinal field.

PO2: Critical Thinking and Problem Solving

CO2: To study the function & biochemistry of Zinc, nickel, Molybdenum, Copper & Manganese.

CO3: get knowledge about Radiopharmaceuticals & their applications in biology.

CO4: get knowledge about application of inorganic elements in medicinal field.

CO7: Students analyze the biological functions of metals in human body.

PO3: Social Competence:

CO3: get knowledge about Radiopharmaceuticals & their applications in biology.

CO4: get knowledge about application of inorganic elements in medicinal field.

CO7: Students analyze the biological functions of metals in human body.

PO4: Research related skills and scientific temper

CO3: get knowledge about Radiopharmaceuticals & their applications in biology.

CO4: get knowledge about application of inorganic elements in medicinal field.

CO7: Students analyze the biological functions of metals in human body.

PO5: Trans-disciplinary Knowledge

CO4: get knowledge about application of inorganic elements in medicinal field.

CO6: To study about metal based chemotherapeutic drugs as well as diagnostic agents.

CO7: Students analyze the biological functions of metals in human body.

PO6: Personal and Professional Competence

CO2: To study the function & biochemistry of Zinc, nickel, Molybdenum, Copper & Manganese.

CO7: Students analyze the biological functions of metals in human body.

PO7: Effective citizenship and ethics

CO7: Students analyze the biological functions of metals in human body.

PO8: Environment and sustainability

CO3: get knowledge about Radiopharmaceuticals & their applications in biology.

CO4: get knowledge about application of inorganic elements in medicinal field.

PO9: Self-directed and Life-long Learning

CO1: get knowledge about role of metals in Biology.

CO2: To study the function & biochemistry of Zinc, nickel, Molybdenum, Copper & Manganese.

CO4: get knowledge about application of inorganic elements in medicinal field.

CO5: To know about metalloproteins as a drug target.

CO7: Students analyze the biological functions of metals in human body.

Practical course I

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

Course objectives:

1. Students should be able to select method for analysis, decide and prepare for analysis.
2. Students should able to select procedure for analysis, identify sources possible errors in the result obtained.
3. Students should able to introduce methods of chemical analysis.
4. Perform required calculations involved in the analysis by titrametrically as well as gravimetrically.
5. Students should able to know various instrumental methods of analysis.
6. Students will gets an opportunities to handle and understand principles of different instruments.
7. Exercise their critical thinking in creating new knowledge.
8. Effectively communicate the knowledge of their study and research in their respective disciplines.

Course outcomes:

After successfully completing this course students will know,
CO1: student thinks about correct route of estimation of alloy & ore analysis.
CO2: develop critical thinking skills apply their knowledge to troubleshoot experiments, Identify source of error & propose improvements to experimental procedure.
CO3: Students will gain hands on experience in using various laboratory techniques.
CO4: To determine elements from soil sample by UV visible spectrophotometer.
CO5: Separations and estimation of mixture by using ion exchange chromatography.
CO6: to develop research related skills in students.
CO7: To develop ethical values like safety, honesty, tolerance in students during lab work.

A. Alloy analysis (any2)

1 To determine the amount and percentage of Ni, Fe, Cr from Stainless steelalloy
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 (any2)

1 To determine amount and percentage of Fe, Ti, Al and silica from llemenite 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 (any8)

1 Estimation of Mn from tealeaves.
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 fromzinc 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 canalysis: A.I.Vogel
2. Inorganic synthesis–King
3. Synthetic inorganic chemistry :W.L.Jolly
4. Experimental Inorganic chemistry byW.G.Palmer
5. The analysis of minerals and ores of rare elements: W.R.Schoeller, A.R.Powell, Charles, Griffin and company limited

Choice Based Credit System Syllabus (2019 Pattern)

Mapping of Program Outcomes with Course Outcomes

Class: M.Sc. (Sem III) **Subject**: Chemistry

Course: Analysis, Estimations and computer applications **Course Code**: CHI 5305

Weightage: 1=weak or low relation, 2=moderate or partial relation, 3=strong or direct relation

	Programme Outcomes(POs)								
Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	3	0	0	0	0	0	0	0	0
CO2	3	3	0	2	0	2	0	0	0
CO3	3	0	0	0	0	0	0	0	3
CO4	2	0	0	3	0	0	0	2	0
CO5	3	3	0	0	0	0	0	0	0
CO6	3	2	0	2	0	0	0	0	0
CO7	2	0	3	1	3	3	2	0	0

Justification for the mapping

PO1: Disciplinary Knowledge

CO1: student thinks about correct route of estimation of alloy & ore analysis.

CO2: develop critical thinking skills apply their knowledge to troubleshoot experiments, identify source of error & propose improvements to experimental procedure.

CO3: Students will gain hands on experience in using various laboratory techniques.

CO4: To determine elements from soil sample by UV visible spectrophotometer.

CO5: Separations and estimation of mixture by using ion exchange chromatography.

CO6: to develop research related skills in students.

CO7: To develop ethical values like safety, honesty, tolerance in students during lab work.

PO2: Critical Thinking and Problem Solving

CO2: develop critical thinking skills apply their knowledge to troubleshoot experiments, identify source of error & propose improvements to experimental procedure.

CO5: Separations and estimation of mixture by using ion exchange chromatography.

CO6: to develop research related skills in students.

PO3: Social Competence:

CO7: To develop ethical values like safety, honesty, tolerance in students during lab work.

PO4: Research related skills and scientific temper

CO2: develop critical thinking skills apply their knowledge to troubleshoot experiments, identify source of error & propose improvements to experimental procedure.

CO4: To determine elements from soil sample by UV visible spectrophotometer.

CO6: to develop research related skills in students.

CO7: To develop ethical values like safety, honesty, tolerance in students during lab work.

PO5: Trans-disciplinary Knowledge

CO4: To determine elements from soil sample by UV visible spectrophotometer.

PO6: Personal and Professional Competence

CO7: To develop ethical values like safety, honesty, tolerance in students during lab work.

CO2: develop critical thinking skills apply their knowledge to troubleshoot experiments, identify source of error & propose improvements to experimental procedure.

PO7: Effective citizenship and ethics

CO7: To develop ethical values like safety, honesty, tolerance in students during lab work.

PO8: Environment and sustainability

CO4: To determine elements from soil sample by UV visible spectrophotometer

PO9: Self-directed and Life-long Learning

CO3: Students will gain hands on experience in using various laboratory techniques.

Practical course II

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

Course Objectives:

1. Students should able to know various instrumental methods of analysis.
2. Students should able to introduce methods of chemical analysis.
3. Student should be able to knowledge about magnetic succeptibility, TGA, CV aquation etc.
4. Student should able to know the various instrumental methods of analysis.
5. should be able to understand magnetic properties of compound
6. student will get knowledge about instrumental methods and analysis of compound.

Course outcomes:

CO1: Students will able to trained in proper laboratory safety protocols including handling & disposal of inorganic compounds

CO2: collaborate in laboratory setting, working effectively in group to share responsibilities, troubleshoot experimental challenges & communicate findings.

CO3: To understand the methods of characterization of metal complexes

CO4: students will gain hands on experience in using various laboratory techniques.

CO5: To interpret given XRD spectrum

CO6: To understand handling of UV, IR magnetic susceptibility.

CO7: Student able to calculate the quantity from observation of the experiment.

A. Inorganic preparations (any8)

1 Preparation of mercury tetrathiocyanatocobaltate (II)
2 Preparation of dichloro(triphenylphosphine)nickel(II)sulphate
3 Preparation of potassium hexathiocyanatochromate(III)
4 Preparation of trans-dichlorobisethylenediamminecobalt(III)chloride
5 Preparation of tris(acetylacetonato)manganese(III)
6 Preparation of chloroaquotetramminecobaltsulphate
7 Preparation of chromealum
8 Preparation of $Cu(o\text{-}phen)_2$
9 Preparation of potassium dihydroxodioxalatotitanate(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 (any3)

1. Magnetic susceptibility of Co-ordination complexes by Gauy's method To determine number of unpaired electrons from given complex
2. Thermogravimetric 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. Photo catalytic degradation of dye using TiO_2nanoparticles
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 dichloro bis-ethylenediammine 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 inH_2SO_4

(Note: Minimum 6 experiments should be completed in this course.)

Reference Books:

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

Choice Based Credit System Syllabus (2019 Pattern)

Mapping of Program Outcomes with Course Outcomes

Class: M.Sc. (Sem III) **Subject**: Chemistry

Course: Inorganic preparations and Instrumental analysis **Course Code**: CHI:5306

Weightage: 1=weak or low relation, 2=moderate or partial relation, 3=strong or direct relation

	Programme Outcomes(POs)								
Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	3	0	0	0	0	0	0	0	0
CO2	3	0	0	2	0	2	0	0	0
CO3	2	2	0	3	0	0	0	0	0
CO4	2	3	0	0	0	3	0	0	0
CO5	0	3	0	0	0	0	0	0	3
CO6	2	0	0	2	3	2	0	0	0
CO7	0	2	0	1	3	1	0	0	3

Justification for the mapping

PO1: Disciplinary Knowledge

CO1: Students will able to trained in proper laboratory safety protocols including handling & disposal of inorganic compounds

CO2: collaborate in laboratory setting, working effectively in group to share responsibilities, troubleshoot experimental challenges & communicate findings.

CO3: To understand the methods of characterization of metal complexes

CO4: students will gain hands on experience in using various laboratory techniques.

CO6: To understand handling of UV, IR magnetic susceptibility.

PO2: Critical Thinking and Problem Solving

CO3: To understand the methods of characterization of metal complexes

CO4: students will gain hands on experience in using various laboratory techniques.

CO5: To interpret given XRD spectrum

CO7: Student able to calculate the quantity from observation of the experiment.

PO4: Research related skills and Scientific temper

CO2: collaborate in laboratory setting, working effectively in group to share responsibilities, troubleshoot experimental challenges & communicate findings.

CO3: To understand the methods of characterization of metal complexes

CO6: To understand handling of UV, IR magnetic susceptibility.

CO7: Student able to calculate the quantity from observation of the experiment.

PO5: Trans-disciplinary Knowledge

CO6: To understand handling of UV, IR magnetic susceptibility.

CO7: Student able to calculate the quantity from observation of the experiment.

PO6: Personal and Professional Competence

CO2: collaborate in laboratory setting, working effectively in group to share responsibilities, troubleshoot experimental challenges & communicate findings.

CO4: students will gain hands-on experience in using various laboratory techniques.

CO6: To understand handling of UV, IR magnetic susceptibility.

PO9: Self-directed and Life-long Learning

CO5: To interpret given XRD spectrum.

CO7: Student able to calculate the quantity from observation of the experiment.