Re-Accredited 'B++' 2.86 CGPA by NAAC
VEER NARMAD SOUTH GUJARAT UNIVERSITY
University Campus, Udhna-Magdalla Road, SURAT - 395 007, Gujarat, India.
વીર નર્મદ દક્ષિણ ગુજરાત યુનિવર્સિટી
યુનિવર્સિટી કેમ્પસ, ઉધના-મગદલ્લા રોડ, સુરત - ૩૯૫ ૦૦૭, ગુજરાત, ભારત.
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-: પરિપત્ર :-

વિજ્ઞાન વિદ્યાશાખા હેઠળની સંલગ્ન તમામ અનુસ્નાતક અભ્યાસક્રમ ચલાવતી કોલેજોનાં આચાર્યશ્રીઓને તથા ડિપાર્ટમેન્ટના વિભાગીય વડાશ્રીઓને જણાવવાનું કે, શૈક્ષણિક વર્ષ ૨૦૨૩–૨૪ થી અમલમાં આવનાર M.Sc. Inorganic Chemistry Sem.- 4 નો અભ્યાસક્રમ રસાયણશાસ્ત્ર વિષયની અભ્યાસ સમિતિના ચેરમેનશ્રીએ અભ્યાસ સમિતિવતી મંજૂર કરી વિજ્ઞાન વિદ્યાશાખાને કરેલ ભલામણ વિજ્ઞાન વિદ્યાશાખાની તા.૨૭/૦૩/૨૦૨૪ ની સભાના ઠરાવ ક્રમાંક :૬ અન્વયે મંજૂર કરી એકેડેમિક કાઉન્સિલને કરેલ ભલામણ એકેડેમિક કાઉન્સિલની તા.૦૧/૦૩/૨૦૨૪ ની સભાના ઠરાવ ક્રમાંક :૧૦૪ અન્વયે માન.કુલપતિશ્રીને આપેલ સત્તા અંતર્ગત માનનીય કુલપતિશ્રી દ્વારા મંજૂર કરેલ છે.જેનો અમલ કરવા આથી જાણ કરવામાં આવે છે.

વિજ્ઞાન વિદ્યાશાખાની તા.૨૭/૦૩/૨૦૨૪ની સભાનાં ઠરાવ ક્રમાંકઃ૦૬

:: આથી ઠરાવવામાં આવે છે કે, શૈક્ષણિક વર્ષ ૨૦૨૩–૨૪ થી અમલમાં આવનાર M.Sc.Inorganic Chemistry Sem.- 4 નો અભ્યાસક્રમ અભ્યાસ સમિતિનાં ચેરમેનશ્રીએ અભ્યાસ સમિતિવતી મંજૂર કરી વિજ્ઞાન વિદ્યાશાખાને કરેલ ભલામણ સ્વીકારી તે મંજૂર કરવા એકેડેમિક કાઉન્સિલને ભલામણ કરવામાં આવે છે.

(બિડાણઃ ઉપર મુજબ)

ક્રમાંક : એસ./સાયન્સ/પરિપત્ર/૭૬૫૨/૨૦૨૪
તા.૦૪–૦૪–૨૦૨૪

કુલસચિવ

પ્રતિ,
૧) વિજ્ઞાન વિદ્યાશાખા હેઠળની સંલગ્ન તમામ અનુસ્નાતક અભ્યાસક્રમ ચલાવતી કોલેજોનાં આચાર્યશ્રીઓ. તથા વિભાગીય વડાશ્રી.
..... આપશ્રીની કોલેજના સંબંધિત શિક્ષકોને તથા વિદ્યાર્થીઓને જાણ કરી અમલ કરવા સારૂ.
૨) અધ્યક્ષશ્રી, વિજ્ઞાન વિદ્યાશાખા.
૩) પરીક્ષા નિયામકશ્રી, પરીક્ષા વિભાગ, વીર નર્મદ દ.ગુ.યુનિવર્સિટી, સુરત.
.....તરફ જાણ તેમજ અમલ સારૂ.

Veer Narmad South Gujarat University, Surat

Syllabus

M.Sc. Inorganic Chemistry

Semester-IV

To be effective from June-2023

NEP-2020

Name of Program	**Master of Science(Chemistry) and M.Sc. Organic Chemistry (Evening)**
Abbreviation	**M.Sc.**
Duration	**2 Years**
Eligibility Criteria	**M.Sc. (Organic Chemistry)** Eligibility: Graduation in Science with Chemistry or any subject equivalent to or allied to Chemistry. **M.Sc. (Inorganic Chemistry)** Eligibility: Graduation in Science with Chemistry or any subject equivalent to or allied to Chemistry. **M.Sc. (Physical Chemistry)** Eligibility: Graduation in Science with Chemistry or any subject equivalent to or allied to Chemistry. **M.Sc. (Analytical Chemistry)** Eligibility: Graduation in Science with Chemistry or any subject equivalent to or allied to Chemistry. **M. Sc . Environmental Chemistry** Eligibility: Graduation in Science with Chemistry or any subject equivalent to or allied to Chemistry. **M.Sc. (Pharmaceutical Chemistry)** Eligibility: Graduation in Science with Chemistry or any subject equivalent to or allied to Chemistry. **M.Sc. Organic Chemistry (Evening)** Eligibility: Graduation in Science with Chemistry or any subject equivalent to or allied to Chemistry.
Objective of Program	The core objective of the M.Sc. programme is to prepare the students for dynamic career in industry and academia by providing an excellent environment of teaching and research in the core and emerging areas of the discipline.

Program Outcome	PO1: To enhance the knowledge of chemistry domains and become master in respective branch of chemistry. To be able to communicate clearly and effectively with in and across disciplinary lines. PO2: Built up entrepreneurship ability by taking advantage of industrial hub in periphery of our university. PO3: Establishment of research center with the aid of interdisciplinary subject being run in university. PO4: Persuasion of doctoral degree in the concern subject and further study. PO5 : Development of related short term courses related to demanded subject in anticipation of strengthening knowledge and application PO6: Training/internship of students for employment in public sector, private sector and national laboratories. PO7: Participation in scientific discussions showing respect and lead interdisciplinary work with experts from other fields. PO8: To understand and adopt the best safety practices in chemical research. PO9: Participation in scientific discussions showing respect and lead Interdisciplinary work with experts from other fields. PO10: To understand and adopt the best safety practices in research.

Program Specific Outcomes	Students need to build up foundation in the fundamentals & application of current chemical and scientific theories in the concerned branches of Inorganic, Organic, Analytical, Physical, Environmental and Pharmaceutical Chemistry. PSO1 : Develop scientific temper, communicate scientific information in a clear, concise and precise manner. PSO2 : Find job opportunities at all level of chemical industries(dyes & pharmaceutical), national laboratories & research centers. PSO3 : Apply the knowledge in sustainable and eco friendly technologies. PSO4 : Inculcate logical thinking to addressess the problem and become result oriented. PSO5 : Development of research culture in persuasion of Ph.D. program at national & international institute/university. PSO6 : Participate in specific competitive examination conducted by various public service commission and other public sector. PSO7 : Develop and apply the fundamental knowledge to build small scale industry in context to Atma Nirbhar Bharat. PSO8 : Scale up the synthetic product to a pilot level plant and gradually to bulk. PSO9 : Enhance the scientific temperament among the students in anticipation of developing research culture and implementation of policies at global & local level. PSO10 : Communicate scientific information clear in both writing and orally. PSO11 : Students shall start to become better readers, thinkers and learners in their discipline by processing their ideas through writing. PSO12 : Will build new scientific understanding as it provides students the opportunity to articulate their thinking as they engage in the science practicesduring an investigation.

Mapping between POs and PSOs		PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8	PSO9	PSO10	PSO11	PSO12
	PO1												
	PO2												
	PO3												
	PO4												
	PO5												
	PO6												
	PO7												
	PO8												
	PO9												
	PO10												
Medium of Instruction		English											

Evaluation Pattern		
Sr. No.	Details of the Evaluation	Weightage
1.	Internal Written / Practical Examination (As per CBCS R.6.8.3)	30%
2.	University Examination	70%

Teaching-Learning Methodology	To meet the effective teaching and the learning requirements, teaching-learning methodology comprise classroom teaching, use of e-resources, library, IT tools, encourages students to participate in seminars/ workshops, presentations by students, assignments etc.

VEER NARMAD SOUTH GUJARAT UNIVERSITY

Name of Program	**Master of Science (Chemistry)**
Abbreviation	**M.Sc.**
Duration	**2 Years**
Eligibility Criteria	**Course- M.Sc. Inorganic Chemistry** Eligibility: Graduation in Science with Chemistry or any subject equivalent to or allied to Chemistry.

M.Sc. Inorganic Chemistry, Semester-IV

Theory Paper /Practical	Teaching schedule Hrs/week	Exam Schedule			Total marks	Credit
		Duration Hrs	Internal marks	External marks		
Theory papers:						
1) Core-1 (ICC-401) *Selected Topics in Inorganic Chemistry*	4	3	30	70	100	4
2) Core-2 (ICC-402) *General Topics in Inorganic chemistry*	4	3	30	70	100	4
3) Core-3 (ICC-403) *Advanced and fundamental Inorganic Chemistry*	4	3	30	70	100	4
Inter/Multidisciplinary(AECC) 4) Elective Paper-1 (IEC-401) *Coordination Chemistry and Organometallic Chemistry* **Or** Elective Paper-2 (IEC-402) *Nuclear Chemistry and Metallurgy*	4	3	30	70	100	4
5) Skill Based Elective paper* /Swayam/MOOC courses (OSEC-401)	2	2	15	35	50	2
6) Practical (IP-401)	12	12	60	140	200	6
Total	30	26	195	455	650	24

VEER NARMAD SOUTH GUJARAT UNIVERSITY, SURAT

Master of Science, M.Sc. Inorganic Chemistry,

Semester-IV

To be effective from June-2023

(NEP-2020)

Core-I: Selected topics in Inorganic Chemistry

Total Periods: 60

Course Code	ICC-401	Title ofthe Course	Selected topics in Inorganic Chemistry
Total Credits of the Course	4	Hours per Week	4 hrs

Course Objectives:	• To learn fundamentals of Photochemistry of Inorganic compounds and Photo physical process. • To study different aspects of Environmental Chemistry. • To understand Homogeneous Catalysis. • To study Transition metal compounds with Bond to Hydrogen and Reactions of Homogeneous catalysis

Unit-I: Photochemistry of Inorganic compounds and co-ordination Compounds **(15 periods)**

Introduction: Photochemistry laws and photochemical kinetics, Absorption of light, quantum yield and reactivity, life time, kinetic aspects of photochemical process, temperature dependence of photochemical process and photochemical equipment.

Photo physical process : Introduction , theory and relative process stimulated absorption, spontaneous emission, selection rules, oscillator strength and radiative life time, Frank Condon principle, theory of non-radiative processes, radiationless transitions and bimolecular.

Unit-II : Environmental Chemistry **(15 periods)**

Various types of pollution: Introduction, definition and classification
(a) Air Pollution: Sources and sinks of gases pollutants on living and non-living things, Green House Effect, Acid rain, Ozone layer Depletion and their consequences on environment. Effect of air pollution, photochemical smog and major air pollution.

(b) Method of control of air pollution: Different methods of control air pollution, precipitation wet and dry scrubber, filters, gravity and cyclonic separation, adsorption, absorption and condensation of gaseous effluent.

(c) Water pollution : types, sources and classification of water pollution, constituent and oxygen control of water and aquatic life, oxygen electrode and its use. Effect of water pollutants on life and environment.

(d) Method of control of water pollution: Principle of coagulation, flocculation, softening, disinfection, demineralization, and fluoridation. Objective analysis: color, turbidity, total solids, conductivity, acidity, alkalinity, hardness, chlorine, sulphate, fluoride, silica, phosphate and different form. DO, BOD, COD and significance.

Unit-III: Homogeneous Catalysis **(15 Periods)**

Introduction, types of catalysts, Catalytic steps, Hydrogenation of alkene, Ziegler-Natta polymerization of olefins, Hydrocarbonylation of olefins, The wacker process, Monsanto Acetic Acid Synthesis, Water-gas Shift Reaction, Hydrosilation, Activation of C-H bond.

Unit-IV: Transition metal compounds with Bond to Hydrogen and Reactions of Homogeneous catalysis **(15 Periods)**

(a)Transition metal compounds with Bond to Hydrogen:

Introduction, characterization of transition metal hydride complexes, methods of preparation, properties, Mononuclear polyhydrides, Homoleptic polyhydrido anions, Metal carbonyl hydrides, Dihydrogen complexes.

(b) Reactions of Homogeneous catalysis

Oxidative-Addition Reaction : Energetics and Mechanism, Reductive-Elimination Reaction, Insertion Reaction: classification and some examples, Deinsertion Reaction, Nucleophilic and Electrophilic Attack on Coordinated ligands

Teaching-Learning Methodology	To meet the effective teaching and the learning requirements, teaching-learning methodology comprise classroom teaching, use of e-resources, library, IT tools, encourages students to participate in seminars/ workshops, presentations by students, assignments etc.

Evaluation Pattern		
Sr. No.	Details of the Evaluation	Weightage
1.	Internal Written / Practical Examination (As per CBCS R.6.8.3)	30%
2.	University Examination	70%

Course Outcomes: Having completed this course, the learner will be able to	
1.	To learn introduction of photochemistry, photochemical process, photochemical equipment photo physical process, theory of non-radiative processes and radiationless transitions and bimolecular.
2.	To learn various types of pollution, Introduction, definition and classification especially Air Pollution, methods of control of air pollution, Water pollution: types, sources and classification of water pollution, method of control of water pollution.
3.	To learn about Introduction, types of catalysts, Catalytic steps, different catalytic based synthesis.
4.	To learn about Transition metal compounds with Bond to Hydrogen, characterization of transition metal hydride complexes, methods of preparation, properties and Reactions of Homogeneous catalysis, Oxidative-Addition Reaction, Reductive-Elimination Reaction, Insertion Reaction Nucleophilic and Electrophilic Attack on Coordinated ligands

REFERENCE BOOKS

1. Fundamentals of photochemistry, K. K. RohatgiMu kerjee.
Wiley Eastern Limited, New Delhi, (1978).
2. Photochemistry, J. G. Calvents and J. N. Pitts. John-Wiley & Sons.
3. Introduction to photochemistry. Wells
4. Photochemistry of solutions. C. A. Parker, Elsevier.
5. Photochemistry of coordination compounds, V. Balzani and V. Carassitti, Academic Press, London (1970).
6. Concept of Inorganic photochemistry, A. W.Adamson and Paur D.Fleischauer, A Wiley Interscience Publication, New Delhi, 1975
7. Water pollution. J. E. Jajic, Marcel-Dekker,
8. Air pollution. H. W. Parker, Prentice-Hall
9. Environmental chemistry. A. K. De, Wiley Eastern Ltd, New Delhi.
10. Environmental pollution control in process industries. S. P. Mahajan.
11. Introduction to air pollution. P. K. Trivedi.
12. Environmental pollution Analysis, S. M. Khopkar
13. A text book of Environmental pollution. D.D.Tyagi and M. Mehre.
14. Environmental pollution Engineering and control. C. S. Rao.
15. Environmental Chemistry, B. K. Sharma, Goel Publishing house,
16. Environmental Chemistry, S.C Bhatia, CBS Publisher and Distributer
17. Elements of Magnetochemistry, R.L. Datta& A. Syamal, Affiliated East- West Press Pvt. Ltd., New Delhi (1993).

Master of Science, M.Sc. Inorganic Chemistry,Semester-IV
To be effective from June-2023
(NEP-2020)

Core-II: General Topics in Inorganic chemistry

Total Periods: 60

Course Code	ICC-402	Title ofthe Course	**General Topics in Inorganic chemistry**
Total Credits of the Course	4	Hours per Week	4 hrs

Course Objectives:	• To define supramolecular chemistry, classify supramolecular host-guest compounds, study receptors, coordination and lock-and-key analogy, and describe the nature of supramolecular interactions, and discuss supramolecular concepts and design. • To provide basic theoretical understanding of different types of isomerism include structural isomerism, Isomerism Among inorganic complexes • To understand chemistry of solid state including basics of crystals, types of crystals, lattice arrangement and the shape crystals and calculation, Born equation and its application, experimental determination of lattice energy, defect structures of crystals, semiconductors ,fabrication of transistors. • To understand and familiarize the fundamentals Oxidation and Reduction reactions

Unit-I: Basic of Supramolecular chemistry **(15 periods)**

Definition and development of supramolecular chemistry, classification of supramolecular Host-Guest compounds, Receptors, coordination and lock and key analogy, binding constant, cooperativity and the chelate effect, preorganization and complementarity, Thermodynamic and kinetic selectivity and discrimination, nature of supramolecular interactions, solvation and hydrophobic effects, supramolecular concepts and design.

Unit-2: Isomerism Among inorganic complexes **(15 periods)**

Structural isomerism, stereoisomerism or space isomerism, geometrical isomerism in 4- and 6- coordinates compound, distinguish between cis and trans- isomers, optical or mirror image isomerism. Condition for a molecule to show optical isomerism. Optical isomerism in4- and 6- coordinates compounds. Resolution of racemic mixtures.

Unit-3: Chemistry of solid state **(15 periods)**

Crystalline and amorphous solids, size and shape of crystals, symmetry in crystals, space lattice and unit cell, Bravais lattices, Miller indices, types of crystals, close packing of identical solid spheres, interstitial sites in close packing of spheres, limiting radius ratio, radius ratio rule and the shape of an ionic crystal, structure of metallic crystals and ionic crystals, lattice energy of an ionic crystal and calculation, Born equation and its application, experimental determination of lattice energy, defect structures of crystals, semiconductors ,fabrication of transistors.

Unit-4: Oxidation and Reduction **(15 periods)**

Oxidation number, Galvanic cell, single electrode potential, sign of electrode potential, standard electrode potentials, electrochemical series, Nernst equation, application of electrochemical series, source of electrical energy in a galvanic cell, hydrogen over voltage, oxygen over voltage, redox stability in water, oxidation by atmospheric oxygen, Latimer diagram, Frost diagram, pourbaix diagram

Teaching-Learning Methodology	To meet the effective teaching and the learning requirements, teaching-learning methodology comprise classroom teaching, use of e-resources, library, IT tools, encourages students to participate in seminars/ workshops, presentations by students, assignments etc.

Evaluation Pattern		
Sr. No.	Details of the Evaluation	Weightage

1.	Internal Written / Practical Examination (As per CBCS R.6.8.3)	30%
2.	University Examination	70%

	Course Outcomes: Having completed this course, the learner will be able to
1.	To define and understand development of supramolecular chemistry, classification of supramolecular Host-Guest compounds, Receptors, coordination and lock and key analogy, binding constant, cooperativity and the chelate effect, preorganization and complementarity, supramolecular concepts and design.
2.	To understand basic theoretical understanding of Different types of isomerism include structural isomerism, optical or mirror image isomerism, geometrical isomerism in 4- and 6-coordinate compounds, and stereoisomerism or space isomerism. Requirements for the optical isomerism of a molecule. Optical isomerism in compounds with four and six coordinates. Settling of mixtures with racemes.
3.	To comprehend the principles of solid state chemistry, encompassing crystal types, defects in crystals, lattice configuration, crystal shape, and computation; Born equation and its use; experimental determination of lattice energy; semiconductors; and transistor fabrication.
4.	To acquire knowledge of hydrogen overvoltage, oxygen overvoltage, redox stability in water, oxidation by atmospheric oxygen, single electrode potential, sign of electrode potential, and to calculate number of oxidation, Nernst equation, application of electrochemical series, Diagrams for pourbaix, Frost, and Latimer
	Suggested References:

Reference Books:

1. Supramolecular chemistry by Jonathan W. steed, Jerry L. Atwood, John Wiley & sons Ltd.
2. A. F. Wells, Structural Inorganic chemistry, 3rd Edn, oxford Fair Lawn, N. J. 1962.
3. Principles of inorganic chemistry: Puri, Sharma, Kalia, Thirty third Edn. (Vishal publishing co.)
4. Advanced in inorganic chemistry: S. K. Agrawal, Keemti Lal, Fifteenth Edn. (Pragati Edition)
5. A. I. Vogel's text book of quantitative inorganic analysis, ELBS III Edn. 1987.
6. Advanced in inorganic chemistry vol. 1 & 2, Gurdeep Raj, Krishna Publication Meerut.
7. Selected topics in inorganic chemistry: Malik, Tuli, Madan

8.

On-line resources to be used if available as reference material
On-line Resources

Master of Science, M.Sc. Inorganic Chemistry,Semester-IV
To be effective from June-2023
(NEP-2020)

Core-3: Advanced and fundamental Inorganic Chemistry

Total Periods: 60

Course Code	ICC-403	Title ofthe Course	**Advanced and fundamental Inorganic Chemistry**
Total Credits of the Course	4	Hours per Week	4 hrs

Course Objectives:	• To study pollution from agriculture pesticides and fertilizers. • To understand fundamentals of electron Spin resonance. • To provide understanding of NMR spectroscopy, application NMR for lanthanide complexes, Proton, Boron, Carbon, Nitrogen, Phosphorous NMR of inorganic compounds , Chemistry of Lanthanides and Actinides, Separations, spectral and magnetic properties, organometallic chemistry of lanthanides and actinides • To learn principles, interpretation, application for inorganic compounds or metal complexes of Mossbauer spectroscopy

Unit-I: Pollution from agriculture pesticides and fertilizers **(15 periods)**

Pesticides: general aspects and classification, structural features of some common insecticides, mode of action-general aspects,fate of insecticides in environment and environment hazards, characteristics features of some commonly used insecticides, some important fungicides herbicides and their characteristics features,major disasters with the pesticides and herbicides, alternative to chemical pesticides, fertilizers and environmental hazards from the fertilizers, eutrophication.

Unit-2 : Electron Spin resonance **(15 periods)**

Principle and presentation of the spectrum. Hyperfine splitting. Anisotropy and interpretation of g values. Hyperfine coupling and zero field splitting. Survey of EPR spectra of first row transition metal ion complexes. Double Resonance and Fourier transform EPR techniques.

Unit-3: **(15 periods)**

(A) NMR spectroscopy

Principle and application of FT-NMR, Chemical shift, contact shift and pseudo contact shift. lanthanide complexes as shift reagents. Double resonance technique, Proton, Boron, Carbon, Nitrogen, Phosphorous NMR of inorganic compounds

(B) Chemistry of Lanthanides and Actinides

Separations, spectral and magnetic properties, organometallic chemistry of lanthanides and actinides, transurenium elements

Unit-4: Mossbauer spectroscopy **(15 periods)**

Basic principle, Spectral parameters and spectrum display. Interpretation of Isomer shift. Application of technique to the studies of bonding and structure of Fe^{+2} and Fe^{+3} compounds, Sn^{+2} and Sn^{+4} compounds and detection of oxidation states. FAB and electron spray, mass spectrometry of metal complexes

Teaching-Learning Methodology	To meet the effective teaching and the learning requirements, teaching-learning methodology comprise classroom teaching, use of e-resources, library, IT tools encourages students to participate in seminars/ workshops, presentations by students, assignments etc.

Evaluation Pattern		
Sr. No.	Details of the Evaluation	eightage
1.	Internal Written / Practical Examination (As per CBCS R.6.8.3)	30%
2.	University Examination	70%

Course Outcomes: Having completed this course, the learner will be able to	
1.	Comprehend the general aspects and classification, the structural features of some common insecticides, the general aspects of their mode of action, the hazards they pose, the characteristics, some significant fungicides and herbicides and their characteristics, major pesticide and herbicide-related disasters, substitutes for chemical pesticides, fertilizers and the environmental risks they pose, and eutrophication.
2.	Understand principles, spectrum presentation, hyperfine splitting, anisotropy interpretation, hyperfine coupling, zero field splitting, EPR spectra of transition metal ion complexes, double resonance and Fourier transform techniques..
3.	Learn NMR spectroscopy, lanthanide complexes, double resonance technique, proton, boron, carbon, nitrogen, phosphorous NMR, lanthanides and actinides, separations, spectral and magnetic properties, organometallic chemistry, classification properties, and applications.
4.	To study explores basic principles, spectrum parameters, isomer shift interpretation, bonding and structure of Fe+2 and Fe+3 compounds, Sn+2 and Sn+4 compounds, oxidation states detection, FAB, electron spray, and mass spectrometry of metal complexes.

Suggested References:

Reference Books:

1. Structural methods in inorganic chemistry. E. A. V. Ebsworth, D. W. H. Rankin and S. Cardock.
2. Spectroscopic identification of organic compounds-R. M. Silverstein, G. C. Bassler and Morril.
3. Physical methods in Inorganic chemistry- R. S. Drago.
4. Application of absorption spectroscopy of organic compounds- J. Dyers.
5. Electron Spin Resonance-Elementary theory and Practical Applications- Wertz and olton.
6. Principles of inorganic chemistry: Puri, Sharma, Kalia, Thirty third Edn. (Vishal publishing co.)
7. Advanced in inorganic chemistry: S. K. Agrawal, Keemti Lal, Fifteenth Edn. (Pragati Edition)
8. Advanced in inorganic chemistry vol. 1 & 2, Gurdeep Raj, Krishna Publication Meerut.
9. Environmental chemistry with green chemistry:Asim K.Das, Books and allied (p) ltd.

1.

On-line resources to be used if available as reference material
On-line Resources

VEER NARMAD SOUTH GUJARAT UNIVERSITY, SURAT

Master of Science, M.Sc. Inorganic Chemistry,
Semester-IV

To be effective from June-2023
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Inter/Multidisciplinary (AECC)

Elective Paper-: Coordination Chemistry and Organometallic Chemistry

Total Periods: 60

Course Code	**INEC-401**	Title of the Course	**CO-ORDINATION CHEMISTRY (Elective-I)**
Total Credits of the Course	4	Hours per Week	4 hrs

Course Objectives:	• To comprehend the kinetics and reaction mechanism of transition metal complexes, octahedral substitution reactions, stereochemical changes in octahedral complexes, and redox reactions. • To learn about Metal-ligand complex equilibria in solution, to determine stability constants of binary complex by experimental methods • To understand Magnetic properties of Transition metal complexes. Anomalous magnetic behavior. • To understand selected topic in Inorganic chemistry e.g. Stereochemistry of unusual co-ordination number 2 to 9., Metal sequestration and its industrial applications, Catalysis and Green Chemistry:

Unit-I: **(15 Periods)**

Kinetics and Reaction Mechanism of Transition Metal Complexes:

Reactivity of metal complexes, ligand replacement reaction, classification of mechanism.

Kinetics of octahedral substitution reaction:

Complementary reaction, Non-complementary reaction, Anation reaction, reactions without metal-ligand bond cleavage.

Stereochemical changes in octahedral complexes:

Molecular rearrangement in complexes, reaction of geometrical and optical isomers. Isomerization and racemization of octahedral complexes, Ligand stereo specificity.

Redox reaction:

Electron transfer reactions, mechanism of one electron transfer reactions, outer sphere electron transfer reactions, tunneling effect, cross reaction, Marker-Hush theory, inner sphere electron transfer reactions, bridged activated mechanism, experimental Techniques.

UNIT-II: Metal-ligand complex equilibria in solution: **(15 Periods)**

Stability of complex ions in solution, Basic principles, mathematical function and interrelationship.

Determination of stability constants of binary complex by experimental methods:

Spectrophotometric methods, Potentiometric method (pH-metric titration technique. i.e. Irving-Rossotti methods), Polarographic method. Factors affecting the stability of metal complexes with reference to the nature of metal ion and ligand. Statistical, electronic, chelate effect and its thermodynamics (ΔG, ΔH and ΔS)

UNIT-III: Magnetic properties of Transition metal complexes. **(15 Periods)**

Anomalous magnetic behavior:

Solute-Solvent interaction, Solute-Solute interaction, configurationl equilibrium, Equilibrium between two spin states, magnetically non-equivalent sites in the unit -cell, Quenching of Orbital moments, Orbital contribution to magnetic moments, Spin cross-over, Magnetic exchange coupling, stereochemical applications of magnetic properties.

UNIT-IV: Selected topic in Inorganic chemistry **(15 Periods)**

1. Stereochemistry of unusual co-ordination number 2 to 9.
2. Metal sequestration and its industrial applications.
3. Catalysis and Green Chemistry:

Biocatalysts- Enzyme, Synthesis, Advantages and Disadvantages, Uses.

Photocatalysts: Synthesis, Photochemical Reactions, Advantages and Challenges.

Teaching-Learning Methodology	To meet the effective teaching and the learning requirements, teaching-learning methodology comprise classroom teaching, use of e-resources, library, IT tools, encourages students to participate in seminars/ workshops, presentations by students, assignment etc.

Evaluation Pattern		
Sr. No.	Details of the Evaluation	Weightage
1.	Internal Written / Practical Examination (As per CBCS R.6.8.3)	30%
2.	University Examination	70%

Course Outcomes: Having completed this course, the learner will be able to	
1.	Understand the kinetics and reaction mechanisms of transition metal complexes, octahedral substitution reactions, stereochemical changes in octahedral complexes, and redox reactions.
2.	To learn the stability of complex ions in solution, their mathematical function, and the factors affecting their stability, including the statistical, electronic, and chelate effects.
3.	To understand Solute-Solvent interaction, configuration equilibrium, spin state equilibrium, magnetically non-equivalent sites, orbital moment quenching, spin cross-over, magnetic exchange coupling, and stereochemical applications of magnetic properties.
4.	Understand the stereochemistry of unusual co-ordination numbers 2 to 9, metal sequestration, catalysis, green chemistry, biocatalysts, and photocatalysts, their synthesis, advantages, and challenges.

REFERENCE BOOKS

1. Inorganic reaction mechanism, Basello and Pearson, Wiley Eastern Ltd. New Delhi-1977.
2. Kinetic and Mechanism of Inorganic reactions: A study of metal complexes in solution, A. A. Frost and R. G. Pearson, Wiley, New York-(1953, 1961).
3. Inorganic reaction mechanism, S. k. Skyes.
4. Electron Transfer reaction of metal complex ions in solution, H. Taube, Academic press, London-1970.
5. Modern Inorganic Chemistry, J. Lewis and R. G. Wilkinson, Interscience, New York.
6. Inorganic Reaction Mechanism, M. L. Obe, Nelson, London-1972.
7. Mechanism of Inorganic Reactions in solutions: An Introduction, D. Benson, Mc GrowHill, Chapter-15, P-455, 1968.
8. "Comprehensive coordination Chemistry" G. Wilkinson, R. D. Gillard and J. A. Mcclevertypergamon, London, Vol-1. P-281-322, 331-374,385-411, 415-458 (Chapter-7-4) and P-463-471-1987.
9. Coordination Chemistry, Rajbir Singh, Mittal Publication, New Delhi.
10. Coordination Chemistry, G with more

11. Instability constants of complex compounds, K.B. Yatsimirskil and V.P.A. Vasilis (Translated from Russian), D. Van Mostrand Co. Inc. Princeton, New Jersey.
12. Chemistry of complex Equilibria, M.T. Beck (Hungary), translated by R.A., van Nostrand Co., London, 1970.
13. Rossotti F.J.C. and Rossotti H.S., The determination of stability constants, McGrow Hill, New York, P-108, 1961.
14. Irving H. and Rossotti H. S. J. Chem. Soc, 3397, 1953.
15. Elements of Magnetochemistry, R.L. Datta & A. Syamal, Affiliated East-West press Ltd., New Delhi (1993).
16. Magnetochemistry, R. L. Karlin, Springer-Verlag, New York (1993).
17. Introduction to Magnetochemistry, A. Earnashaw, Academic Press, New York (1968).
18. Magnetism and Transition metal Complexes, F. E. Mabbs & D. J. Machin, Chapman and Hall, London (1973).
19. Stereo chemistry and bonding in Inorganic chemistry, J. E. Fergusion. Prentice Hall, Inc. Eryleword Cliffs, N. J. 1974.
20. Inorganic chemistry (Principles of structure and coordination compounds), J. E. Huhee Harper and Row Intermediated series, N.Y. 1963.
21. Organic sequestering agents, Chaberck S. and Martell, John Wiley and Sons, Inc, New York (1959).
22. Green Chemistry, K. R. Desai, Tarulata Chhowala, Bhavanaben Mistry, Himalaya Publication, Mumbai.

On-line resources to be used if available as reference material
On-line Resources

Master of Science, M.Sc. Inorganic Chemistry,
Semester-IV

To be effective from June-2023
(NEP-2020)

Inter/Multidisciplinary (AECC)

Elective Paper-: Nuclear Chemistry and Metallurgy

Total Periods: 60

Course Code	**IEC-402**	Title of the Course	**Nuclear Chemistry and Metallurgy (Elective-I)**
Total Credits of the Course	4	Hours per Week	4 hrs

Course Objectives:	• To comprehend nuclear binding energy, radioactivity and nuclear reactions. • To learn about electrochemical applications • To understand basics of occurrence of metals and extraction techniques. • To understand non-Ferrous extractive metallurgy of Copper, Zinc and Lead

Unit-I: Nuclear Chemistry-I **(15 Periods)**

Introduction, Nuclear binding energy, Radioactivity and Nuclear reactions, Nuclear fission, and nuclear fusion, Spectroscopic techniques based on nuclear properties, Ortho and para hydrogen, The separation of stable isotopes, The separation of unstable isotopes.

UNIT-II: Nuclear Chemistry-II **(15 Periods)**

Electrochemical applications, Applications of radioactivity in analytical chemistry, biochemical, physiological and medicinal application of isotopic tracers, Technological and industrial applications.

UNIT-III: Basics of occurrence of metals and extraction techniques **(15 Periods)**

Occurrence of metals in India, Definition of Ores, Important ores of some common elements like Fe, Al, Cu, Zn, Pb, Sn, Ag, Ti, Na etc. General principles of extraction of metals- (I) Crushing and Pulverising (II) Concentration and dressing of ores :– a) Gravity separation (Hydraulic washing) b) Magnetic separation method c) Froth flotation method d) Chemical method (III) Calcination or Roasting of Ores (IV) Reduction of metal oxides to free metals:- a) Smelting b) Reduction of concentrated ores by other methods such as precipitation, electrolytic reduction (V) Purification and refining of metals:- a) Liquification b) Poling c) Distillation d) Electrolytical Refining.

UNIT-IV: Non-Ferrous extractive metallurgy of Copper, Zinc and Lead **(15 Periods)**

(A) Extraction of Copper (Cu) in pyrometallurgical process: - (I) Extraction of Cu from sulphide ore: - (a) Conventional route- concentration, roasting, smelting, converting, refining (b) Newer process - Flash smelting, Continuous smelting by WORCRA process, Noranda process and Mitsubishi process. (II) Areas of extraction and application of copper.

(B) Extraction of Zinc (Zn) in pyrometallurgical process: - (I) Extraction of Zn from sulphide ore: - (a) Horizontal retort reduction (b)Vertical retort reduction (c) Exothermic reduction (d) Electrolytic reduction (f) Imperial Smelting Process (ISP). (II) Zinc from Lead slag by Slag Fuming process. (III) Areas of extraction and application of Zinc.

(C) Extraction of Lead (Pb) in pyrometallurgical process: - (I) Extraction of Lead Bullion (II) Parkes Process (III) Cupellation (IV) Dezincing Process (V)Areas of extraction and application of Lead.

Teaching-Learning Methodology	To meet the effective teaching and the learning requirements, teaching-learning methodology comprise classroom teaching, use of e-resources, library, IT tools, encourages students to participate in seminars/ workshops, presentations by students, assignment etc.

Evaluation Pattern		
Sr. No.	Details of the Evaluation	Weightage
1.	Internal Written / Practical Examination (As per CBCS R.6.8.3)	30%
2.	University Examination	70%

Course Outcomes: Having completed this course, the learner will be able to	
1.	Define nuclear binding energy, radioactivity and nuclear reactions.
2.	Differentiate between Nuclear Fusion and Nuclear Fission.
3.	Discuss spectroscopic techniques based on nuclear properties and separation of stable and unstable isotopes.
4.	Describe Electrochemical applications of radioactivity in analytical chemistry and biochemical, physiological and medicinal, technological and industrial applications of isotopic tracers.
3.	Define Ores and explain general principles of extraction of metals from their ores like Fe, Al, Cu, Zn, Pb, Sn, Ag, Ti, Na.
4.	Define Non-Ferrous extractive metallurgy and describe pyrometallurgical processes for extraction of Cu, Zn and Pb.

REFERENCE BOOKS

1) Principles of Inorganic Chemistry- Puri Sharma and Kalia, Vishal publishing 33rd Ed.
2) Technical EIA guidance manual for metallurgical industry- Ministry of Environment and Forest, Govt of India.
3) A Text book of metallurgy by AR. Bailey, Macmillan Ed. 1967, second edition.
4) Extraction of non-ferrous metals, H. Ray, H. S Shridhar, K.P. Abraham, affiliated to east west Pvt ltd 2014
5) Inorganic chemistry by Alan G. Sharpe, Pearson publication
6) Nuclear chemistry and its application by M. Haissinky, Addison- Wesley Pub.
7) Nuclear chemistry, Bernard G. Harvey by Prentice-Hall, Inc., Englewood cliffs, N. J.
8) Elements of Nuclear Chemistry by R. Gopalan, Vikas Publishing House Pvt. Ltd.
9) Essentials of Nuclear chemistry by H. J. Amikar, Wiley Eastern Limited, New Delhi.

On-line resources to be used if available as reference material
On-line Resources

Syllabus of Master of Science,
M.Sc. Inorganic Chemistry,
Semester IV
To be effective from June 2023
(NEP-2020)
OSEC-401: Green Chemistry
(Skill Enhancement Course)

Total Periods: 30

Course Code	**OSEC-401**	**Title of the Course**	Green Chemistry
Total Credits of the Course	2	**Hours per Week**	2 hrs.

Course Objectives:	• To provide knowledge on green and sustainable chemistry • To learn and introduces various principle of green chemistry. • To learn about the replacement of toxic chemicals with environment friendly green compounds and benefits of utilizing concept of green reagents and green catalyst. • To create awareness among students regarding to develop skills to develop an understanding of social and environmental responsibilities within the broad area of Green Chemistry

Unit	Description

1.	**BASICS CONCEPTS OF GREEN CHEMISTRY & GREEN REAGENTS** **A. BASICS CONCEPTS OF GREEN CHEMISTRY** Basic principles of green chemistry: (i) Waste minimization (ii) Atom economy(iii) Hazardous products minimization (iv) Designing safer chemicals (V) Planning for minimum energy requirement for synthesis (vi) Proper Solvent selection (vii) Proper starting material selection (viii) Use of Protecting groups (ix) Use of Catalysts (x) Biodegradable product designing (xi) Proper designing of manufacturing plants (xii) Strengthening analysis techniques. **B. GREEN REAGENTS AND WATER BASED GREEN SYNTHESIS** Polymer Based Green Reagents, Water Based Reactions: Diels-Alder Reaction, Claisen Rearrangement, Michael Reaction, Aldol Condensation, Knoevenagel Reaction, Benzoin Condensation, Claisen-Schmidt Condensation and Heck Reaction

2.	**GREEN CATALYSTS** (i) Acid Catalysts (ii) Oxidation Catalysts (iii) Basic Catalysts (iv) Polymer Supported Catalysts (v) Polystyrene-aluminium Chloride (vi) Polymeric Super Acid Catalysts (vii) Polystyrene-metalloporphyrins (viii) Polymer Supported Photosensitizers (ix) Polymer Supported Phase Transfer Catalysts and (x)Phase Transfer Catalyst in Green Chemical Reaction(xi) Miscellaneous Illustration catalysts like TiO_2 Photocatalyst in Green Chemistry, Solid Support Reagents, Synthesis of Bromo organics: Development of Newer and Ecofriendly Sromination Protocols and Brominating Agents, Synthesis of Pyridinium Fluorochromate (PFC) and Synthesis of Isooctane

Teaching-Learning Methodology	To meet the effective teaching and the learning requirements, teaching-learning methodology comprise classroom teaching, use of e-resources, library books, IT tools, encouraging students to participate in seminars/ workshops, presentations by students, assignments etc.

Evaluation Pattern		
Sr. No.	Details of the Evaluation	Weightage
1.	Internal Written	15 Marks
2.	University External Written Examination	35 Marks

Course Outcome: Having Completed this course, the learner will be able to	
1.	To get the basic concept, background and significance of green chemistry, various tools and twelve principles of green chemistry.
2.	To get the design and development of green synthetic methods by using principles of green chemistry that reduces the generation of waste and hazardous substances.
3.	To get basic concepts to Identify and differentiate between green reagents and conventional reagents and find out suitable green alternatives in chemical processes.
4.	To differentiate and critically evaluate the green catalysts against conventional catalysts and applications of these green catalysts.

Suggested Reference Books:

1. V.K. Ahluwalia, M. Kidwai, New Trends in Green Chemistry, Kluwer Academic Publishers, Boston, London, 2012, pp. 5-36 and the reference cited there in.
2. Paul T. Anastas and John C. Warner, Green Chemistry, Theory and Practice, Oxford University Press, New York, 1998.
3. Colin Baird, Environmental Chemistry, W.H. Freeman, New York, 1999.
4. V.K. Ahluwalia and Renu Aggarwal, Organic Synthesis: Special Techniques, Narosa Publishing House, New Delhi, 2001, pp. 150-190 and the references cited therein.
5. P. T. Anastas and 1.c. Warner, 'Green Chemistry, Theory and Practice', Oxford University Press (1998).

Master of Science, M.Sc.
Inorganic Chemistry,Semester-IV

To be effective
from June-2023
(NEP-2020)

IP-401: Inorganic Chemistry Practicals

Course Code	**Practical (IP-401)**	Title of the Course	**Practicals**
Total Credits of the Course	4	Hours per Week	4 hrs

Course Objectives:	• To understand and prepare the inorganic synthesis.

1. Preparation and Estimation of chloro-penta ammine Cobalt-II chloride $[CoCl(NH_3)_5]Cl_2$
2. Preparation and Estimation of Reineck's salt [Ammonium tetrathiocyanato diammne chromate] $[NH_4(NH_3)_2Cr(CNS)_4]$
3. Preparation and Estimation of Bis[Ethylene diammine]copper sulphate.
4. Preparation and Estimation of potassium trioxalato ferrate $[K_3(Fe(C_2O_4)_3.3H_2O]$
5. Preparation and Estimation of Potassium trioxalato aluminate $K_3[Al(C_2O_4).3H_20$
6. Preparation and Estimation of Cu[Resacetophenone]$_2$ $[Cu(C_8H_7O_3)_2$
7. Preparation and Estimation of Cu[Salicylaldehyde]$_2$ $[Cu(C_7H_5O_2)_2]$
8. Preparation and Estimation of Cu[Salicylaldehyde]$_2$Schiff base $[Cu(C_7H_6ON)_2]$
9. Preparation and Estimation of Ni[Salicylaldehyde]$_2$ $[Ni(C_7H_5O_2)_2]$
10. Preparation and Estimation of Ni[Salicylaldehyde]$_2$Schiff base $[Ni(C_7H_6ON)_2]$
11. Preparation and Estimation of Potash alum $[K_2SO_4.Al_2(SO4)_3.24H_2O]$
12. Preparation and Estimation of Co[Salicylaldehyde]$_2$ $[Co(C_7H_5O_2)_2]$
13. Preparation and Estimation of Co[Salicylaldehyde]$_2$Schiff base $[Co(C_7H_6ON)_2]$
14. Analysis of water sample
15. Determine the stability constant of Ni-glycine complex by using Irving-Rossoti method
16. Determine the stability constant of Co-glycine complex by using Irving-Rossoti method

17. Determine the stability constant of Cu-glycine complex by using Irving-Rossoti method

Teaching-Learning Methodology	Introduction, interaction with students in calculation of mole ratios, carry out experiments at each step according to the respective practical, interpretation of spectra and deduce the structure.

Evaluation Pattern		
Sr. No.	Details of the Evaluation	Weightage
1.	Internal Written / Practical Examination (As per CBCS R.6.8.3)	30%
2.	University Examination	70%

Course Outcome: Having Completed this course, the learner will be able to	
1.	To synthesize different Inorganic compounds
2.	To perform water analysis
3.	To estimate some Inorganic compounds

Reference Books Recommended

1. A text book of quantitative Inorganic Analysis - A. I. Vogel.
2. Text book of Quantitative Inorganic Analysis - Kolthoff and Sandell.
3. Experimental Inorganic Chemistry - Palmer W. G.
4. Advanced Practical Inorganic Chemistry - Adams and Raynor.
5. Manual in Dairy Chemistry - I.C.A.R. Sub-Committee on Diary Education.
6. Chemical methods for environmental analysis - R. Ramesh and M. Anbu.

On-line resources to be used if available as reference material
On-line Resources