Name of Program	**Master of Science(Chemistry)**
Abbreviation	**M.Sc.**
Duration	**2 Years**
Eligibility Criteria	**M.Sc. Chemistry** **(Organic/Inorganic/ Analytical/Physical)** ELIGIBILITY:(SC/ST- 35%, OPEN/SEBC-40%), A candidate who has obtained his/her Bachelor's Degree with chemistry shall be considered eligible for admission in M .Sc .Chemistry **M.Sc. (Organic Chemistry** ELIGIBILITY :(SC/ST- 35%, OPEN/SEBC-40%), A candidate who has obtained his/her Bachelor's Degree with chemistry shall be considered eligible for admission in M.Sc.- Chemistry/Organic Chemistry. **M. Sc .Environmental Chemistry** ELIGIBILITY :(SC/ST- 35%, OPEN/SEBC-40%) A candidate who has obtained his/her Bachelor's Degree with chemistry shall be considered eligible for admission in M.Sc.- Chemistry/Organic Chemistry (SF.)/ Environmental Chemistry (S.F.) Course. **M.Sc. Organic Chemistry (Evening)** ELIGIBILITY :(SC/ST- 35%, OPEN/SEBC-40%) A candidate selecting M.Sc. Evening course (2 years) with Organic Chemistry as specialization must have passed the Bachelor's Degree examination with Chemistry and English as compulsory subject. Those who are in service will have to produce minimum one year's experience certificate from the Employer.
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 practices during 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												

Structure of M. Sc, Syllabus
Semester-I

Sr. No.	Course Code	Course Title	L	T/C/S	Credit
1	1803080201010001	Inorganic Chemistry	4		4
2	1803080201020001	Organic Chemistry	4		4
3	1803080201030001	Physical Chemistry	4		4
4	1803080201040001	Instrumental and chemical analysis	4		4
5		Practicals + T/C/S	12	3	6 + 3
			28	3	25

Faculty Code: Science Subject code:
Level code:
Name of program: M. Sc. Subject: Chemistry
External Examination Time Duration: 03 hrs

Name of Exam	Semester	Paper No	Course group	Credit	Internal Marks	External Marks	Total Marks
M. Sc.	I	I	Core	04	30	70	100
		II	Core	04	30	70	100
		III	Core	04	30	70	100
		IV	Core	04	30	70	100
			Practical + T/C/S	06 +3	60	140	200
			Total	25	180	420	600

Master of Science, Inorganic Chemistry
M.Sc. Inorganic Chemistry, Semester I

Course Code	[1803080201010001]	Title of the Course	**INORGANIC CHEMISTRY**
Total Credits of the Course	4	Hours per Week	4 hrs

Course Objectives:	• To understand concept of symmetry and group theory with its application. • To understand basics of Quantum mechanics, familiarize with various types of operators and implant the knowledge of orbital configuration. • To learn the inorganic reaction mechanism. Different types of reaction mechanism and also various types of transition state theory. • Understanding of concepts of metal cluster, classification of metal clusters, Wade's rule, Carboranes, low and high nuclearity carbonyl clusters.
Mapping between CO and PSO	

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8	PSO9	PSO10	PSO11	PSO12
CO1		■	■				■	■	■	■		
CO2	■		■		■		■	■	■	■		■
CO3	■		■	■	■				■	■	■	■
CO4	■	■	■	■			■		■	■	■	■

Course Content		
Unit	Description	Weightage* (%)
1.	**SYMMETRY AND GROUP THEORY IN CHEMISTRY AND ITS APPLICATIONS** Representation of Group: preparation of matrics and vectors matrix notation for geometric transformation, Orthogonality theorem and its consequences, reducible and irreducible representation and their relation, preparation of character table for C_{2v} and C_{3v} point groups, applications of group theory transformation properties of atomic crystals.	25

2.	**QUANTUM MECHANICS** Discussion of solution of Schrodinger equation to same model system e.g. the one dimensional harmonic oscillator, two particle rigid rotator. Ordinary angular momentum, generalized angular momentum, Eigen functions of angular momentum, eigen values of angular momentum, different types of operators and their uses, addition of angular momentum, spin, Russell-Saunders terms and coupling scheme, term separation energies of the p^n and d^n configuration, magnetic effect: spin orbit coupling and Zeeman effect(splitting)	25
3.	**INORGANIC REACTION MECHANISM** Labile and inert complexes, factors responsible for lability and inertness of complexes. Reactivity of metal complexes, ligand replacement reaction: classification of mechanism and energy profile of reaction. Inert and labile complexes, interpretation of liability and inertness of transition metal complex on the basis of reaction rate, VBT and CFT. Transition state or activated complex, substrate, attacking regents electrophilic and nucleophilic, nature central atom. Kinetic application of CFT. Kinetics of octahedral substitution, acid hydrolysis, factor affecting acid hydrolysis, base hydrolysis conjugate base mechanism, direct and indirect evidences in favour of conjugate mechanism.	25
4.	**METAL CLUSTERS** Introduction, classification, carbonyl cluster, low nuclearity carbonyl clusters, high nuclearity carbonyl clusters, electron counting scheme for HNCCS, Wade's rules. Halides types clusters: dinuclear clusters, trinuclear clusters, tetranuclear clusters, hexanuclear cluster. Chevrel phases and zintl ions, Carboranes, metalloboranes, metallo carboranes, higher boranes(hexaborane-10, decaborane-14), number and types of bonds present in higher boranes.	25

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.	Details of the Evaluation	Weightage

No.		
1.	Internal Written / Practical Examination (As per CBCS R.6.8.3)	30%
3.	University Examination	70%

Course Outcomes: Having completed this course, the learner will be able to	
1.	Understand the of matrices and vectors matrix notations, reducible representation and their relation, applications of group theory
2.	Learn regarding quantum mechanics, angular momentum, understanding the solution of Schrodinger equation, Different types of operators and their uses
3.	Learn different types of inorganic reaction mechanism, acid hydrolysis, base hydrolysis . conjugate base mechanism their synthetic application
4.	Understand the introduction and classification of metal clusters, electron counting scheme for HNCCS and Wade's rule and their synthetic application

Suggested References:

1. Chemical applications of group theory by F.A Cotton (Second edition), Wiley Eastern Limited, 1976 New Delhi
2. Group theory and its application by P.K. Bhattacharya, Himalaya publishing hours, Mumbai, 1986
3. Group theory and symmetry by L. R. hall, McGraw hill, New York, 1989.
4. Quantum Chemistry by Ira N. Levine, Prentice-Hall of India Pvt. Lid, New Delhi, 1994.
5. Introductory Quantum Chemistry (Third edition) by N. W. Hanna, Benjamin, Menlo Park, Cailf, 1988.
6. Quantum Chemistry and Spectroscopy by M. S. Pathania, Vishal Publications, India, 1981.
7. Kinetic and Mechanism' by A. A. Frost and R. G. Pearson, Wiley, New York, 1953, 1961.
8. Mechanism of Inorganic Reactions by F. Basolo and R.G. Pearson, Second Edition, Wiley Eastern Limited, New Delhi, 1977.
9. Advanced Inorganic Chemistry by F. A Cotton and R.G. Wilkinson, John Wiley & Sons, N. Y.
10. Principales of Inorganic Chemistry, by Puri. Sharma and Kalia, 33rd Edition, Vishal publishing Co. Jalandhar, Dehli, 2017.
11. Advanced Inorganic Chemistry by S. K. Agarwala and Keemtilal, Pragati Prakashan, Meerut.
12. Advanced Inorganic Chemistry, Volume-Il by Gurdeep Raj, Krishna Prakashan Media Ltd., Meerut.
13. Inorganic Chemistry by Gary L Miessler and Donald A. Tarr, Pearson Education

International.

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

Master of Science, Inorganic Chemistry
M.Sc.Inorganic Chemistry, Practicals

Course Code	[1803081001050001]	Title of the Course	**INORGANIC CHEMISTRY**
Total Credits of the Course	4	Hours per Week	4 hrs

Course Objectives:	• To impart basic knowledge of qualitative analysis of Inorganic mixture • To identify three anions and three cations including one rare earth element by group separation. • To impart knowledge of different radicals by confirmative test. • Preparation of inorganic metal salts and it's crystallization • To confirm the structure and prepare the relevant derivative.
Mapping between CO and PSO	
	•

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8	PSO9	PSO10	PSO11	PSO12
CO1		■	■				■	■	■	■		
CO2	■		■		■		■	■	■	■		■
CO3	■		■	■	■				■	■	■	■
CO4	■	■	■	■			■		■	■	■	■
CO5	■	■	■	■			■		■	■	■	■

Course Content

1. Inorganic Qualitative Analysis: (Six elements including ONE rare element)
2. Inorganic Preparation.
   - I. Hexa-ammine nickel (II) chloride
   - II. Mohr's salt (Ferrous Ammonium sulphate)
   - III. Sodium trioxalato ferrate trihydrate
   - IV. Sodium cobaltinitrite

V. Tetra amine cupric sulphate
VI. Reineck's salt (Ammonium tetrathiocyanate diammine Chromate)

Teaching-Learning Methodology	Introduction, demonstration of handling equipments, reference books and frequent instruction according to the respective practical.

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

Course Outcomes: Having completed this course, the learner will be able to	
1.	Understand basics analysis of Inorganic mixtures.
2.	Identify anions by dry test of the mixture.
3.	Separation of each anions by group test from mixture.
4.	Identify each cation and confirm it by confirmative test.
5.	Understand different methods of Preparations of inorganic salts.
6.	Appreciate good laboratory practices.

Suggested References:

1. Textbook of practical inorganic chemistry – A.I. Vogel
2. Practical Chemistry by Dr O. P. Pandey, D. N. Bajpai, Dr. S. Giri
3. Advance inorganic analysis by Agarwal, Keemti lal
4. Qualitative Inorganic analysis - Vogel
5. Inorganic practical by Chatwal and Anand

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

On-line Resources

Master of Science, Organic Chemistry
M.Sc. Organic Chemistry, Semester I

Course Code	[1803080201020001]	Title of the Course	**ORGANIC CHEMISTRY**
Total Credits of the Course	4	Hours per Week	4 hrs

Course Objectives:	• To understand concept of reactive intermediate and their application in organic synthesis. • To understand basics of pericyclic reaction, familiarize with various theories of pericyclic reaction to access the feasibility of various pericyclic reaction and implant the knowledge to predict stereo chemical outcome of various pericyclic reactions. • To learn anchimeric assistance, stereo chemistry and internal substitution reaction of aliphatic and allylic compounds. Aromatic nucleophilic substitution, cine substitution, elimination reactions, their stereo chemistry and mechanisms. • Understanding of concepts of chirality, topicity, prochirality, dynamic resolutions, types of stereo selective and stereo specific reactions, conformation of substituted and fused aromatic rings along with respective strains theories.
Mapping between CO and PSO	

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8	PSO9	PSO10	PSO11	PSO12
CO1		■	■				■	■	■	■		
CO2	■		■		■		■	■	■	■		■
CO3	■		■	■	■				■	■	■	■
CO4	■	■	■	■			■		■	■	■	■

Course Content		
Unit	Description	Weightage* (%)
1.	**REACTION MECHANISM & REACTIVE INTERMEDIATES** Detailed study of organic reaction intermediates. Generation, structure, stability and reactions of –	25

	Carbocations (Classical and non-classical): Phenonium ion, norbornyl system, common carbocation rearrangements- Demjanov, Pinacole-Pinacolone, Rupe. **Carbanions:** Mechanism of condensation involving enolates - Aldol, Claisen, Mannich, Dieckmann, Michael and Shapiro reactions. **Carbenes:** Mechanism of Arndt-Eistert reaction, Reimer-Tiemann reaction and Bamford Steven's rearrangement reaction. **Free Radicals:** Allylic halogenation (NBS), coupling of alkenes and arylation of aromatic compounds by diazonium salts. Sandmeyer reactions. Free radical rearrangements, Hunsdiecker reaction.	
2.	**PERICYCLIC REACTIONS** **Introduction** - Definition, Characteristics and Classification Molecular orbitals and symmetry properties of ethylene, 1,3-butadiene, 1,3,5- hexatriene and allylsystems. **Electrocyclic Reactions:** Woodward-Hoffman Correlation diagram and derivation of selectionrules Conrotatory and disrotatory motions, FMO and PMO approach for 4n and (4n+2)Πelectron system and allyl systems. **Cycloaddition Reactions** : Antarafacial and suprafacial additions. FMOand PMO approach for 4n and (4n+2)Πelectron Systems(No correlation diagram),Diels-Alder reaction, stereoselectivity,Effect of substituents. **Sigmatropicrearrangements:**Suprafacial and antarafacialshifts involving H & C moieties, retention and inversion of configurations. The Cope and Claisen rearrangements, Ene reaction, 1, 3- dipolar cydoadditions. Examples of electrocyclic, cycloaddition and sigmatropic rearrangements.	25
3.	**SUBSTITUTION AND ELIMINATION REACTIONS** **A: Aliphatic Nucleophilic Substitution:** The SN1 , SN2 , SNi mechanisms. Reactions of Allylic halides, neighbouring group participation by -OH, -NH2, -COO- , -RS, - halogen, aromatic ring. **B: Aromatic Nucleophilic Substitution:** The SN2 , SN1 and benzyne mechanisms, Reactivity - effect of substrate structure, leaving group and attaching nucleophile, The Von Richter rearrangement. **C: Elimination reaction:** Hoffmann and Zaitsev's rule of elimination, E1, E2 and E1CB Reaction mechanism and orientation.	25
4.	**STEREOCHEMISTRY:** Stereo chemical principles; Enantiomeric relationships; Distereomeric relationship; R-S and E-Z nomenclature; Dynamic stereochemistry; Chiral-Prochiral relationships; Stereo selective and Stereo specific reactions; Racemates and racemic modification, Resolution of racemic modification, Optical activity in the absence of chiral carbons biphenyl, allenes, spiranes. **B.** Confirmational Analysis: Interconversion of Fischer, Newman and Sawhorse projections. Newer method of asymmetric synthesis	25

	(including enzymatic and catalytic nexus), enantio and diastereo selective synthesis.Simple acyclic and cyclic (chair and boat cyclohexanes, Decalins, Perhydrophenanthrene)systems Effects of conformation on reactivity in acyclic compounds and substituted cyclohexanes.	

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 / Practical Examination (As per CBCS R.6.8.3)	30%
3.	University Examination	70%

Course Outcomes: Having completed this course, the learner will be able to	
1.	Understand generation of reactive intermediates, their mechanism, rearrangement based on each intermediate, application of reactive intermediate in organic synthesis and industries application.
2.	Recognise pericyclic reactions, understanding of thermal and photochemical reaction, determination of mechanistic pathway, symmetry properties, aromaticity based on mobius method, application of pericyclic reactions in organic synthesis.
3.	Learn difference between eliminations and addition reaction, concept of anchimeric assistance in various groups like sulphide, halogen, phenyl, hydroxyl, tosylates & mesilates, amino group etc, aromatic nucleophilic substitution through addition elimination, elimination addition, cine substitution and their synthetic application.
4.	Detect chirality in moleculer structure, recognize the relationship between enantiomeric and diastereomeric structures, understand and distinguis h stereoselective and stereospecific reactions, dynamic resolution, confirmative study of various substituted aromatic and fused aromatic rings and their application inn pharmaceutical industry.

Suggested References:

Unit I:

1. Carbenes, Benzynes and Nitrenes by Gilchrist, T. L. and Rees.
2. Advanced Organic Chemistry-Reactions, Mechanism and Strucuture, Jerry March, John Wiley.
3. Reaction Mechanism in Organic Chemistry by S. M. Mukherji and S. P. Singh (McMillan India Ltd., 1976).
4. Organic Chemistry (3/e) by J. B. Hendrickson, Donald J. Crem and George S. Rammond (McGraw-Hill Book Co. &Kogekusha Co. Ltd., 1970).
5. Organic Chemistry (5/e) by Morrison & Boyd (Prentice Hall).
6. Advanced Organic Chemistry by Carey &Sundberg (3rd edition).
7. A Guide Book to Mechanism in Organic Chemistry, Peter Sykes, Longman.
8. Advanced Organic Chemistry, F. A. Carey and R. J. Sundberg, Plenum.
9. Organic chemistry 2nd ed. Jonathan clayden, Nick greeves, Stuart Warren.
10. Reaction Mechanism and Reagents in Organic Chemistry by C. R. Chatwal (Himalaya Publishing House, Bombay, 1987).

UNIT II:

1. March's Advanced Organic Chemistry Reactions, Mechanisms, And Structure 7th ed. 2013 Michael B. Smith. Wiley.
2. Mechanism AndTheory In Organic Chemistry-2007 by Thomas H. Lowry, Kathleen S. Richardson, Forbes.Harper& Row, Publishers. New York, Hagerstown, San Francisco, London.
3. Advanced Organic Chemistry Part A: Structure and Mechanisms by Carey &Sundberg (5th edition),2000, Springer.
4. Pericyclic Reactions, S. M. Mukherji, Macmillan, India.
5. Photochemistry AndPericyclic Reactions 3rd ed. by Jagdamba Singh 2010. New Age International Publishers Ltd. New Delhi.
6. Pericyclic Reactions A mechanistic and problem solving approach Sunil Kumar, Vinod Kumar, S.P.Singh Academic Press 2015

UNIT III:

1. Advanced Organic Chemistry-Reactions, Mechanism and Strucuture, Jerry March, John Wiley.
2. Reaction Mechanism in Organic Chemistry by S. M. Mukherji and S. P. Singh (McMillan India Ltd., 1976).
3. Organic Chemistry (3/e) by J. B. Hendrickson, Donald J. Crem and George S. Rammond (McGraw-Hill Book Co. &Kogekusha Co. Ltd., 1970).
4. Organic Chemistry (5/e) by Morrison & Boyd (Prentice Hall).
5. Organic Chemistry by Carey &Sundberg (3rd edition).
6. A Guide Book to Mechanism in Organic Chemistry, Peter Sykes, Longman.
7. Physical organic chemistry by Jack Hyne
8. Reaction mechanism by Jagdambasingh.
9. Organic chemistry - Reaction mechanism, by P.S. Kalsi, New age international publishers.

UNIT IV:

1. Advanced Organic Chemistry: Part A: Structure and Mechanisms; By Francis A. Carey, Richard J. Sundberg, fifth edition, Published by Springer.

2. Advanced Organic Chemistry: Part B: Reaction and Synthesis; By Francis A. Carey, Richard J. Sundberg, fifth edition, Published by Springer.
3. Stereochemistry of Carbon Compounds; By Ernest L. Eliel, Published by Tata McGraw-Hill Publishing Company Ltd.
4. Basic organic stereochemistry; By Ernest Ludwig Eliel, Samuel H. Wilen, Michael P. Doyle, Published by Wiley-Interscience.
5. Introduction to Stereochemistry; By Kurt Martin Mislow, Dover Publication INC.
6. Stereochemistry of Organic Compounds: Principles and Applications; By D. Nasipuri, New Age International (P) Ltd. Publisher.
7. Stereochemistry Conformation and Mechanism; By P.S. Kalsi, New Age International (P) Ltd. Publisher.
8. Basic Stereochemistry of Organic; By SubrataSen Gupta, First edition, Published by Oxford University Press.

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

Master of Science, Organic Chemistry
M.Sc.Organic Chemistry, Practicals

Course Code	[1803081001050001]	Title of the Course	**ORGANIC CHEMISTRY**
Total Credits of the Course	4	Hours per Week	4 hrs

Course Objectives:	• To impart basic knowledge for the separation of organic ternary mixture • To identify nature of mixture i.e., solid-solid, solid-liquid, liquid-liquid etc. • To impart knowledge of different purification techniques including distillation. • Separation and identification of component with their functional group test and M.P. /B.P. • To confirm the structure and prepare the relevant derivative.
Mapping between CO and PSO	

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8	PSO9	PSO10	PSO11	PSO12
CO1		■	■				■	■	■	■		
CO2	■		■		■		■	■	■	■		■
CO3	■		■	■	■				■	■	■	■

	CO4 ■ ■ ■ ■ ■ ■ ■ ■ ■ ■ ■ ■ CO5 ■ ■ ■ ■ ■ ■ ■ ■ ■ ■ ■ ■

Course Content

3. Mixture analysis: (Minimum eight mixtures) Ternary mixture to be given. (S+S+S), Semisolids or (L+L+L). Type, determination, Separation by physical and chemical methods. (both permitted in case of liquids)
4. Paper Chromatography

Teaching-Learning Methodology	Introduction, demonstration of handling equipments, reference books and frequent instruction according to the respective practical.

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

Course Outcomes: Having completed this course, the learnerwill be able to	
1.	Understand basics of separation of organic tertary mixtures.
2.	Identify and chemical nature of mixture.
3.	Separate of each component from mixture.
4.	Identify each component through their functional group test, elemental analysis and M.P/BP.
5.	Purify the compounds using different techniques including distillation, crystallization etc.
6.	Record physical constants for individual compounds.

7.	Appreciate good laboratory practices.

Suggested References:
1. A text book of practical organic chemistry – A. I. Vogel 2. Practical organic Chemistry – Mann and Saunders 3. A handbook of quantitative and qualitative analysis – H. T. Clarke 4. Comprehensive Practical Organic Chemistry : Qualitative Analysis V K Ahluwalia& S. Dhingra. 5. Comprehensive Practical Organic Chemistry : Preparations and Quantitative Analysis V K Ahluwalia& R. Aggarwal Universities Press. 6. An Advance Course in practical Chemistry, A K. Nad, B. Mahapatra and A. Ghoshal.
On-line resources to be used if available as reference material
On-line Resources

Master of Science, Physical Chemistry
M.Sc.Physical Chemistry, Semester I

Course Code	[1803080201030001]	Title of the Course	**PHYSICAL CHEMISTRY**
Total Credits of the Course	4	Hours per Week	4 hrs

Course Objectives:	• To understand concept of thermodynamics in solution. • To understand type of interactions and orientation of molecules in solution. • To understand basic concept of statistical thermodynamics. • Understanding of concepts of kinetics of different types of chemical reaction. • To lean basic concept of synthesis of polymer and solution behaviour of polymer
Mapping between CO and PSO	

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8	PSO9	PSO10	PSO11	PSO12
CO1		■	■				■	■	■	■		
CO2	■		■		■		■	■	■	■		■
CO3	■		■	■	■				■	■	■	■

CO4													
CO5													

Course Content		
Unit	Description	Weightage* (%)
1.	**CHEMICAL KINETICS** Theories of Unimolecular gas reactions: Lindemann theory, Kinetics of some complex reactions (i)Reversible reactions(only first order opposed by first order) (ii)Consecutive reactions(A→B→C); Steady state treatment or approximation, Enzyme catalysed reactions, Kinetics of general Chain reaction, Kinetics of photochemical reactions(H_2-$Cl_2$and H_2-Br_2) , Kinetics , Mechanism ,determination of activation energy and chain length of some organic decomposition (i) decomposition of ethane (ii) decomposition of acetaldehyde, Effect of Ionic strength on rates of ionic reactions (Primary and secondary salt effect) Numerical.	25
2.	**THERMODYNAMICS** Introduction to Laws of thermodynamics, state and path functions and their applications, thermodynamic description of various types of processes,Maxwell's relations, Partial molar quantities, Calculation of partial molar quantities, determination of partial molar volume and partial molar enthalpy, Ideal and non-ideal liquid mixtures,Thermodynamics functions of mixing of non-ideal solutions (i) free energy of mixing (ii) entropy of mixing (iii) volume of mixing and (iv) enthalpy of mixing ,Excess functions(μ^E,G^E , S^E ,H^E and V^E) for non-ideal solutions and expression for excess thermodynamic functions. Numerical	25
3.	**STATISTICAL THERMODYNAMICS** Basics of Statistical Thermodynamics (Assembly,Canonica l ensemble, occupation numberstatistical weight factor, probabilit y) , Thermodynamic probability,Probability and entropy, Maxwell-Boltzmann, Bose-Einstein and Fermi-Dirac statistics. Lagrange's methods of multipliers, Partition function,Thermodynamic properties in term of partition functions(i) Internal energy (ii) Heat Capacity (iii) Third law of thermodynamics(iv) Helmholtz free energy (v) Enthalpy (vi) Gibb's free energy(vii) Chemical potential (viii) Equilibr ium constant Molecular partition functions for an ideal gas , Derivation for Translational, Rotationaland Vibrational partition functions Numerical.	25

4.	**POLYMER CHEMISTRY** Types of polymers, Stereochemistry of polymers, Kinetics of polymerization (Addition and Condensation),Thermodynamics of polymerization, Phase techniques of polymerization (Bulk, solution, suspension and emulsion), Number & Mass average Molecular mass, Polydispersity Index (P.D.I) Molecular mass determination by Viscometry and Osmometry, Thermal transitions in polymer: glass transition temperature and its significance, Numerical	25

Teaching-Learning Methodology	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 / Practical Examination (As per CBCS R.6.8.3)	30%
3.	University Examination	70%

Course Outcomes: Having completed this course	
1.	Students learn thermodynamic terminology, fundamental thermodynamic properties, properties of solution, fundamental knowledge assist student to understand related topic in next semester.
2.	Understand kinetics of different types of reaction. Understand the factors responsible for behaviour of different kind of chemical reaction
3.	Learn relation between quantum chemistry and statistical thermodynamics. Understand basic terminology and their application in calculation of thermodynamic function.
4.	Understand the method for synthesis of polymer and their characterization

Suggested References:

Unit I:

1. Chemical Kinetics, Laidler K.J. TATAMcGRAW-HILL PUBLISHING COMPANY LTD

2. Principles of Chemical Kinetics, James E. House, Elsevier Publication
3. Kinetics and Mechanism of Chemical Transformations, Rajaraman, J. and Kuriacose, J., McMillan (2008)b
5. Engel, T. & Reid, P. Physical Chemistry, Pearson
6. Maron, S. & Prutton Physical Chemistry

UNIT II:

1. Thermodynamics for chemist Samuel Glasstone, East-West Press Pvt. Ltd. (2008)
2. Physical Chemistry, Volume 1: Thermodynamics and Kinetics (10th Edition) by Professor Peter Atkins, Julio De Paula
3. Principles of Physical ChemistryPuri B.R., Sharma L.R. and Pathania, M.S., Vishal Publishing Co
4 A Text Book of Physical chemistry K.L.Kapoor Vol-5 Macillan India Ltd. 2007
5 An Introduction to Chemical Thermodynamics R P Rastogi and R R Mishra VIKASH PUBLISHING HOUSE PVT LTD. 6th edition
6 Advanced Physical Chemistry D.N.Bajpai S.CHAND& COMPANY LTD. 2nd EDITION

UNIT III:

1. Statistical Thermodynamics BY M. C. Gupta New Age International, 2007
2. An Introduction to Statistical Thermodynamics, Terrell L. Hill, ADDITION WESLAY PUBLISHING COMPANY
3. Principles of Physical Chemistry Puri B.R., Sharma L.R. and Pathania, M.S., Vishal Publishing Co
4. A Text Book of Physical chemistry K.L.Kapoor Vol-5 Macillan India Ltd. 2007

UNIT IV:

1. Polymer science by V.R.Gowarikar. WILEY EASTERN LTD
2. Principal of polymer chemistry by A. Ravve, Springer
3. A Textbook of Polymer Chemistry, M S Bhatnagar, S Chand Publications.
4. Principles of Physical Chemistry Puri B.R., Sharma L.R. and Pathania, M.S., Vishal Publishing Co

Master of Science, Physical Chemistry
M.Sc. Physical Chemistry, Practicals

Course Code	[1803081001050001]	Title of the Course	**PHYSICAL CHEMISTRY**
Total Credits of the Course	4	Hours per Week	4 hrs

Course Objectives:	• To study the physical chemistry parameters for reaction between acid and base. • To study the behaviour of surfactant in aqueous solution • To determine the concentration of solution by colorimetry • To understand the conductivity behaviour of electrolytes solution. • Partitioning behaviour of component in two phases
Mapping between CO and PSO	

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8	PSO9	PSO10	PSO11	PSO12
CO1		■	■				■	■	■	■		
CO2	■		■		■		■	■	■	■		■
CO3	■		■	■	■				■	■	■	■
CO4	■	■	■	■			■		■	■	■	■
CO5	■	■	■	■			■		■	■	■	■

Course Content

1. Determine the dissociation constant and strength of borax solution pH-metrically.
2. Determine the velocity constant of the hydrolysis of ethyl acetate with sodium hydroxide at room temperature by conductance measurements.
3. Determine the solubility of silver chloride in water potentiometrically.
4. To determine the concentration of given components in a mixture colorimetrically.
5. Determine the equilibrium constant of the reaction $I^- + I_2 = I_3^-$ by distribution method.

6. Investigation the reaction between H2O2 and HI at two different temperatures and calculate the energy of activation for the reaction
7. Determine the formula of a complex between Cu+2and NH3 by distribution method.
8. Determine CST of Phenol -Water system
9. Determine CST of Phenol –NaCl system

Teaching-Learning Methodology	Introduction, explanation of theory and procedure of the experiments and interpretation of results.

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

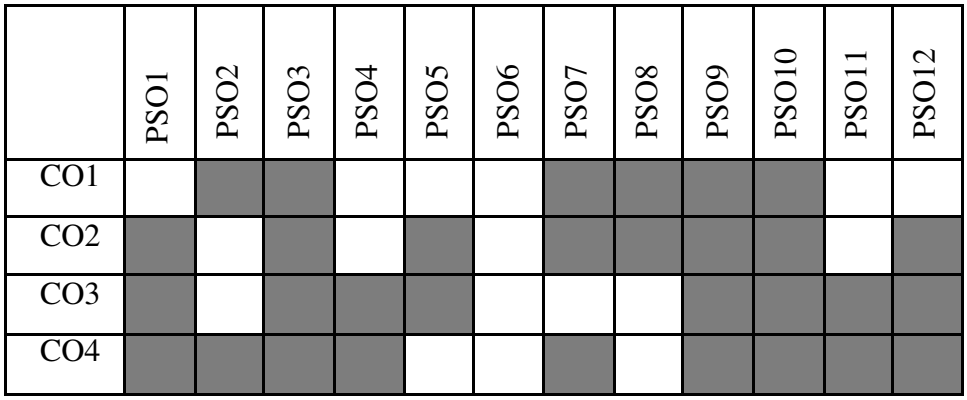
Course Outcomes: Having completed this course, the learnerwill be able to	
1.	Understand preparation of solutions.
2.	Qualitative analysis of compound
3.	calculate the concentration of unknown solution by pH, potentiometer and colorimeter
4.	Understand behaviour of surfactant and polymer
5.	Separation of solvent using phase diagram

Suggested References:

1. Advanced Practical Physical Chemistry by Yadav J. B., Krishna Prakashan Media
2. Practical Physical Chemistry, Dr. M. Satish Kumar Sankalp Publication
3. Gurtu, J. N., Kapoor, R., Advanced Experimental Chemistry S. Chand & Co. Ltd.
4. Mendham, J., A. I. Vogel's Quantitative Chemical Analysis 6th Ed., Pearson

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

Master of Science, Instrumental and Chemical Analysis
M.Sc. Analytical Chemistry, Semester I

Course Objectives:	• To understand concept of electromagnetic radiation, auxochrome, chromophores, various factors affect the UV-Visible spectra and impart the knowledge to understand the spectra. • To understand basics of concepts of chromatography, their classification and importance as well as working of various parts of the chromatography instruments. Use of this TLC and GC in various application. • To learn the different types of errors occur in qualitative and quantitative and the validation of result obtained in experiments with the help of Q test and Students' t test. • To learn the thermal methods, their instrumentation, various factors effect on the experimental results and their application in various field.
Mapping between CO and PSO	

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8	PSO9	PSO10	PSO11	PSO12
CO1		■	■				■	■	■	■		
CO2	■		■		■		■	■	■	■		■
CO3	■		■	■	■				■	■	■	■
CO4	■	■	■	■			■		■	■	■	■

Course Code	[18030802010040001]	Title of the Course	**INSTRUMENTAL AND CHEMICAL ANALYSIS**
Total Credits of the Course	4	Hours per Week	4 hrs

Course Content		
Unit	Description	Weightage* (%)
1.	**UV-VISIBLE SPECTROPHOTOMETRY** Types of electronic transition, auxochrome, chromophore, Bathochromic effect, Hypso chromic effect, Hyper chromic effect, Hypo chromic effect, Factor affecting λ_{max} like resonance, hyper conjugation, hydrogen bonding, steric effect, Woodward's rules for α, β-unsaturated ketones, Diene systems, aromatic system, Effect of solvent on absorption bands, law of absorption with derivation, Elementary idea of double beam automatic recording, Spectrophotometer, Application.	25
2.	**CHROMATOGRAPHY** **Thin-Layer Chromatography:** Selection of stationary and mobile phase, Detection techniques – Elementary idea of HPTLC **Gas Chromatography:** Selection of mobile phase – Selection of stationary phase in GLC and GSC – Detectors: FID (with modifications), TCD and ECD, Their comparison, Packed column, WCOT, SCOT (advantages and disadvantages) –Temperature programming – Derivatisation in GC – Quantitative Analysis.	25
3.	**CHEMICAL MATHEMATICS** Errors in Chemical analysis, classification of errors, nature and origin of errors, Propagation of error, Accuracy and precision, Average deviation and standard deviation and its physical significance, Normal Distribution curve and its properties. Confidence limit and probability, Statistical treatment for error analysis, students't' test, rejection criteria and Q test, method of least square	25
4.	**THERMAL METHODS OF ANALYSIS** **(A) THERMOGRAVIMETRY** Thermogravimetry, Instruments for TGA- thermobalace and furnace, Calibration of temperature scale, Factors affecting TGA results instrumental and experimental, Applications. **(B) THERMOMETRIC TITRATION:** Thermometric Titration (TT), Advantages, Instrument, Applications of TT in Neutralization Titration, Precipitation Titration, Complexometry Titration and Redox Titration.	25

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.

Course Outcomes: Having completed this course, the learner will be able to

1.	Understand the basic concept of electromagnetic radiation and their interaction with the matter and use of UV-Visible spectrophotometer in structure identification and quantitative determination.
2.	Recognize the use of different stationary and mobile phase for the separation of organic molecule and identify the problems and their solution during the analysis and learn the use of the chromatography for those whose don't identified by the techniques.
3.	Learn difference between different types of errors observed during analysis and use of statistical treatment of data. Also learn to accept and reject the data with help of different type of tests.
4.	Use of the thermometric techniques when the other methods are failed. The requirement of the techniques and identified the problems arise during the analysis.

Evaluation Pattern

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

Suggested References:

1. Fundamental of molecular spectroscopy, C. N. Banwell, Tata McGraw Hill Pub. Camp.
2. Spectrometric Identification of Organic Compounds (4^{th} edition/5^{th} edition), Silverstein, Bassler & Morril, John Wiley & Sons.
3. Introduction to Molecular Spectroscopy, G. M. Barrow, McGraw – Hill.
4. Modern Spectroscopy, J.M.Hollas, John Wiley.
5. Basic Principles of Spectroscopy, R.Chang, McGraw-Hill.
6. Modern Methods of Chemical Analysis (2^{nd} ed.), Pecsok, Shields, Cairns & McWilliom, John Wiley & Sons.
7. Instrumental Analysis by R. D. Braun, McGraw-Hill.

8. Mathematics for Chemistry, Doggett and Sucliffe, Longman.
9. Mathematical preparation for Physical Chemistry, F. Daniels, McGraw Hill.
10. Introduction to Instrumental Analysis by R. D. Brawn, McGraw-Hill Book.
11. Fundamentals of Analytical Chemistry: Skoog D. R. and West D. M. (Holt, Rinehart & Winston, New York).
12. Chemical Analysis in Industry (in Gujarati) by M. N. Desai.
13. Instrumental Methods of Analysis by G. W. Ewing.
14. Modern Method of Chemical Analysis by Pecsok, Shield, Cairns, McWilliam, John Wiley and Sons.
15. Quantitative Analysis, 6th Ed., R. A. Day and A. L. Underwood, Prentice – Hall of India, 1993.
16. Instrumental Analysis: G. D. Caristian and J. E. O'Reilly (Allyn & Bacon Inc., New York, 2nd edition.
17. Instrumental Methods of Chemical Analysis: G. W. Ewing (McGraw-Hill, New York), 5th edition.
18. Instrumental Methods of Analysis: H. R. Willard, L. L. Merrit, J. A. Dean, F. A. Settle (Van Nostrand Reinhold Co., New York), 6th edition.
19. Modern Methods of Chemical Analysis: Pecsok, Shield & Cairns (John Wiley), 2nd edition.
20. Introduction to Instrumental Analysis (1987), R. D. Braun (McGraw-Hill Book Company), New Delhi.
21. Analytical Chemistry: Principles and Techniques: Larry G. Hargis (Prentice-Hall International edition).
22. Introduction to Modern Liquid Chromatography: L. R. Shyder & J. J. Kirkland (John Wiley & Sons, New York).
23. Treatise on Analytical Chemistry: I. M. Kohthoff & P. J. Elving (John Wiley & Sons, New York).
24. Handbook of Analytical Chemistry: L. Meites (McGraw-Hill, New York).

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

Structure of M. Sc, Syllabus
Semester-II

Sr. No.	Course Code	Course Title	L	T/C/S	Credit
1	1903080202010001	Inorganic Chem	4		4
2	1903080202020001	Organic	4		4
3	1903080202030001	Physical	4		4
4	1903080202040001	Instrumental and chemical analysis	4		4
5		Practicals + T/C/S	12	3	6 + 3
			28	3	25

Faculty Code: Science Subject code:
Level code:
Name of program: M. Sc. Subject: Chemistry

External Examination Time Duration: 03 hrs

Name of Exam	Semester	Paper No	Course group	Credit	Internal Marks	External Marks	Total Marks
M. Sc.	II	I	Core	04	30	70	100
		II	Core	04	30	70	100
		III	Core	04	30	70	100
		IV	Core	04	30	70	100
			Practical + T/C/S	06 + 3	60	140	200
			Total	25	180	420	600

Master of Science, Inorganic Chemistry
M.Sc.Inorganic Chemistry, Semester II

Course Code	[1903080202010001]	Title of the Course	**INORGANIC CHEMISTRY**
Total Credits of the Course	4	Hours per Week	4 hrs

Course Objectives:	• To learn the properties of non-transition metal elements. • To learn the synthesis, bonding, properties and applications of main group elements. • To understand the Bio inorganic chemistry of Hemoglobin, Myoglobin, Ferritin and Transferrin • To understand the metal complexes in Medicine and anticancer activity of Platinum complexes
Mapping between CO and PSO	

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8	PSO9	PSO10	PSO11	PSO12
CO1		■	■				■	■	■	■		
CO2	■		■		■		■	■	■	■		■
CO3	■		■	■	■				■	■	■	■
CO4	■	■	■	■			■		■	■	■	■

Course Content

Unit	Description	Weightage* (%)
1.	**ELEMENTS OF MAGNETOCHEMISTRY** Definitions of magnetie properties, type of magnetic bodies, the source of paramagnetism, diamagnetism and pascal's constant, Example of pascals constant. Curie and Curie-Weiss law, Magnetic Properties of transition elements. Determination of magnetic susceptibility: (a) Gouy method (b) Faraday method (s) Null deflection method Application of magnetic susceptibility measurements, Temperature independent paramagnetism (TIP), Orbital contribution to magnetic moment	25
2.	**METAL π - COMPLEXES** **Metal carbonyls:** Introduction, classification of metal carbonyls, structure and bonding. vibrational spectra studies for bonding and structure elucidation. Preparation of metal carbonyls by (1) Direct synthesis and (2) From metal compounds. preparation Properties and structure of $Ni(CO)_4$ $Fe_2(CO)_9$ and $Co_2(CO)_8$, 18-electron rule and EAN of metal carbonyls **Metal Nitrosyls** : Introduction, coordination compounds of metal nitrosyls, preparation properties of nitrosyl compounds like nitrosyl halides, nitrosyl cyanides, hydroxides and nitrosyl aquo compounds Complex of NO^+ iron, EAN and structures of nitrosyls.	25
3.	**INORGANIC POLYMERS** Definition of polymers and their depiction. Characteristics of inorganic polymer. Characterization of inorganic polymers (physical properties) by molecular weight, number average and weight average. Structural features of polymers: (1) Backbone bonding (2) Branching and cross-linking (3) Chemical and Stereo chemical variability Classification of inorganic polymers, synthesis, properties, structures uses and application of polyphosphazenes and polysiloxanes.	25
4.	**COORDINATION COMPOUNDS** Classification of coordination compounds, Werner's theory of coordination, Electronic interpretation of coordination compounds, Factors effecting the formation of complex ions, Detection of complex ion in solution, Chelation, Factors influencing the stability of metal chelates, Importance of chelates, Role of metal chelates in living system and	25

	polynuclear complexes, Determination of composition of complex ions	

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%
3.	University Examination	70%

Course Outcomes: Having completed this course, the learner will be able to	
1.	Understand the definitions of magnetic properties, type of magnetic bodies, determination of magnetic susceptibility and its applications.
2.	Understand, classification of metal carbonyls and nitrosyls, structure and bonding. Vibrational spectra studies for bonding and structure elucidation, preparation of metal carbonyls and nitrosyls.
3.	To learn the characteristics of inorganic polymer and characterization of physical properties by molecular weight, number average and weight average. Structural features of polymers by different bonding.
4.	Understand the classification of coordination compounds, Werner's theory, Electronic interpretation, factors effecting the formation of complex ions, detection of complex ion in solution, stability of metal chelates and Importance of chelates, role of metal chelates in living system

Suggested References:

1. Magneto chemistry by R. L Carlin
2. Element of Magnetochemistry by A. Syamal and R. L. Dutta, Affileted East-West press,

new Delhi, 1993.
3. Introduction to metal pi-complex chemistry by M. Tsusui, M. lchikwa, K. Mori, Plenum press, New york
4. Introductory polymer chemistry by G. S Mishra, Wiley Eastern Ltd,1993.
5. Phosphorous-Nitrogen Compounds, H. R. Allock, Academic, New York, 1972.
6. Advanced in Inorganic Chemistry by S. K. Agarwal, Keemtilal, Pragati prakashan, Meerut
7. Coordination Chemistry by Ajaykumar, Aaryush Education publication, Thind publication
8. Principles of inorganic chemistry by Puri, Sharma and Kalia, Vishal publication Co. Jalandhar, Delhi
9. Coordination Chemistry by Gurdeep Chatwal, M.S. Yadav, Himalaya Publishing house
10. inorganic polymers by Prof G. R. Chatwal, Himalaya Publishing House

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

Master of Science, Inorganic Chemistry
M.Sc.Inorganic Chemistry, Practicals

Course Code	[19030811002050001]	Title of the Course	**INORGANIC CHEMISTRY**
Total Credits of the Course	4	Hours per Week	4 hrs

Course Objectives:	• To impart basic knowledge for carrying out analysis of alloy. • Understand the types of complexometric titrations • To understand and calculate the percentage purity of salt. • Determination of physical constant and confirmation of product. • Concept of estimation and determination of each radical quantitatively and qualitatively.
Mapping between CO and PSO	

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8	PSO9	PSO10	PSO11	PSO12
CO1												
CO2												
CO3												

	CO4 ■ ■ ■ ■ ■ ■ ■ ■ ■ ■ ■ ■ CO5 ■ ■ ■ ■ ■ ■ ■ ■ ■ ■ ■ ■

Course Content

Quantitative Analysis :

1. Analysis of Solder and Type metal (Alloy Analysis)
2. Determine the amount of Ca as $CaC_2O_4H_2O$ or as $CaCO_3$, in limestone
3. Estimation of Cu^{+2} as CUSCN
4. Estimation of Iron in Iron ore
5. Estimation of available chlorine in bleaching powder
6. Estimation of Ca^{+2} and Pb^{+2} in Admixture
7. Determine the amount of Fe^{+3} and Cr^{+3} Present in given Admixture
8. Determine the percentage purity of the given sample of Manganese salt
9. Estimation of Aluminium by back titration.

Teaching-Learning Methodology	Introduction, interaction with students in calculation of mole ratios, Carrying out experiments at each step according to the respective practical.

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

Course Outcomes: Having completed this course, the learner will be able to	
1.	Understand the analysis of alloy and ore and calculation of molarity and mole ratio.
2.	Learn to methods to find copper, zinc gravimetrically and volumetrically.
3.	Learn to find available chlorine bleaching powder.
4.	Learn to determine calcium, lead, Iron and chromium in admixture,

5.	Appreciate good laboratory practices.

Suggested References:

1. A textbook of practical inorganic chemistry - A.L.Vogel
2. Practical Chemistry by Dr.O.P.Pandey, D.N.Bajpai, Dr.S.Giri
3. Advance inorganic analysis by Agarwal, Keemti lal
4. Qualitative Inorganic analysis – Vogel
5. Inorganic practical by Chatwal and Anand

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

On-line Resources

Master of Science, Organic Chemistry
M.Sc.Organic Chemistry, Semester II

Course Code	1903080202020001	Title of the Course	**ORGANIC CHEMISTRY**
Total Credits of the Course	4	Hours per Week	4 hrs

Course Objectives:	• To learn transition metal catalyst based on C-C, C-N coupling reaction, formylation reaction, various acid base catalyzed condensation reactions, reactions which changes configuration etc. and their mechanism. • To learn aromaticity based on different concept, measurement of aromaticity through various parameters, annulenes, azzulene and types of aromaticity. • To understand the role of chemical reactants in oxidation, reduction, dehydration, cyclisation and transformation of various organic functional groups. • To understand photochemistry, various types of its reaction, photochemical cleavage of carbonyl compounds, their mechanism and application in synthesis.
Mapping between CO and PSO	

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8	PSO9	PSO10	PSO11	PSO12
CO1												

	CO2 ■ □ ■ □ ■ □ ■ ■ ■ ■ □ ■ CO3 ■ □ ■ ■ ■ □ □ □ ■ ■ ■ ■ CO4 ■ ■ ■ ■ □ □ ■ □ ■ ■ ■ ■

Course Content		
Unit	Description	Weightage* (%)
1.	**Organic Name Reactions** General nature, method, mechanism and synthetic applications of the following reactions: (i) Heck reaction (ii) Dakin reaction (iii) Darzen'sglycidic ester synthesis (iv) Leuckart reaction (v) Suzuki reaction (vi) Willgerodt reaction (vii) Buchwald-Hartwig reaction (viii) H. V. Z reaction (ix) Vilsmeyer-Hack reaction (x) Mitsunobu reaction (xi) Sonagashira reaction (xii) Dickmann reaction.	25
2.	**AROMATICITY** A. Aromaticity and Aromatic character; structure and stability of benzene, Frost circle diagram, concept of aromaticity; Resonance and chemical stabilization; criteria to checkaromatic character-IR, NMR, heat of hydrogenation; Huckel's rule; HMO method B. Antiaromaticity, homoaromaticity, nonaromaticity; aromaticity in benzanoid compounds: naphthalene, pyrene, acepleialdelene. C. Aromaticity non-benzenoid compounds: azulene, tropolones, charged rings,annulenes fullerenes, and hmesoionic compounds.	25
3.	**ORGANIC TRANSFORMATION AND REAGENTS** I. Sharplessepoxidation II. Umpolung reagent (1,3-dithiane) III. Dess martin periodinane IV. DDQ V. Tri-n-butyltinhydride (C4H9)3SnH VI. Diisobutyl aluminum hybride (DIDAL-H) VII. Lithium disoprpyl amide (LDA) VIII. OZONE / IX. K3Fe(CN)6and DMSO X. Merrifield Peptide Synthesis\	25

	XI. Crown ethers XII. Wilkinson's Catalyst	
4.	**PHOTO CHEMISTRY** A. Energy of molecules, photochemical energy, electronic excitation, Jablonski diagram, laws of photochemistry, quantum efficiency. B. Photochemistry of carbonyl compounds- α- cleavage of acyclic, cyclicand α-β unsaturated cleavage of carbonyl compounds, β-cleavage of, inter and intramolecularhydrogen abstraction, addition to carbon- carbon doublr bond, photo reduction of carbonylcompounds. C. Photo induce rearrangement of enones, dienones and alkenes. Photochemistry of alkenesand aromatic compounds- isomerization, dimerization and addition reactions D. Photochemistry of visiob, singletoxygenoxygenations,solar energy conversion and storage	25

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%
3.	University Examination	70%

Course Outcomes: Having completed this course, the learner will be able to	
1.	Understand the role of transition metal in organic synthesis by studying Heck, Suzuki, Sonogashira and Buchwald Hartwing reaction, formylation by Villsmayer Heck reaction, substituted amines, amides formation reaction, cyclisation through condensation reaction and inverted configuration through Mitsunobu reaction.
2.	Understand aromaticity, various parameters for the measurement of aromaticity, frost circle method and calculation of energy for the determination of aromaticity.

	Aromaticity measurement through NMR, types of aromaticity and aromaticity measurement in fused rings, annulenes and azulenes etc
3.	To learn the chemistry involved in oxidation-reduction reactions by employing numerous reagents & appropriate chemo-selectivity of the reagents, suggest use of miscellaneous reagents in organic synthesis including Wilkinson catalyst, DIBAL-H, PTC-crown ether, 1,3-Dithiane etc.
4.	Get one self familiarize with usual photochemical reactions, terms of photochemistry, understanding fluorescence, phosphorence by photoexcitation decay/discipation of energy. Types photochemical reactions like Norrish type-I & II, Paterno-Buchi etc., Photodimensation and their application in organic synthesis.

Suggested References:

1. Advanced Organic Chemistry-Reactions, Mechanism and Structure, Jerry March, John Wiley.
2. Reaction Mechanism in Organic Chemistry by S. M. Mukherji and S. P. Singh (McMillan India Ltd., 1976).
3. Organic Chemistry (3/e) by J. B. Hendrickson, Donald J. Crem and George S. Rammond (McGraw-Hill Book Co. &Kogekusha Co. Ltd., 1970).
4. Organic Chemistry (5/e) by Morrison & Boyd (Prentice Hall).
5. Advanced Organic Chemistry by Carey &Sundberg (3rd edition).
6. A Guide Book to Mechanism in Organic Chemistry, Peter Sykes, Longman.
7. Name Reactions by A. R. Parikh &H.A.Parikh
8. Name reaction: A collection of detailed reaction machanisms by Jie Jack Li
9. Reaction Mechanism and Reagents in Organic Chemistry by C. R. Chatwal (Himalaya Publishing House, Bombay, 1987).
10. Organic Chemistry-Reactions and Mechanism by P S Kalsi
11. Advanced Organic Chemistry : Reactions and Mechanisms byM.S. Singh
12. Organic chemistrybyCram, Hammond, Pine and Handrickson
13. Photochemistry and Pericyclic Reactions by Jagdamba Singh
14. Pericyclic reactions: A text book by S. Sankararaman
15. Excited states in Organic Chemistry by J. D. Coyle and J. A. Barltrop
16. March's Advanced Organic Chemistry: Reactions, Mechanisms and Structure by Michael B. Smith
17. Advanced Organic Chemistry: Part B: Reaction and Synthesis byCarey & Francis
18. Organic Chemistry byJonathanClayden

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

On-line Resources

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Master of Science, Organic Chemistry
M.Sc.Organic Chemistry, Practicals

Course Code	[19030811002050001]	Title of the Course	**ORGANIC CHEMISTRY**
Total Credits of the Course	4	Hours per Week	4 hrs

Course Objectives:	• To impart basic knowledge for carrying out preparation. • Understand nature of reaction and establishment of reaction condition with mechanism. • To understand calculation of mole and mole ratio for each reaction. • Isolation of product from individual step and purification by crystallization. • Determination of physical constant and confirmation of product. • Concept of estimation and determination of each component quantitatively.
Mapping between CO and PSO	

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8	PSO9	PSO10	PSO11	PSO12
CO1												
CO2												
CO3												
CO4												

Course Content

Preparation of organic compounds :

i) Nitration
ii) Bromination
iii) Acylation
iv) Reduction
v) Oxidation
vi) Condensation reaction
vii) Diazotization reaction
viii) Friedl-Craft's reaction
ix) Cannizzaro reaction
x) Aldol condensation

Quantitative Estimations

a. Estimation of ester + acid
b. Estimation of formaldehyde
c. Estimation of glycine
d. Estimation of amide + acid

Teaching-Learning Methodology	Introduction, interaction with students in calculation of mole ratios, Carrying out experiments at each step according to the respective practical.

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

Course Outcomes: Having completed this course, the learnerwill be able to	
1.	Understand the basics to carry out reactions, nature of reaction and calculation of mole and mole ratio.
2.	Establish mechanism and monitora reaction at specified condition.
3.	Work-up after the completion of reaction and purification.
4.	Confirmation of product through the references.
5.	Appreciate good laboratory practices.

Suggested References:

1. A text book of practical organic chemistry – A. I. Vogel
2. Practical organic Chemistry – Mann and Saunders
3. A handbook of quantitative and qualitative analysis – H. T. Clarke
4. Comprehensive Practical Organic Chemistry : Qualitative Analysis V K Ahluwalia & S. Dhingra.
5. Comprehensive Practical Organic Chemistry : Preparations and Quantitative Analysis V K Ahluwalia& R. Aggarwal Universities Press.
6. An Advance Course in practical Chemistry, A K. Nad, B. Mahapatra and A. Ghoshal.

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

Master of Science, Physical Chemistry
M.Sc. Physical Chemistry, Semester II

Course Code	[1903080202030001]	Title of the Course	**PHYSICAL CHEMISTRY**
Total Credits of the Course	4	Hours per Week	4 hrs

Course Objectives:	• To learn conductivity behaviour of strong electrolytes in solution, factors affecting electrolysis process. • To learn basics and application of colloids. • To understand the basics of surface chemistry. • To understand basics of molecular spectroscopy.
Mapping between CO and PSO	

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8	PSO9	PSO10	PSO11	PSO12
CO1		■	■				■	■	■	■		
CO2	■		■		■		■	■	■	■		■
CO3	■		■	■	■				■	■	■	■
CO4	■	■	■	■			■		■	■	■	■

Course Content		
Unit	Description	Weightage* (%)
1.	**UNIT-I:THEORIES OF ELECTROLYTIC CONDUCTANCE AND OVER VOLATEGE** Debye-Huckel theory of strong electrolytes, relaxation effect and electrophoretic effect, Debye Falkenhagen effect, Weineffect.Ionic strength and its determination ,Debye-Huckel limiting law. Activity and activity coefficient,	25

	determination of activity coefficient by (i) solubility (solubilit y product principle) (ii) EMF method (cell without transference), Determination of dissociation constant of monobasic acid by conductance method and approximate EMF method, Electrolytic polarization, Dissolution and Decomposition potential, Concentration polarization, Decomposition potential and its determination, over voltage, determination of over voltage,theories of over voltage:combination of atom as slow process (Tafel theory) Numerical.	
2.	**UNIT-II: SURFACE CHEMISTRY** Adsorption Multilayer Adsorption, the BET adsorption isotherms, derivation of BET equation, determination of surface area and area of cross section of molecules by BET equation.Derivation of Langmuir equation from BET equation. Explanation of different adsorption isotherms, Change in enthalpy ,entropy and free energy of adsorption, Adsorption at the surface of liquid : Gibbs adsorption isotherms (derivation).Thermodynamic treatment of adsorption,Surface –Active substances, orientations of surfactants on the surface of solution , surface inactive substances, surface pressure,Insoluble surface films on liquid Numerical	25
3.	**UNIT-III: COLLOIDS:** Types of colloidal systems, preparation of lyophobic colloidal, Properties of Colloidal systems: (i) electrical properties origin of charges on colloidal, electrical double layer, Zeta potential and its determination by electrophoresis, factor affecting zeta potential, explanation on DLVO theory of colloid stability (ii) Electrokinetic properties: Electrophoresis, elecroosmosis. Surface active agents, critical micellar concentration (CMC), factors affecting the CMC of surfactants, thermodynamics of micellization: mass action and phase separation model, solubilisation, emulsion, types of emulsion, methods for determination of types of emulsion, microemulsion, types of microemulsion, theories of microemulsion.	25
4.	**UNIT IV: MOLECULAR SPECTROSCOPY** Molecular spectra, Microwave spectroscopy (Rotational spectroscopy): The Rotation of molecules, Linear molecule, Symmetric tops ,Spherical tops, Asymmetric tops, Rotational spectra of rigid diatomic molecule ,Intensities of spectral lines , Effect of isotopic substitution, Techniques and instrumentation of rotational spectrum, IR Spectroscopy: Classical frequency of harmonic oscillator,The classical potential energy of harmonic vibration of a diatomic molecule, Quantum expression of potential energy, energy level diagram, Relative population of energy levels ,Mechanism of	25

	interaction with radiation, selection rule, determination of force constant, Amplitude of vibration, The anharmonicvibrationor oscillator , Morse potential , Vibrational energy of diatomic molecule following the Morse potential, energy level diagram, vibrational transitions. Vibrational –Rotational spectra of diatomic molecule(CO molecule) Application of Vibrational rotational spectra Numerical	

Teaching-Learning Methodology	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%
3.	University Examination	70%

Course Outcomes: Having completed this course, the learnerwill be able to	
1.	Understand the electrolytes in conductance of solutions. Importance of polorizat ion decomposition potential and over voltage in electrolysis process and in industries
2.	Understand physical phenomena of surface chemistry. Application of surface active substance and factor affecting surface chemistry, adsorption of surface active materials
3.	Understand the solution behaviour of surfactants. Colloidal chemistry explain the importance of micelle formation for colloidal industry
4.	Identify the molecular interactions and concentration and identification of componds

Suggested References:

UNIT : 1.

1. Atkins, P.W., Physical Chemistry, W.H. Freeman (2017) 10 th editon
2. Samuel Glsstone, Introduction to Electro chemistry, East-West Press Pvt. Ltd. (2008)
3. Puri, B.R., Sharma, L.R., and Pathania, M.S., Principles of Physical Chemistry, Vishal Publishing Co.
4. Engel, T. & Reid, P. Physical Chemistry, Pearson
5. Barrow, G.M. Physical Chemistry Tata McGraw Hill (2007)
6. Maron, S. & Prutton Physical Chemistry, Collier Macmillan Ltd

UNIT : 2

1. Puri, B.R., Sharma, L.R., and Pathania, M.S., Principles of Physical Chemistry, Vishal Publishing Co.
2. Engel, T. & Reid, P. Physical Chemistry, Pearson
3. Barrow, G.M. Physical Chemistry Tata McGraw Hill (2007)
4. Maron, S. & Prutton Physical Chemistry, Collier Macmillan Ltd

UNIT : 3

1. Puri, B.R., Sharma, L.R., and Pathania, M.S., Principles of Physical Chemistry, Vishal Publishing Co.
2. Engel, T. & Reid, P. Physical Chemistry, Pearson
3. Maron, S. & Prutton Physical Chemistry, Collier Macmillan Ltd
4. Colloid Science: Principles, Methods and Applications by T Cosgrove
5. Physical Chemistry of Surfaces" by A W Adamson and A P Gast

UNIT 4

1. Fundamentals of Molecular Spectroscopy C N Banwell TATA McGRAW-HILL15th edition
2. Handbook of Molecular Spectroscopy, by D.N. Sathyanarayana
3. Introduction to Spectroscopy by Donald L. Pavia, George S. Kriz, Gary M. Lampman, James R. Vyvyan
4. Fundamentals of molecular spectroscopy by Walter S. Struve
5. Barrow, G.M. Physical Chemistry Tata McGraw Hill (2007)

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

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Master of Science, Physical Chemistry
M.Sc. Physical Chemistry, Practicals

Course Code	[19030811002050001]	Title of the Course	**PHYSICAL CHEMISTRY**
Total Credits of the Course	4	Hours per Week	4 hrs

Course Objectives:	• To study the physical chemistry parameters for reaction between acid and base. • To study the behaviour of surfactant in aqueous solution • To determine the concentration of solution by colorimetry • To understand the conductivity behaviour of electrolytes solution. • Partitioning behaviour of component in two phases
Mapping between CO and PSO	

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8	PSO9	PSO10	PSO11	PSO12
CO1		■	■				■	■	■	■		
CO2	■		■		■		■	■	■	■		■
CO3	■		■	■	■				■	■	■	■
CO4	■	■	■	■			■		■	■	■	■
CO5	■	■	■	■			■		■	■	■	■

Course Content

1. Determine the dissociation constant and strength of borax solution pH-metrically.
2. Determine the velocity constant of the hydrolysis of ethyl acetate with sodium hydroxide at room temperature by conductance measurements.
3. Determine the solubility of silver chloride in water potentiometrically.
4. To determine the concentration of given components in a mixture colorimetrically.
5. Determine the equilibrium constant of the reaction I- + I2 = I3- by distribution method.
6. Investigation the reaction between H2O2 and HI at two different temperatures and calculate the energy of activation for the reaction
7. Determine the formula of a complex between Cu^{+2} and NH_3 by distribution method.
8. Determine CST of Phenol -Water system
9. Determine CST of Phenol –NaCl system

Teaching-Learning Methodology	Introduction, explanation of theory and procedure of the experiments and interpretation of results.

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

Course Outcomes: Having completed this course, the learner will be able to	
1.	Understand preparation of solutions.
2.	Qualitative analysis of compound
3.	calculate the concentration of unknown solution by pH, potentiometer and colorimeter
4.	Understand behaviour of surfactant and polymer
5.	Separation of solvent using phase diagram

Suggested References:

1. Advanced Practical Physical Chemistry by Yadav J. B., Krishna Prakashan Media
2. Practical Physical Chemistry, Dr. M. Satish Kumar Sankalp Publication
3. Gurtu, J. N., Kapoor, R., Advanced Experimental Chemistry S. Chand & Co. Ltd.
4. Mendham, J., A. I. Vogel's Quantitative Chemical Analysis 6th Ed., Pearson

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

Master of Science, Instrumental and Chemical Analysis
M.Sc. Analytical Chemistry, Semester II

Course Code	1903080202040001	Title of the Course	**INSTRUMENTAL AND CHEMICAL ANALYSIS**
Total Credits of the Course	[1903080202040001]	Hours per Week	4 hrs

Course Objectives:	• To understand theory and instrumentation of infra-red spectroscopy with working of various parts of instruments. Structure elucidation is also learnt with help of IR spectra. • To learn liquid-liquid chromatography with special focus on the instrumentation of high-pressure liquid chromatography and their application in various field. • To understand the basic concept twelve principle and green solvents and their application. Also learn the uses of various instrumental and classical method in the analysis of water for removal of toxicants. • To understand units of solution their uses in numerical and solution preparation. To understand the uses of non-aqueous titration when aqueous titration fails and also analysis of C, H, N, O, S with various techniques.

Mapping between CO and PSO

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8	PSO9	PSO10	PSO11	PSO12
CO1												

	CO2 ■ □ ■ □ ■ □ ■ ■ ■ ■ □ ■ CO3 ■ □ ■ ■ ■ □ □ □ ■ ■ ■ ■ CO4 ■ ■ ■ ■ □ □ ■ □ ■ ■ ■ ■

Course Content		
Unit	Description	Weightage* (%)
1.	**IR SPECTROSCOPY*:*** Introduction: Theory, Instrumentation: single beam, double beam spectrophotometers, FTIR: principle , instrument design, and function of beam splitter, radiation sources, sample cells, monochromators, detectors, sample handling, Resolution, wave number measurement, Advantages of FTIR vs. IR. Useful terms: IR region, types of vibrations: fundamental and overtones, linear and nonlinear molecule, equation for vibrational frequency, selection rule, coupling interactions, hydrogen bonding information, Fermi resonance. IR spectra: group frequency, group frequency region, finger print region, spectra interpretations and structure elucidation.	25
2.	**LIQUID CHROMATOGRAPHY** Principle of Liquid – Solid chromatography, Comparison with GC, Column chromatography, Gradient elution, Displacement chromatography, Principle of HPLC, Instrument and significance of each component, Pumps, Guard column Criteria in selection of mobile phase, Stationary phases (solid, liquid), Bonded phase supports, Detectors: UV absorption, RI detectors – Normal phase and Reversed phase. Method of introducing sample.	25
3.	**GREEN CHEMISTRY AND WATER ANALYSIS** **(A) Green Chemistry** Twelve principles, green solvents and their applications: Ionic liquids, types, properties and applications, ILs as solvents, Supercritical fluids, Supercritical CO_2, its properties and applications in dry cleaning and decaffeination of coffee. **(B) Water analysis** Sources of water pollution, Sewage and industrial effluents, Analysis of water pollutants, Sampling, Preservation, Measurement of parameters such as COD, BOD, DO, TDS, suspended solids, TCC, phenols, fluoride.	25

4.	**TITRIMETRIC METHODS AND ELEMENTAL ANALYSIS** **Solution and Their Concentration:** Molarity, Molality, Normality, ppm, ppb, ppt, %w/v, %w/w, %v/v, Formality, Primary and Secondary standard, Acid Value, Density and Specific Gravity, Numerical. **Non-Aqueous Titration:** Protic and Aprotic Solvent, Solvent system, Dielectric constant, Titrant, Titration Curve, Determination of Equivalence point, Karl Fisher Titration, Numerical. **Elemental Analysis:** Step on Analysis, C and H Analysis, N Analysis, Halogen Analysis and Sulpher Analysis, Numerical.	25

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 Examination (As per CBCS R.6.8.3)	30%
3.	University Examination	70%

Course Outcomes: Having completed this course, the learner will be able to	
1.	Understand the basic concept of Infrared radiation and their interaction with the matter and use of FTIR spectrophotometer in structure identification and quantitative determination.
2.	Recognize the use of different stationary and mobile phase for the separation of organic molecule in liquid chromatography and identify the problems and their solution during the analysis.
3.	Learn different principles of green chemistry and their use in various techniques, also learn the determination of various pollutants in water by different techniques available such as classical and instrumental techniques.

4.	Understand the making of different solution with the help of different concentration and learn the non-aqueous titration when aqueous titration fails. Also learn the determination of various elements in organic compounds.

Suggested References:

1. Fundamental of molecular spectroscopy, C.N. Banwell, Tata McGraw Hill Pub. Camp.
2. Spectrometric Identification of Organic Compounds (4th edition/5th edition), Silverstein,Bassler&Morril,JohnWiley&Sons.
3. IntroductiontoMolecularSpectroscopy,G.M.Barrow, McGraw – Hill.
4. Modern Spectroscopy, J.M.Hollas, John Wiley.
5. Basic Principles of Spectroscopy, R.Chang, McGraw-Hill.
6. ModernMethodsofChemicalAnalysis(2nd ed.),Pecsok,Shields,Cairns&McWilliom, JohnWiley&Sons.
7. Instrumental Analysis byR. D. Braun, McGraw-Hill.
8. Mathematics for Chemistry, Doggett and Sucliffe, Longman.
9. Mathematical preparation for Physical Chemistry, F. Daniels, McGrawHill.
10. Introductionto Instrumental Analysis by R. D. Brawn, McGraw-Hill Book.
11. FundamentalsofAnalyticalChemistry:SkoogD.R.andWestD.M.(Holt,Rinehart&Winston, New York).
12. Chemical Analysis in Industry(in Gujarati) by M. N. Desai.
13. Instrumental Methods of Analysis by G. W. Ewing.
14. ModernMethodofChemicalAnalysisbyPecsok,Shield,Cairns,McWilliam,John Wiley and Sons.
15. Quantitative Analysis, 6th Ed.,R.A.DayandA.L.Underwood, Prentice– Hall of India, 1993.
16. Instrumental Analysis: G. D. Caristian and J. E. O'Reilly (Allyn& Bacon Inc., NewYork, 2ndedition.
17. Instrumental Methods of Chemical Analysis: G. W. Ewing (McGraw-Hill, NewYork), 5thedition.
18. Instrumental Methods of Analysis: H. R. Willard, L. L. Merrit, J. A. Dean, F. A. Settle (Van Nostrand Reinhold Co., New York), 6thedition.
19. Modern Methods of Chemical Analysis: Pecsok, Shield & Cairns (John Wiley), 2ndedition.
20. Introduction to Instrumental Analysis (1987), R. D. Braun (McGraw-Hill Book Company), New Delhi.
21. Analytical Chemistry: Principles and Techniques: Larry G. Hargis (Prentice-Hall International edition).
22. Introduction to Modern Liquid Chromatography: L. R. Shyder& J. J. Kirkland (John Wiley & Sons, New York).
23. Treatise on Analytical Chemistry: I. M. Kohthoff& P. J. Elving (John Wiley & Sons, New York).
24. Handbook of Analytical Chemistry: L. Meites (McGraw-Hill, New York).
25. Environmental Chemistry: B. R. Sharma, H. Kaur (Goel Publishing House, Meerut).
26. Environmental Chemistry by A.K.de

27. Spectrometric Identification of Organic Compounds; By Robert M. Silverstein, Francis X. Webster, David J. Kiemle, David L. Bryce, Eight edition, Published by Wiley
28. Introduction to Spectroscopy; By Donald L. Pavia, Gary M. Lampman, George S. Kriz, James A. Vyvyan,Fourth edition, Published by Brooks cole.
29. Spectroscopic Methods in Organic Chemistry; By D.H Williams, I. Fleming, Sixth edition, Published by Tata Mcgraw Hill Education.
30. Spectroscopy of Organic Compounds; By P S Kalsi, Sixth edition, Ne Age International Publisher.
31. Organic Spectroscopy: Principles and Applications; By Jag Mohan, Second edition, Published by Alpha Science International Ltd.
32. Organic Spectroscopy (NMR, IR, Mass and UV); By Dewan S.K.,First edition, CBS Publisher & Distributors Pvt Ltd.
33. Basic Principles of Spectroscopy; By Raymond Chang, Published by McGraw-Hill Inc.
34. Elementary Organic Spectroscopy; By Y R Sharma, S. Chand & Company Pvt. Ltd.
35. Organic Spectroscopy; By William Kemp, Published by Palgrave Macmillan.

36. Green chemistry by V. K. Ahluwalia, Narosa Pub New Delhi
37. Green Chemistry, Theory and Practice, P. T. Anastas and John C. Warner, Oxford University Press, 2000, New York, USA.
38. Green Chemistry: An Introductory Text, Mike Lancaster, Green Chemistry Network, University of York, RSC, 2002.

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

M.Sc. Semester-III (INORGANIC CHEMISTRY)

Sr. No.	Course Title	L	T/C/S	Credit
1	Selected Topics in Inorganic Chemistry	4	1	4
2	Metallurgy, Bio-fertilizer & Ion exchange Chromatography	4	1	4
3	General Topics in Inorganic Chemistry	4	1	4
4	Co-ordination Chemistry (Special Paper)	4	1	4
5	Practicals	12		8
		28	4	24

External Examination Time Duration: 03 hrs

Name of Exam	Semester	Paper No	Course Group	Credit	Internal Marks	External Marks	Total Marks
M. Sc.	III	I	Core	04	30	70	100
		II	Core	04	30	70	100
		III	Core	04	30	70	100
		IV	Core	04	30	70	100
			Practical	08	60	140	200
			Total	24	180	420	600

Master of Science, Inorganic Chemistry
M.Sc.Inorganic Chemistry, Semester III
PAPER-I

Course Code	[1903080203010002]	Title of the Course	**SELECTED TOPICS IN INORGANIC CHEMISTRY**
Total Credits of the Course	4	Hours per Week	4 hrs

Course Objectives:	• To learn the properties of non-transition metal elements. • To learn the synthesis, bonding, properties and applications of main group elements. • To understand the Bio inorganic chemistry of Hemoglobin, Myoglobin, Ferritin and Transferrin • To understand the metal complexes in Medicine and anticancer activity of Platinum complexes
Mapping between CO and PSO	

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8	PSO9	PSO10	PSO11	PSO12
CO1		■	■				■	■	■	■		
CO2	■		■		■		■	■	■	■		■
CO3	■		■	■	■				■	■	■	■
CO4	■	■	■	■			■		■	■	■	■

Course Content		
Unit	Description	Weightage*

		(%)
1.	**CHEMISTRY OF NON-TRANSITION ELEMENTS** General discussion on the properties of the non-transition elements, Polymorphism in carbon, phosphorus and sulphur, Synthesis, properties and structure of boranes, carboranes, silicates. carbides, phosphazenes, sulphur-nitrogen compounds, peroxo compounds of boron, carbon, sulphur, structure and bonding in oxyacids of nitrogen, phosphorus, sulphur and halogens, interhoalogen, pseudohalides	25
2.	**ORGANOMETALLIC COMPOUND** 1. Introduction, definition and scope of organometallic Chemistry. 2. Metal-Carbon multiple bonded compounds: Synthesis, bonding. Properties and applications of: (a) Carbenes (b) carbynes 3. ηC_nR_n carbocyclic polyenes: Synthesis, bonding. Properties and applications of a) allyls η^3 - C_3R_5, b) pentadienyls $\eta 5$-C_5R_7, c) cyclobutadienyls η^4-C_4R_4 d) cyclopentadienyls η^5-C_5R_5 e) arenas η^6-C_6R_6 f) cycloheptatrienyls η^7-C_7R_7 4. Synthetic applications of Main group organometallic compounds. a) Organolithium b) Organomagnesium c) Organozinc d) Organoboron e) Organothallium	25
3.	**BIOINORGANIC CHEMISTRY-I** **1. Biological Chemistry of Iron:** a) Transport of Iron b) Hemoglobin and Myoglobin c) Storage and Transport Proteins of Iron viz Fermitin and Transferrin d) Cytochromes e) Iron-Sulfur Proteins. **2. Biochemistry of Cobalt** a) B_{12} coenzymes and Model compounds	25

	b) Actions of Cobalmins and Cobinamides c) Adenosylcobalmin as a coenzyme d) Ribonucleotidereductase e) Methylcobalamin as cofactor.	
4.	**BIOINORGANIC CHEMISTRY-II** **1. Biological Chemistry of Copper** a) Type I, Il and III b) Blue Copper Proteins (plastocyanins, Arurins and Blue Oxidases) c) Models of Blue Copper compounds d) Non-blue copper proteins (Tyrosinase, Galactose Oxidase, SOD) **2. Biochemistry of Zinc** a) Carboxypeptidase and carbonic anhydrase **3. Metal complexes in Medicine.** a) Disease due to Metal deficiency and its treatment: Fe, Cu, Zn and Mn b) Metals used in diagnosis: MRI **4.** Anticancer activity of Platinum complexes.	25

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%
3.	University Examination	70%

Course Outcomes: Having completed this course, the learner will be able to

1.	To learn the properties, synthesis, structure and bonding of the non-transition elements,
2.	To learn the M-C multiple bonded compounds and synthetic applications of main group organometallic compounds.
3.	To learn the biological chemistry of Iron and Cobalt
4.	To understand the biological chemistry of Copper and Zinc, Metal complexes in medicine and anticancer activity of complexes.

Suggested References:

Reference Books Recommended:

1. A. F. Wells, Structural Inorganic Chemistry - 5th edition (1984)
2. J. D. Lee, Concise inorganic Chemistry, Elbs with Chapman and Hall, London
3. M. C. Day and J. Selbin, Theoretical Inorganic Chemistry, Reinhold, EWAP
4. F. A. Cotton, R. G. Wilkinson. Advanced Inorganic chemistry
5. Willam L. Jooly, Modern Inorganic Chemistry
6. Advanced Inorganic Chemistry, Bahl and Tuli, S. Chand and Company
7. Inorganic Chemistry 3rd edn. D. F. Shriver and P. W. Atkins, Oxford University Press, 1999, Chapter 16.
8. Organotransition Metal Chemistry, Anthony F. Hill, Royal Society of Chemistry, Tutorial Chemistry Text, 2002. Chapters 1 to 7.
9. Organometallics: A concise Introduction, Ch. Elshebroicn and A. Salzer, VCH, Chapters 12 to 16.
10. Organotransition Metal Chemistry: Applications to Organic Synthesis, S. G. Davies, Pergamon 1982.
11. Bioinorganic Chemistry: A Short Course -Rosette M.Roat-Malone, Wiley Interscience, 2002.
12. Biological Inorganic Chemistry -An Introduction, Robert Crichton, ElsevierScience, 2007
13. The Biological Chemistry of the Elements- The Inorganic Chemistry of Life J. J. R. Frausto da Silva and R. J. P. Williams Clarendon Press, Oxford,1991. 1
14. Bioinorganic Chemistry, Dr. Asim. K. Das, Books Allied Lid, Kolkata

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

On-line Resources

Master of Science, Inorganic Chemistry
M.Sc.Inorganic Chemistry, Semester III
PAPER-II

Course Code	[1903080203020002]	Title of the Course	**METALLURGY, BIO-FERTILIZER & ION EXCHANGE CHROMATOGRAPHY**
Total Credits of the Course	4	Hours per Week	4 hrs

Course Objectives:	• To understand the classification, methods of production, chemical properties and uses of different fertilizers. • To learn the different types of magnetic bodies and its magnetochemistry • To learn types of corrosion principles and corrosion inhibitors • To understand the synthesis, characterization and properties of ion exchangers.
Mapping between CO and PSO	

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8	PSO9	PSO10	PSO11	PSO12
CO1		■	■				■	■	■	■		
CO2	■		■		■		■	■	■	■		■
CO3	■		■	■	■				■	■	■	■
CO4	■	■	■	■			■		■	■	■	■

Course Content

Unit	Description	Weightage* (%)
1.	**CHEMICAL AND BIOFERTILIZERS** Definition, classification, methods of production, chemical properties and uses of urea, Ammonium sulphate, ammonium sulphate nitrate, ammonnum chloride, single super phosphate, triple super phosphate, biofertilizers, types of biofertilizers, nitrogen fixing biofertilizers , phosphate-solubilizing biofertilizers, preparation of a biofertilizers	25

2.	**MAGNETO CHEMISTRY** Introduction, definition, types of magnetic bodies, Russel-saunders and LS coupling. Derivation of Russel-Saundersterms, spin-orbit interaction, thermal energy and magnetic property, magnetic moment for different multiple widths, multiple width large compared to KT, multiple width small compared to KT, multiple width comparable to KT, stereo chemical application of magnetic properties of the first transition series, lanthanides and actinides. Determination of magnetic susceptibility by different methods	25
3.	**CORROSION INHIBITORS** Introduction, types of corrosion principles of corrosion inhibitors, corrosion as an electrochemical process, practical aspects of corrosion inhibition, anion inhibitor properties in neutral electrolytes, some application of corrosion inhibitors (cooling water circulation-once through and open systems engine radiation and cooling systems, central heating systems, refrigeration plants and high chloride systems, water for steam raising corrosion inhibitors for paint coating)	25
4.	**ION EXCHANGE** Synthesis, characterization and properties of Ion exchangers, mechanism of ion exchange: equilibria-rate theory, Donnan equilibr ia , liquid ion exchangers and chelate ion-exchange resins, Separation of metal and non-metals using ion exchangers. Inorganic ion exchangers: The clay minerals, zeolites, heteropolyacid salts, hydrous oxides and insoluble salts and their applications.	25

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%
3.	University Examination	70%

Course Outcomes: Having completed this course, the learner will be able to	
1.	To understand the classification, methods of production, chemical properties and uses of urea, Ammonium sulphate, ammonium sulphate nitrate, ammonium chloride, single super phosphate, triple super phosphate, bio fertilizers. Learn the types of biofertilizers like nitrogen fixing and phosphate-solubilizing.
2.	To learn types of magnetic bodies, Russell-Saunders and LS coupling. Derivation of Russell-Saunders terms, spin-orbit interaction, thermal energy and magnetic property, magnetic moment for different multiple widths, multiple width large and small compared to KT, lanthanides and actinides. To understand the determination of magnetic susceptibility by different methods
3.	Learn the types of corrosion principles of corrosion inhibitors, corrosion as an electrochemical process, practical aspects of corrosion inhibition, anion inhibitor properties in neutral electrolytes, some application of corrosion inhibitors
4.	To understand the synthesis, characterization and properties of Ion exchangers, mechanism of ion exchange, equilibria-rate theory, Separation of metal and non-metals using ion exchangers. To learn the Inorganic ion exchangers and their applications

Suggested References:

Reference Books Recommended:

1. CE Harland 1994 lon exchange theory and practice, second Edn,Royal society of chemistry Cambridge.
2. J.Korkisch 1989 Handbook of ion exchange resins,their application to inorganic chemistry CRC press,Boca Raton FL.
3. An introduction to metallic corrosion: U. R. Evans, Cambridge, England
4. UHLIGS Corrosion hand book, R. Winston Revie., John Wiley & Sons JNC.
5. Vogel's text book of quantitative chemical analysis, sixth Edn. J.Mendham R C Denney,J.D.Barnes, M J K Thomas.
6. Advanced in inorganic chemistry vol. 1 & 2, Gurdeep Raj, Krishna Publication Meerut.
7. Collings G. H., Commercial Fertilizers, 5th edition, Mcgrew HillI, New York, 1955.

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

Master of Science, Inorganic Chemistry
M.Sc.Inorganic Chemistry, Semester III
PAPER-III

Course Code	[1903080203030002]	Title of the Course	**GENERAL TOPICS IN INORGANIC CHEMISTRY**
Total Credits of the Course	4	Hours per Week	4 hrs

Course Objectives:	• To learn different theories to understand shape and geometry of different molecules. • To learn about nature of nucleus and theory of radio activity • To learn about principles, different forms and prevention of corrosion chemistry. • To understand basic requirement of titration and types of EDTA titration.
Mapping between CO and PSO	

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8	PSO9	PSO10	PSO11	PSO12
CO1		■	■				■	■	■	■		
CO2	■		■		■		■	■	■	■		■
CO3	■		■	■	■				■	■	■	■
CO4	■	■	■	■			■		■	■	■	■

Course Content

Unit	Description	Weightage* (%)
1.	**STEREOCHEMISTRY AND BONDING COMPOUND** Wave mechanical treatment of covalent bond, valence bond theory, molecular orbital theory, VSEPR theory, walsh diagrams, shapes of molecules having regular and irregular geometry, orbital configuration of some triatomic molecules, hybridization, bent's rule and energetics of hybridization, dπ–pπ bonds, structure of some adducts.	25

2.	**NUCLEAR CHEMISTRY** The nature of the nucleus, nuclear stability, packing fraction, magic number, isotopes, isobars, isotones and isomers, natural radioactivity, theory of radioactivity disintegration, radioactive equilibrium, radioactive series, units of radioactivity, measurement of radioactivity, nuclear transmutation, artificial radioactivity, nuclear reaction, nuclear fission and fusions, trace elements, application of radioactive isotopes	25
3.	**CORROSION CHEMIST RY** Principle of corrosion and rate expressions, different forms of corrosion, corrosion by sea water and boilers, contact and crevice corrosion, stress corrosion, cracking and related phenomena, hydrogen cracking corrosion prevention-corrosion inhibitors and passivators, cathodic and anodic protection, metallic coating, role of paints, plastic linings, alloying for corrosion resistance.	25
4.	**VOLUM ET RIC TITRIME TRY** Terminology, basic require me nts of a titration reaction, standard and primary standard solution, expressing concentra tion of standard solution, volume tric titration co-relation, p-func tions, acid-base titration, theory of acid base indicators, redox titration, comple xometric titration, EDTA titration, indica tors for EDTA titration, titration curves, EDTA titratio n methods, cautions in volume tric titrime try, correction for unavoida ble errors.	25

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%
3.	University Examination	70%

Course Outcomes: Having completed this course, the learner will be able to	
1.	Learnt the wave mechanical treatment of covalent bond, valence bond theory, molecular orbital theory, VSEPR theory, Walsh diagrams, shapes of molecules having regular and irregular geometry, orbital configuration of different molecules
2.	Learnt the nature of the nucleus, natural radioactivity, theory of radioactivity disintegration and its equilibrium, series, units, measurement and application of radioactive isotopes
3.	Understood the principles of corrosion , different forms of corrosion, prevention-corrosion inhibitors and passivators, cathodic and anodic protection, metallic coating, role of paints, plastic linings, alloying for corrosion resistance
4.	Gained knowle dge of basic require me nts of a titration reaction, standa rd and prima r y standard solution, expressing concentra tion of standard solution, volume tric titration co - relation, p-func tio ns, acid-base titration, theory of acid base indica tors, redox titrat i o n , comple xometric titratio n, indica tors for EDTA titration, cautions in volume tric titrime t ri c

Suggested References:

Reference Books Recommended

1. Principle of Inorganic Chemistry:Puri Sharma, Kalia,Thirty Third Edn. (Vishal Publishing Co.)
2. Advanced in Inorganic Chemistry: S. K. Agrawal, Keemti Lal, Fifteenth Edn. (Pragati Edition)
3. An introduction to metallic corrosion: U. R. Evans, Cambridge, England
4. UHLIGS Corrosion hand book, R. Winston Revie., John Wiley & Sons JNC
5. Vogel's text book of quantitative chemical analysis, sixth Edn.
6. Advanced in Inorganic chemistry vol. 1& 2, Gurdeep Raj, Krishna Publication Meerut
7. Selected topics in inorganic chemistry: Malik, Tuli, Madan

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

On-line Resources

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

Course Code	[1903080203040002	Title of the Course	**CO-ORDINATION CHEMISTRY(SPECIAL PAPER)**
Total Credits of the Course	4	Hours per Week	4 hrs

Course Objectives:	• Understand theoretical principle valence bond theory, Crystal field theory. • Learn the Advanced theory Molecular orbital theory for complex ions. • Understand the theoretical aspects of spectra of complexes. • Learn the Crystal field diagram for d^1 and d^{10} configuration, Orgel diagram for Oh and Td complexes (d^1-d^9 states)
Mapping between CO and PSO	

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8	PSO9	PSO10	PSO11	PSO12
CO1		■	■				■	■	■	■		
CO2	■		■		■		■	■	■	■		■
CO3	■		■	■	■				■	■	■	■
CO4	■	■	■	■			■		■	■	■	■

Course Content		
Unit	Description	Weightage * (%)
1.	**THEORIES OF METAL LIGAND BONDING-I**	25

	a) **Valence bond theory(VBT)** Theoretical principle of VBT Inner orbital complexes and outer orbital complexes, example of complexes of co-ordination number 2 to 6, advantages and limitation of valence bond theory b) **Crystal field theory (CFT)** Theoretical principles of CFT CFT to weak and strong field compounds: splitting pattern in octahedral(Oh), tetrahedral(Td), square planar(D_4h), trigonal bipyramidal (TBP), and square planar(SP) complexes, limitation of crystal field theory, structural effects of orbital splitting	
2.	**THEORIES OF METAL LIGAND BONDING –II** a) **Advanced theory:** Jahn teller effects and distortions in Oh complexes. Ligand field theory (LFT), experimental evidences in support of metal ligand overlap. Adjusted crystal field theory (ACFT), determination of ligand group of orbitals, σ bonding and π bonding, b) **Molecular orbital theory for complex ions.** Qualitative molecular orbital energy level diagrams and their interpretation of Oh, Td and square planar complexes with examples	25
3.	**ELECTRONIC SPECTRAL PROPERTIES OF TRANSITION METAL AND METAL COMPLEXES-I** Theoretical aspects of spectra of complexes Spectroscopic terms, coupling of terms, microstates for the p, d and f configurations. Hund's rule for ground state term, derivation of russel-saunders terms, the correlation of spectroscopic term in mulliken symbols, electronic transition selection rules, spin-orbit coupling. Crystal field diagram for d^1 and d^{10} configuration. Orgel diagram for Oh and Td complexes (d^1-d^9 states)	25
4.	**ELECTRONIC SPECTRAL PROPERTIES OF TRANSITION METAL AND METAL COMPLEXES-II** Tanabe Sugano energy level diagram for Oh and Td complexes (d^1-d^9 states). Charge transfer spectra and interligand spectra, factors affecting charge spectra, calculation of Dq, B' and β, parameters for Co(II) and Ni(II) complexes using electronic spectral data under different geometries Spectrochemical series and nephelauxatic series, intensity of spectral	25

	peak: oscillator strength and band width.	

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%
3.	University Examination	70%

Course Outcomes: Having completed this course, the learner will be able to	
1.	Learnt the theoretical principle of VBT Inner orbital complexes and outer orbital complexes, example of complexes of co-ordination number 2 to 6, advantages and its limitations.
2.	Learnt Advanced theories like Jahn teller effects and distortions in Oh complexes, Ligand field theory(LFT), Adjusted crystal field theory (ACFT), Qualitative molecular orbital energy level diagrams and their interpretation of Oh, Td And SP.
3.	Understand Spectrosc opic terms, couplin g of terms, microsta tes for the p, d and f configuratio ns, Hund's rule for ground state term, electronic transitio n selection rules, spin - orbit coupling. Crysta l field diagra m for d^1 and d^{10} configura tion. Orgel diagram for Oh a nd Td comple xes (d^1-d^9)states
4.	Understand the Tanabe Sugano energy level diagram for Oh and Td complexes (d^1-d^9 states). Charge transfer spectra and interliga nd spectra, factors affecting charge spectra, calculation of Dq, B' and β, spectroche mica l series and nephelauxatic series.

Suggested References:

Reference Books Recommended

1. Inorganic chemistry(principle of structure and coordination compounds) J.E

Huheey , Harper and Row International series, New York(1983)
2. Advanced inorganic chemistry F.A. Cotton and G.Wildinson, Interscience, New York (1988)
3. Theoritical Inorganic Chemistry (new edition) M.C.Day And J.Selbin East-West Press Pvt.Ltd (New Delhi) 1971
4. A Modern Introduction Chemistry, T. Moeller John Wiley And Sons, New York
5. Principle of inorganic chemistry, Puri, Kalia And Sharma, Vishal Publishing Co. Jalandhar
6. Advanced inorganic chemistry, S. K Agrawal And Keemtilal, Pragati Prakashan
7. Co-Ordination Chemistry Pimplapure, Jain, Pragati Prakashan
8. General and Inorganic chemistry, R Sarkar, New Central Book Agency
9. Advanced inorganic chemistry, Tulibasu And Madan (Volume-II)
10. Inorganic electronic spectroscopy (II edition), A.B.P. Lever, Elsevier, Amsterdam
11. Introduction to ligand field, B.N.Feggis, Interscience, New York (1966).
12. Physical Methods in Inorganic chemistry (both edition), R.S.Drago, W.B.Saunders, Philadelphia (1977)
13. Introduction to ligand field theory, C.G. Ballhenson, Mcgraw-Hill, New York(1962)
14. Electron absorption spectroscopy and related techniques, D.N. Sathyanarayana Compound, Indrajeetkumar, Pragati Prakashan

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

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Master of Science, Inorganic Chemistry
M.Sc.Inorganic Chemistry, Practicals
Semester- III

Course Code	[1903080203050001]	Title of the Course	**INORGANIC CHEMISTRY**
Total Credits of the Course	4	Hours per Week	4 hrs

Course Objectives:	• To impart basic knowledge of constituents of Ores, alloys and sample • Understand the opening of alloy and ores • To learn the analysis of constituents in alloys and ores. • To learn methods practically for estimation of different metals in ores, alloys gravimetrically and volumetrically • To learn mole-ratio method by Job's method.

Mapping between CO and PSO

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8	PSO9	PSO10	PSO11	PSO12
CO1		■	■				■	■	■	■		
CO2	■		■		■		■	■	■	■		■
CO3	■		■	■	■				■	■	■	■
CO4	■	■	■	■			■		■	■	■	■

Course Content

1	Estimation of Ore-Alloy	4- Credit
2	Analysis of Sample	
3	Job's Method	4- Credit
4	Viva-Voce	

1. Analysis of Brass alloy
2. Analysis of Ultramarine sample
3. Analysis of Hydrogen peroxide (H_2O_2)
4. Analysis of Dolomite Ore
5. Analysis of fertilizer sample
6. Analysis of Stainless Steel
7. Analysis of German Silver
8. Analysis of Portland Cement.
9. Analysis of Available lime
10. Analysis of PO_4^{-3} for K_2HPO_4 spectrometrically
11. Determine the λmax for Cu-en complex[(1:1), (1:2),(1:3)] complex
12. Determine the composition of Cu-en complex by Job's method
13. Determine the λmax for Ni-en complex[(1:1), (1:2),(1:3)] complex
14. Determine the composition of Ni-en complex by Job's method.

Teaching-Learning Methodology	Introduction, interaction with student for analysis of Ore/Alloy, Sample and estimation of metal-ligand by Mole-ratio method and performing the experiment according to the respective method.

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

Course Outcomes: Having completed this course, the learner will be able to	
1.	Understand the basics of opening of ores and alloys
2.	Learn the percentage of constituents in different samples, alloys and ore by different methods.
3.	Learnt to perform experiments using different references.
4.	Learn to perform practicals by qualitative methods.
6.	Learn Mole-ratio of metals and ligands.
7.	Understand the calculation using different references.
8.	Appreciate good laboratory practices.

Suggested References:

Reference Books Recommended

1. Comprehensive Practical Organic Chemistry by V.K. Ahluwalia and Ren Aggarwal
2. Monograph on Green Chemistry Laboratory Experiments by Green Chemistry Task Force Committee, DST
3. Quantitative analysis by Arther I.Vogel
4. Quantitative analysis by V.K.Ahluwalia
5. Quantitative analysis by Mann and sanders

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

M.Sc. Semester-IV (INORGANIC CHEMISTRY)

Sr. No.	Course Title	L	T/C/S	Credit
1	Selected Topics in Inorganic Chemistry	4	1	4
2	General Topics of Inorganic Chemistry	4	1	4
3	Spectroscopy & Agricultural Pollutants	4	1	4
4	Co-ordination Chemistry(Special paper)	4	1	4
5	Practicals	12		8
		28	4	24

Master of Science, Inorganic Chemistry
M.Sc.Inorganic Chemistry, Semester IV
Paper 1

Course Code	[2003080204010002]	Title of the Course	**SELECTED TOPICS IN INORGANIC CHEMISTRY**
Total Credits of the Course	4	Hours per Week	4 hrs

Course Objectives:	• Photochemistry laws and photo physical processes. • Types, sources and control of various types of pollution. • Types of homogeneous catalysis • Transition metal hydrides, dihydrogen complexes.

Mapping between CO and PSO

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8	PSO9	PSO10	PSO11	PSO12
CO1		■	■				■	■	■	■		
CO2	■		■		■		■	■	■	■		■
CO3	■		■	■	■				■	■	■	■
CO4	■	■	■	■			■		■	■	■	■

Course Content

Unit	Description	Weightage* (%)
1.	**PHOTOCHEMISTRY OF INORGANIC COMPOUNDS AND CO-ORDINATION COMPOUNDS** **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 biomolecular	25
2.	**ENVIRONMENTAL CHEMISTRY** 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	25

	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.	
3.	**HOMOGENEOUS CATALYSIS** 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.	25
4.	**TRANSITION METAL COMPOUNDS WITH BOND TO HYDROGEN AND REACTIONS OF HOMOGENEOUS CATALYSIS** 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) Reaction of homogeneous cataysis:** Oxidative-Addition Reaction : Energetics and Mechanism, Reductive-Elimination Reaction, Insertion Reaction: classification and some examples, Deinsertion Reaction, Nucleophilic and Electrophilic Attack on Coordinated ligands	25

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%

3.	University Examination	70%

Course Outcomes: Having completed this course, the learner will be able to	
1.	Learn about Photochemistry laws and photochemical kinetics, photochemical process and photochemical equipment, Photo physical process theory and relative process stimulated absorption, spontaneous emission, selection rules, theory of non-radiative processes, radiationless transitions and bimolecular
2.	Learnt and understand about various types of water pollution, sources, sinks and methods of control.
3.	Understand the types of catalysts, different methods of homogeneous catalysis, 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.
4.	Learn the characterization of transition metal hydride complexes, methods of preparation, properties, Mononuclear polyhydrides, Homoleptic polyhydrido anions, Metal carbonyl hydrides, Dihydrogen complexes,

Suggested References:

Reference Books Recommended:

1. Fundamentals of photochemistry, K. K. Rohatgi, Mukerjee. 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).

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

Master of Science, Inorganic Chemistry
M.Sc.Inorganic Chemistry, Semester IV
Paper II

Course Code	[2003080204020002]	Title of the Course	**GENERAL TOPICS OF INORGANIC CHEMISTRY**
Total Credits of the Course	4	Hours per Week	4 hrs

Course Objectives:	• To understand and familiarize the development of supra molecular chemistry, Host-guest compounds and its concepts and design. • To understand regarding isomerism among Inorganic compounds. • To understand the various solids, closed packing, lattice energy and its calculation. • Learn different cells, oxidation-reduction reaction and related diagram.
Mapping between CO and PSO	

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8	PSO9	PSO10	PSO11	PSO12
CO1		■	■				■	■	■	■		
CO2	■		■		■		■	■	■	■		■
CO3	■		■	■	■				■	■	■	■
CO4	■	■	■	■			■		■	■	■	■

Course Content

Unit	Description	Weightage * (%)
1.	**BASICS OF SUPRAMOLECULAR CHEMISTRY** 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.	25
2.	**ISOMERISM AMONGINORGANIC COMPLEXES** 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 in 4 - and 6 - coordinates compounds. Resolution of racemic mixtures.	25
3.	**CHEMISTRY OF SOLID STATE** 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.	25
4.	**OXIDATION AND REDUCTION** 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	25

	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%
3.	University Examination	70%

Course Outcomes: Having completed this course, the learner will be able to	
1.	Learn about development of Supramolecular chemistry, classification of Supramolecular Host-Guest compounds, Receptors, coordination and lock and key analogy,nature of supramolecular interactions, solvation and hydrophobic effects, supramolecular concepts and design
2.	Understand regarding the structural isomerism, stereoisomerism geometrical isomerism in 4 - and 6 - coordinates compound, cis and trans- isomers, mirror image isomerism, Optical isomerism in 4 - and 6 - coordinates compounds. Resolution of racemic mixtures
3.	Learn about the crystalline and amorphous solids, 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 , experimental determination of lattice energy, defect structures of crystals.
4.	Knowledge of Oxidation number, Galvanic cell, single electrode potential, sign of electrode potential, standard electrode potentials, electrochemical series, Nernst equation, application of electrochemical series, galvanic cell, hydrogen over voltage, oxygen over voltage, redox stability in water, oxidation by atmospheric Oxygen, Latimer diagram, Frost diagram, pourbaix diagram

Suggested References:

Reference Books Recommended:

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

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

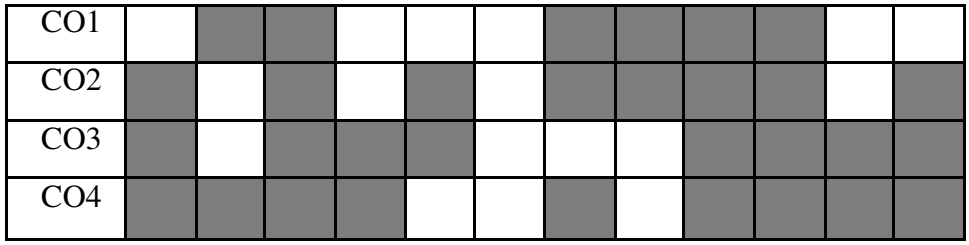
Master of Science, Inorganic Chemistry
M.Sc.Inorganic Chemistry, Semester IV
Paper III

Course Code	[20030802040300002]	Title of the Course	**SPECTROSCOPY & AGRICULTURAL POLLUTANTS**
Total Credits of the Course	4	Hours per Week	4 hrs

Course Objectives:	• General aspects and classification, structural features of some common insecticides. • Learn the Principle and presentation of the ESR spectrum, Hyperfine splitting, Anisotropy and interpretation of g values • Principle, working and application of FT-NMR, its applications. chemistry of lanthanides and actinides • Basic principle, Spectral parameters and spectrum Display. Interpretation of Isomer shift. Application of Moa

Mapping between CO and PSO

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8	PSO9	PSO10	PSO11	PSO12

Course Content		
Unit	Description	Weightage* (%)
1.	**POLLUTION FROM AGRICULTURE PESTICIDES AND FERTILIZERS** 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.	25
2.	**ELECTRON SPIN RESONANCE** 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.	25
3.	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.	25

4.	**MOSSBAUER SPECTROSCOPY** 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.	25

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%
3.	University Examination	70%

Course Outcomes: Having completed this course, the learner will be able to

1.	Learn about general aspects and classification of pesticides, structural features of some common insecticides, mode of action-general aspects, fate of insecticides in environment and environment hazards, characteristics, fungicides herbicides,major disasters with the pesticides and herbicides, alternative to chemical pesticides, fertilizers and environmental hazards from the fertilizers, eutrophication
2.	Understand the principle and presentation of the spectrum of ESR, Hyperfine splitting, Anisotropy and interpretation of g values, hyperfine coupling and zero field splitting, Double Resonance and Fourier transform EPR techniques.
3.	Learn the 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

4.	To learn the 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.

Suggested References:

Reference Books Recommended:

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.

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

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

Course Code	[2003080204040002]	Title of the Course	**CO-ORDINATION CHEMISTRY(SPECIAL PAPER)**
Total Credits of the Course	4	Hours per Week	4 hrs

Course Objectives:	• Reactivity of metal complexes, ligand replacement reaction, classification of mechanism.

	• Spectrophotometric methods, Potentiometric method • Anomalous magnetic behavior
Mapping between CO and PSO	

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8	PSO9	PSO10	PSO11	PSO12
CO1		■	■				■	■	■	■		
CO2	■		■		■		■	■	■	■		■
CO3	■		■	■	■				■	■	■	■

Course Content		
Unit	Description	Weightage* (%)
1.	**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	25

	transfer reactions, bridged activated mechanism, experimental Techniques.	
2.	**METAL-LIGAND COMPLEX EQUILIBRIA IN SOLUTION:** 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)	25
3.	**MAGNETIC PROPERTIES OF TRANSITION METAL COMPLEXES** **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, Spin cross-over, Magnetic exchange coupling, stereochemical applications of magnetic properties.	25
4.	**SELECTED TOPIC IN INORGANIC CHEMISTRY** 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.	25

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%
3.	University Examination	70%

Course Outcomes: Having completed this course, the learner will be able to	
1.	Understand kinetics of octahedral substitution reaction, stereochemical changes in octahedral complexes, redox reaction:
2.	Learn the metal-ligand complex equilibria in solution, 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 methods
3.	Understand the Solute-Solvent interaction, Solute-Solute interaction, configurational equilibrium, Magnetic exchange coupling, stereochemical applications of magnetic properties
4.	Understand the Stereochemistry of unusual co-ordination number 2 to 9, Metal sequestration and its industrial applications, Catalysis and Green Chemistry

Suggested References:

Reference Books Recommended

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. HuheeHarper 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, Inorganic Chemistry
M.Sc.Inorganic Chemistry, Practicals
Semester - IV

Course Code	[2003080204050001]	Title of the Course	
Total Credits of the Course	4	Hours per Week	4 hrs

Course Objectives:	• To impart basic knowledge of complexes • Understand and synthesize different inorganic complexes • Learn and perform practicals of analysis of water. • To understand the Irving-Rossotti method and perform expertiments
Mapping between CO and PSO	

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8	PSO9	PSO10	PSO11	PSO12
CO1		■	■				■	■	■	■		
CO2	■		■		■		■	■	■	■		■
CO3	■		■	■	■				■	■	■	■
CO4	■	■	■	■			■		■	■	■	■

Course Content

1	Water Analysis	4- Credit
2	Preparation of Inorganic complexes	
3	Irving-Rossotti Method	4- Credit

4	Viva-Voce	

INORGANIC PRACTICALS:

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%
3.	University Examination	70%

Course Outcomes: Having completed this course, the learner will be able to	
1.	Understand the basics to carry out reactions, nature of reaction and calculation of mole ratio.
2.	Establish mechanism and monitoring reaction at specified reaction condition.
3.	Learn to work-up after the complexation of metal and ligands
4.	Learn Irving-Rossotti methods through the references.
6.	Perform the practicals at different pH and draw the different graphs.
7.	Understand the calculation with reference to respective factors.
8.	Appreciate good laboratory practices.

Suggested References:

Reference Books Recommended:

1. Vogel's Textbook of practical organic chemistry, 5th edition, B. S. Furniss, A. J. , P. W. G. Smith, A. R. Tatchell (Pearson Education).
2. Comprehensive practical organic chemistry: Preparation and Quantitative analysis, V. K. Ahluwalia, Renu Agarwal (Universities Press).
3. Monograph on Green Chemistry Laboratory Experiments by Green Chemistry Task Force Committee, DST
4. L. D. Field, S. Sternhell, J. R. Kalman - Organic Structures from Spectra-Wiley (2013)
5. Inorganic Vogel by Mendhan