ST. ALOYSIUS COLLEGE(AUTONOMOUS), JABALPUR

Reaccredited 'A+ 'Grade by NAAC(CGPA:3.68/4.00)
College with Potential for Excellence by UGC
DST-FIST Supported & STAR College Scheme by DBT

Faculty of Science

Bachelor of Science (B.Sc.)

SUBJECT: B.Sc.

B.Sc. III Semester

Paper-Major

Reactions, Reagents and Mechanisms in Organic chemistry

SUBJECT	EXAMINATION	MAX. MARKS	MIN.MARKS
CHEMISTRY	CCE EXAM	40	35
	FINAL EXAM	60	

ASSISMENTAND EVALUATION

Assessment and presentation	09
Classtest-I (Objective Question)	08
Classtest-II (Descriptive Question)	08
Overall performance through out the year(attendance and behavior)	15
Total	**40**

Theory Paper:

SECTION WISE MARKS DISTRIBUTION

S. No.	SECTION	TOTALNO. OFQUESTION	MARKS
1	A	Objective Question	5 X1=5
2	B	Short Answer Question	5 X4 =20
3	C	Long Answer Question	5 X7 =35
		Total	**60**
	Internal and External Marks	**Grand Total**	**40+60 =100**

Class	*CourseType*	*CourseCode*	*CourseTitle(Theory/Practical)*	*Marks*	
B.Sc.III Semester	Major/ Minor	S2 CHEM1T	Reactions, Reagents and Mechanisms in Organic chemistry (Theory)	Max: 100	Min: 35

Course objectives:

- To understand organic reaction mechanisms
- To impart athorough knowledge about the chemistry of some selected organic reagents with a view to develop proper aptitude towards the study of organic compounds and their reactions
- To build up an understanding about pericyclic reactions and to predict the reaction outcome
- To develop the concept of Photochemistry and use, mechanism and application of some photochemical reactions

UNIT– I

Substitution Reactions

Aliphatic Nucleophilic Substitution: Introduction, the S_N1, S_N2 and S_Ni mechanism, neighbouring group participation, Effect of substrate, nucleophile, leaving group and reaction medium. Aliphatic Electrophilic Substitution: Elementary treatment. Aromatic Nucleophilic Substitution : The S N Ar, S N 1 and benzyne SrN 1 mechanisms, effect of substrate, nucleophile, and reaction medium. Aromatic Electrophilic Substitution: Arenium ion mechanism, orientation/directive influence. (electronic explanation only) and rectivity, diazonium coupling, Vilsmeir reaction

Keywords/Tags: Nucleophilic Substitution, Electrophilic Substitution,S_N1,S_N2,S_Ni,S_NAr

UNIT– II

Addition and Elimination Reactions

Addition Reactions: Introduction, reactions involving addition to nucleophile, electrophile and free radicals, regio-selectivity and chemo-selectivity, orientation and reactivity, Markovnikov and Anti Markovnikov‟s addition .Elimination Reactions: Introduction E1, E2 and E1cB mechanisms, effect of substrate,attackingspecies,leaving group and reaction medium, Orientation-Saytzaff and HofmannRule.

Keywords/Tags: Addition Reactions, Elimination Reactions, Saytzaff rule, Markovnikov‟s addition, regio-selectivity and chemo-selectivity.

UNIT– III

Reagents, Catalysts and Rearrangements (Mechanism and Applications)

Reagents and Catalysts: Preparation, properties and applications of important reagents andcatalysts in organic synthesis with mechanistic details: Grignard reagent, N- bromosuccinimide(NBS),diazomethane, anhydrous aluminium chloride (AlCl 3), sodamide (NaNH 2), Ziegler-Natta catalyst.

Rearrangements (Reaction Mechanism and Applications): Introduction, Types of rearrangements, Rearrangement to electron deficient Carbon (Pinacol- pinacolone, benzylic acid & amp; Wangler-Meerwein), Rearrangement to electron deficient Nitrogen (Hofmann-Lossen- Curtius & amp; Backmann), Rearrangement to electron deficient Oxygen (Baeyer-Villiger & amp;Dakin)Rearrangement to electron rich Carbon (Witting), Aromatic Rearrangements (Fries & amp;Claisen)
***Keywords/Tags**:* Rearrangement, Reagents, Catalysts, NBS, sodamide, Grignard

UNIT– IV

Oxidation & Reduction Reactions

Oxidation reactions: Introduction, metal based and non- metal based oxidation, Oxidation of alcohols to carbonyls (chromium, manganese and silver based reagents), alkenes to epoxides(peroxides/peracids based), alkenes to diols (manganese and Osmium based),alkenes to carbonyls with bond cleavage (manganese and lead based), oppenauer oxidation. Oxidation of amino group to nitro group: Oxidation by alkaline $KMnO_4$, Oxidation of aliphatic and aromatic amines by peracids, oxidation of primary and secondary amines to hydroxyl amine by hydrogen peroxide.
Reduction reactions: Introduction, reduction to carbon-carbon multiple bonds, carbonyl groups and nitro compounds: Catalytic hydrogenation: heterogenous (Pd-C and Raney Ni),homogeneous(Wilkinson‟s Catalyst)Hydride transfer reagents: sodium borohydride and lithium aluminium hydride, metal based reduction: Birch reduction and Clemmensen reduction. Reduction of nitro compound by catalytic hydrogentation and metal (with mechanism.
***Keywords/Tags**:* Oxidation, Reduction, hydrogenation, Wilkinson‟s Catalyst, metal based reduction

UNIT–V

Photochemical and Pericyclic Reactions
Photochemical Reactions: Introduction to Photochemistry, electronic excitations, Jablonskidiagram, Norrish type I and II reactions and cis-trans isomerism
Pericyclic Reactions: Introduction of Pericyclic Reactions and their classification(Electrocyclic, Sigmatropic rearrangement and Cycloaddditions) 2+2 and 4+2 cycloaddditions, Claisen and Cope rearrangement.
Keywords/tags:Photochemistry, Pericyclic Reactions, Norrish Reactions, Cycloadddition

Course Outcome: By the end of this course students will be able to-

- Develop knowledge of various organic reactions, reagents and their mechanism in under standing organic synthesis.
- Understand the applications of the reactions in the various industries like pharmaceutical, polymer, pesticides, textile, dye etc.

Develop knowledge about important key reactions used in higher studies and research in chemistry.

Reference Books:

ClaydenJ.,GravesN.andWarrenS.,"OrganicChemistry",OxfordUniversity
2012, 2nd
2 MarchJ,andSmithM.B."AdvancedOrganicChemistry"JohnWilyandSons, 6th
3. BrucknerR.,"Organicmechanismreactionsstereochemistryandsynthesis",
2010
4. KalsiP.S.,"Organicreactionsandtheirmechanisms"NewAgeScience,London, 2010,3rd
editio
2. synthesis"John WilyandSons,NewJersey,2005,second edition
3. LiJ.J.,"Namereactionsarecollectionofdetailedmechanismandsynthetic
application"Springer International Publishing, Switzerland, 2014, fifth edition
4. Hornback J.M. "Organic Chemistry" Thomson Learning, Singapore, 2006, second
edition

Class	*CourseType*	*CourseCode*	*CourseTitle(Theory/Practical)*	*Marks*	
B.Sc.III Semester	Elective	S2 CHEM1T	Reactions, Reagents and Mechanisms in Organic chemistry (Theory)	Max: 100	Min: 35

Course objectives:

- To understand organic reaction mechanisms
- To impart athorough knowledge about the chemistry of some elected organic reagents with a view to develop proper aptitude towards the study of organic compounds and their reactions
- To build up an understanding about pericyclic reactions and to predict the reaction outcome.
- To develop the concept of Photochemistry and use, mechanism and application of some photochemical reactions

UNIT– I

(a) *Substitution Reactions*

Aliphatic Nucleophilic Substitution: Introduction, the S_N1, S_N2 and S_Ni mechanism, neighbouring group participation, effect of substrate, nucleophile, leaving group and reaction medium. Aliphatic Electrophilic Substitution: Elementary treatment. Aromatic Nucleophilic Substitution :The S N Ar, S N 1 and benzyne SRN 1 mechanisms, effect of substrate, nucleophile, and reaction medium. Aromatic Electrophilic Substitution: Arenium ion mechanism, orientation/directive influence. (electronic explanation only) and rectivity, diazonium coupling, Vilsmeir reaction

(b) *Addition and Elimination Reactions*

Addition Reactions: Introduction, reactions involving addition to nucleophile, electrophile and free radicals, regio-selectivity and chemo-selectivity, orientation and reactivity, Markovnikov and Anti Markovnikov‟s addition . Elimination Reactions: Introduction E1, E2 and E1cB mechanisms, effect of substrate, attacking species, leaving group and reaction medium, Orientation-Saytzaff and Hofmann Rule.
Keywords/Tags: Nucleophilic Substitution, Electrophilic Substitution, S_N1, S_N2, S_Ni, S_NAr Addition Reactions, Elimination Reactions, Saytzaff rule, Markovnikov‟s addition, regio-selectivity and chemo-selectivity.

UNIT– II

Reagents, Catalysts and Rearrangements (Mechanism and Applications)

Reagents and Catalysts: Preparation, properties and applications of important reagents and catalysts in organic synthesis with mechanistic details: Grignard reagent, N- bromosuccinimide(NBS),diazomethane, anhydrous aluminium chloride ($AlCl_3$), sodamide ($NaNH_2$), Ziegler-Natta catalyst.
Rearrangements (Reaction Mechanism and Applications): Introduction, Types of rearrangements, Rearrangement to electron deficient Carbon (Pinacol-pinacolone, benzylic acid & Wangler-Meerwein), Rearrangement to electron deficient Nitrogen (Hofmann-Lossen- Curtius& Backmann), Rearrangement to electron deficient Oxygen (Baeyer-Villiger&Dakin)Rearrangement to electron rich Carbon (Witting), Aromatic Rearrangements (Fries &Claisen)

***Keywords/Tags**:* Rearrangement, Reagents, Catalysts, NBS, sodamide,Grignard

UNIT– III

Oxidation & Reduction React ions

Oxidation reactions: Introduction, metal based and non- metal based oxidation, Oxidation of alcohols to carbonyls (chromium, manganese and silver based reagents), alkenes to epoxides(peroxides/peracids based),alkenestodiols(manganeseandOsmiumbased),alkenestocarbonylswithbondcleavage

(manganese and lead based),open auer oxidation. Oxidation of amino group to nitro group: Oxidation by alkaline $KMnO_4$, Oxidation of aliphatic and aromatic amines by peracids, oxidation of primary and secondary amines to hydroxyl amine by hydrogen peroxide.

Reduction reactions: Introduction, reduction to carbon-carbon multiple bonds, carbonyl groups and nitro compounds: Catalytic hydrogenation: heterogenous (Pd-C and Raney Ni), homogeneous(Wilkinson‟s Catalyst) Hydride transfer reagents: sodium borohydride and lithium aluminium hydride, metal based reduction: Birch reduction and Clemmensen reduction. Reduction of nitro compound by catalytic hydrogentation and metal (with mechanism.

***Keywords/Tags**:*Oxidation,Reduction,hydrogenation,Wilkinson‟sCatalyst,metalbased reduction

UNIT– IV

Photochemical and Pericyclic Reactions
Photochemical Reactions: Introduction to Photochemistry, electronic excitations, Jablonski diagram, Norrish type I and II reactions and cis-trans isomerism
Pericyclic Reactions: Introduction of Pericyclic Reactions and their classification(Electrocyclic, Sigmatropic rearrangement and Cycloaddditions) 2+2 and 4+2 cyclo addditions, Claisen and Cope rearrangement.
Keywords/tags: Photochemistry, Pericyclic Reactions, Norrish Reactions, Cycloadddition

Course Outcome: By the end of this course students will be able to-

- Develop knowledge of various organic reactions, reagents and their mechanism in understanding organic synthesis.
- Understand the applications of the reactions in the various industries like pharmaceutical, polymer, pesticides, textile, dye etc.
- Develop knowledge about important key reactions used in higher studies and research in chemistry.

ReferenceBooks:

1 ClaydenJ.,GravesN.andWarrenS.,"OrganicChemistry",OxfordUniversity2nd

2012, MarchJ.andSmithM.B."AdvancedOrganicChemistry"JohnWilyandSons.

2 BrucknerR.,"Organicmechanismreactionsstereochemistryandsynthesis",

6t

4. KalsiP.S.,"Organicreactionsandtheirmechanisms"NewAgeScience,London,

editio2010,3rd

5. synthesis"John WilyandSons,NewJersey,2005,second edition

9. LiJ.J.,"Namereactionsarecollectionofdetailedmechanismandsynthetic application"Springer International Publishing, Switzerland, 2014, fifth edition

10. Hornback J.M. "Organic Chemistry" Thomson Learning, Singapore, 2006, second edition

11 SinghJ.andSinghJ. "PhotochemistryandPericyclicReactions"New

Class	*CourseType*	*CourseCode*	*CourseTitle(Theory/Practical)*	*Marks*	
B.Sc.III Semester	Major/ Minor/ Elective	S2CHEM1P	Organic Qualitative Analysis, reactions and synthesis(Practical)	Max: 100	Min: 35

Course objectives:

- To develop the skills for identification, separation and purification of organic compounds
- To widen problem solving ability and scientific thinking which will be helpful in Higher studies and research

EXTERNALASSESSMENT: 60marks

Inorganic Chemistry

- Crystallization of $CuSO_4$
- Sublimation of amixture of Napthalene

Physical Chemistry-Volumetric analysis.

- Determination of aceticacid in commercial vinegar using NaOH.
- Determination of alkali content-antacid table using HCl.
- Estimation of calcium content in chalk as calcium oxalate by permagnatometry.
- Estimation of hardness of water by EDTA.

Organic Chemistry

- ***Paper chromatography :Ascending***

Determination of Rf values and identification of organic compounds-Separation of a mixture of phenylalanine and glycine, alanine and aspartic acid. Spray reagent ninhydrin.

- Binary mixture analysis containing two solids Separation, identification and preparation of derivatives
- Preparation

i) Acetylation (ii)Benzolyation (iii)Meta-dinitrobenzene (iv)Picric acid

INTERNALASSESSMENT:40marks

Internalassessment	Marks	Externalassessment	Marks
Class Interaction/	15	Viva-Voceon Practical	15
Attendance	5	PracticalRecordFile	10
Assignment(Charts/modelseminar/Rural services/ Technology dissemination/ Report of Excursion/ Lab visits/Survey/Industrial visit)	20	Table work/ Experiments	35
TOTAL	40		60

Course Learning Outcome: By the end of this course students will be able to:

- Perform various reactions, which will be helpful in under standing organic synthesis.
- Under stand the user e agents while performing experiments based on certain organic reactions
- Analyze and Synthesizes organic compounds
- Understand the use of chromatographic techniques and its application in monitoring organic reactions

Class	*CourseType*	*CourseCode*	*CourseTitle(Theory/Practical)*	*Marks*	
B.Sc.IV Semester	Major/Minor	S2 CHEM2T	Transition Elements, Chemi-energetics, PhaseEquilibria(Theory)	Max: 100	Min: 35

Course objectives:

- To enrich the students with the understanding of fundamentals and concepts of thermodynamics, thermochemistry, phase equilibrium, Solutions, Electrochemistry, adsorption, adsorption and its applications.
- To enable the students to understand the fundamentals of the inorganic chemistry through schematic study of transition, inner transition elements and their properties and compounds
- To build up an understanding of coordination chemistry, their reactions, structure, isomerism and applications

UNIT– I

Chemistry of d-&f-block elements

(a) Chemistry of Transition elements: First, Second and Third Transition series**.** General group trends with special reference to- Electronic Configuration, Coordination Geometry, Colour,Variable Valency, Spectral, Magnetic and Catalytic Properties, Ability to form Complexes.

(b) Chemistry of Inner Transition elements: Lanthanides and Actinides. General group trends with specialreferencetoElectronicConfiguration,OxidationStates,Colour,SpectralandMagneticProperties. Lanthanide Contraction. Separation of Lanthanides (lon-exchange method only).

(c) Trans uranic elements: General Introduction.

Keywords/Tags: Knowledge Tradition of Indian Chemistry, Transition elements, Spectral Properties, Magnetic Properties, Catalytic Properties, Lanthanide Contraction.

UNIT–II

Coordination Chemistry

(a) Structures, Stereochemistry and Metal-Ligand Bonding in Transition Metal Complexes: Werner theory for complexes. Electronic interpretation by Sidwik.

(b) Valence Bond Theory (VBT)- Postulates and applications for Tetrahedral, Square planar and Octahedral complexes. Limitations of VBT.

(c) Crystal Field Theory (CET); Postulates and application: Crystal field splitting of d-orbitals Crystal field stabilization energy(CFSE) in Tetrahedral, Squareplanar and Octahedral complexes, CFSE of weak and strong fields. Factors affecting the crystal field parameters. Measurement of 10 Dq (Δo) and factors affecting its magnitude. Comparison of octahedral and tetrahedral coordination. Tetragonal distortions from octahedral geometry. Jahn-Teller theorem. Square planar geometry. Limitations of CFT. Qualitative aspect of Ligand field and Molecular Orbital (MO) Theory. Spectrochemical and Nephelauxetic series. Coordination number, coordination geometries of metal ions, types of ligands.

(d) Isomerism in coordination compounds:
Structural isomerism: Ionization, Linkage, Coordination-Ligand Isomerism.

Stereo isomerism: Geometrical isomerism: Square planar metal complexes of type- $[MA_2B_2]$, $[MA_2BC]$, $[M(AB)_2]$, [MABCD]. Octahedral metal complexes of type-$[MA_4B]$, $[M(AA)_2B_2$:], $[MA_3B_3]$.Optical isomerism:Tetrahedral complexes of type-[MABCD]complexes of type-$[M(AA)_2B_2]$,$[M(AA)_3]$.

UNIT-III

Thermodynamics

(a) First Law of Thermodynamics: Concept of heat (Q), work (W), internal energy (U), Statement of the first Law, Enthalpy(H),Relation between heat capacities. Calculation of Q, W, ΔU and ΔH under isotherm and adiabatic conditions for Reversible, Irreversible and free (ideal and Van der Waals) expansions of gas. Joule Thomson effect and its theory, Inversion temperature.

(b) Second Law of Thermodynamics: Carnot cycle, Statement of the Second Law of Thermodynamics. Concept of Entropy, Calculation of entropy change for Reversible and irreversible processes, Concept of residual entropy, Free energy Function: Gibbs and Helmholtz functions. Variation of entropy(S), Gibbs free energy (G), work function (A) with temperature (T), volume (V) & pressure (p).Free energy change and spontaneity, Gibbs-Helmholtz equation.

(c) Third Law of Thermodynamics: Nernst heat theorem and its significance, Statement of third law, Calculation of absolute entropy of substance.

Keyword/Tag: Thermodynamics, Law of Thermodynamics, Carnot cycle, Enthalpy, Free energy

UNIT-IV

Electrochemistry

Electrical Conduction: conduction in metals and in electrolyte solutions, specific and equivalent conductance, Measurement of equivalent conductance. Effect of dilution on conductivity Migration of ions and Kohlrausch-law and its application.

Weak and strong electrolytes: Theory of Strong electrolytes, Debye-Huckel Onsagar‟s (DHO) theory and equation.

Transport Numbers: determination of Transport numbers by Hittorf method and moving boundary method. Electrode reactions: Nernst equation, Derivation of equation for single electrode potential. Electrode: Reference electrodes, Standard hydrogen electrode Quinhydrone, glass electrodes, Calomel electrode. Standard electrode potential, Electrochemical Series and its application. Electrochemical Cell: Nernst equation, calculation of e.m.f. of cell

Keyword/Tag: Electrical Transport, Conduction, DHO theory, Transport Numbers Nernst equation, Electrode, Electrochemical Series

UNIT–V

Phase equilibrium

Concept phase, component and the degree of freedom, thermodynamic derivation of the Gibbs phase rule for reactive and nonreactive system.

Clausius-Clapeyron and its applications Solid–Liquid, Liquid-Vapour and Solid–Vapour equilibria.

Phase diagrams for one component system with application: water, and Sulphur. Phase diagrams for system of solid-liquid equilibria involving-Eutectic, Congruent and Incongruent melting points. Water and Sulphur system simple, Ag-Pb and Mg-Zn system, NaCl-H_2O system.

Binary solution:,Raoult‟law.Non-ideal system or azeotropes mixture Immiscible Liquid, Steam Distillation.

Keyword/Tag: Phase equilibrium, Gibbs phase rule, Clausius-Clapeyron equation Raoult‟s Law

Course outcome-By the end of this course students will be able to-:

- Develop an understanding about traditional Indian Chemistry
- Understand the concepts of chemistry of d & f block elements, basic concepts of coordination chemistry.
- Explain Stereochemistry of transition metal complexes.
- Gain a thorough knowledge about Laws of thermodynamics and thermochemistry
- Develop the concept of phase equilibrium with reference to solid solution, liquid-liquid mixture, partially miscible liquids.
- Develop an understanding about basic concepts of electrochemistry, various types of electrodes and their reactions

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Reference Books:

1. Bariyar R and Goyal S, BSc Chemistry combined (in Hindi) Krishna education publishers, year 2019
2. Lee J.D., Concise InorganicChemistry,Wiley,2008,5th edition
3. Kalia K. C,.Puri B.R., Sharma L. R., Principles of Inorganic Chemistry, Vishal Publishing Company 2020
4. Sodhi G. S., Textbook of Inorganic Chemistry, Viva Books private limited, New Delhi
5. Singh J, Singh J and Anand vardhan, A logical approach to moderninorganicchemistry,Anubooks, 2019
6. Gopalan R and Ramalingan V, Concise coordination chemistry, Vikas publishing houseprivate limited, New Delhi, 2005, 1st edition
7. Madan R. L., Chemistry for degree students, BSc II year, S. Chand and Company limited,New Delhi,2011
8. Prakash S, Tuli G.D. Basu S.K. and MadanR.D., Advanced Inorganic Chemistry, volume 2, SChandand company limited, New Delhi, 2007, 19th edition
9. Malik W.U., Tuli G.D and Madan R.D. Selected topics in inorganic chemistry, S Chand andcompanylimited, New Delhi 2014
10. PuriB.R.,PathaniaM.S.,SharmaL.R.,Principalsofphysicalchemistry,VishalPublishingCompany 2020

Class	*CourseType*	*CourseCode*	*CourseTitle(Theory/Practical)*	*Marks*	
B.Sc. IV Semester	Elective	S2 CHEM2T	Transition Elements, Chemi-energetics,PhaseEquilibria(Theory)	Max: 100	Min: 35

Course objectives:

- To enrich the students with the understanding of fundamentals and concepts of thermodynamics, thermo chemistry, phase equilibrium, Solutions, Electrochemistry, adsorption, adsorption and its applications.
- To enable the students to understand the fundamentals of the inorganic chemistry through schematic study of transition, inner transition elements and their properties and compounds
- To build up an understanding of coordination chemistry, their reactions, structure, isomerism and applications

UNIT– I

Chemistry of d-&f-block elements

(a) Chemistry of Transition elements: First, Second and Third Transition series**.** General group trends with special reference to- Electronic Configuration, Coordination Geometry, Colour,Variable Valency, Spectral, Magnetic and Catalytic Properties, Ability to form Complexes.

(b) Chemistry of Inner Transition elements: Lanthanides and Actinides. General group trends with specialreferencetoElectronicConfiguration,OxidationStates,Colour,SpectralandMagneticProperties. Lanthanide Contraction. Separation of Lanthanides (lon-exchange method only).

(c) Trans uranicelements: General Introduction..

Coordination Chemistry

(d) Structures, Stereochemistry and Metal-LigandBondinginTransitionMetalComplexes: Wernertheoryforcomplexes.Electronicinterpretation bySidwik.

(e) Valence Bond Theory (VBT)- Postulates and applications for Tetrahedral, Square planar and Octahedral complexes. Limitations of VBT.

(f) Crystal Field Theory (CET); Postulates and application: Crystal field splitting of d-orbitals Crystal field stabilization energy (CFSE) in Tetrahedral, Square planar and Octahedral complexes, CFSE of weak and strong fields. Factors affecting the crystal field parameters. Measurement of 10 Dq (Δo) and factors affecting its magnitude. Comparison of octahedral and tetrahedral coordination. Tetragonal distortions from octahedral geometry. Jahn-Teller theorem. Square planar geometry. Limitations of CFT. Qualitative aspect of Ligand field and Molecular Orbital (MO) Theory. Spectrochemical and Nephelauxetic series. Coordination number, coordination geometries of metal ions, types of ligands.

(g) Isomerismincoordinationcompounds:

Structuralisomerism:Ionization,Linkage,Coordination-Ligand Isomerism.

Stereo isomerism: Geometrical isomerism: Square planar metal complexes of type- $[MA_2B_2]$,$[MA_2BC]$,

$[M(AB)_2]$, [MABCD]. Octahedral metal complexes of type-$[MA_4B]$, $[M(AA)_2B_2:]$, $[MA_3B_3]$.Optical isomerism: Tetrahedral complexes of type-[MABCD] complexes of type- $[M(AA)_2B_2]$, $[M(AA)_3]$.

Keywords/Tags: Knowledge Tradition of Indian Chemistry, Transition elements, Spectral Properties, Magnetic Properties, Catalytic Properties, Lanthanide Contraction.

UNIT-II

Thermodynamics

(c) First Law of Thermodynamics: Concept of heat (Q), work (W), internal energy (U),Statement of the first Law, Enthalpy(H),Relation between heat capacities. Calculation of Q, W, ΔU and ΔH under isotherm and adiabatic conditions for Reversible, Irreversible and free (ideal and Van der Waals) expansions of gas. Joule Thomson effect and its theory, Inversion temperature.

(d) Second Law of Thermodynamics: Carnot cycle, Statement of the Second Law of Thermodynamics. Concept of Entropy, Calculation of entropy change for Reversible and irreversible processes, Concept of residual entropy, Free energy Function: Gibbs and Helmholtz functions. Variation of entropy(S), Gibbs free energy (G), work function (A) with temperature (T), volume (V) & pressure (p).Free energy change and spontaneity, Gibbs-Helmholtz equation.

(c) Third Law of Thermodynamics: Nernst heat theorem and its significance, Statement of third law, Calculation of absolute entropy of substance.

Keyword/Tag:Thermodynamics,LawofThermodynamics,Carnotcycle, Enthalpy,Freeenergy

UNIT-III

Electrochemistry

Electrical Conduction: conduction in metals and in electrolyte solutions, specific and equivalent conductance, Measurement of equivalent conductance. Effect of dilution on conductivityMigration of ions and Kohlrausch-law and its application.

Weak and strong electrolytes: Theory of Strong electrolytes, Debye-HuckelOnsagar"s(DHO) theory and equation.

Transport Numbers: determination of Transport numbers by Hittorf method and movingboundarymethod. Electrodereactions:Nernstequation,Derivationofequationforsingle electrodepotential.Electrode: Reference electrodes, Standard hydrogen electrode Quinhydrone, glass electrodes,Calomel electrode.Standard electrode potential,ElectrochemicalSeriesanditsapplication.ElectrochemicalCell:Nernstequation,calculationof e.m.f.of cell

Keyword/Tag:ElectricalTransport,Conduction,DHOtheory,TransportNumbersNernst equation, Electrode, Electrochemical Series

UNIT– IV

Phase quilibrium

Concept phase, component and the degree of freedom, thermodynamic derivation of the Gibbsphase rule for reactive and nonreactive system.

Clausius-Clapeyronand itsapplicationsSolid–Liquid, Liquid-Vapourand Solid–Vapourequilibria.

Phase diagrams for one component system with application: water, and Sulphur. Phasediagrams for system of solid-liquid equilibria involving-Eutectic, Congruent and Incongruent melting points.Water and Sulphursystem simple, Ag-Pb and Mg-Zn system, NaCl-H_2O system.

Binarysolution:,Raoult"law.Non-idealsystemorazeotropesmixtureImmiscibleLiquid,SteamDistillation.

Keyword/Tag:Phaseequilibrium,Gibbsphaserule,Clausius-ClapeyronequationRaoult"sLaw

Courseoutcome-Bytheend ofthiscoursestudentswill be ableto-:

- Developanunderstandingabouttraditional Indian Chemistry
- Understandtheconceptsofchemistryofd&fblockelements,basicconceptsofcoordination chemistry.
- ExplainStereochemistryoftransitionmetalcomplexes.
- GainathoroughknowledgeaboutLawsofthermodynamicsandthermochemistry

- Developtheconceptofphaseequilibriumwithreferencetosolidsolution,liquid-liquidmixture, partially miscible liquids.
- Developanunderstandingaboutbasicconceptsofelectrochemistry,varioustypesofelectrodes and their reactions.

ReferenceBooks:

11. BariyarRandGoyalS,BSc Chemistrycombined(inHindi)Krishnaeducationpublishers,year2019
12. LeeJ.D.,Concise InorganicChemistry,Wiley,2008,5th edition
13. KaliaK.C,.PuriB.R.,SharmaL.R.,Principlesof InorganicChemistry,VishalPublishingCompany2020
14. SodhiG.S.,Textbookof InorganicChemistry,VivaBooksprivatelimited,NewDelhi
15. SinghJ,SinghJandAnandvardhan,Alogicalapproachtomoderninorganicchemistry,Anubooks, 2019
16. Gopalan R and Ramalingan V, Concise coordination chemistry, Vikas publishing houseprivate limited, New Delhi, 2005, 1st edition
17. Madan R. L., Chemistry for degree students, BSc II year, S. Chand and Company limited,New Delhi,2011
18. Prakash S, Tuli G.D. Basu S.K. and Madan R.D., AdvancedInorganic Chemistry, volume 2, SChandand company limited, New Delhi, 2007, 19th edition
19. Malik W.U., Tuli G.D and Madan R.D. Selected topics in inorganic chemistry, S Chand andcompanylimited, New Delhi 2014
20. PuriB.R.,PathaniaM.S.,SharmaL.R.,Principalsofphysicalchemistry,VishalPublishingCompany 2020

Class	*CourseType*	*Course Code*	*Course Title(Theory/Practical)*	*Marks*	
B.Sc. IV Semester	Major/Minor/Elective	S2CHEM 2P	Metal complex preparation, Thermo chemistry & phase equilibrium experiments (Practical)	Max: 100	Min: 35

Course Objectives:

- To enable the students to create an understanding about the laboratory practices, various laboratory and analytical techniques.
- To enrich the students with the concepts of physical chemistry viz. thermodynamic and phase equilibrium

EXTERNAL ASSESSMENT: 60marks

Inorganic Chemistry

- To obtain pure water from NaCl solution by distillation.
- To obtain pure potash alum by the process of crystallization.

Volumetric Analysis

- To determine the percentage of acetic acid in commercial vinegar.
- Estimation of calcium content in chalk as calcium oxalate by permagnatometry.
- To prepare M/20 solution of Mohr‟s salt and, using this solution find out the molarity and strength of the given potassium permanganate ($KMnO_4$) solution.
-

Gravimetry-Estimation of Copper

Physical Chemistry

A. Phase equilbrium

- To determine the critical solution temperature of two partially miscible liquid by determining their solubility in each other.
- To study the effect of solute (e.g.NaCl, succinic acid) on the critical solution temperature of two partially miscible liquid (e.g., phenol water system).

B. Thermo chemistry

To determine the enthalpy of neutralization of weak acid / weak base versus strong acid/strong base and determine the enthalpy of ionization of the weak acid/base.

INTERNALASSESSMENT:40marks

Internal assessment	Marks	Externalassessment	Marks
ClassInteraction/Quiz	15	Viva-Voceon Practical	15
Attendance	10	PracticalRecordFile	10
Assignment (Charts/ model seminar/ Ruralservices/Technologydissemination/ Report of Excursion/ Lab visits/Survey/Industrialvisit)	15	Table work/ Experiments	35
TOTAL	40		60

Course Outcome: By the end of this course students will beable to:

- Develop an understanding of preparation of inorganic complexes.
- Explain the use of calorimeter for the chemistry experiments. Determine the enthalpy of various systems and reactions
- Perform the experiments on phase equilibria with understanding of changes involve dintransitions
- Gain athorough knowledge about construction of phase diagrams and study of reaction equilibrium