J.J COLLEGE OF ARTS AND SCIENCE (Autonomous)

SIVAPURAM, PUDUKKOTTAI-622422

DEPARTMENT OF CHEMISTRY

PG - PROGRAMME - M.Sc CHEMISTRY

(2022-2023)

PROGRAMME OBJECTIVES FOR M.Sc

- To make the students aware of descriptive chemistry
- To impart the basic analytical and technical skills to work effectively in the various fields of chemistry
- To develop the ability to perform accurate quantitative measurements with an understanding of theory and use of chemical instrumentations
- To develop laboratory competence relating to chemical structure and spectroscopic phenomena
- To develop the ability to synthesize, separate and characterize the chemical compounds using published reactions, protocols and modern instrumentation.

J.J COLLEGE OF ARTS AND SCIENCE (Autonomous)
DEPARTMENT OF CHEMISTRY
M.Sc. CHEMISTRY

Proposed Course Structure based on UGC-LOCF and TANSCHE
(Choice Based Credit System)
(Applicable for the candidates admitted from academic year 2022-2023 onwards)

Sem	Course Code	Course Title	Hrs./ Week	Credit	Exam Hrs.	Marks		Total
						Int.	Ext.	
I	P1R2CHCC1	Reaction Mechanism and Stereochemistry	6	5	3	25	75	100
	P1R2CHCC2	Coordination Chemistry	6	5	3	25	75	100
	P1R2CHCC3P	Organic Chemistry Practical-I	6	5	6	40	60	100
	P1R2CHCC4P	Inorganic Chemistry Practical-I	6	5	6	40	60	100
	P1R2CHDSE1:1/1:2	Discipline Specific Elective Course -1	6	3	3	25	75	100
		Total	**30**	**23**				**500**
II	P2R2CHCC5	Chemical Kinetics, Electrochemistry and Group theory	5	5	3	25	75	100
	P2R2CHCC6	Spectroscopy, Spectrometry and their Applications	5	5	3	25	75	100
	P2R2CHCC7	Reaction mechanism, Rearrangement, Name Reactions, Oxidation and Reduction	5	5	3	25	75	100
	P2R2CHCC8P	Organic Chemistry Practical-II	5	5	6	40	60	100
	P2R2CHCC9P	Inorganic Chemistry Practical-II	5	5	6	40	60	100
	P2R2CHDSE2:1/2:2	Discipline Specific Elective Course -2	5	3	3	25	75	100
		Total	**30**	**28**				**600**
III	P3R2CHCC10	Quantum Chemistry, Thermodynamics and Analytical Techniques	5	5	3	25	75	100
	P3R2CHCC11	Structure and Bonding	5	5	3	25	75	100
	P3R2CHCC12	Inorganic Photochemistry, Spectroscopy and Organometallics	5	5	3	25	75	100
	P3R2CHCC13P	Physical Chemistry Practical-I	5	5	6	40	60	100
	P3R2CHCC14P	Physical Chemistry Practical-II	5	5	6	40	60	100
	P3R2CHSEC1:1/1:2	Skill Enhancement Course-1	5	3	3	25	75	100
		Total	**30**	**28**				**600**
IV	P4R2CHGEC1	Generic Elective Course-1	6	3	3	25	75	100

	P4R2CHCC15PW	Project Work	24	8	3			100
		Total	**30**	**11**				**200**
		Grand Total	**120**	**90**				**1900**

CC-Core course/ DSE-Discipline Elective Course/P-Practical /SEC-Skill Enhancement Course / GEC-Generic Elective Course.

Discipline Specific Elective Courses

Discipline Specific Elective - 1

1. Bioorganic Chemistry
2. Medicinal Chemistry

Discipline Specific Elective - 2

1. Industrial Chemistry
2. Green Chemistry

Skill Enhancement Courses

Skill Enhancement Course - 1

1. Natural Products
2. Quality Control and Environmental Chemistry

Generic Elective Courses (offered by the Department)

1. Instrumental Methods of Analysis
2. Advanced Topics in Chemistry

TITLE OF THE COURSE	REACTION MECHANISM AND STEREOCHEMISTRY	MARKS: CIA: 25 + EXT: 75=100
CATEGORY OF THE COURSE:	CORE COURSE	HRS/WEEK : 5
COUSE CODE	P1R2CHCC1	TOTAL INST. HRS : 90
NATURE OF THE COURSE:	CORE COURSE	SEM: I / CRIDIT: 5

Objectives

- Understanding the fundamental mechanism involved in reactions
- Know the electrophilic reactions, nucleophilic reactions and reactions that involve Transient Species.
- Understanding the basic aspects of stereochemistry such as chirality, nomenclature, stereoselectivity Vs stereospecificity and Asymmetric synthesis
- Understand the concept of organic reactive intermediates.
- Understanding the conformational analysis of six member ring systems.

UNIT-I: REACTION MECHANISM (18 Hrs)

Kinetic and Non kinetic methods of determining organic reaction mechanisms. Isolation and trapping of intermediates, isotopic labeling studies. Primary Kinetic Isotopic effect. Generation of Kinetic and Thermodynamic enolates. Hammett equation-simple problems and Taft equation.Siginificance of reaction as well as substituent constants. Ambident nucleophiles such as CN^-, NO_2^- and ambident dianions. Williamson's ether synthesis.

UNIT-II: ALIPHATIC NUCLEOPHILIC SUBSTITUTION (18 Hrs)

Mechanism of nucleophlic substitution reaction: S_N1, S_N2 and S_Ni mechanisms. Solvent and leaving group effects and neighbouring group participation (NGP). Substitution at carbonyl, vinylic and bridgehead system. Substitution with ambident nucleophiles- "O" Vs "C"alkylation. Role of LDA, crown ethers and phase transfer catalysts (PTC) in nucleophilic substitution reactions.Generation of enolates, enolate selectivity (Kinetic Vs Thermodynamic), alkylation of enolates and stereochemistry of enolate alkylation. Mechanism of ester hydrolysis (only BAc^2, AAc^2 and AAl^1). Alkylation of active methylene compounds. Asymmetric alkylation (Evans, Enders and Meyers procedures). Preparation and synthetic utility of enamines, Finkelstein reaction, Wurtz coupling.

UNIT-III: AROMATIC ELECTROPHILIC AND NUCLEOPHILIC SUBSTITUTIONS (18 Hrs)

Aromatic electrophilic substitution: mechanism of nitration, sulfonation, Friedel-Crafts alkylation and acylation reactions. Synthesis of di- and tri-substituted benzenes from benzene or mono-substituted benzenes. Hammett and Hammett-Taft equation. Haworth reaction (for naphthalene), Scholl reaction, Vilsmeier-Haack formylation, Gattermann reaction, Reimer-Tiemann and Bischler-Napieralski reactions.Aromatic nucleophilic substitution in aryl halides by Meisenheimer

complex mechanism and benzyne mechanism. Reactions of aryldiazonium salts. Zeigler alkylation, Vicarious Nucleophlic Substitution (VNS), Chichibabin and Schiemann reactions.

UNIT-IV: REACTIVE INTERMEDIATES (18 Hrs)

Organic reactive intermediates: Generation, stability and reactivity of carbocations, carbanions, free radicals, carbenes, carbenoids, benzynes and nitrenes.

UNIT-V: STEREOCHEMISTRY (18 Hrs)

Chirality, Symmetry elements, Asymmetric and Dissymmetric chiral molecules. Calculation of number of optical isomers. Stereochemistry of mono and di-substituted cyclopropane, cyclobutane, cyclopentane and cyclohexane. Stereochemistry of tri-substituted cyclopentane, trisubstituted pentane and tetra-substituted hexane. Description of various types of optically active compounds including allenes, cumulenes, spiranes, biphenyls, *trans*-cyclooctene.Compounds containing two asymmetric centers; Erythro and threo isomers. Conversion of Fischer projection into perspective forms. Erythro and Threo-Inter conversion of Fischer to Sawhorse and Newman projections. Zig-Zag representation of glucose. Interpretation of homotopic, enantiotopic and diastereotopic atoms and faces. Pro-chiral carbon. Concept of *Re*- and *Si*- faces. R & S nomenclature of simple compounds, allenes, spiranes and biphenyls. Stereospecific and Stereoselective reactions. Asymmetric Synthesis-Crams rule and Felkin-Anhmodel. Conformational analyses of cyclohexane. Di-substituted cyclohexanes and decalin.

Reference and text books

1. Jerry March, Advanced Organic Chemistry, John Wiley & Sons, 5th Ed, **2001.**
2. F. Carey and R. J. Sundberg, Advanced Organic Chemistry-Part A and B, Springer Science + Business Media, 5 th Ed, **2007.**
3. M. B. Smith and Jerry March, Advanced Organic Chemistry, John Wiley & Sons, 5th Ed, **2001.**
4. J. Clayden, N. Greeves and S. Warren, Organic Chemistry, Oxford University Press, 2nd Ed, **2012**.
5. M. B. Smith, Organic Synthesis, Academic Press, 3rd Ed, **2011.**
6. R. O. C. Norman and J. M. Coxon, Principles of Organic Synthesis, Chapman & Hall, 3rd Ed, **1993.**
7. Stuart Warren, Organic Synthesis: Disconnection Approach, Wiley India (P) Ltd, **2007**.
8. I. L. Finar, Organic Chemistry Vol 2: Stereochemistry and the Chemistry of Natural product, Dorling Kindersley India (P) Ltd, **2009.**
9. E. N. Eliel, Stereochemistry of Carbon Compounds, Tata McGraw Hill Ed, Reprint **2008.**
10. D. Nasipuri, Stereochemistry of Organic Compounds, New Age International (P) Ltd, Reprint, **2005.**

11. Kalsi. P. S, Organic Reactions: Stereochemistry and Mechanism through solved problems, New
12. Age International (P)Ltd, 4th Ed, **2007.**
13. E. L. Eliel and S. H. Wilen, Stereochemistry of Organic Compounds, Wiley India Ed, **2008.**

Expected outcomes

CO.No	CO-statements	(k - level)
On successful completion of the course ,students will be able to		
CO-1	Define the various types of reaction mechanisms involved in synthetic organic transformation	***K5***
CO-2	Illustrate the basic stereochemistry concept in a proper perspective	***K2***
CO-3	Explain the reactive intermediates of organic compounds	***K4***
CO-4	Outline the concept of asymmetric synthesis	***K2***
CO-5	Determine the conformational analysis of six membered ring system	***K5***

Relationship Matrix for course Outcome, Programme Outcomes and Programme Secific Outcomes

TITLE OF THE COURSE: REACTION MECHANISM AND STEREOCHEMISTRY						**COURSE CODE: P1R2CHCC1**					
COURSE OUTCOMES (COS)	**PROGRAMME OUTCOMES(POS)**					**PROGRAMME SPECIFIC OUTCOMES (PSOS)**					**MEAN SCORE OF COS**
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PSO1**	**PSO2**	**PSO3**	**PSO4**	**PSO5**	
CO1	3	2	2	2	3	2	3	2	2	3	**2.4**
CO2	3	2	2	2	3	2	3	2	3	1	**2.3**
CO3	2	2	2	2	3	3	2	2	2	3	**2.3**
CO4	3	3	2	3	3	2	2	3	2	3	**2.6**
C	2	2	3	3	2	2	2	2	3	2	**2.3**
	MEAN OVERALL SCORE										**2.38**
	RESULT										**HIGH**

TITLE OF THE COURSE	**COORDINATION CHEMISTRY**	**MARKS: CIA:25 + EXT:75=100**
CATEGORY OF THE COURSE	**CORE COURSE**	**HRS/WEEK :06**
COURSE CODE	**P1R2CHCC2**	**TOTAL INST. HRS: 96**
NATURE OF THE COURSE	**SKILL DEVELOPMENT**	**SEM : I / credit :5**

Objectives: To help students acquire a deep knowledge

- To learn about thermodynamic and stereochemical aspects of complex formation
- To learn about Various theories of complexes and their magnetic properties
- To learn about term symbols and energy level diagram of weak and strong field ligands, charge transfer spectra and spectral properties of lanthanides and actinides.
- To learn about various mechanisms of substitution and electron transfer reactions.
- To study the recent development in the catalysis.

UNIT – I: Stability of Complexes (20 Hrs)

Stability of Complexes - Factors affecting Stability of Complexes .Thermodynamic aspects of Complex. Formation, Stepwise and Overall Formation Constants, Stability Correlations ,Statistical Factors Chelate effect, Determination of Stability Constant and Composition of the Complexes: Formation Curves and Bjerrum's half method, Potentiometric method, Spectrophotometric method, Ion exchange method, polorographic method and Continuous Variation method(Job's method) **.**Stereo chemical aspects- Stereoisomerism in inorganic complexes- Isomerism arising out of ligand distribution and ligand conformation, Chirality and nomenclature of chiral complexes;

UNIT-II: Metal Ligand Bonding (18 Hrs)

Crystal field theory – Splitting of d orbitals under various geometries - factors affecting splitting, CFSE, evidences for CFSE(Structural and thermodynamic effects), spectrochemical series, Jorgensen relation, site preferences, Jahn Teller distortion – Dynamic and Static J.T. effect, Jahn Teller effect and chelation, Application of CFT – Magnetic properties, spectral properties and Kinetic properties, Limitations of CFT, Evidences for M-L overlap. MOT – MO theory and energy level diagrams concept of Weak and strong fields, Sigma and pi bonding in octahedral, square planar and tetrahedral complexes. Nephlauxetic effect, Magnetic properties of complexes. Comparison of CFT and MOT of bonding in octahedral complexes.

UNIT-III: Electronic Spectra of Complexes (18 Hrs)

Spectroscopic term symbols for d^nions – derivation of term symbols and ground state term symbol, Hunds rule, Selection rules – breakdown of selection rules, spin orbit coupling, band intensities, weak and strong field limits – correlation diagram, Energy level diagrams. Orgel diagram for weak field Oh and Td complexes – Splitting of energy level due to Jahn-Teller

distortion. Modified orgel diagram – Limitiations of orgel diagram Tanabe–Sugano (T-S) diagrams – Evaluation of Dq and B values for d^2–d^8complexes charge transfer spectra. Complications in band classification between LF(d-d) and CT bands. Comparison between d-d bands and CT bands – Numerical problems, Lanthanides and Actinides- Spectral properties.

UNIT – IV: Inorganic Reaction Mechanism (20 Hrs)

Electron transfer reactions – Inner sphere (ISET) and outer sphere (OSET) electron transfer processes.. Role of bridging ligand with ISET reaction – tunneling transfer – multiple bridging in the activated complex in the ISET process. Complimentary and non-complimentary ET reactions. Cross reactions and marcus Hush theory.Reaction mechanism of coordination compounds – Types of ligand substitution reactions – mechanism; Dissociative mechanism (D), Associative mechanism (A) interchange mechanism (I), Labile and Inert complexes. Substitution Reaction in octahedral complexes – general mechanism, general rate law for A,D and I - distinction between D, Id, IA pathways, replacement of coordinated water, mechanism of acid hydrolysis, base hydrolysis – DCB mechanism – direct and indirect evidences in favour of the mechanism. Ligand substitution reactions without cleavage of M-L Bond. Anation Reactions. Substituion in square planar complexes – General mechanism, Trans effect, influences of entering and leaving groups. Application of trans effect – synthesis of isomers of Pt(II) complexes – theories of trans effect and cis-trans isomerisation reaction.

UNIT – V: Catalysis (20 Hrs)

General principles of catalysis – basic reactions involved in the catalysis by organometallic compounds. Hydrogenation of olefins (Wilkinsons catalyst) ; Hydro formylation of olefins using Cobalt or Rhodium catalysts (OXO process); oxidation of olefins to aldehydes and ketones (wacker process) Monsanto acetic acid synthesis from methanol. Cyclooligomerisation of acetylene using Ni catalyst (Reppes catalyst) Synthetic gasoline by using ZSM-5 catalyst (Fisher-Tropsch and mobil process) polymerization of olefins (Zeigler – Natta Catalyst), polymer bound catalyst.

Text Books

1. F.A. Cotton and G. Wilkinson, Advanced Inorganic Chemistry, 4th Ed., A Wiley - Interscience Publication, John –Wiley & Sons, Reprint 2012.
2. J.E. Huheey, Inorganic Chemistry 3rd Ed., Harper & Row publisher, Singapore. S.F.A. Kettle, Physical
   Inorganic Chemistry – A Coordination Chemistry Approach.
3. Spectrum Academic Publishers, Oxford University Press, 2012.
4. J. Ferraudi, Elements of Inorganic Photochemistry, Wiley, New York, 1988.

Reference Books

1. M. C. Day and J. Selbin, Theoretical Inorganic Chemistry, Affiliated East West Press Pvt. Ltd.2ndEd.,1985.

2. A. W. Adamson and P. D. Fleischauer, Concepts of Inorganic Photochemistry, Wiley,New York, 1975.
3. F.Basolo and R.G.Pearson, Mechanism of Inorganic Reactions, John Wiley, New York.

Course Outcomes

CO.No	CO-statements	(k - level)
	On successful completion of the course ,students will be able to	
CO-1	Stability constant, types of macrocyclic ligands and nomenclature of chiral complexes	***K1***
CO-2	Evaluating the value of Dq and B values with the help of Orgel diagrams	***K5***
CO-3	Distortion in co-ordination complexes concept of sigma and pi bonding in complexes	***K2***
CO-4	Application of substitution reactions in the synthesis of Platinum and Cobalt complexes	***K4***
CO-5	The use of catalytic activity of co-ordination complexes in the synthesis of organic compounds	***K3***

Relationship Matrix for course Outcome, Programme Outcomes and Programme Secific Outcomes

Title of the Course: COORDINATION CHEMISTRY						**Course Code: P1R2CHCC2**				
Course Outcomes (Cos)	**Programme Outcomes(POs)**					**Programme Specific Outcomes (PSOs)**					**Mean Score of Cos**
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PSO1**	**PSO2**	**PSO3**	**PSO4**	**PSO5**	
CO1	2	2	3	2	3	2	2	2	3	3	**2.4**
CO2	2	3	2	2	3	2	3	2	3	1	**2.3**
CO3	1	2	2	2	3	3	2	2	2	3	**2.2**
CO4	3	3	2	3	3	2	2	3	2	3	**2.6**
CO5	2	2	3	3	2	2	2	2	3	2	**2.3**
	Mean Overall Score										**2.36**
	Result										**High**

TITLE OF THE COURSE	**ORGANIC CHEMISTRY PRACTICAL-I**	**MARKS: CIA: 25 + EXT: 75=100**
CATEGORY OF THE COURSE:	**CORE COURSE**	**HRS/WEEK : 6**
COUSE CODE	**P1R1CHCC3P**	**TOTAL INST. HRS : 90**
NATURE OF THE COURSE:	**CORE COURSE**	**SEM: I / CREDIT : 5**

Objectives: Train students in

- *the separation of binary organic mixtures*
- *the methods of qualitative analysis of organic compounds*
- *single stage preparations of organic compounds*

A. Qualitative Analysis of an organic mixture containing two components (40 Marks)

Pilot separation, bulk separation, analysis and derivatization.

B. Preparation of Organic compounds (Single stage) (10 Marks)

(a) methyl –*m*- nitrobenzoate from methylbenzoate (nitration)
(b) glucose pentaacetate from glucose (acetylation)
(c) resorcetophenone from resorcinol (acetylation)
(d) benzophenoneoxime from benzophenone (addition)
(e) *o*-chlorobenzoic acid from anthranillic acid (Sandmayer reaction)
(f) *p*-benzoquinone from hydroquinone (oxidation)
(g) Phenyl-azo-2-napthol from aniline (diazotization)

Course Outcomes: At the end of the course, the learners will be able to

- Perform qualitative separation of binary mixture of organic compounds and individual qualitative analysis

of isolated compound adopting qualitative methods

- Separate the functional groups and demonstration the regeneration process
- Understanding the isolation and purification of compounds

Scheme of Valuation:

Record and Viva	- 10 Marks
Solvent Separation	- 10 Marks
Analysis and Derivative	- 30 Marks
Preparation (Single stage)	- 10 Marks

Reference Book

1. B.S. Furniss, A. J. Hannaford, P. W. G. Smith and A. R. Tatchell, Vogel's Textbook of Practical Organic Chemistry- 5th Ed., Pearson publication.
2. V. Vengataswaran,*et al.*, Basic Principle of Practical Chemistry – Sultan Chand and sons, New Delhi (1997).
3. Ganapragasm and Ramamurthy,Organic Chemistry Lab Manual, 2nd Ed.,S. Vishwanathan Printers and Publishers (P) Ltd., Chennai (2007) .

Expected outcomes

CO.No	CO-statements	(k - level)
	On successful completion of the course ,students will be able to	
CO-1	Define the methyl –*m*- nitrobenzoate from methylbenzoate (nitration)	***K5***
CO-2	Illustrate the glucose pentaacetate from glucose (acetylation)	***K2***
CO-3	Explain the resorcetophenone from resorcinol (acetylation)	***K4***
CO-4	Outline the benzophenoneoxime from benzophenone (addition)	***K2***
CO-5	Determine the *o*-chlorobenzoic acid from anthranillic acid (Sandmayer reaction)	***K5***

Relationship Matrix for course Outcome, Programme Outcomes and Programme Secific Outcomes

TITLE OF THE COURSE: ORGANIC CHEMISTRY PRACTICAL-I						**COURSE CODE: P1R1CHCC3P**					
COURSE OUTCOMES (COS)	**PROGRAMME OUTCOMES(POS)**					**PROGRAMME SPECIFIC OUTCOMES (PSOS)**					**MEAN SCORE OF COS**
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PSO1**	**PSO2**	**PSO3**	**PSO4**	**PSO5**	
CO1	3	2	2	2	3	2	3	2	2	3	**2.4**
CO2	3	2	2	2	3	2	3	2	3	1	**2.3**
CO3	2	2	2	2	3	3	2	2	2	3	**2.3**
CO4	3	3	2	3	3	2	2	3	2	3	**2.6**
C	2	2	3	3	2	2	2	2	3	2	**2.3**
	MEAN OVERALL SCORE										**2.38**
	RESULT										**HIGH**

TITLE OF THE COURSE	**INORGANIC CHEMISTRY PRACTICAL-I**	**MARKS: CIA: 40 + EXT: 60=100**
CATEGORY OF THE COURSE:	**CORE COURSE**	**HRS/WEEK : 6**
COUSE CODE	**P1R1CHCC4P**	**TOTAL INST. HRS : 90**
NATURE OF THE COURSE:	**CORE COURSE**	**SEM: I / CREDIT : 5**

Objectives: to train students in

- *the qualitative analysis of common metals and rare metals*
- *the principles and instrumental analysis of colorimetric method*
- *demonstrate the common ion effect and solubility product*
- *preparing inorganic complexes qualitatively*

1. Theoretical Principles

Classification of cations into groups, group reagents – intergroup and intragroup separations – Confirmatory test for cations– the react ions and the products.

2. Analysis of Mixture of Cations (35 Marks)

Analysis of a mixture of four cations containing two common and two rare cations.

Common cations: Group I: Pb and Hg; Group II: Cu, Cd, Bi, Sb, As, and Sn;
Group III: Al, Fe, and Cr; Group IV: Mn, Zn, Co, and Ni; Group V: Ca, Sr, and Ba; Group VI: Mg and NH_4^+

Rare cations: Group I: W and Tl; Group IA: Se and Te; Group II: Mo; Group III: Be, Ce, Ti, Th, Zr, V; Group VI: Li

3. Estimation of ions using photoelectric colorimeter (15 Marks)

Estimation of Cu, Fe, Ni, Cr, Co and Mn using photoelectric colorimeter

Course Outcomes: At the end of the course, the learners will be able to

- Get better knowledge on qualitative analysis of common metals and rare metals
- Understand the Beer's Lamberts law and colorimetric analysis of common metals
- Set up manage experimental conditions for the preparation of complexes
- acquire expertise in the elimination of interrupting ions during analysis

Scheme of Valuation:

Record and Viva - 10 Marks
Procedure Writing and Presentation - 07 Marks
Analysis - 4 radicals correct with suitable test: 28 Marks
3 radicals correct with suitable test: 21 Marks
2 radicals correct with su itable test: 14 Marks
1 radical correct with suitable test: 07 Marks

Colorimetric Estimations
1-2% - 15 Marks
2-3% - 12 Marks
3-4% - 09 Marks
> 4% - 06 Marks

Reference Books

1. V. V. Ramanujam, Inorganic Semimicro Qualitative Analysis, 3rd Ed., The National Publishing Company, Chennai, 1990.
2. Vogel's Text book of Inorganic Qualitative Analysis, 7th Ed, ELBS, London, 1996.
3. G. H. Jeffery, J. Bassett,J.Mendham, R. C. Denney, Vogel's 's Textbook of Quantitative Chemical Analysis; 5th Ed., VELBS" 1989.
4. J. D. Woollins, Ed., Inorganic Experiments; VCH: Weinheim, 1994.

CO.No	CO-statements	(k - level)
	On successful completion of the course ,students will be able to	
CO-1	Illustrate the procedure of Classification of cations into groups, group reagents	***K2***
CO-2	Determine the Analysis of a mixture of four cations	***K5***
CO-3	Defend the Estimation of Cu, Fe, Ni, Cr, Co and Mn using photoelectric colorimeter	***K5***
CO-4	. explain the methods of preparation of synthetic perfume Group III: Be, Ce, Ti, Th, Zr, V;	***K3***
CO-5	. Identify the cations qualitative analysis	***K5***

Relationship Matrix for course Outcome, Programme Outcomes and Programme Secific Outcomes

TITLE OF THE COURSE: INORGANIC CHEMISTRY PRACTICAL-I						**COURSE CODE: P1R1CHCC4P**					
COURSE OUTCOMES (COS)	**PROGRAMME OUTCOMES(POS)**					**PROGRAMME SPECIFIC OUTCOMES (PSOS)**					**MEAN SCORE OF COS**
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PSO1**	**PSO2**	**PSO3**	**PSO4**	**PSO5**	
CO1	2	2	2	2	3	2	2	2	2	3	**2.2**
CO2	3	2	2	2	3	2	3	2	3	1	**2.3**
CO3	2	2	2	2	3	3	2	2	2	3	**2.3**
CO4	3	3	2	3	3	2	2	3	2	3	**2.6**
C	2	2	3	3	2	2	2	2	3	2	**2.3**
	MEAN OVERALL SCORE										**2.34**
	RESULT										**HIGH**

TITLE OF THE COURSE	BIOORGANIC CHEMISTRY	MARKS: CIA: 25 + EXT: 75=100
CATEGORY OF THE COURSE:	CORE COURSE	HRS/WEEK : 6
COUSE CODE	P1R2CHDSE1:1	TOTAL INST. HRS : 90
NATURE OF THE COURSE:	CORE COURSE	SEM: I / CREDIT : 3

Objectives: To make students learn about

- *amino acids and proteins*
- *enzymse and co-factors*
- *nucleic acids and protein synthesis*
- *lipids and carbohydrates*
- *retrosynthetic analysis*

UNIT-I: Amino Acids and Proteins (13 Hrs)

Amino Acids: Structure, classification, synthesis and properties of amino acids, isoelectric point, biosynthesis of amino acids. oligo- and polypepides, geometry of peptide linkage, N-terminal and C-terminal residue analysis, synthesis of peptides-amino and carboxyl protecting groups-solid phase peptide synthesis. classification and properties (denaturation, isolelectric point and electrophoresis), primary, secondary, tertiary and quaternary structures of proteins, collagen and triple helix.

UNIT-II: Enzymes and Cofactors (14 Hrs)

Enzymes: Mechanism of enzyme catalysis, Factors influencing enzyme action, Examples of typical enzyme mechanisms: chymotrypsin, ribonuclease and lysozyme, Enzyme-catalyzed addition, elimination, condensation, carboxylation and decarboxylation, isomerisation, group transfer and rearrangement reactions.:structure and biological functions of coenzyme A, thiamine pyrophosphate, pyridoxal phosphate, NAD+, NADP+, FMN, FAD, lipoic acid and Vitamin B_{12}. Mechanisms of reactions catalysed by the above cofactors.

UNIT-III: Nucleic Acids and Protein Synthesis (14 Hrs)

.Nucleic Acids: Nucleotides and nucleosides, DNA: primary and secondary structure-replication of DNA.

RNA and Protein Synthesis: Messenger RNA synthesis-transcription, Ribosomes- rRNA, Transfer RNA. Determination of base sequence of DNA. Polymerase Chain Reaction (PCR).targeted drugs-intercalaters, sequence specific drugs. A brief account of ribozyme and iRNA(interference).

UNIT-IV:Planning Of Organic Synthesis -1 (14 Hrs)

Desinnig: organic synthesis – –synthonsdisconnection approach and synthestic equivalents-one group disconnections :alcohol ,olefine,ketone,acids-two groups disconnection : 1.2-,1,3-,1,4-,and 1,5-defunctional compounds –convergent synthesis-functional groups interconversions – functional groups additions –carbon hetero atom bonds –methods for 3 to 6 membered rings

UNIT-V: Planning Of Organic Synthesis -1I (14 Hrs)

Combinatorial Synthesis In Medicinal Chemistry; Solid Phase Techniques –Methods Of Parallel Synthesis – Mix And Split Techniques- Dynamic Combinatorial Chemistry – Screening And Deconvolution-Limitations Of Combinatorial Synthesis –Asymmetric Synthesis ; Basic Principles ;Stereo Selective And Stereo Specific –Methods For Determining Enantiomeric Excess –Chiral Auxiliary ,Reagents And Catalysts And The Applications .(Wherever Applicable) In Alkylation , Hydrogenation ,Hydroxylation ,Epoxidation And Hydroboration Of Alkenes ,Reduction Of Ketones –Cram And Felkin-Ahn Models .Noyori's BINAP – Jacobson Catalyst –Evans Catalyst.

VI: Latest Learning's (For CIA only) (03 Hrs)

Latest development related to the course during the semester concerned

Course Outcomes: At the end of the course, the learners will be able to

- Understand the various structure of proteins and peptide synthesis from amino sequence
- Identify enzyme action and biosynthesis of enzymes by cofactors
- Get knowledge on structure identification of nucleic acids and proteins
- Know about the planning of synthesis form disconnection

Text Books

1. Hermann Dugas and C. Penny, Springe-Verlag.,Bioorganic Chemistry: A Chemical approach to Enzyme action.
2. N.C. Price and L.Stevens, Fundamentals of Enzymology, Oxford University Press.
3. C. Walsh, W.H.Freeman., Enzymatic Reaction Mechanisms,
4. Stuart Warren, Designing Organic Synthesis: The Disconnection Approach, Wiley, 2nd Ed., 1984.

References Books

1. H. B. Kagan, Asymmetric Synthesis, Thieme Medical Publishers, 2003.
2. Francis A. Carey and Richard B. Sundberg, Advanced Organic Chemistry: Part-A and Part-B by, Springer, 5thEd, 2007.
3. Harish K.Chopra, Anupriya parmar and Parmjit S.Panesar, Bio organic Chemistry, Narosa publishers, 2013.Herman dugas, Bio organic Chemisrty, 3rd Edition, 2003.

Expected outcomes

CO.No	CO-statements	(k - level)
On successful completion of the course ,students will be able to		
CO-1	Define the various types of reaction mechanisms involved in synthetic organic transformation	***K5***
CO-2	Illustrate the basic stereochemistry concept in a proper perspective	***K2***
CO-3	Explain the reactive intermediates of organic compounds	***K4***
CO-4	Outline the concept of asymmetric synthesis	***K2***
CO-5	Determine the conformational analysis of six membered ring system	***K5***

Relationship Matrix for course Outcome, Programme Outcomes and Programme Secific Outcomes

TITLE OF THE COURSE: BIOORGANIC CHEMISTRY						COURSE CODE: P1R2CHDSE1:1					
COURSE OUTCOMES (COS)	PROGRAMME OUTCOMES(POS)					PROGRAMME SPECIFIC OUTCOMES (PSOS)					MEAN SCORE OF COS
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5	
CO1	3	2	2	2	3	2	3	2	2	3	2.4
CO2	3	2	2	2	3	2	3	2	3	1	2.3
CO3	2	2	2	2	3	3	2	2	2	3	2.3
CO4	3	3	2	3	3	2	2	3	2	3	2.6
C	2	2	3	3	2	2	2	2	3	2	2.3
	MEAN OVERALL SCORE										2.38
	RESULT										HIGH

TITLE OF THE COURSE	MEDICINAL CHEMISTRY	MARKS: CIA: 25 + EXT: 75=100
CATEGORY OF THE COURSE:	CORE COURSE	HRS/WEEK : 6
COUSE CODE	P1R2CHDSE1:1:2	TOTAL INST. HRS : 90
NATURE OF THE COURSE:	CORE COURSE	SEM: I / CREDIT : 3

Objectives: To introduce learners

- *To the action of drugs and the importance of drugs*
- *Some important drugs and their Mechanism of Action*
- *To the procedures of Drug Discovery, Design and Development*
- *To the Lead and analogue synthesis by group disconnection approach*
- *To the Lead and analogue synthesis by asymmetric synthesis*

UNIT-I: Introduction to Drugs and Their Action (13 Hrs)

Drugs: Historical background-sources and classification of drugs-important terminologies in medicinal chemistry.

Drug Action: Role of intermolecular forces-drug targets: lipids, carbohydrates, proteins (enzymes,receptor) and nucleic acids as drug targets. administration,absorption, distribution, metabolism, elimination of drugs-bioavailability of drugs-side effects.

UNIT-II: Selected Examples of Drugs and Their Mechanism of Action (14 Hrs)

Antibacterial agents: Mechanism of action-antibacterial agents that act against cell metabolism(sulfonamides), inhibit cell wall synthesis (penicillins, cephalosporins), interact with plasma membrane(valinomycin and gramicidin A), impair protein synthesis (tetracyclines, chloramphenicol) and act on nucleicacids (quinolones and fluoroquinolones, rifamycins). **.Antiviral and antifungal agents:** General principles-nucleic acidsynthesis inhibitors (HIV), host

cell penetration inhibitors, inhibitors of viral protein synthesis. Azoles, allyamines and phenols. Anticancer drugs and their mechanism of action- role ofantimetabolites, antisense drugs, alkylating agents and interchelating agents in cancer chemotherapy.**Cardiovascular drugs:**Antiarrhythemic and antihypertension drugs.

UNIT-III: Drug Discovery, Design and Development (14 Hrs)

Identification of diseases and corresponding targets- bioassays and leads. Stereochemistry and solubility issues in drug design. Structure activity relationships (SARs): changing size and shape-introduction of newsubstituents.

Quantitative structure activity relationships (QSARs): lipophilicity-electronic and steric effects-Hansch Analysis-Topliss decision tree. Chemical and process development of drugs. Preclinical trials:pharmacology, toxicology, metabolism and stability studies-formulation. **3.3.Clinical trials:** phase I-IV studies ethical issues. Patent protection. Regulation.

UNIT-IV: Lead and Analogue Synthesis-I (14 Hrs)

4Designing organic synthesis: Disconnection approach-synthons and synthetic equivalents-one groupdisconnections: alcohol, olefin, ketone, acids.

Two group disconnections:1,2-, 1,3-, 1,4- and 1,5-difunctionalcompounds-convergent synthesis-functional group interconversions- functional group additions-carbonheteroatombonds-methods for 3- to 6-membered rings.

UNIT-V: Lead and Analogue Synthesis-II (14 Hrs)

Combinatorial synthesis in medicinal chemistry: Solid phase techniques-methods of parallel synthesis-mix and split techniques-dynamic combinatorial chemistry-screening and deconvolution-limitations of combinatorial synthesis. **Assymmetric synthesis:** basic principles-stereoselective and stereospecific reactions- methods for determining enantiomeric excess-chiral auxiliary, reagents and catalysts and their applications (wherever applicable) in alkylation, hydrogenation, hydroxylation, epoxidation and hydroboration of alkenes, reduction of ketones-Cram and Felkin-ahn models. Noyori's BINAP – Jacobson catalyst – Evans catalyst.

Unit -VI: Latest Learning's (For CIA only) (03 Hrs)

Latest development related to the course during the semester concerned

Course Outcomes: At the end of the course, the learners will be able to

- Understand the basic concepts of Drugs and their functions
- To know about the Action of drugs
- Understand the processes of drug discovery and development
- Have a deeper understanding of lead and analogue synthesis through disconnection approach and asymmetric synthesis

Text Books

1. Gareth Thomas, Fundamentals of Medicinal Chemistry, John Wiley & Sons, 2003.

2. Gareth Thomas, Medicinal Chemistry: An Introduction, Wiley-Interscience, 2nd Ed, 2008.
3. Graham L. Patric, An introduction to Medicinal Chemistry, Oxford University Press, USA, 3rd Ed., 2005.
4. Wilson and Giswald's Textbook of Organic Medicinal and Pharmaceutical Chemistry by John Blockand John M Beale (Eds), Lippincott Williams & Wilkins, 11th Ed., 2003.

Reference Books

1. The Organic Chemistry of Drug Design and Drug Action by Richard B. Silverman, Academic press,2nd Ed., 2004.
2. Designing Organic Synthesis: The Disconnection Approach by Stuart Warren, Wiley, 2nd Ed., 1984.
3. Asymmetric Synthesis by H. B. Kagan, Thieme Medical Publishers, 2003.

Francis A. Carey and Richard B. Sundberg,Advanced Organic Chemistry: Part-A and Part-B, Springer, 5th Ed.,2007.

Expected outcomes

CO.No	CO-statements	(k - level)
	On successful completion of the course ,students will be able to	
CO-1	Illustrate the Drugs and Their Action	***K2***
CO-2	Define Mechanism of Action Antibacterial agents	***K5***
CO-3	Explain the Drug Discovery, Design and Development	***K4***
CO-4	Outline the concept of alcohol, olefin, ketone, acids	***K2***
CO-5	Determine the Combinatorial synthesis in medicinal chemistry	***K5***

Relationship Matrix for course Outcome, Programme Outcomes and Programme Secific Outcomes

TITLE OF THE COURSE: MEDICINAL CHEMISTRY						**COURSE CODE: P1R2CHDSE :2:2**					
COURSE OUTCOMES (COS)	**PROGRAMME OUTCOMES(POS)**					**PROGRAMME SPECIFIC OUTCOMES (PSOS)**					**MEAN SCORE OF COS**
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PSO1**	**PSO2**	**PSO3**	**PSO4**	**PSO5**	
CO1	3	2	2	2	3	2	3	2	2	3	**2.4**
CO2	3	2	2	2	2	2	3	2	3	2	**2.3**
CO3	2	2	2	2	3	3	2	2	2	3	**2.3**
CO4	3	3	2	3	3	2	2	3	2	3	**2.6**
C	2	2	3	3	2	2	2	2	3	2	**2.3**
	MEAN OVERALL SCORE										**2.38**
	RESULT										**HIGH**

TITLE OF THE COURSE	CHEMICAL KINETICS,ELECTROCHEMISTRY AND GROUP THEORY	MARKS: CIA:25 + EXT :75=100
CATEGORY OF THE COURSE	CORE COURSE	HRS/WEEK : 05
COURSE CODE	P21R2CHCC5	TOTAL INST. HRS : 90
NATURE OF THE COURSE	SKILL DEVELOPMENT	SEM: II / CRIDIT: 5

Objectives: To make the students.

- *Understand the kinetics of chemical kinetics and explore the reaction kinetics of fast reactions*
- *Learn the various techniques and mechanism of involved in catalysis.*
- *Gain on understanding of the Ionic activity, ionic interactions, Debye-Hückel-Bjerrum model, Debye- Hückel limiting law.*
- *Study the th Debye-Hückeleory of strong electrolytes. To study the Electrical double layer, electro capillary phenomena, surfactants.*
- *The design and applications of the batteries and Fuel Cells, Corrosion and its Protection.*

UNIT-I: CHEMICAL KINETICS AND CATALYSIS (18 Hrs)

Absolute reaction rate theory -Thermodynamic terms-Significance of entropy and volume of activation. Reactions in solution: factors determining reaction rates in solutions, effect of dielectric constant and ionic strength, - Bronsted –Bjerrum equation-Primary and Secondary salt effect, influence of solvent on reaction rates. Acid base catalysis-Bronsted relations, catalytic coefficients and their determination. Enzyme catalysis and its mechanism, Michaelis-Menten equation, effect of pH and temperature on enzyme catalysis, Mechanism of enzyme inhibition kinetics of surface reactions- unimolecular reactions-Bimolecular reactions-Langmuir Hinshelwood and Elay-Rideal mechanism.

UNIT II: GROUP THEORY-I (18 Hrs)

Symmetry elements; symmetry operations**,** Abelian group-point groups-determination of point group- Group multiplication table - Matrix representation of symmetry operations-Similarity transformations; Space groups of crystals-Mulliken symbols-reducible and irreducible representations; Symbols and rules of irreducible representations-reduction formula-direct product representation; Great orthogonality theorem; character table-construction of character tables C_{2v}, C_{3v} and D_{2h}.

UNIT-III: PHOTOCHEMISTRY (18 Hrs)

Jablonski diagram, Primary and Secondary Processes, quantum yield and its determination-chemical actinometer. Excimers and exciplexes-Kinetics of collisional quenching- Stern Volmer equations.Photosensitization, Chemiluminescence.Photosynthesis, solar energy conversions. Semiconductor photo catalysis, lasers.Radiation Chemistry-linear energy transfer, G-value, dosimeters, radiolysis of water, solvated electrons.

UNIT IV: ELECTROCHEMISTRY – I (18 Hrs)

Deviation from ideal behaviour.ion-solvent and ion-ion interactions. Debye-Hückel-Bjerrum model, Ion association and triple ion formations.Expression for the mean activity coefficient.Debye-Hückel limiting law and its applications -Diverse ion effect.Van't Hoff factor and its relation to colligative properties.Debye-Hückel theory of strong electrolytes.Debye-Hückel length and potential around a central ion, its interpretation. Transport of ions in Solution: Electrolytic conduction- Debye - Hückel-Onsager treatment of strong electrolytes- ionic atmosphere- Anomalous conductance of non-aqueous electrolytes.

UNIT V: ELECTROCHEMISTRY- II (18 Hrs)

Electrical double layer - Electrocapillary phenomena - Surfactants - Lipmann's equation, Electrokinetic phenomena.Zeta potential and its applications.Structure of electrical double layer – Helmholtz-Perrin, Guoy-Chapmann and Stern models. Butler-Volmer equation for one electron transfer reaction - equilibrium and exchange current densities- and symmetry factor - transfer coefficient.Cyclic voltammetry and Stripping voltammetry - principle – instrumentation-Corrosion and passivation of metals - Pourbaix diagram - Evans diagram –Batteries and Fuel cells-Ion selective electrodes.

Reference and text books

1. R. G. Frost and Pearson, Kinetics and Mechanism, Wiley New York, **1961**.
2. C. Capellos and B. H. J. Bielski, Kinetic Systems, Wiley Interscience, New York, **1968**.
3. K. J. Laidler, Chemical Kinetics, Harper and Row, New York, **1987**.
4. R. G. Frost and Pearson, Kinetics and Mechanism, Wiley New York, **1961**.
5. G. M. Harris, Chemical Kinetics, D. C. Healthand Co, **1966**.
6. A. W. Anderson, Physical Chemistry of Surfaces, Wiley - Interscience, Newyork, 1990.
7. Paula, Peter Atkins and Julio de, Elements of Physical chemistry, 5th Ed, Oxford U. P,**2012**.
8. John O'M Bockris, Amula K. N. Reddy, and Maria Gamboa–Aldeco, Modern Electrochemistry 2A, 2nd Ed, Kluwer Academic / Plenuim Publishers, NewYork, **2000**.
9. Mordechay Schlesinger, Modern Aspects of Electrochemistry: Issue 43, Springer, Netherlands, **2009**.
10. Philip H. Rieger, Electrochemistry ,2nd Edition, **2010**.

11. Keith Oldham, Jan Myland and Alan Bond, Electrochemical Science and Technology: Fundamentals and Applications, John Wiley and Sons, New York, **2012**.
12. G. L. Agarwal, Basic Chemical Kinetics, Tata McGraw Hill, **1990**.
13. K. J. Laidler, Chemical Kinetics, Tata Mc Graw Hill, **1990**.
14. N. J. Turro, Modern molecular photochemistry, Benjamin/Cummings, Menlo Park, California, **1978**.
15. Revise G. W. Castellan, Physical Chemistry, Narosa publishing House, New Delhi, Ed,**2011**.
16. Gordon. M. Barrow, Physical Chemistry, Tata McGraw Hill Edition, New York, **2011**.
17. L. R. Puri, Y. R. Sharma and R. S. Pathania, Principles of Physical Chemistry 46th Ed,**2012**.
18. J. N. Gurtu and A. Gurthu, Advanced Physical Chemistry, Pragathi Prakashan, Meerut, Revised, **2014.**

Expected outcomes

CO.No	CO-statements	(k - level)
	On successful completion of the course ,students will be able to	
CO-1	*To* define *the reaction kinetics of fast reactions*	***k1***
CO-2	*To determine the theory, kinetics and mechanism of enzyme catalysis*	***K5***
CO-3	*To understand and learn Jablonski diagram ,lasers.Radiation ,dosimeters, radiolysis of water and solvated electrons*	***k2***
CO-4	To develop *concepts of Ionic interactions, theory of electrolytes, double layer models,*	***k3***
CO-5	Explain *the utilize of Batteries, Fuel cells and ion selective electrodes*	***k2***

Relationship Matrix for course Outcome, Programme Outcomes and Programme Secific Outcomes

TITLE OF THE COURSE: CHEMICAL KINETICS,ELECTROCHEMISTRY AND GROUP THEORY						**COURSE CODE: P21R2CHCC5**					
COURSE OUTCOMES (COS)	**PROGRAMME OUTCOMES(POS)**					**PROGRAMME SPECIFIC OUTCOMES (PSOS)**					**MEAN SCORE OF COS**
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PSO1**	**PSO2**	**PSO3**	**PSO4**	**PSO5**	
CO1	2	3	1	2	3	3	2	1	3	2	2.2
CO2	3	2	2	2	1	2	1	2	3	2	2.0
CO3	2	3	3	3	3	1	3	3	1	3	2.5
CO4	2	3	3	3	1	3	2	3	2	1	2.3
CO5	3	2	2	1	3	3	3	2	3	2	2.4
	MEAN OVERALL SCORE										**2.28**
	RESULT										**HIGH**

Title of the Course :	**SPECTROSCOPY ,SPECTROMETRIC AND THEIR APPLICATIONS**	**Marks: CIA:25 + Ext:75=100**
Category of the Course :	**Core Course**	**Hrs/Week :05**
Course Code :	**P2R2CHCC6**	**Total Inst. Hrs: 90**
Nature of the Course :	**Employability**	**SEM: II / CRIDIT: 5**

Objectives

- *To understand the basic aspects of NMR spectroscopy and NMR spectra of simple organic molecules.*
- *To understand, UV and IR spectra of organic compounds.*
- *To understand mass spectral cleavage pattern of organic compounds.*
- *To understand the structural elucidation of organic compounds using UV, IR, NMR and Mass Spectral data.*

UNIT I: UV AND IR SPECTRA OF ORGANIC COMPOUNDS (16 Hours)

Electronic absorption: Beer-Lamberts law, Types of electronic excitation. Chromophore and Auxochrome-Bathochromic and Hypsochromic shift. UV-vis spectra of simple organic compounds such as alkenes, phenols, anilines, carbonyl compounds and 1,3-diketones. Woodward-Fieser rule.

Infrared Spectra: Identification of functional groups in Organic Compounds, Finger print region. Inter and Intramolecular hydrogen bonding. Various factors affecting IR stretching frequencies.

UNIT II: NUCLEAR MAGNETIC RESONANCE AND THEIR APPLICATIONS

(16 Hours)

Origin of NMR spectrum-Nuclear spin states–NMR active nuclei–Nuclear magnetic moment–Larmor equation–Absorption of energy and Resonance–Population density of nuclear spin states.–Chemical shift-Standards in NMR–Shielding and Deshielding–Factors affecting chemical shift–electronegativity, hybridization, hydrogen bonding-anisotropic effect–double bond, triple bond, aromatic compounds, Spin-spin coupling–splitting origin and rules–factors affecting coupling constant: cis, trans, gem, ortho, meta, para coupling–exchange with deuterium. Vicinity of the proton, Long range coupling, Karplus equation and curve. Two interacting nuclei: AB, AX, AA'BB', dd, pair of doublet and AB quartet. Three interacting nuclei: AMX, ABX, ABC systems (only pattern is required). Double irradiation/Spin decoupling, Nuclear Overhauser Effect (NOE) and NMR imaging (MRI).

UNIT-III: ^{13}C NMR, ^{19}F NMR & ^{31}P NMR AND 2-D NMR TECHNIQUES (15 Hours)

^{13}C NMR–difficulties in recording ^{13}C NMR: Homo nuclear and heteronuclear coupling. Off Resonance decoupled spectrum identification of various types of carbon (functional groups) using ^{13}C NMR. Origin of ^{13}C satellite peaks. Attached Proton Test (APT) & Distortionless Enhancement by Polarization Transfer (DEPT) spectrum (DEPT-45, DEPT-90 and DEPT-135 ^{19}F NMR–Precessional frequency and heteronuclear coupling. Identification of organofluoro compounds (CF_3CO_2Et and CF_3CH_2OH) using NMR. ^{31}P NMR– Chemical

shift and heteronuclear coupling. Identification of organo phosphorous compounds such as $(Me)_3P$, $(EtO)_3P=O$ and Ph_3P. P-P bond in NMR.Basic aspects of 2-D NMR techniques: Correlation spectroscopy (COSY). HOMO COSY(HOMCORR: 1H-^{1}H connectivity, ^{13}C-^{13}C connectivity): HSQC and HETERO COSY (HETCORR): HMBC. 2D NOE Correlation Spectroscopy (NOESY).

UNIT-IV: MASS SPECTROMETRY (17 Hours)

Origin, basics and bloc diagram of Mass spectrum-Various types of Ionization techniques-Stability of Molecular ions, Meta stable ions. Base peaks and Isotope peaks. Fragmentation patterns of organicmoleculessuchasbenzenes,phenylhalides,phenols,benzyalcohols,benzylaliphaticalcohols,alaaromatic aldehydes, ketones, acids, esters and amides. Fragmentation patterns of aliphatic/aromatic nitro and amine compounds. Fragmentation patterns of heterocyclic compounds (furan, pyrrole and pyridine only). McLafferty rearrangements of organic molecules

UNIT-V: IDENTIFICATION OF ORGANIC COMPOUNDS USING ANALYTICAL AND SPECTRAL DATA (16 Hours)

Determination of molecular formula of organic compounds using elemental (CHN) analysis data. Structural determination of simple organic compounds using UV, IR, NMR and Mass spectral data.

Reference and text books

1. William Kemp, Organic Spectroscopy, Macmillan Education UK, 3rd Ed, **1991**.
2. P. S. Kalsi, Spectroscopy of Organic Compounds, New Age International Publishers, 6th Ed, Reprint, **2005.**
3. R. M. Silverstein, G. C. Bassler and T. C. Morrill, Spectrometric identification of Organic compounds, John Wiley, 5th Ed, **1991.**
4. R. M. Silverstein, F. X. Webster and D. Kiemle, Spectrometric identification of Organic compounds, Wiley, 7th Ed, **2005.**
5. William Kemp, NMR in Chemistry: A Multinuclear Introduction, MacMillan, **1988**.
6. R. S. Macomber, A Complete Introduction to NMR Spectroscopy, Wiley, **1998.**
7. Jag Mohan, Organic Spectroscopy Principles & Applications, Alpha Science International Ltd, 2nd Ed, **2004.**
8. D. L. Pavia, G. M. Lampman, G. S. Kriz and J. R. Vyvyan, Introduction to Spectroscopy, 4th Ed, **2009.**

Expected outcomes

CO.No	CO-statements	(k - level)
On successful completion of the course ,students will be able to		
CO-1	*To Determine the students to correlate the UV absorption values as well as IR stretching frequencies of organic compounds with their functional groups.*	***K5***

CO-2	*To Define the students to interpret the ^{1}H as well as ^{13}C NMR spectra of organic compounds with individual nuclei (protons/carbons).*	***K1***
CO-3	*To Develop the students to understand NMR spectral techniques such as decoupling, NOE and MRI*	***K3***
CO-4	To understand the *interpret different types of carbons (CH, CH_2, CH_3 and quaternary C) using ^{13}C NMR spectral editing and ^{13}C NMR DEPT techniques.*	***K2***
CO-5	Explain *the the structure of simple organic compounds from UV, IR, NMR and Mass spectral data.*	***k2***

Relationship Matrix for course Outcome, Programme Outcomes and Programme Secific Outcomes

TITLE OF THE COURSE: CHEMICAL KINETICS,ELECTROCHEMISTRY AND GROUP THEORY						**COURSE CODE: P2R2CHCC6**					
COURSE OUTCOMES (COS)	**PROGRAMME OUTCOMES(POS)**					**PROGRAMME SPECIFIC OUTCOMES (PSOS)**					**MEAN SCORE OF COS**
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PSO1**	**PSO2**	**PSO3**	**PSO4**	**PSO5**	
CO1	2	3	2	2	3	3	2	2	3	2	2.4
CO2	3	2	2	2	1	2	1	2	3	2	2.0
CO3	2	3	3	3	3	1	3	3	1	3	2.5
CO4	2	2	3	3	1	3	2	2	2	2	2.2
CO5	2	3	2	1	3	3	3	2	1	2	2.2
	MEAN OVERALL SCORE										**2.74**
										RESULT	**HIGH**

TITLE OF THE COURSE	REACTION MECHANISM, REARRANGEMENT, NAME REACTION, OXIDATION AND REDUCTION	**MARKS: CIA: 25+ EXT: 75=100**
CATEGORY OF THE COURSE	**CORE COURSE**	**HRS/WEEK:5**
COUSE CODE	**P2R2CHCC7**	**TOTAL INST. HRS: 90**
NATURE OF THE COURSE	**CORE COURSE**	**SEM: II / CRIDIT: 5**

Objectives

- Understanding addition and elimination reactions along with their mechanism and synthetic utility.
- Understanding rearrangement and name reactions along with their mechanism and synthetic utility.
- Understanding various types of oxidation and reduction reactions along with their mechanism and synthetic utility.
- Understanding the various types of elimination reaction
- Understanding the mechanism of molecular rearrangement and name reactions

UNIT-I: ADDITION TO CARBON-CARBON DOUBLE BOND (18 Hrs)

Electrophilic addition to carbon–carbon double and triple bonds. Nucleophilic addition to carbon–carbon multiple bonds. Generation and addition of carbenes-Michael addition and Robinson annulation.Hydroxylation of olefinic double bonds (OsO_4, $KMnO_4$); Woodward and Prevost oxidation. Epoxidation using peracids including Sharpless epoxidation, Ozonolysis. Hydrogenation (homogenous and heterogeneous) and Transfer hydrogenation. Hydration of carbon-carbon double and triple bonds.

UNIT-II: ADDITION TO CARBON-OXYGEN DOUBLE BOND (18 Hrs)

Nucleophilic addition to –C=O bond. A study of Mannich, benzoin, Darzen's glycidic ester, Stobbe and Knovenagel condensation reactions; Wittig, Wittig-Horner olefination reactions; Sulfur and Sulfonium ylides and their reactions, Julia olefination & Peterson alkene synthesis. Asymmetric reduction of carbonyl functions (Corey's procedure).

UNIT-III: ELIMINATION (18 Hrs)

Elimination reactions: E1, E2, E1cb and Ei-elimination. Conformation of mechanism; solvent, substrate, leaving group effects-Saytzeff's *Vs* Hoffman elimination; Stereochemistry of E_2 eliminations, Elimination in cyclohexane ring system; Mechanism of pyrolytic eliminations. Examples: Chugaev reactions and Cope elimination, Hoffmann degradation and pyrolysis of esters.

UNIT-IV: MOLECULAR REARRANGMENTS & NAME REACTIONS (18 Hrs)

A study of mechanism of the following rearrangements: Beckmann, Curtius, Hofmann, Schmidt, Lossen, Wolff, Pinacol, Wagner Meerwin, Demjanov, Dienone-Phenol, Favorski, Benzidine, Claisen, Cope, Sommlet-Hauser, Pummerer and Von-Richter rearrangements. A study of the following name reactions: Dieckmann cyclization, Hofmann-Loffler Freytag reaction, Mitsunobu reaction, Shapiro reaction, Eschenmoser-Tanabe and Ramburg-Backlund reactions.

UNIT-V: OXIDATION AND REDUCTIONS REACTIONS (18 Hrs)

Oxidation with Cr (including PCC, PDC, Jones) and Mn (including MnO_2 and $BaMnO_4$) reagents; Oxidation with LTA, DDQ and SeO_2; Oxidation using DMSO either with DCC or Ac_2O or Oxaloyl chloride; Oxidation using IBX and Dess-Martin Periodinane (DMP) reagent.Reduction with $NaBH_4$, $NaCNBH_3$, $Zn(BH_4)_2$ $LiAlH_4$, $Li(^tBuO)_3AlH$, DIBAL-H, Red-Al, Et_3SiH and Bu_3SnH; Reduction using selectrides; Birch reduction.

Reference and text books

1. Jerry March, Advanced Organic Chemistry, John Wiley & Sons, 5th Ed, **2001.**
2. F. Carey and R. J. Sundberg, Advanced Organic Chemistry-Part A and B, Springer Science + Business Media, 5 th Ed, **2007.**
3. M. B. Smith and Jerry March, Advanced Organic Chemistry, John Wiley & Sons, 5th Ed, **2001.**
4. J. Clayden, N. Greeves and S. Warren, Organic Chemistry, Oxford University Press, 2nd Ed, **2012**.
5. M. B. Smith, Organic Synthesis, Academic Press, 3rd Ed, **2011.**
6. R. O. C. Norman and J. M. Coxon, Principles of Organic Synthesis, Chapman & Hall, 3rd Ed, **1993.**
7. Stuart Warren, Organic Synthesis: Disconnection Approach, Wiley India (P) Ltd, **2007**.
8. V. K. Ahluwalia, Oxidation in Organic Synthesis, CRC Press, 1st Ed, **2012.**
9. V. K. Ahluwalia, Reduction in Organic Synthesis, CRC Press, 1st Ed, **2012.**

Expected outcomes

CO.No	CO-statements	(k - level)
On successful completion of the course ,students will be able to		

CO-1	Determine the reaction mechanisms involved in various addition reactions	***K5***
CO-2	*Outline the mechanism involved in elimination reactions*	***K2***
CO-3	*Define the reaction mechanisms involved in rearrangement as well as name reactions along with their synthetic utilities*	***K5***
CO-4	Illustrate the basic concept of addition to carbon-carbon double bond	***K2***
CO-5	Explain *the various types of oxidation and reduction reactions along with their synthetic utilities*	***K4***

Relationship Matrix for course Outcome, Programme Outcomes and Programme Secific Outcomes

REACTION MECHANISM, REARRANGEMENT, NAME REACTION, OXIDATION AND REDUCTION						**Course Code: P2R2CHCC7**					
Course Outcomes (Cos)	**Programme Outcomes(POs)**					**Programme Specific Outcomes (PSOs)**					**Mean Score of Cos**
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PSO1**	**PSO2**	**PSO3**	**PSO4**	**PSO5**	
CO1	**3**	**2**	**2**	**1**	**3**	**2**	**3**	**2**	**2**	**3**	**2.3**
CO2	**2**	**2**	**2**	**2**	**3**	**2**	**3**	**2**	**3**	**1**	**2.2**
CO3	**3**	**2**	**2**	**2**	**3**	**3**	**2**	**2**	**3**	**2**	**2.4**
CO4	**3**	**2**	**2**	**3**	**3**	**2**	**2**	**3**	**2**	**2**	**2.3**
CO5	**3**	**2**	**3**	**3**	**2**	**2**	**3**	**2**	**3**	**3**	**2.6**
	Mean Overall Score										**2.36**
	Result										**High**

TITLE OF THE COURSE	**ORGANIC CHEMISTRY PRATICAL-II**	**MARKS: CIA: 40 + EXT: 60=100**
CATEGORY OF THE COURSE:	**CORE COURSE**	**HRS/WEEK : 6**
COUSE CODE	**P2R1CHCC8P**	**TOTAL INST. HRS : 90**
NATURE OF THE COURSE:	**CORE COURSE**	**SEM: II / CREDIT : 5**

Objectives: To give students practice in

- *Quantitative analysis of organic compounds*
- *Some double stage organic preparations*

A. Quantitative analysis of organic compounds (30 Marks)

Estimation of phenol, aniline, ketone, glucose, nitrobenzene, saponification value of an oil and Iodine value of an oil.

B. Preparation of organic compounds (Double stage) (20 Marks)

a. *p*-bromo acetanilide from aniline (acetylation and bromination).
b. acetyl salicylic acid from methyl salicylate (hydrolysis and acetylation).
c. 1,3,5-tribromobenzene from aniline (bromination, diazotization and hydrolysation).

d. *p*-nitroaniline from acetanilide (nitration and hydrolysis).
e. benzillic acid from benzoin (rearrangement).
f. *p*-amino benzoic acid from p-nitro toluene (oxidation and reduction).
g. benzanilide from benzophenone (rearrangement).
h. *p*-bromoaniline from acetanilide (bromination and hydrolysis).
i. *m*-nitroaniline from nitrobenzene (nitration and reduction).
j. 1,2,4-triacetoxy benzene from hydroquinone (oxidation and acylation).

Course Outcomes: At the end of the course, the learners will be able to

- ❖ Perform quantitative separation of binary mixture of organic compounds
- ❖ Observe the separation and regeneration of the compounds
- ❖ Understand isolation and purification of compounds
- ❖ Know about the saponification value of an oil
- ❖ Know the Iodine value of an oil

Scheme of Valuation:

Record and Viva - 10 Marks
Estimation - 30 Marks
Preparation (Double stage) - 20 Marks

Text Books

1. N.S. Gnanapragasam and G. Ramamurthy, Organic Chemistry – Lab manual,S. Viswanathan Co. Pvt. Ltd, 2007.
2. J.N. Gurtu and R. Kapoor, Advanced Experimental Chemistry, S. Chand and Co., 1987.

Reference Book

1. Vogel's Text book of Practical Organic Chemistry, 4thEd., ELBS/Longman, England, 1984**.**

Expected outcomes

CO.No	CO-statements	(k - level)
On successful completion of the course ,students will be able to		
CO-1	Define the *p*-bromo acetanilide from aniline (acetylation and bromination).	***K5***
CO-2	Illustrate the acetyl salicylic acid from methyl salicylate (hydrolysis and acetylation).	***K2***
CO-3	Explain 1,3,5-tribromobenzene from aniline (bromination, diazotization and hydrolysation).	***K4***
CO-4	Outline the concept of benzanilide from benzophenone (rearrangement).	***K2***
CO-5	Determine the *p*-amino benzoic acid from p-nitro toluene (oxidation and reduction).	***K5***

Relationship Matrix for course Outcome, Programme Outcomes and Programme Secific Outcomes

TITLE OF THE COURSE: ORGANIC CHEMISTRY PRACTICAL -II	COURSE CODE: P2R1CHCC8P

COURSE OUTCOMES (COS)	PROGRAMME OUTCOMES(POS)					PROGRAMME SPECIFIC OUTCOMES (PSOS)					MEAN SCORE OF COS
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5	
CO1	2	2	2	2	3	2	3	2	2	2	2.2
CO2	3	2	2	2	3	2	3	2	3	1	2.3
CO3	2	2	2	2	3	3	2	2	2	3	2.3
CO4	3	2	2	3	2	2	2	3	2	3	2.4
C	2	2	3	3	2	2	2	2	3	2	2.3
	MEAN OVERALL SCORE										2.3
	RESULT										HIGH

TITLE OF THE COURSE	INORGANIC CHEMISTRY PRATICAL-II	MARKS: CIA: 40 + EXT: 60=100
CATEGORY OF THE COURSE:	CORE COURSE	HRS/WEEK : 6
COUSE CODE	P2R1CHCC9P	TOTAL INST. HRS : 90
NATURE OF THE COURSE:	CORE COURSE	SEM: II / CREDIT : 5

Objectives: To give learners practice in

- *Quantitative separation of metal ions in binary mixtures*
- *Simple single stage preparations of some inorganic complex compounds*

Titrimetry and Gravimetry **(35 Marks)**

A mixture of solution(s) should be given for estimation

1. Cu (V) and Ni (G)
2. Cu (V) and Zn (G)
3. Fe (V) and Zn (G)
4. Fe (V) and Ni (G)
5. Zn (C) and Cu (G)

Preparation of the Following Compounds **(15 Marks)**

a. Tetramminecopper (II) sulphate.
b. Potassium trioxalatochromate (III).
c. Potassium trioxalatoaluminate (III).
d. Trithioureacopper (I) chloride.
e. Trithioureacopper (I) sulphate.
f. Dibenzyltindichloride

Course Outcomes: At the end of the course, the learners will be able to

- Perform qualitative separation of binary mixtures and individual quantitative estimation adapting volumetric and gravimetric methods
- Well versed in advanced methods of estimation of metal ions through complexation

- ❖ Apply suitable techniques to obtain maximum yield of the dried product without any wastage
- ❖ Know about the principles of volumetric and gravimetric analysis
- ❖ Prepare the Inorganic complex

Scheme of Valuation:

Record and Viva	- 10 Marks
Complex Preparation	- 15 Marks
Volumetric Estimation	- 20 Marks
Gravimetric Estimation	- 15 Marks

Text Books

1. G. H. Jeffery, J. Bassett, J.Mendham, R.C. Denney, Vogel's 's Textbook of Quantitative Chemical Analysis; 5th Ed., ELBS,1989.
2. J. D., Woollins, Ed., Inorganic Experiments; VCH: Weinheim, 1994.
3. G. Pass, H. Sutcliffe, Practical Inorganic Chemistry; Chapman Hall, 1965.
4. W. G. Palmer, Experimental Inorganic Chemistry; Cambridge University Press, 1954.

Expected outcomes

CO.No	CO-statements	(k - level)
	On successful completion of the course ,students will be able to	
CO-1	Define the preparation of tetramminecopper (ii) sulphate	***K5***
CO-2	Illustrate the preparation of Potassium trioxalatochromate (III). basic stereochemistry concept in a proper perspective	***K2***
CO-3	Explain the the preparation of Potassium trioxalatoaluminate (III	***K4***
CO-4	Outline the concept of the preparation of the preparation of Trithioureacopper (I) chloride.	***K2***
CO-5	Determine the Trithioureacopper (I) sulphate	***K5***

Relationship Matrix for course Outcome, Programme Outcomes and Programme Secific Outcomes

TITLE OF THE COURSE:INORGANIC CHEMISTRY PRACTICAL -II											**COURSE CODE: P2R1CHCC9P**
COURSE OUTCOMES (COS)	**PROGRAMME OUTCOMES(POS)**					**PROGRAMME SPECIFIC OUTCOMES (PSOS)**					**MEAN SCORE OF COS**
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PSO1**	**PSO2**	**PSO3**	**PSO4**	**PSO5**	
CO1	3	2	2	2	3	2	3	2	2	3	**2.4**
CO2	3	2	2	2	3	2	3	2	3	1	**2.3**
CO3	2	2	2	2	3	3	2	2	2	3	**2.3**
CO4	3	3	2	3	3	2	2	3	2	3	**2.6**
C	2	2	3	3	2	2	2	2	3	2	**2.3**

	MEAN OVERALL SCORE	**2.38**
	RESULT	**HIGH**

Title of the course :	**INDUSTRIAL CHEMISTRY**	**Marks:CIA:25 +Ext:75=100**
Category of the course:	**Skill Enhancement**	**Hrs/week :05**
Course code:	**P2R2CHEC2:1**	**Total Inst. Hrs:**
Nature of the course:	**Employability**	**SEM: II / CREDIT : 5**

Objectives

- *To understand leather, dyes*
- *To understand the concept of fuels, biofuels*
- *To know about oil, fats, soaps*
- *To know about synthetic perfumes*
- To understand *corrosion and batteries*

UNIT-I: Tanning of Leather and Dyes

Introduction-Animal skin, manufacture of leather-preparation of hides-vegetable tanning, chrome tanning- finishing-oil tanning.**Dyes:**Introduction-senation of colour-colour and constitution-nomenclature-basic operations in dyeing classification of dyes according to the mode of application – synthesis, reaction an applications of diphenylmethane dyes-triphenylmethane dyes-phthalein dyes-xanthene dyesacridine dyes-sulphur dyes, cyanine dyes.

UNIT-II: Fuels.

Fossil fuels- classification and unique features- Coal, Petroleum, natural gas. **Biofuels:** Biomass-biodiesel. Nuclear fuels: for various types of nuclear reactors.**. Hydrogen as fuel in the future**-Hydrogen storage materials. Fuel cells – basic principle.

UNIT-III: Oils, Fats, Waxes and Soaps

Introduction-Distinction between oils and fats-properties and its classifications-animal fats and oils difference between, animal, vegetable and mineral oils-isolation of essential oils and their uses. saponification value-ester value-acid value-iodide value-wijs method – Reichert meissel value-Henher value-elaident test-hydrogenation of oils.

Soaps and its manufacture-general consideration in soap making – manufacture of toilet and transparent soaps – oil to be used for soap – cleansing action of soap.

UNIT-IV: Synthetic Perfumes

.Introduction-Esters-alcohols – ketones–aionones – nitromusks – aldehydes – dipheny-

production of natural perfumes-flower perfumes-fruit flavours-artificilal flavours.

UNIT-V: Corrosion and Batteries

Corrosion: Introduction – Dry and Wet Corrosion – Electrochemical theory of Corrosion-Mechanism – Galvanic corrosion, Concentration cell, corrosion Waterline Attack – Pitting – passivity – stress corrosion - Corrosion control methods. **Batteries:** Fundamentals of Batteries – Classification of Batteries – Sizes of Batteries – Primary Batteries – Le'clanche dry cell – Magnesium dry cell – Secondary batteries –Lead acid battery – Alkaline Storage Batteries.

Text Books

1. Chemical Process Industries – Norrish Shreve, R. and Joseph A. Brink Jr. McGraw Hill, Industrial Book Company, London.
2. Mathew George and Lincy joseph, Text book of pharmaceutical chemistry, 2009.
3. JayashreeGhose – Text book of Pharmaceutical chemistry, 2nd Ed., 2003.
4. S. Lakshmi, Pharmaceutical Chemistry, 3rdEd.,Sulthan Chand and Sons, New Delhi,2004.

References Books:

1. Production and Properties of Industrial Chemicals – Brain A. C. S. Reinhold – New York.
2. Petroleum Products Hand Book. Guthrie V., McGraw Hill, Tokyo.
3. Industrial Chemistry (Including Chemical Engineering) – B. K. Sharma 10thEd.,
4. Outlines of Chemical Technology – For the 21stCentury – M. Gopala Rao &Matshall S.Sittig, 3rd Ed.,
5. Charles E. Carraher, Polymer chemistry, 6th Ed, Marcel Dckker, Brijbasi Art Pvt.Ltd, 2003.
6. V.R.Gowariker, N.V. Viswanathan and JayadevSreedhar, Polymer Science, New Age Publishers,New Delhi, 1986.

Expected outcomes

CO.No	CO-statements	(k - level)
On successful completion of the course ,students will be able to		
CO-1	Illustrate the procedure of dying process	***K2***
CO-2	Determine the tanning methods of fabric and leather	***K5***
CO-3	Defend the classification of fuels and its importance	***K5***
CO-4	. explain the methods of preparation of synthetic perfumes	***K3***
CO-5	. Identify the corrosion and batteries	***K5***

Relationship Matrix for course Outcome, Programme Outcomes and Programme Secific Outcomes

TITLE OF THE COURSE: INDUSTRIAL CHEMISTRY						COURSE CODE: P2R2CHDSE2:1					
COURSE OUTCOMES (COS)	PROGRAMME OUTCOMES(POS)					PROGRAMME SPECIFIC OUTCOMES (PSOS)					MEAN SCORE OF COS
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5	
CO1	2	2	2	2	3	2	2	2	2	3	2.2
CO2	3	2	2	2	3	2	3	2	3	1	2.3
CO3	2	2	2	2	3	3	2	2	2	3	2.3
CO4	3	3	2	3	3	2	2	3	2	3	2.6
C	2	2	3	3	2	2	2	2	3	2	2.3
	MEAN OVERALL SCORE										2.34
	RESULT										HIGH

TITLE OF THE COURSE	GREEEN CHEMISTRY	MARKS: CIA: 40 + EXT: 60=100
CATEGORY OF THE COURSE:	CORE COURSE	HRS/WEEK : 5
COUSE CODE	P2R2CHEC2:2	TOTAL INST. HRS : 90
NATURE OF THE COURSE:	CORE COURSE	SEM: II / CREDIT : 5

Objectives: To introduce learners to

- *the basic concepts of green chemistry*
- *Microwave Assisted Organic Synthesis*
- *Ionic liquids and phase transfer catalyst*
- *Bio-Catalysts for Green Chemistry*
- *Alternative Reagents for synthesis*

UNIT-I: Introduction to Green Chemistry (11 Hrs)

Green chemistry-relevance and goals, Anastas' twelve principles of green chemistry - Tools of green chemistry: alternative starting materials, reagents, catalysts, solvents and processes with suitable examples.

UNIT-II: Microwave Assisted Organic Synthesis (MAOS) (12 Hrs)

Microwave activation – advantage of microwave exposure – specific effects of microwave – Neat reactions – solid supports reactions _ Functional group transformations – condensations reactions – oxidations – reductions reactions – multi-component reactions.

UNIT-III: Ionic Liquids and PTC (11 Hrs)

Introduction – synthesis of ionic liquids – physical properties – applications in alkylation – hydroformylations – expoxidations – synthesis of ethers – Friedel-craft reactions – Diels-Alder reactions – Knoevengal condensations – Wittig reactions – Phase transfer catalyst - Synthesis – applications.

UNIT-IV: Supported Catalysts and Bio-Catalysts for Green Chemistry (12 Hrs)

Introduction – the concept of atom ecomomy – supported metal catalysts – mesoporoussilicas – the use of Biocatalysts for green chemistry - modified bio catalysts – fermentations and

biotransformations – fine chemicals by microbial fermentations – vitamins and amino acids – Baker's yeast mediated biotransformations – Bio-catalyst mediated Baeyer-Villiger reactions – Microbial polyester synthesis.

UNIT -V: Alternative Synthesis, Reagents and Reaction Conditions (11 Hrs)A photochemical alternative to Friedel-crafts reactions - Dimethyl carbonate as a methylating agent – the design and applications of green oxidants – super critical carbon dioxide for synthetic chemistry.

Unit -VI: Latest Learning's (For CIA only) (03 Hrs)

Latest development related to the course during the semester concerned

Course Outcomes: At the end of the course, the learners will be able to

- ❖ understand the basic concepts of green chemistry and Microwave Assisted Organic Synthesis
- ❖ Work for Reducing the pollution in the environment
- ❖ Synthesize the new material using green chemistry
- ❖ Understand the uses of green solvents

Text Book

1. Rashmi Sanghi & M. M. Srivastava, Green Chemistry – Environment friendly alternatives, Narora Publishing House, 2003.
2. V.K.Ahulwalia, A text book of green chemistry, Narosa publishers, Reprint, 2013.
3. K.R.Deasi, A text book of green chemistry, 2nd Revised Edition 2014.

Reference Books

1. 1.V. K. Ahluwalia, Green Chemistry – Environmentally benign reactions, Ane Books India, 2006.
2. Green Chemistry – Designing Chemistry for the Environment – edited byPaul T. Anastas& Tracy C. Williamson. Second Edition, 1998.
3. Green Chemistry – Frontiers in benign chemical synthesis and processes- edited byPaul T. Anastas& Tracy C. Williamson. Oxford University Press, 1998.

Expected outcomes

CO.No	CO-statements	(k - level)
On successful completion of the course ,students will be able to		
CO-1	Determine the principles of green chemistry	***K5***
CO-2	Outline the Microwave Assisted Organic Synthesis	***K2***
CO-3	Explain the Ionic Liquids and PTC	***K4***
CO-4	Illustrate the Supported Catalysts and Bio-Catalysts for Green Chemistry	***K2***
CO-5	Define the Alternative Synthesis, Reagents and Reaction Conditions	***K5***

Relationship Matrix for course Outcome, Programme Outcomes and Programme Secific Outcomes

TITLE OF THE COURSE: GREEEN CHEMISTRY						COURSE CODE: P2R2CHDSE2:2					
COURSE OUTCOMES (COS)	PROGRAMME OUTCOMES(POS)					PROGRAMME SPECIFIC OUTCOMES (PSOS)					MEAN SCORE OF COS
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5	
CO1	3	2	2	2	3	2	3	2	2	3	2.4
CO2	3	2	2	2	3	2	3	2	3	1	2.3
CO3	2	3	2	2	3	3	2	2	2	3	2.4
CO4	3	3	2	3	3	2	2	3	2	3	2.6
C	2	2	3	3	2	2	2	2	3	2	2.3
	MEAN OVERALL SCORE										2.4
	RESULT										HIGH

TLE OF THE COURSE	QUANTUM CHEMISTRY ,THERMODYNAMICS AND ANALYTICAL TECHNICS	MARKS: CIA:25 + EXT :75=100
CATEGORY OF THE COURSE	CORE COURSE	HRS/WEEK : 05
COURSE CODE	P3R2CHCC10	TOTAL INST. HRS : 96
NATURE OF THE COURSE	SKILL DEVELOPMENT	SEM : III / CRDIT : 5

CORE 6: QUANTUM CHEMISTRY AND ANALYTICAL TECHNIQUES

Objectives: To make the students.

- *Learn the principles of quantum mechanics of simple systems.*
- *Learn the quantum mechanical treatment of multi electron atoms.*
- *learn the principles, instrumentation, interpretation and applications of micro wave,*
- *IR and Raman spectroscopy.*
- *Learn the principles, instrumentation and applications of Polarography,*
- *Amperometry, Coulometry*
- *understand the principles, instrumentation and applications of various thermal*
- *analysis techniques*
- *understand the principles, instrumentation and applications of various*
- *elemental analysis and surface analysis techniques*

UNIT-I: QUANTUM CHEMISTRY-I (18 Hrs)

Black body radiation-Planck's quantum theory-Wave particle duality-Uncertainty Principle. Operators-linear, commutation, Hermitian and Hamiltonian operators. Eigen functions and Eigen values-Postulates of quantum mechanics. Derivation of Schrodinger's time-independent wave .equation and its application to particle in a one dimensional box, particle in a three dimensional box, harmonic oscillator, rigid rotor and hydrogen atom.

UNIT-II: QUANTUM CHEMISTRY-II (18 Hrs)

Born-Oppenheimer approximation-Hydrogen molecule ion.LCAO-MO and VB treatments of the hydrogen molecule.Antisymmetry and Pauli's exclusion principle. Slater detrimental wave function, term symbols and spectroscopic states-Russell Saunders coupling.The variation theorem and Perturbation theory.Applications of variation method and perturbation theory to the helium atom.Hybridization-determination of bond angles of sp, sp2 and sp3 hybridizations.Huckel pi electron (HMO) theory and its applications to ethylene, butadiene and benzene. A brief idea of Hartree and Hartree-Fockself consistent field theory.

UNIT-III: THERMODYNAMICS AND NON-IDEAL SYSTEMS (18 Hrs)

Concepts of Partial Molar Properties-Partial Molar Free Energy and Partial Molar Volume.Gibbs-Duhem equation, Chemical potential-Variation of chemical potential with temperature and pressure, Van't Hoff isotherm. Fugacity–Determination of fugacity of gases by graphical method-Variation of fugacity with temperature and pressure -Lewis Randal rule-Duhem- Margules equation. Determination of activity and activity coefficient of non-electrolyte (e.m.f method)-Excess functions.

UNIT IV: ANALYTICALTECHNIQUES (18 Hrs)

Principles, theory, instrumentation and applications of Polarography, amperometry, coulometry, EDAX, XPS, AAS, AES, interpretation of spectra-Merits and demerits.

UNIT V: SURFACE AND THERMAL ANALYSIS TECHNIQUES (18 Hrs)

Principles, theory, instrumentation and applications of SEM, STM, TEM, AFM, ESCA - interpretation of spectra-Merits and demerits.Principles, theory and applications of TGA, DTA, DSC, DTG. Interpretation of various thermal analysis curves.

Reference and text books

1. P. W. Atkins, Molecular Quantum Mechanics, Oxford University Press, Oxford, **1983.**
2. M. W. Hanna, Quantum Mechanics in Chemistry, W. A Benjamin Inc. London **1965.**
3. I. N. Levine, Quantum Chemistry, Allyn and Bacon, Boston, **1983.**
4. H. Eyring, J. Walter and G. Kimball, Quantum Chemistry, John Wiley and Sons, New York, **1944**.
5. M. W. Hanna, Quantum Mechanics in Chemistry, W.A. Benjamin Inc. London, **1965**.
6. G. M. Barrow, Introduction to Molecular Spectroscopy, McGraw Hill, New York, **1988**.
7. D. A. McQuarrie, Quantum Chemistry, University Science Books, MilValley,California,**1998**.
8. B. K. Sen, Quantum Chemistry, Tata McGraw Hill, **1992**.
9. A. K. Chandra, Introduction to Quantum Chemistry, Tata McGraw Hill, **1997**.
10. W. Levine, Quantum Chemistry, Prentice Hall, **1994**.
11. R. K. Prasad, Quantum Chemistry, Wiley Eastern, **1993**.
12. C. F. Banwell, Fundamentals of Molecular Spectroscopy, McGraw Hill, New York, **966**.
13. D. A. Skoog and D. M. West, Fundamentals of Analytical Chemistry, Holt Rinehart And Winston Publications, IV Edn, **1982.**
14. D. A. Skoog, D. M. West, F. J. Holler and S. R. Crouch, Fundamentals of

Analytical Chemistry, Thomson Asia Pte Ltd., Singapore, 8th Ed, **2004**.

15. D. A. Skoog, Principles of Instrumental Analysis, Saunders College Pub.Co, 3rd Ed, **1985**.16. Willard, Merit, Dean and Settle, Instrumental Methods of Analysis, CBS Publishers and Distributors, 4th Ed, **1989**.
17. G. D. Christian and J. E. O. Reilly, Instrumental Analysis, Allyn and Bacon Inc, 2nd Ed, **1986**.
18. R. S. Drago, Physical methods in chemistry, Reinhold, New York, **1968**.

Expected outcomes

CO.No	CO-statements	(k level)
	On successful completion of the course ,students will be able to	
CO-1	Importance of the principles ad postulates of quantum mechanics of simple systems and one 1-D and 3-D boxes	***K5***
CO-2	solve to calculate the energy of simple multi electron atoms and molecules and MO and VB	***K3***
CO-3	Understand the principles, instrumentation, interpretation and applications of micro wave, IR and Raman spectroscopy	***k2***
CO-4	Elaborate explain the principles, instrumentation and applications of Polarography, Amperometry, Coulometry	***K6***
CO-5	Illustrate the principles, instrumentation and applications of various elemental analysis and surface analysis techniques	***k2***

Relationship Matrix for course Outcome, Programme Outcomes and Programme Secific Outcomes

TITLE OF THE COURSE: QUANTUM CHEMISTRY,THERMODYNAMICS,AND ANALYTICAL TECHNQUES						**COURSE CODE: P3R2CHCC10**					
COURSE OUTCOMES (COS)	**PROGRAMME OUTCOMES(POS)**					**PROGRAMME SPECIFIC OUTCOMES (PSOS)**					**MEAN SCORE OF COS**
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PSO1**	**PSO2**	**PSO3**	**PSO4**	**PSO5**	
CO1	3	1	3	2	2	3	2	3	2	2	2.3
CO2	3	2	3	2	3	2	2	2	3	2	2.4
CO3	2	2	2	1	3	2	3	2	3	2	2.2
CO4	3	3	1	3	3	3	2	3	2	3	2.6
CO5	3	3	2	3	2	2	3	2	2	2	2.4
	MEAN OVERALL SCORE										**2.38**
	RESULT										**HIGH**

TITLE OF THE COURSE	**STRUCTURE AND BONDING**	**MARKS: CIA:25 + EXT:75=100**
CATEGORY OF THE COURSE	**CORE COURSE**	**HRS/WEEK :05**
COURSE CODE	**P3R2CHCC11**	**TOTAL INST. HRS : 80**
NATURE OF THE COURSE	**SKILL DEVELOPMENT**	**SEM : III / CRIDIT : 5**

CORE 1: STRUCTURE AND BONDING

Objectives

- To provide knowledge of basic and advanced concepts in bonding and enable the students to identify the structure and bonding of simple molecules.
- To provide an understanding of the various types of solid state packing and the types of chemical forces
- To enable students appreciate the structure of inorganic chain and cluster compounds.
- To provide knowledge of the structure and bonding in boron compounds.
- T provide knowledge about diffraction methods.

UNIT I: CHEMICAL BONDING (16 Hrs)

V.B. approach to bonding-Hitler-London, Pauling and Slater refinements, Concept of hybridization and structure of molecules, VSEPR theory shapes of molecules. M.O. approach to covalent bonding – symmetry and overlap of atomic orbitals – symmetry of molecular orbitals – sigma and pi bonding – energy levels in homo and hetero nuclear diatomic systems – bond length, bond order and bond energy, Application to small molecules such as $BeCl_2$, BCl_3 and CCl_4, SF_4, etc, ionic character in a covalent bond - The concept of multicentre bonding. Pseudo halogens: Structure and bonding in ClF_3, BrF_3 , BrF_5 , IF_5, IF_7 etc . Oxides and oxyacids of halogens, Bonding in Noble gas compounds – $XeCl_2$, XeF_4, $XeOF_4$, XeF_6.

UNIT II: CHEMISTRY OF SOLID STATE- I (16 Hrs)

Weak Chemical forces: van der Waals forces, Hydrogen bonding, Close packing of atoms and ions HCP and BCC types of packing voids, radius ratio – derivation – its influence on structures. Lattice energy – Born-Lande equation - Kapustinski equation, Madelung constant. Representative structures of AB and AB_2 types of compounds - rock salt, cesium chloride, wurtzite, zinc blende, rutile, fluorite, antifluorite, cadmium iodide and nickel arsenide. Structure of graphite and diamond. Spinels -normal and inverse types and perovskite structures.

UNIT III: CHEMISTRY OF SOLID STATE II: (16 Hrs)

Band theory of solids- non-stoichiometry- point defects – linear defects- effects due to dislocations-electrical properties of solids-conductor, insulator, semiconductor-intrinsic-impurity semiconductors-optical properties-lasers and phosphors-elementary study of liquid crystals. Difference between point group and space group – screw axis – glide plane - symmetry elements–relationship between molecular symmetry and crystallographic symmetry – The Concept of reciprocal lattice – X-ray diffraction by single crystal – rotating crystal – powder diffraction. Neutron diffraction: Elementary treatment – comparison with X-ray diffraction.

Electron diffraction- Basic principle. Crystal Growth methods: From melt and solution (hydrothermal, Gel methods).

UNIT IV: BORONCOMPOUNDS AND CLUSTERS (16 Hrs)

Chemistry of boron – boranes, higher boranes, borazines , boron nitrides, hydroborate ions – Preparation, properties and structure, STYX numbers, Wade's rules.Carboranes- Types such as nido-closo, arachno-preaprtion properties and Structure. Metallocarboranes-a general study. Metal clusters: Chemistry of low molecularity metal clusters only, Structure of Re_2Cl_8; multiple metal-metal bonds.

UNIT V: INORGANIC CHAIN AND CLUSTER COMPOUNDS (16 Hrs)

Types of inorganic polymers, comparison with organic polymers, silanes, higher silanes, multiple bonded systems, silicon nitrides, siloxanes. P-N compounds, cyclophosphazenes and cyclophosphazanes. S-N compounds – S_4N_4, $(SN)_x$.Isopoly and heteropoly acids – Structure and bonding of 6- and 12 – isopoly and heteropoly anions. Structure of silicates - applications of Paulings rule of electrovalence - isomorphous replacements in silicates – ortho, meta and pyro silicates – one dimensional, two dimensional and three dimensional silicates.

Reference and text books

1. D. E. Douglas, D.H. McDaniel and J. J. Alexander, Concepts and Models in Inorganic Chemistry, 3rd Ed, **1994**.
2. M. C. Day, J. Selbin, Theoretical Inorganic Chemistry, 2nd Ed, East West Press, **1985**.
3. L. Pauling, The Nature of the Chemical Bond, 3rd Ed., Cornell University Press, **1960**.
4. F. A. Cotton, G. Wilkinson, Advanced Inorganic Chemistry, 4th Ed, John Wiley & Sons, **1986**.
5. D.F. Shriver, P.W. Atkins, Inorganic Chemistry, 3rd Ed, **1999**.
6. A.G. Sharpe, Inorganic Chemistry, Pearson Education, **2008**.
7. N. H. Ray, Inorganic Polymers, Academic Press, **1978**.
8. A. R. West, Basic Solid State Chemistry, John Wiley, **1991**.
9. E. L. Mutteri, Polyhedral Boranes, Academic Press, NY, **1975.**

Expected outcomes

CO.No	CO-statements	(k - level)
On successful completion of the course ,students will be able to		
CO-1	predict the structure of inorganic compounds	***K3***
CO-2	Find the type packing of atoms and ions	***K1***
CO-3	Define the diffraction method	***K1***
CO-4	Construct the structure the boron's	***K3***

CO-5	Distinguish between inorganic and organic polymers	***K4***

Relationship Matrix for course Outcome, Programme Outcomes and Programme Secific Outcomes

TITLE OF THE COURSE: STRUCTURE AND BONDING						**COURSE CODE: P3R2CHCC11**				
COURSE OUTCOMES (COS)	**PROGRAMME OUTCOMES(POS)**					**PROGRAMME SPECIFIC OUTCOMES (PSOS)**				**MEAN SCORE OF COS**
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PSO1**	**PSO2**	**PSO3**	**PSO4**	**PSO 5**	
CO1	3	2	3	2	2	3	2	3	2	2	2.4
CO2	3	2	2	2	3	2	2	2	3	2	2.3
CO3	2	2	3	1	3	2	3	2	3	3	2.4
CO4	3	3	1	3	2	3	2	2	2	2	2.3
CO5	3	3	2	2	2	2	2	2	2	2	2.2
	MEAN OVERALL SCORE										**2.32**
	RESULT										**HIGH**

TITLE OF THE COURSE	**INORGANIC PHOTO CHEMISTRY , SPECTROSCOPY AND ORGANO METALLICS**	**MARKS: CIA:25 + EXT:75=100**
CATEGORY OF THE COURSE	**CORE COURSE**	**HRS/WEEK : 05**
COURSE CODE	**P3R2CHCC12**	**TOTAL INST. HRS : 90**
NATURE OF THE COURSE	**EMPLOYABILITY**	**SEM : III / CRIDIT : 5**

Objectives: To make the students.

- *Learn the photo electron spectroscopy of inorganic compounds.*
- *Study the theory, determination of structure, growth of crystals.*
- *Study the applications of IR, Raman and NMR spectroscopy in inorganic compounds*
- *Learn the detail study of synthetic organometallic complexes and their reactivity.*
- *Know about ESR and Mössbauer spectroscopy*

UNIT-I: INORGANIC PHOTO CHEMISTRY AND PHOTO ELECTRON SPECTROSCOPY (16 Hours)

Unimolecular charge-transfer photochemistry of cobalt(III) complexes – mechanism of CTTM, photoreduction – ligand-field photochemistry of chromium(III) complexes – Adamson's rules, photoactive excited states, V-C model – photophysics and photochemistry of ruthenium – polypyridine complexes, emission and redox properties. Photoelectron Spectroscopy PES - Theory, Types, origin of fine structures - shapes of vibrational fine structures – adiabatic and vertical transitions, PES of homonuclear diatomic molecules (N_2, O_2) and heteronuclear diatomic molecules (CO, HCl) and polyatomic molecules (H_2O, CO_2, CH_4, NH_3) – evaluation of vibrational constants of the above molecules, Koopman's theorem- applications and limitations.

UNIT-II: NUCLEAR AND RADIATION CHEMSITRY (16 Hours)

Properties of nucleus – different types of nuclear forces , Nuclear structure and nuclear stability, Nuclear models- – liquid drop model, shell model of nucleus, Radioactivity and nuclear reactions, nuclear reactions induced by charged particles – Q value – nuclear reaction cross section, significance and determination – theory of nuclear fission, nuclear fusion, stellar energy. Hot atom chemistry, Nuclear fission and fusion reactors. The interaction of nuclear radiations with matter. Radiation hazards and therapeutics. Detectors and their principles. Tracer Application of radioisotopes in agriculture, industry and medicine. Isotope dilution and radio-activation methods of analysis.

UNIT-III: APPLICATIONS OF IR, RAMAN AND NMR SPECTROSCOPY TO INORGANIC COMPOUNDS (15 Hours)

IR spectroscopy- Introduction, selection rules, stretching frequency of some inorganic ions- effect of coordination on the stretching frequency- sulphato, carbonato, sulphito, aqua, nitro, thiocyanato, cyano, thiourea, DMSO complexes.- **Raman spectroscopy** – Introduction, combined applications of IR and Raman spectroscopy in the structural elucidation of N_2O, ClF_3, NO_3 ,ClO_4, metal carbonyls.**NMR spectroscopy**- Introduction, structural assessment of simple inorganic compounds, applications of ^{1}H, ^{15}N,^{19}F, ^{31}P-NMR spectroscopy in structural problems, fluxional molecules, quadrupolar nuclei- effect in NMR spectroscopy, shift reagents- application.

UNIT-IV: ESR AND MÖSSBAUER SPECTROSCOPY (17 Hours)

ESR spectroscopy-Introduction, presentation of esr spectra g and A parameters, spin densities, Mc-Connel relationship, factors affecting the magnitude of g and A. Zero field splitting, Kramer's degeneracy, esr spectra of V(II), Mn(II) Fe (II), Co (II), Ni(II), Cu (II) complexes, bis(salicylaldimine)copper (II) , $[(NH_3)_5Co\text{-}O_2\text{-}Co(NH_3)_5]^{5+}$.**Mössbauer spectroscopy –** Introduction, principle, instrumentation, recoil energy, Dopple effect, number of MB signals, isomer shift, quadrupole splitting, magnetic hyperfine splitting- applications to ^{57}Fe, ^{119}Sn and ^{129}I compounds.

UNIT-V: ORGANOMETALLIC CHEMISTRY (16 Hours)

Types of organometallic compounds on the basis of the nature of M-C bond. EAN rule 18e- and 16e- rules – determinator of oxidation state, configuration, coordinanumber of the metal centre – Types and application $18e^-$ / $16e^-$ rules. Carbonyls – isolated concept.- Structure of carbonlys (simple and polynuclear) Nitrosyls – bridging and terminal nitrosyls, bent and linear nitorsyls. Dinitrogen compounds donors – Alkyl and Aryl – preparation and properties; chain carbon donors – olefins, acetylene and allyl complexes – synthesis, structure and bonding; cyclic carbon donors – (metallocene) – synthesis, structure and bonding.Important types of reactions of organometallic compounds – substitution – electrophilic and nucleophilic attack on ligands; carbonylation and decarbonylation; oxidative addition and reductive elimination, insertion and deinsertion(elimination).

Reference and text books

1. H. Kaur – "Spectroscopy", 3rd Ed., Pragati Prakasan Publications, Meerut, **2006**.
2. R. S. Drago, Physical methods in inorganic chemistry; Affiliated East-West Press Pvt. Ltd., New Delhi, **2012**.
3. R.S.Drago, Physical methods in chemistry; Saunders college publications, Philadelphia,**1992**.
4. P. J. Wheatley, The determination of molecular structure, 2nd edition, Dover Publications,
5. Mineola, **1981**.
6. C. N. Banwell, Fundamentlas of molecular spectroscopy 4th edition, McGraw Hill Education, Noida, **1994**.
7. E. A. V. Ebsworth, Structural Methods in Inorganic Chemistry, 3rd Ed ELBS, Great
8. Britain,**1987**.
9. H. J. Arniker, Essentials of Nuclear Chemistry, 2nd Ed, Wiley Eastern Co, **1987**.
10. G. Friedlander, J. W. Kennedy and J. M. Miller, Nuclear and Radiochemistry, Wiley, **1968.**

Expected outcomes

CO.No	CO-statements	(k - level)
On successful completion of the course ,students will be able to		
CO-1	*Apply photo electron spectroscopy to inorganic compounds*	***K3***
CO-2	*Describe the nuclear structure*	***K2***
CO-3	*Interpret the IR, Raman and NMR spectroscopic data of simple inorganic compounds.*	***K2***
CO-4	*Analyses ESR and Mössbauer spectroscopy to characterise inorganic and organometallic compounds*	***K4***
CO-5	*Define organometallic complexes which are very useful in the modern era.*	***K1***

Relationship Matrix for course Outcome, Programme Outcomes and Programme Secific Outcomes

TITLE OF THE COURSE: INORGANC PHOTOCHEMISTRY AND ORGANOMETALLICS						**COURSE CODE: P3R2CHCC12**					
COURSE OUTCOMES (COS)	**PROGRAMME OUTCOMES(POS)**					**PROGRAMME SPECIFIC OUTCOMES (PSOS)**					**MEAN SCORE OF COS**
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PSO1**	**PSO2**	**PSO3**	**PSO4**	**PSO5**	
CO1	3	1	3	2	1	3	2	2	2	2	2.1
CO2	3	2	2	3	3	2	2	2	3	2	2.4
CO3	2	2	2	1	3	2	2	2	3	3	2.2

CO4	3	3	1	3	3	3	2	2	2	3	2.5
CO5	3	3	2	3	3	2	3	2	3	2	2.6
	MEAN OVERALL SCORE										**2.36**
	RESULT										**HIGH**

TITLE OF THE CO URSE	**PHYSICAL CHEMISTRY PRACTICAL-I**	**MARKS:CIA:40 + EXT:60**
CATEGORY OF THE COURSE	**CORE COURSE**	**HRS/WEEK :6**
COURSE CODE	**P3R2CHCC13P**	**TOTAL INST. HRS :80**
NATURE OF THE COURSE	**SKILL DEVELOPMENT**	**SEM : III / CRIDIT : 5**

Objective

- *To learn some non-electrical physical chemistry experiments*
- *To study the kinetics of some reactions and phase diagram of some binary system*
- *To learn the determination methods of physical constants of substances*
- *To study the kinetics of some reactions and phase diagram of some three component system*
- *To study the CST of Phenol- Water system*

Any ten experiments out of the following experiments.

1. Kinetics- Acid hydrolysis of Ester- Comparison of strengths of acids.
2. Kinetics- acid hydrolysis of Ester- Determination of energy of activation (Ea).
3. Kinetics- Saponification of Ester- Determination of Ea by conductometry.
4. Kinetics- Persulphate- Iodine reaction- Determination of order, effective of ionic strength on rateconstant.
5. Determination of molecular weight of substance by Transition Temperature method.
6. Determination of molecular weight of substances by Rast method.
7. Determination of Critical Solution Temperature (CST) of phenol- water system and effect ofimpurity on CST.
8. Study of phase diagram of two components forming a simple eutectic.
9. Study of phase diagram of two compounds forming a compound.
10. Study of phase diagram of three components system.
11. Determination of molecular weight of substances by cryoscopy.
12. Determination of integral and differential heat of solutions by colorimetry.
13. Polymerization- Rate of polymerization of acrylamide.
14. Distribution law- Study of Iodine- Iodine equilibrium.
15. Distribution law- Study of association of benzoic acid in benzene.
16. Adsorption- Oxalic acid/Acetic acid on charcoal using freundlich isotherm.

Reference books

1. J.B.Yadav, " Advanced Practical Physical chemistry", 20th Ed., GOEL publishing House, KrishnaPakashan Media Ltd., (2001).

2. Findlay's "Practical Physical Chemistry" Revised and edited by B.P. Levitt 9th ed., Longman,London, 1985.
3. J.N. Gurtur and R.Kapoor, "Advanced Experimental chemistry", Vol.I. Chand & Co., Ltd, New Delhi.

Course Outcomes:

CO.No	*CO-statements*	**(k - level)**
On successful completion of the course ,students will be able to		
CO-1	***Determine the phase rule to predict the eutectic composition temperature***	***K5***
CO-2	***Identity the dependency of temperature, pressure and phase transitions***	***K3***
CO-3	***Distinguish the liphophilic, liphophophlic character of compound***	***K4***
CO-4	***. Determine the molecular weight of unknown molecular rectification***	***K5***
CO-5	***Determine the parameters which are helpful to predict the reaction pathway***	***K5***

Relationship Matrix for course Outcome, Programme Outcomes and Programme Secific Outcomes

TITLE OF THE COURSE: PHYSICAL CHEMISTRY PRACTICAL-I						**COURSE CODE: P3R2CHCC13P**					
COURSE OUTCOMES (COS)	**PROGRAMME OUTCOMES(POS)**					**PROGRAMME SPECIFIC OUTCOMES (PSOS)**					**MEAN SCORE OF COS**
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PSO1**	**PSO2**	**PSO3**	**PSO4**	**PSO5**	
CO1	3	2	3	2	3	2	3	2	3	3	**2.6**
CO2	2	3	2	2	3	2	3	2	3	1	**2.3**
CO3	1	2	2	2	3	3	2	2	2	3	**2.2**
CO4	2	3	1	3	3	2	2	3	2	3	**2.4**
CO5	2	2	3	3	2	2	3	2	2	2	**2.3**
	MEAN OVERALL SCORE										**2.36**
	RESULT										**HIGH**

TITLE OF THE COURSE	**PHYSICAL CHEMISTRY PRACTICAL-I**	**MARKS:CIA:40 + EXT:60**
CATEGORY OF THE COURSE	**CORE COURSE**	**HRS/WEEK :5**
COURSE CODE	**P3R2CHCC13P**	**TOTAL INST. HRS :80**
NATURE OF THE COURSE	**SKILL DEVELOPMENT**	**SEM: III / CRIDIT : 5**

Objective

- *To learn some non-electrical physical chemistry experiments*
- *To study the kinetics of some reactions and phase diagram of some binary system*
- *To learn the determination methods of physical constants of substances*
- *To study the kinetics of some reactions and phase diagram of some three component system*

- *To study the CST of Phenol- Water system.*

Any ten experiments out of the following experiments.

a. Conductometry- Acid- alkali titrations.
b. Cuctometry- Precipitation titrations.
c. Conductometry- Displacement titrations.
d. Conductometry- Determination of dissociation constant of weak acids.
e. Conductometry- solubility product of sparingly soluble silver salts.
f. Verification of Onsager equation- conductivity method.
g. Determination of degree of hydrolysis and hydrolysis constant of a substance.
h. Potentiometric titrations- Acid alkali titrations.
i. Potentiometric titrations- Precipitation titrations.
j. Potentiometric titrations- Redox titrations.
k. Potentiometry- Determination of dissociation constant of weak acids.
l. Potentiometry- Determination of solubility of silver salts.
m. Potentiometry- Determination of activity and activity coefficient of ions.
n. *pH* titration of *ortho*-phosphoric acid.
o. To determine the relative strength of two acids by conductance measurements.
p. To determine the pH of a buffer solution using a quinhydrone electrode.

Course Outcomes: At the end of the course, the learners will be able to

- Discuss the concept of eletrochemistry
- Apply the concepts of electrochemistry to make new discoveries
- Measure various electrochemical parameters
- Plan and perform experimental procedures

Scheme of Valuation:

Record and Viva	- 10 Marks
Procedure and Formula	- 10 Marks
Practical	- 40 Marks
<1%	- 40 Marks
1-2%	- 30 Marks
2-3%	- 20 Marks
> 3%	- 10 Marks

Reference books

1. J.B.Yadav, "Advanced Practical Physical chemistry", 20th Ed., GOEL publishing House, KrishnaPakashan Media Ltd., (2001).
2. Findlay's "Practical Physical Chemistry" Revised and edited by B.P. Levitt 9th ed., Longman,London, 1985.
3. J.N. Gurtur and R.Kapoor, "Advanced Experimental chemistry", Vol.I. Chand & Co., Ltd, New Delhi.

Course Outcomes:

CO.No	*CO-statements*	**(k - level)**
On successful completion of the course ,students will be able to		
CO-1	***Determine the phase rule to predict the eutectic composition temperature***	***K5***
CO-2	***Identity the dependency of temperature, pressure and phase transitions***	***K3***
CO-3	***Distinguish the liphophilic, liphophophlic character of compound***	***K4***
CO-4	***. Determine the molecular weight of unknown molecular rectification***	***K5***
CO-5	***Determine the parameters which are helpful to predict the reaction pathway***	***K5***

Relationship Matrix for course Outcome, Programme Outcomes and Programme Secific Outcomes

TITLE OF THE COURSE: PHYSICAL CHEMISTRY PRACTICAL-I						**COURSE CODE: P3R2CHCC13P**					
COURSE OUTCOMES (COS)	**PROGRAMME OUTCOMES(POS)**					**PROGRAMME SPECIFIC OUTCOMES (PSOS)**					**MEAN SCORE OF COS**
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PSO1**	**PSO2**	**PSO3**	**PSO4**	**PSO5**	
CO1	3	2	3	2	3	2	3	2	3	3	**2.6**
CO2	2	3	2	2	3	2	3	2	3	1	**2.3**
CO3	1	2	2	2	3	3	2	2	2	3	**2.2**
CO4	2	3	1	3	3	2	2	3	2	3	**2.4**
CO5	2	2	3	3	2	2	3	2	2	2	**2.3**
	MEAN OVERALL SCORE										**2.36**
	RESULT										**HIGH**

Title of the course:	**NATURAL PRODUCT**	**Marks:CIA:25 +Ext:75=100**
Category of the course:	**Skill Enhancement**	**Hrs/week:5**
Course Code:	**P3R2CHSEC 1:1**	**Total Inst. Hrs:80**
Nature of the course	**Skill Development**	SEM : III / CRDIT :3

Objectives

- *To understand the some important natural pigments*
- *To know the concept of alkaloids and terpenoids*
- *To understand the biosynthesis of steroid*
- *To elucidate the structure of some natural product*
- To understand the nucleic acids and protein synthesis

UNIT-1: Natural pigments **(16 Hrs)**

Carotenoids and Anthocyanins -Introduction-Classification-Isolation and Seperation of carotenoids-Characteristics-function-elucidation of constitution-synthesis.

.Flavones and Xanthones- Introduction-properties –Isolation-Separation and purification Elucidation of structure-synthesis.

UNIT-II: Alkaloids (**16 Hrs)**

Definition-Occurrence, extraction of alkaloids from plants, general properties, determination of the chemical constitution of the alkaloids, functional group analysis, estimation of groups, degradation and synthesis. Coniine, Piperine, nicotine and ephedrine.

UNIT-III: Terpenoids (15 Hrs)

Introduction-Nomenclature-properties-Isolation-Isoprene rule-Gem-dialkyl rule-Determination of structures of terpenoids. Myrcene-Introduction-Elucidation of constitution-Synthesis. .Citral Introduction-Isolation-Elucidation of constitution-Synthesis. Menthone-Introduction-Elucidation of constitution-Synthesis. Irones- Introduction-Elucidation of constitution-Synthesis. Carone Introduction-Elucidation of constitution-Synthesis.

UNIT-IV: Nucleic Acids and Protein Synthesis (**15 Hrs)**

Nucleic Acids: Nucleotides and nucleosides, DNA: primary and secondary structure replication of DNA.

RNA and Protein Synthesis: Messenger RNA synthesis-transcription, Ribosomes- rRNA, Transfer RNA. Determination of base sequence of DNA. Polymerase Chain Reaction (PCR).-targeted drugs-intercalaters, sequence specific drugs. A brief account of ribozyme and iRNA(interference).

UNIT-V: Steroids (18 Hrs)

Cholesterol-Introduction-Elucidation of constitution. **Stigmastero**l-Introduction-Elucidation of constitution.

Introduction-Elucidation of constitution. Sexharmones-Introduction**Oestrogen-** Oestrone-Introduction-Elucidation of constitution. IntroductionElucidation of constitution.**Androsterone-**Introduction-Elucidation of constitution.

Reference Book

1. I. L. Finar, Organic Chemistry, VolI & II, 6th Ed., England, Wesley Longman Ltd. (1996).
2. GurdeepChatwal and Anand, Chemistry of Natural Products, Himalayan Publishing Co, 2001
3. O. P. Agarwal, Chemistry of Natural Products, Vol-1, 2 ,Goel Publishing House, 1997.

Expected outcomes

CO.No	CO-statements	(k - level)
On successful completion of the course ,students will be able to		

CO-1	. Construct the basic concepts of natural products	***K3***
CO-2	. Demonstrate the alkaloids, terpenoids and their medicinal values	***K2***
CO-3	Discuss the synthesis of harmones	***K4***
CO-4	Explain the protein synthesis	***K2***
CO-5	Elaborate the Natural pigments	***K5***

Relationship Matrix for course Outcome, Programme Outcomes and Programme Secific Outcomes

TITLE OF THE COURSE: NATURAL PRODUCT						**COURSE CODE:** P3R2CHSEC1:1					
COURSE OUTCOMES (COS)	**PROGRAMME OUTCOMES(POS)**					**PROGRAMME SPECIFIC OUTCOMES (PSOS)**					**MEAN SCORE OF COS**
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PSO1**	**PSO2**	**PSO3**	**PSO4**	**PSO5**	
CO1	3	2	2	2	3	2	2	2	1	3	**2.2**
CO2	3	2	1	2	3	2	3	2	3	1	**2.2**
CO3	2	2	2	2	3	3	2	2	2	3	**2.3**
CO4	3	3	2	3	3	2	2	3	2	3	**2.6**
C	2	2	2	3	2	2	2	3	3	2	**2.3**
	MEAN OVERALL SCORE										**2.32**
	RESULT										**HIGH**

TITLE OF THE COURSE	**QUALITY CONTROL AND ENVIRONMENTAL CHEMISTRY**	**MARKS: CIA: 25 + EXT: 75=100**
CATEGORY OF THE COURSE:	**CORE COURSE**	**HRS/WEEK : 5**
COUSE CODE	**P3RCHSEC 1;2**	**TOTAL INST. HRS : 90**
NATURE OF THE COURSE:	**CORE COURSE**	**SEM: III / CREDIT : 5**

Objectives: To make learners understand

- Food adulteration and its impact on human health
- Pollution and recycling techniques
- The application of chemistry in quality control measures
- About the energy sources

UNIT – I: Quality Control Measurements **(12 Hrs)**

1.1. Moisture, ash, crude protein, fat, crude fibre, carbohydrates, calcium, potassium, sodium and phosphate.

1.2. Food adulteration – common adulterants in food, contamination of food stuffs–Microscopic examination of foods for adulterants – Pesticides analysis in food products – analysis of toxic metals in food (Mercury, cadmium, cobalt, tin and chromium).

1.3. Determination of iodine, Saponifiction and acid value of an oil – Food standards – ISI and Agmark.

UNIT – II: Energy Sources – Non Conventional **(12 Hrs)**

2.1. Solar energy – Technologies based on capture of heat from sun light – solar water heating systems – solar air conditioning. Technologies for converting solar energy to electricity – heat engines, photo voltaic – principle and operation.

1.2. Wind energy – wind mills – wind farm sitting and properties – storage. Tidal energy – advantages and limitations of tidal power generation. Environmental impact of renewable energy sources.
1.3. Bio mass energy sources – advantages –Fuel cell – hydrogen-oxygen fuel cell, Hydrocarbon-oxygen fuel cell

UNIT –III: Water Pollution and its Control Analysis of Water Pollution (11 Hrs)
3.1. Sources of water pollution – domestic – industrial – agricultural – soil and radioactive wastes as sources of pollution.Water pollutants and their effects.
3.2.Objectives of analysis – parameter for analysis-colour – turbidity – total solids – conductivity – acidity – alkalinity – hardness – chloride -sulphate – fluoride – silica – phosphates, different forms of nitrogen, DO, BOD, COD.
3.3. Heavy metal pollution-public health significance of cadmium – chromium – copper – lead – zinc– manganese –mercury and arsenic- Prevention and control its measures.

UNIT –IV: Radioactive and Thermal Pollution (11 Hrs)
4.1. Radioactivity and kinds of radiation – Sources of radioactive pollution – Radio waste generated by nuclear power plants – Harmful effects of radiation – Dangerous from nuclear power plants –Disposal methods of radioactive wastes.
4.2. Source of thermal pollution – Thermal power plant pollution – Hazardous effect – Prevention and control of thermal pollution.
UNIT – V: Wealth from Waste (Recycling) (11 Hrs)
5.1. Introduction – Recycling Technique – Construction materials from waste – Medicines from agricultural waste – Liquid fuels from agricultural – Urban waste and bagasses for electricity.
5.2. Agriculture waste for biomass into cheap and efficient fuel – Bacteria for paper making – Waste into objects of daily use – Garbage into fuel – How to use garbage to generate power.

Unit -VI: Latest Learning's (For CIA only) (03 Hrs)

Latest development related to the course during the semester concerned

Course Outcome: At the end of the course, the students will be able to

- Identify the adulterants in food.
- Understand energy sources using various methods
- Understand about radioactive and thermal pollution and their control methods
- Understand about recycling process

TEXT BOOKS:1. B.K. Sharma and H. Kaur, "Environmental chemistry" ,Goel Publishing House, Meerut, 2008.

2. B.K. Sharma - "Instrumental Methods of Chemical Analysis",Goel Publishing House, Meerut. 2001.

3. B.K. Sharma – "Industrial Chemistry", Goel Publishing House, Meerut, 2015.

UNIT I: Text Book 1,2
UNIT II: Text Book 1,3
UNIT III: Text Book 1,2,3
UNIT IV: Text Book 3
UNIT V: Text Book 2,3

REFERENCES:

1. S.A. Abbasi and Naseema Abbasi – "Renewable energy sources and their environmental impact", Prentice-Hall, New Delhi,2002.

2. H. Kaur, Pragati Prakashan, Meerut – "Instrumental Methods of Chemical Analysis", 2001.

Expected outcomes

CO.No	CO-statements	(k - level)
On successful completion of the course ,students will be able to		
CO-1	Determine the Quality Control Measurements	*K5*
CO-2	List out the : Energy Sources – Non Conventional	*K2*
CO-3	Define the Water Pollution and its Control Analysis of Water Pollution	*K5*
CO-4	Illustrate the basic concept of Radioactivity and kinds of radiation	*K2*
CO-5	Explain the Wealth from Waste (Recycling)	*K4*

Relationship Matrix for course Outcome, Programme Outcomes and Programme Secific Outcomes

QUALITY CONTROL AND ENVIRONMENTAL CHEMISTRY						Course Code: P3RCHSEC 1;2					
Course Outcomes (Cos)	Programme Outcomes(POs)					Programme Specific Outcomes (PSOs)					Mean Score of Cos
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5	
CO1	3	2	2	1	3	2	3	2	2	3	2.3
CO2	2	2	2	2	3	2	3	2	3	1	2.2
CO3	3	2	2	2	3	3	2	2	3	2	2.4
CO4	3	2	2	3	3	2	2	3	2	2	2.3
CO5	3	2	3	3	2	2	3	2	3	3	2.6
	Mean Overall Score										2.36
	Result										High

TITLE OF THE COURSE	INSTRUMENTAL METHODS OF ANALYSIS	MARKS:CIA:25 + EXT:75=100
CATEGORY OF THE COURSE	SKILL ENHANCEMENT	HRS/WEEK : 6
COURSE CODE	P4R2CHGEC1	TOTAL INST. HRS : 80
NATURE OF THE COURSE	SKILL DEVELOPMENT	SEME : IV / CRIDIT : 3

Objectives

- To understand the Instrumental methods of various spectroscopy
- To acquire skill of calculation of analytical data
- To understand the electroanalytical techniques and thermo analytical methods in analytical techniques

UNIT-I: Instrumental methods of Analysis (15 Hrs)

Principles and Applications of Extended X-ray absorption fine structure (EXAFS)– Surface extended X-ray absorption (SEXAFS).. Atomic Absorption Spectroscopy (AAS)-Flame Emission Spectroscopy (FES). Electroanalytical techniques-Polarography-principles & instrumentation-Principles of Cyclic voltammetry-instrumentation of cyclic voltammetry-applications.

UNIT-II: Data and Error Analysis (15 Hrs)

Various types of Error–Accuracy, precision, significant figures–Frequency distributions, the binomial distribution, the Poisson distribution and normal distribution–Describing data, population and sample, mean, variance, standard deviation, way of quoting uncertainty, robust estimators, repeatability and reproducibility of measurements–Hypothesis testing, levels of confidence and significance, test for an outlier, testing variances, means t-Test, Paired t-Test..Analysis of variance (ANOVA) – Correlation and Regression – Curve fitting , Fitting of linear equations, simple linear cases, weighted linear case, analysis of residuals – General polynomial equation fitting , linearizing transformations, exponential function fit–r and its abuse – multiple linear regression analysis, elementary aspects.

UNIT-III: Chromatography (15 Hrs)

Solvent extraction – principles of ion exchange, paper, thin layer and column Chromatography techniques– Columns, adsorbents, methods, Rf values, McReynold's constants and their uses. HPTLC, HPLC techniques – Adsorbents, columns, detection methods, estimations, preparative column – GC-MS techni**ques: methods, principles and uses.**

UNIT-IV: Thermo Analytical Methods (15 Hrs)

Principles-factors affecting thermogram, instrumentation and thermal decomposition of CaC2O4.H2O and CuSO4.5H2O. Differential technique:Instrumentation,experimental,instrumental factors of DTA and DSC. Thermal studies of CuSO4.5H2O by DTA and determination of purity of pharmaceuticals and phase transition studies by DSC – evaluation and thermodynamic parameters.. Electrogavimetry:Principle,instrumentation, deposition and separation.Electrolysis at constant. Thermometric titrations.

UNIT-V: Electroanalytical Techniques and Fluorescence Spectroscopy (15 Hrs)

.Electrochemical sensors- ion sensitive electrodes, glass – membrane electrodes, solid liquid membrane electrodes – ion-selective field effect transistors (ISFETs) – Sensors for the analysis of gases . Amperometric gas sensors – Amperometric titrations: Principles- Apparatus –techniques – applications. Basic aspects of synchronous fluorescence spectroscopy – Spectral hole burning – flow cytometry–Instrumentation on fluorescence ratio.

References Books

1. Analysis for chemistry, Oxford University Press, 2006.
2. J. Topping, Errors of Observation and their treatment, 4th Ed., Chapman Hall, London, 1984.
3. .R. Stock and C. B. F. Rice, Chromatographic Methods, Chapman and Hall, New York.
4. V.K. Srivastava and K.K. Srivastava, Introduction to Chromatography, S. Chand & Co., New Delhi, 2nd Ed,1981.
5. Willard, Merrit, Dean and Settle, Instrumental methods of Analysis CBS Publishers and Distributors, 6th Ed., 1986.
6. D. A. Skoog, D.M.West, F.J. Holler, F. J., Fundamentals of Analytical Chemistry, 7th Ed., Harcourt College Publishers, Singapore.

7. .A.Sharma, S.G. Schulman, Introduction to Fluoresceence Spectroscopy, WileyInterscience.New York,1999.
8. C.N.Banwell and E.M.McCash, Fundamentals of Molecular spectroscopy, 4th Ed., TataMcGraw-Hill, New Delhi, 1994.
9. Vogel, A. I., Text book of Quantitative Inorganic Analysis, ELBS.
10. .Daniel C Harris, Quantitative Chemical Analysis, 4th Ed., W. H. Freeman and Company, New York, 1995.
11. S.C.Gupta, Fundamentals of Statistics,6th Ed., Himalaya Publ. House, Delhi, 2006.

Course Outcomes: At the end of the course, the learners will be able to

Course Outcomes:

CO.No	***CO-statements***	**(k - level)**
On successful completion of the course ,students will be able to		
CO-1	Understand the accuracy, precision and errors	***K5***
CO-2	Know the solvent extraction and recrystallization techniques	***K3***
CO-3	Understand the principle, instrumentation, working and uses of various chromatography technique	***K4***
CO-4	. Understand the principle, instrumentation, working of thermal analytical methods.	***K5***
CO-5	Know the basic concepts of electro analytical technique	***K5***

Relationship Matrix for course Outcome, Programme Outcomes and Programme Secific Outcomes

TITLE OF THE COURSE: INSTRUMENTAL METHODS OF ANALYSIS						**COURSE CODE: P4R2CHSE4:1**					
COURSE OUTCOMES (COS)	**PROGRAMME OUTCOMES(POS)**					**PROGRAMME SPECIFIC OUTCOMES (PSOS)**					**MEAN SCORE OF COS**
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PSO1**	**PSO2**	**PSO3**	**PSO4**	**PSO5**	
CO1	3	2	3	2	3	2	3	2	3	3	**2.6**
CO2	2	3	2	2	3	2	3	2	3	1	**2.3**
CO3	1	2	2	2	3	3	2	2	2	3	**2.2**
CO4	2	3	1	3	3	2	2	3	2	3	**2.4**
CO5	2	2	3	3	2	2	3	2	2	2	**2.3**
	MEAN OVERALL SCORE										**2.36**
	RESULT										**HIGH**

TITLE OF THE COURSE	SEM-IV: PROJECT WORK	MARKS: CIA: 40 + EXT: 60=100
CATEGORY OF THE COURSE:	CORE COURSE	HRS/WEEK : 24
COUSE CODE	P4R1CHCC15PW	TOTAL INST. HRS : 90
NATURE OF THE COURSE:	CORE COURSE	SEM: IV / CREDIT : 3

Objectives:

- *To give students an exposure to research methods in chemistry*
- *to make them choose a topic on which chemical research is possible*
- *to make them plan and execute the necessary experiments using the right procedures*
- *to sharper the observation and interpretation skills of the students*
- *to initiate students in proper procedures of documentation*

Course outcomes: On completion of the work students will have

Expected outcomes

CO.No	CO-statements	(k - level)
On successful completion of the course ,students will be able to		
CO-1	Analytical skills doing research task in the field of chemistry	***K3***
CO-2	Employability skills which will enable them to find jobs in chemistry field	***K5***
CO-3	Apply various analytical techniques like IR,Mass,NMR and XRD to structural characterization of unknown compounds	***K3***
CO-4	Critical thinking ,analytical mind in chemistry	***K2***
CO-5	Become employable as research associate in reputed laboratories	***K1***

Relationship Matrix for course Outcome, Programme Outcomes and Programme Secific Outcomes

TITLE OF THE COURSE: PROJECT WORK						COURSE CODE: P4R1CHCC15PW					
COURSE OUTCOMES (COS)	PROGRAMME OUTCOMES(POS)					PROGRAMME SPECIFIC OUTCOMES (PSOS)					MEAN SCORE OF COS
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5	
CO1	2	2	2	2	3	2	3	2	2	2	2.2
CO2	3	2	2	2	3	2	3	2	3	1	2.3
CO3	2	2	2	2	3	3	2	2	2	3	2.3

CO4	2	2	2	3	3	2	2	3	2	2	**2.4**
C	2	2	3	3	2	2	2	2	3	3	**2.3**
	MEAN OVERALL SCORE										**2.30**
	RESULT										**HIGH**

J.J COLLEGE OF ARTS AND SCIENCE (Autonomous)

SIVAPURAM, PUDUKKOTTAI-622422

DEPARTMENT OF CHEMISTRY

PG - PROGRAMME - M.Sc CHEMISTRY

(2022-2023)

PROGRAMME OUTCOMES FOR M.Sc

Post Graduates will be able to

- Gain complete knowledge about fundamental aspects of all branches of Chemistry
- Learn about the potential uses of analytical chemistry, industrial chemistry, Quality control and environmental chemistry.
- Apply the various analytical techniques like IR, Mass, NMR and XRD to structural characterization of unknown compounds
- Obtain knowledge in spectral, Analytical, Qualitative and Quantitative techniques and contribute new scientific insights or innovative applications of chemical research to the next generation.