St. Xavier's College (Autonomous), Ahmedabad

Syllabus of Semester – V of the following departments under Faculty of Science based on Under Graduate Curriculum Framework - 2023 to be implemented from the Academic Year 2025-26.

FACULTY OF SCIENCE

DEPARTMENT OF CHEMISTRY

BSc. (Hons.) Chemistry
Category – V

Major Course- Organic Chemistry-II (Theory)

CREDIT DISTRIBUTION, ELIGIBILITY AND PRE-REQUISITES OF THE COURSE

Course Title & Code	Credit Distribution of The Course			Eligibility Criteria	Perquisite(s) of the Course (if any)
	Lecture	Tutorial	Practical / Practice		
Organic Chemistry CHMC551C	4	0	0	10 + 2 from a recognized board in any stream	Basic foundation for studying Organic Chemistry

LEARNING OBJECTIVES (LO)	
LO-1	Explain the fundamental principles of stereochemistry to determine the configuration of molecules without achiral carbon and to determine the stereochemical outcome of chemical reactions
LO-2	Describe and impart knowledge of Inorganic reagents for organic synthesis and also understand selected Molecular rearrangements and Name Reactions.
LO-3	Explain the knowledge of the mechanistic of Elimination Reactions and nucleophilic substitution reactions on aliphatic and aromatic molecules
LO-4	Explain and impart chemistry of selected Carbohydtaes and Heterocyclic compounds.

COURSE OUTCOMES (CO)	
On Completion of this course, the student will be able to	
CO-1	Students will gain the knowledge of stereochemistry to determine the configuration of molecules without a
CO-2	Students will be gain the knowledge of Inorganic reagents for organic synthesis and also understand selected Molecular rearrangements and Name Reactions
CO-3	Students will be able to apply their knowledge of the mechanistic of Elimination Reactions and nucleophilic substitution reactions on aliphatic and aromatic molecules
CO-4	Students will gain the knowledge and chemistry of Carbohydras like Starch Cellulose etc and heterocyclic compounds.

Unit-1 STEREO CHEMISTRY (15L)

A Stereo Chemistry-I Optical activity in the absence of chiral carbon (Biphenyls, Allenes and Spirans)

B Stereo Chemistry -II: Stereoselective and stereospecific reactions.
Concept of prostereo isomerism and chiral synthesis (Asymmetric Induction), Cram's rule, Prelog's generalization, Prelog's rule and assignment of configuration.

Unit-2 INORGANIC REAGENTS, ORGANIC REARRANGEMENTS AND NAME REACTIONS (15L)

A Inorganic reagents for organic synthesis: Use of specific reagents and their synthetic applications with mechanism.
(i) Aluminium Isopropoxide (ii) Lithium Aluminium Hydride (iii) Adams's catalyst (PtO_2) (iv) Selenium Dioxide (v) Osmium Tetroxide (vi) Lead Tetraacetate

B Molecular rearrangements and Name Reactions: Rearrangements occurring through carbocations, carbenes and nitrenes Principle, Mechanism and Synthetic applications of the reactions:
(i)Wolf rearrangement (ii) Fries migration (iii) Hoffmann reaction
(iv) Oppenauer oxidation reaction (v) Diels-Alder reaction (vi) Birch Reduction

Unit-3 NUCLEOPHILIC SUBSTITUTION REACTIONS (15L)

A Nucleophilic Substitution at a Saturated Carbon Atom: Mechanism and scope of reaction-available mechanism, Kinetic Characteristics, Scope of reaction, Stereochemistry of SN1 and SN2 reactions, Relative reactivity in substitution, Solvent effect, variation at carbon site, Relative leaving group activity, SNi (substitution nucleophilic internal) Mechanism and Neighboring group participation. Elimination Reactions, E1, E2 and E1cB mechanism, Orientation E1and E2 reactions and stereochemistry, Elimination Vs Substitution.

B Nucleophilic Aromatic Substitution: Nucleophilic aromatic substitution, Bimolecular displacement and its mechanism, Reactivity, Orientation, Electron withdrawal by resonance, Evidence for the two steps-mechanism, Elimination-addition

mechanism-Benzyne.(7Marks)

Unit- 4 CARBOHYDRATE AND HETEROCYCLIC CHEMISTRY (15L)

A Carbohydares (i) Chemistry of Polysaccharides : Starch, Cellulose ,
(ii) Classifications of Glycosides, Amygdalin, Indican, Salicin,
(iii) Dedoxy sugars,Glycals, Glycosamine, Glycosyl amine, Glycans and Anhydrosugars

B Heterocyclic compounds: Chemistry of (synthesis and or reactions etc of
(i) Five heterocycles membered with Two hetero atoms Pyrazole, Oxazole, Thiazole Imidazole etc
(ii) Six heterocycles members with Two hetero atoms Pyrimidines(Synthesis of Pyrimidine, Uracil, Thymine and Cytosine)
(iii) Fuses heterocycles and Purines(Synthesis of Purines, Adenine and Guanine)

Suggestive Reading:

1. Organic Chemistry: I. L. Finar, Vol-II, 5th Edition, Pearson Education Ltd
2. Organic Chemistry: Morrison & Boyd, 6th Edition, Prentice Hall of India Pvt. Ltd.
3. Stereochemistry of carbon compounds: E. L. Eliel, Wiley Eastern Ltd.
4. Stereochemistry and mechanism through solved problems: P. S. Kalsi, New Age International
5. Stereochemistry of Organic Compounds: Principles and Applications: D. Nasipuri; New Academic Science; 4th Revised Edition
6. Organic Chemistry: Hendrickson, Cram, Hammond, McGraw-Hill.
7. Organic Chemistry: 6th Edition, John Mcmurry, Brooks Cole, International Edition
8. Organic Chemistry: T.W. Graham Solomons and Craig B. Fryhle Wiley, 8th Edition
9. Organic Chemistry: Francis A. Carey, McGraw-Hill, 7th Edition
10. Organic Chemistry: Leroy G.Wade, Prentice Hall, 6th Edition.
11. Organic Chemistry: Jonathan Clayden, Nick Greeves, Stuart Warren and Peter Wothers. Oxford University Press, USA.
12. Heterocyclic Chemistry by Raj K. Bansal, New Age International Publication, New Delhi
13. Heterocyclic Chemistry, by GILCHRIST, Pearson Education India., Delhi
14. Advances in Carbohydrate Chemistry, Allegra Smith(Editor), NY Research Press

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FACULTY OF SCIENCE

DEPARTMENT OF CHEMISTRY

BSc. (Hons.) Chemistry
Category – V

Major Course – 2: Physical Chemistry – II

CREDIT DISTRIBUTION, ELIGIBILITY AND PRE-REQUISITES OF THE COURSE

Course Title & Code	Credit Distribution of The Course			Eligibility Criteria	Perquisite(s) of the Course (if any)
	Lecture	Tutorial	Practical / Practice		
Physical Chemistry – II CHMC552C	4	0	0	10 + 2 from a recognized board in any stream	Basics of electrochemistry, phase rule and spectroscopy

LEARNING OBJECTIVES (LO)	
LO-1	To study the effect of pressure on transition temperature by Clausius-Clapeyron equation, to know van't Hoff's reaction isotherm and isochore, to understand elevation in boiling point and depression in freezing point and also to know third law of thermodynamics.
LO-2	To understand the basic Concept of electrochemical cell, working and functions of various types of reference electrodes and their usefulness, also to know various types of concentration cells and applications
LO-3	To understand the behavior of various types of liquid binary system under variable conditions and their separation with various methods.
LO-4	To study the significance of photochemistry by knowing quantum yield, factors affecting it. And also various phenomena like Fluorescence and Phosphorescence, Chemiluminescence, related to it
LO-5	To understand the origin of molecular and Raman spectra, how they complement each other? and applications

COURSE OUTCOMES (CO)	
On Completion of this course, the student will be able to	
CO-1	Derive the Clausius-Clapeyron equation and apply it for various systems as well as derive equations to study the effect of temperature on equilibrium constant, Remember the colligative properties and third law of thermodynamics.
CO-2	Remember the fundamentals of electrochemistry and apply them to comprehend the working of electrodes. Remember and recognize the working of a concentration cell.
CO-3	Use the basics of phase rule to describe binary systems and solve numerical based on them.
CO-4	To remember the basics of photochemistry, the laws and various phenomena associated as well as solve numerical based on them.
CO-5	Remember and recognize the fundamental principles of rotational and vibrational spectra
CO-6	Remember the theoretical principles and instrumentation of Raman spectroscopy.

Unit-1 THERMODYNAMICS (15L)

Clapeyron equation, Clausius - Clapeyron equation, Trouton's Rule, Craft's equation, van't Hoff's reaction isotherm and isochore equations, Colligative properties: Boiling point elevation and freezing point depression, Third law of thermodynamics.

Unit-2 ELECTROCHEMISTRY (15L)

A Determination of EMF by Poggendorff's compensation method and Weston cell, Types of Solid electrodes employed -representation and half-cell equation, Reference electrodes and their types- SHE, Calomel Electrode and Silver-silver chloride electrode – representation and half-cell equation, pH sensitive electrode: Quinhydrone electrode and numerical based on the above.

B Concentration cell and their classification, Cell with and without-transference, Electrode concentration cell and Gas electrode concentration cell, Applications of EMF to determine Ksp, Valancy of ion, Ka, Kh (hydrolysis constant)

Unit-3 PHASE RULE AND PHOTOCHEMISTRY (15L)

A Phase Rule

Completely miscible liquid pair -ideal solution, real solutions- positive and negative deviation from Raoult's law, distillation of binary miscible solutions (zeotropes and azeotropes), fractional distillation, partially miscible liquid pairs- Phenol water system, Triethylamine water system and nicotine water system, completely immiscible liquid pair- steam distillation

B Photochemistry:

Laws of Photochemistry: Grotthuss-Draper Law, Einstein Law, Quantum yield, Reasons for high and low quantum yield, Fluorescence and Phosphorescence, Chemiluminescence, Photosensitized reactions.

Unit-4 MOLECULAR SPECTRA AND RAMAN SPECTRA

A Molecular spectra

Pure rotational spectra, -energy level diagram, application to determine bond

distance. Pure vibrational spectra–equation for frequency of spectral lines, determination of force constant, amplitude of vibration, Morse potential and vibrational transitions, dissociation energy of a diatomic molecule. Vibrational-Rotational spectra, Equation for frequency of vibrational-rotational spectral line

B Raman Spectra

Introductions, Characteristic properties of Raman lines, Comparison of IR and Raman spectra, Mechanism of Raman Effect (i) Classical theory of Raman effect (ii)Quantum theory, Instrumentation, Application of Raman spectra

Suggestive Reading:

1. Physical Chemistry by Puri, Sharma and Pathania 48th edition, Vishal publication, 2021
2. Thermodynamics: a core course by Srivastava, Saha and Jain , 3rd edition, PHI learning 2021
3. An Introduction to Electrochemistry by S Glasstone, East-West Press (Pvt.) Ltd ,2006
4. Physical Chemistry by Atkins,11th edition, Oxford,2018
5. Thermodynamics for Chemists by S. Glasstone, Ewp, 2008
6. Advanced Physical Chemistry by Gurdeep Raj KRISHNA PRAKASHAN MEDIA P. LTD., 2016
7. A Textbook of Physical Chemistry - Quantum Chemistry and Molecular Spectroscopy by K L Kapoor Volume 4, 6th Edition, 2020
8. A Textbook of Physical Chemistry by K L Kapoor Volume 5, 6th Edition, 2020

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FACULTY OF SCIENCE

DEPARTMENT OF CHEMISTRY

BSc. (Hons.) Chemistry
Category – V

Major Course-3: Organic, Inorganic, and Physical Chemistry (Practical)

CREDIT DISTRIBUTION, ELIGIBILITY AND PRE-REQUISITES OF THE COURSE

Course Title & Code	Credit Distribution of The Course			Eligibility Criteria	Perquisite(s) of the Course (if any)
	Lecture	Tutorial	Practical / Practice		
Organic, Inorganic, and Physical Chemistry practical-3 (CHMC553L)	0	0	4	10 + 2 from a recognized board in any stream	Basic Knowledge of Chemistry Laboratory work

LEARNING OBJECTIVES (LO)	
LO-1	To apply the basic knowledge of solubility product, ionic product, common ion effect along with precipitation methods to carry out separation of inorganic ions
LO-2	To understand various titrimetric instrumental method like pH, Potentiometry and conductometry to determine equivalence point, dissociation constant.
LO-3	To study the Beer law and its application to determine unknown concentration of analyte.
LO-4	To understand the organic synthesis through various name reactions and to apply the concept of green synthesis

LO-5	To understand the separation and purity of organic compound by applying the chromatography technique based on TLC
COURSE OUTCOMES (CO)	
On Completion of this course, the student will be able to	
CO-1	Perform semi-micro qualitative analysis of a mixture of inorganic salts (6 ions) and identify the cations and anions
CO-2	Apply the principles of various instruments like conductometry, pH metry, Potentiometry and colorimetry.
CO-3	To investigate the order of reaction by kinetic study
CO-3	Perform single step organic synthesis.
CO-4	To perform TLC of two components

Practical-1 Inorganic and Physical Practical

A **Inorganic Qualitative Analysis:** Inorganic Qualitative Analysis of mixture containing six radicals only. (Minimum 08 mixtures to be done)

B **Physical Chemistry (Kinetics study & Instruments):**

(I) Kinetics study: Investigate the order of reaction in experiments no. 1, 2 and 3 by graphical method.

Exp 1: Reaction between $K_2S_2O_8$ and KI ($a \neq b$)

Exp 2: Reaction between $KBrO_3$ and KI ($a = b$)

Exp 3: Reaction between H_2O_2 and HI ($a = b$)

(II) Instruments:

Exp 1: Determine dissociation constant of monobasic acid (CH_3COOH) using pH meter.

Exp 2: Determine the amount of bases in given mix ($NaOH+NH_4OH$) conductometrically using standard solution of HCl

Exp3: Determine the amount of ferrous in the given solution of Ferrous Ammonium Sulphate potentiometerically using standard KMnO4 solution.

Exp 4: Determine the concentration of Cu2+ and Fe3+ in the given solution by Colourimetry.

Practical-II Organic Preparation and TLC

A **Organic Preparation:**

(i) Nitration of Acetanilide

(ii) Acetanilide from Aniline (Green Preparation)

(iii) Benzilic Acid from Benzil (Green Preparation)

(iv) 1,5-Diphenyl-penta-1,4-diene-3-one from Benzaldehyde and Acetone (Green Preparation)

B **TLC (Two components)**

(i) TLC with spots of (a) Acetanilide (b) Paracetamol and (c) Mixture of

Acetanilide and

(ii) TLC with spots of (a) Paracetamol (b)Salicylic acid and (c) Mixture of Paracetamol and

(iii) TLC with spots of (a) Aniline (b) Acetanilide and (c) Mixture of Aniline and Acetanilide

Suggestive Reading:

1. A. I. Vogel, "Elementary Practical Organic Chemistry Part-II, Qualitative Organic Analysis": CBS Publishers & Distributers, New Delhi, 2nd Edition, 2004.
2. A. I. Vogel, "Elementary Practical Organic Chemistry Part III Quantitative Organic Analysis": CBS Publishers & Distributers, New Delhi, 2nd Edition, 2004.
3. Hand book of Organic qualitative analysis by H. T. Clarke.
4. "Practical Organic Chemistry: F. G. Mann and B. C. Saunders. Low – priced Text Book. ELBS, Longman.
5. V.K. Ahluwalia, SunitaDhingra, "Comprehensive Practical Organic Chemistry – Qualitative Analysis": University Press (India) Private Limited, Hyderabad, 1st Indian Edition, 2010.
6. "Advanced Practical Organic Chemistry": Stanley Thornes Publishers Ltd., J Leonard, B Lygo, G Procter, 1st Indian Edition, 2004.
7. "Quantitative Analysis":R. A. Day, A. L. Underwood, Prentice-Hall of India Pvt. Ltd.,New Delhi, 6th Edition, 2004.

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