

# **ST. XAVIER'S COLLEGE (AUTONOMOUS)**

## **AHMEDABAD**

### **Chemistry Syllabus for Four-Year Undergraduate Programme as per National Education Policy (NEP-2020) (Semester I)**



**(EFFECTIVE FROM JUNE 2023)**

**ST. XAVIER'S COLLEGE (Autonomous), AHMEDABAD**  
**CHEMISTRY**  
**Theory syllabus**

**PROGRAMME SPECIFIC OUTCOMES**

**PSO1: Knowledge:** Apply the principles of analytical, organic, inorganic and physical chemistry to solve basic chemical problems locally and globally

**PSO2: Laboratory skills:** Employ classical and modern laboratory techniques in the performance and documentation of experiments, suitable for a chemical industry or a chemistry graduate program.

**PSO3: Environmental concern:** Practice environmentally benign chemistry

**PSO4: Employability/future prospects:** Develop problem-solving skills and aptitude that are highly valuable to employers and entrepreneurship skills for self-employment

**PSO5: Scientific communication:** Have effective written and oral scientific communication skills, especially the ability to transmit complex technical information in a clear and concise manner

## St. Xavier's College (Autonomous), Ahmedabad

**Syllabus of Semester – I of the following department under Faculty of Science based on Under Graduate Curriculum Framework - 2023 to be implemented from the Academic Year 2023-24.**

### FACULTY OF SCIENCE

### DEPARTMENT OF CHEMISTRY

Course	Title	Content	Hours/week	Credit
<b>DSC-1 (Theory)</b>	General Chemistry –I (Theory)	U-1: Selected Reactions of Hydrocarbons U-2: Inorganic chemistry U-3: Physical Chemistry U-4: Chemistry of selected carbonyl compounds and quantitative analysis in organic chemistry	4 hrs	4
<b>DSC-1 (Lab)</b>	Chemistry Practical-I	1: Inorganic Qualitative Analysis 2: Inorganic preparation, Volumetric Analysis, and Investigative projects	8 hrs	4
<b>Minor-1 (Theory)</b>	Basics of Chemistry-1	U-1A: Addition and substitution reaction U-1B: Atomic Structure and Chemical Bonding U-2A: Thermodynamics and Chemical kinetics U-2B: Carbonyl compound and quantitative organic analysis	2 hrs	2
<b>Minor-1 (Lab)</b>	Basics of Chemistry (Lab)	1: Volumetric Analysis (Acid and Base) 2: Inorganic Qualitative Analysis	4 hrs	2
<b>SEC</b>	Separation methods in Chemistry	U-1: Physical Methods of separation (Distillation) U-2: Introduction to Solvent Extraction U-3: Introduction to chromatography U-4: Specific Chromatographic techniques	4 hrs	2
<b>MDC + IDC</b>	Integrated Chemistry-1  Chemistry in Daily Life	U-1A: Addition and substitution reaction U-1B: Atomic Structure and Chemical Bonding U-2A: Thermodynamics and Chemical kinetics U-2B: Carbonyl compound and quantitative organic analysis  U-1: Food U-2: Essential Oils U-3: Water & Soil	4 hrs	4
<b>AEC</b>	English	(To be offered by the concerned subject Department)		
<b>VAC</b>		(To be offered by the concerned subject Department)		

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## FACULTY OF SCIENCE

### DEPARTMENT OF CHEMISTRY

BSc. (Hons.) Chemistry  
Category – IV

#### Minor Course – 1: Basics of Chemistry-1 (Theory)

#### CREDIT DISTRIBUTION, ELIGIBILITY AND PRE-REQUISITES OF THE COURSE

Course Title & Code	Credit Distribution of The Course			Eligibility Criteria	Prerequisite(s) of the Course (if any)
	Lecture	Tutorial	Practical / Practice		
Basics of Chemistry-1 (Theory) (CH-1101)	2	0	2	10 + 2 from a recognized board in any stream	Basic Knowledge of Chemistry, Observation and analytical skills

#### LEARNING OBJECTIVES (LO)

**LO1:** To learn and understand the mechanisms involved and predict products formed in the addition and elimination reactions as well as substitution reactions of unsaturated hydrocarbons

**LO 2:** To get acquainted and apply the fundamentals of chemical bonding and to describe atomic structure as well as molecular structure.

**LO3:** To learn basic chemistry of entropy, various thermodynamic process Principles of chemical kinetics and rate equations for various types of reactions

**LO4:** To learn and understand, preparation and nucleophilic addition reactions of aldehydes and ketones some basic calculations in organic chemistry

## **COURSE OUTCOME(CO)**

On Completion of this course, the student will be able to-

**CO1:** Remember the mechanisms involved and predict products formed in the addition and elimination reactions as well as substitution reactions of unsaturated hydrocarbons

**CO2:** To recognize and apply the fundamentals of chemical bonding and to describe atomic structure as well as molecular structure.

**CO3:** Interpret the role of entropy in various thermodynamic process and also apply the principles of chemical kinetics to derive the rate equations for various types of reactions

**CO4:** To remember the preparations and nucleophilic addition reactions of aldehydes and ketones and some basic calculations in organic chemistry

### **Unit 1A ADDITION AND SUBSTITUTION REACTION**

**(15 L)**

Electrophilic and free radical additions on alkenes; Markownikoff's rule, peroxide effect, hydroboration-oxidation and oxymercuration-reduction, Substitution reaction: SN 1 and SN 2 nucleophilic substitutions with mechanism. Elementary treatment of (free radical substitution reaction (cf. Alkane), Electrophilic aromatic substitution reaction

### **Unit 1B ATOMIC STRUCTURE AND CHEMICAL BONDING**

Idea of de-Broglie's matter wave (dual nature) and Heisenberg's uncertainty principle, shapes of s, p and d orbitals and characteristics., (1) Valence bond theory and its Limitations (2) Various types of hybridization and shapes of simple inorganic molecules and ions (such as NH<sub>3</sub>, H<sub>3</sub>O<sup>+</sup>, SF<sub>4</sub>, SF<sub>6</sub>, PCl<sub>5</sub>, ClF<sub>3</sub>, I<sub>3</sub><sup>-</sup>, NH<sub>4</sub><sup>+</sup>, BF<sub>4</sub><sup>-</sup>, XeF<sub>4</sub>, XeF<sub>6</sub>) by Valence Shell Electron pair Repulsion (VSEPR) Theory.

### **Unit 2A THERMODYNAMICS AND CHEMICAL KINETICS**

**(15 L)**

Limitations of first law and need for the second law, Entropy- its physical significance, entropy of gas and calculation of entropy for different processes. Derivation of second order rate reaction constant for (a=b) and (a≠b). Derivation of third order equation (a=b=c), Determination of half-life time for the 2<sup>nd</sup> and 3<sup>rd</sup> order reaction.

### **Unit 2B CARBONYL COMPOUND AND QUANTITATIVE ORGANIC ANALYSIS**

Introduction, Nomenclature, Properties, of aldehydes and ketones, Preparation of aldehydes, and ketones (CH<sub>3</sub>CHO, C<sub>6</sub>H<sub>5</sub>CHO, CH<sub>3</sub>COCH<sub>3</sub>) Nucleophilic addition reactions of ketone and aldehyde. Determination of Nitrogen by Kjeldahl's method and Kjeldahl's method modified with boric acid. Molecular weight of organic acid by Ag-salt method and organic base by Chloroplatinate method

#### **Suggestive Reading:**

- Elements of Quantum Mechanics by Michael D. Fayer, Oxford University Press, Indian Edition.
- Concise Inorganic Chemistry by J. D. Lee, 5/E, Oxford University Press, Indian Edition.
- Basic Inorganic Chemistry by F. A. Cotton and G. Wilkinson, Wiley publication.
- Inorganic Chemistry by Shriver & Atkins, 4/E, Oxford University Press, Indian Edition.

- Introductory Quantum Chemistry by A. K. Chandra, 4/E, Tata McGraw Hill Publishing Company Limited, New Delhi.
- Organic Chemistry by G. Marc Loudon, 4/E, 2010, Oxford University Press, Indian Edition
- Organic Chemistry by Robert Thornot Morrison, Robert Neilson Boyd, 6/E, 1992, Prentice Hall of India Pvt Ltd, New Delhi.
- Text book of Organic Chemistry by P. L. Soni and H. M. Chawla, 26/E, 1995, Sultan Chand & Sons Publication, New Delhi.
- Text book of Organic Chemistry by P. S. Kalsi, 1999, MacMillan of India Pvt. Ltd.
- Organic Chemistry by Bhupinder Mehta, Manju Mehta, Prentice Hall of India Pvt. Ltd, New Delhi.
- Elements of Physical Chemistry by Peter Atkins & Julio De Paula, 5/E, Oxford University Press, Indian Edition.
- Physical Chemistry by P. W. Atkins, 7/E, 2002, Oxford University Press, Indian Edition.
- Physical Chemistry by W. J. Moore, 1996, 6/E, MacGraw Hill Publication.
- Principle of Physical Chemistry by Puri, Sharma & Pathania, 41/E, Vishal Publishers.
- Essentials of Physical Chemistry by Bahl & Tuli. 22/E, S.Chand publication New Delhi
- Advanced Physical Chemistry by Gurdeep Raj, 19/E, Goel Publishing House Meerut.

#### Suggested Online Links/Readings:

<https://swayam.gov.in>

[https://www.iscnagpur.ac.in/knowledge\\_learning\\_files/5.7\\_General\\_Open\\_Access\\_e-Resources.pdf](https://www.iscnagpur.ac.in/knowledge_learning_files/5.7_General_Open_Access_e-Resources.pdf)

<https://ndl.iitkgp.ac.in>

<https://nptel.ac.in/course.html>

#### Pedagogy:

1. Lecture method with teaching aids.
2. Audio-Visual Teaching mode with Projector Method.
3. Dialogue and context-based class.
4. Assignments, Learning seminar, Class Test etc.

#### MODE OF EVALUATION FOR THEORY PAPER

Evaluation will be divided in two parts.

ASSESSMENT	MARKS
INTERNAL	
Attendance	05
Assignments	05
Continuous Internal Assessment I and II	15
TOTAL	25 marks
EXTERNAL	
End Semester Exam	25 marks

Students will prepare and present (in pairs) a Submission related to the topic of Assignment on assigned topics. These Submission will be presented in form of Activity/ Hand written notes etc. Points for evaluation: Presentation (20%) + Content (20%) + explanation (20%) +Creativity (20%) + Overall impression (20%).

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### DEPARTMENT OF CHEMISTRY

BSc. (Hons.) Chemistry  
Category – IV

#### Minor Course – 1: Basics of Chemistry-1 (LAB)

#### CREDIT DISTRIBUTION, ELIGIBILITY AND PRE-REQUISITES OF THE COURSE

Course Title & Code	Credit Distribution of The Course			Eligibility Criteria	Prerequisite(s) of the Course (if any)
	Lecture	Tutorial	Practical / Practice		
Basics of Chemistry - I (CH-1101)(Practicals)		0	2( 4 hours)	10 + 2 from a recognized board in any stream	Basic Knowledge of Chemistry , Observation and Analytic skills

#### LEARNING OBJECTIVES (LO)

- LO1:** To learn and Perform semi-micro qualitative analysis of inorganic salts to identify the cation and anion
- LO2 :** To understand and learn the principles of titrimetric analysis to determine the concentration of unknown acid or base

#### COURSE OUTCOMES(CO):

On Completion of this course, the student will be able to-

**CO1:** Perform semi-micro qualitative analysis of inorganic salts to identify the cation and anion

**CO2:** Use the principles of titrimetric analysis to determine the concentration of unknown acid or base



(A) Volumetric Analysis (Acid and Base)

(1) Preparation and Standardization of NaOH and HCl

(2) Succinic Acid -----NaOH

(3) Oxalic Acid ----- NaOH (Hydrated and/or Anhydrous)

(4) Na<sub>2</sub>CO<sub>3</sub> (Anhydrous)-----HCl

(B) Inorganic Qualitative Analysis (Two Radicals) (Minimum Eight Salts)

Water Soluble and Insoluble Inorganic salts of following cations and anions:

Cations : K<sup>+</sup>, NH<sub>4</sub><sup>+</sup>, Mg<sup>2+</sup>, Ba<sup>2+</sup>, Ca<sup>2+</sup>, Sr<sup>2+</sup>, Fe<sup>2+</sup>, Fe<sup>3+</sup>, Al<sup>3+</sup>, Cr<sup>3+</sup>, Zn<sup>2+</sup>, Mn<sup>2+</sup>, Co<sup>3+</sup>, Pb<sup>2+</sup>, Cu<sup>2+</sup>.

Anions : S<sup>2-</sup>, SO<sub>4</sub><sup>2-</sup>, CO<sub>3</sub><sup>2-</sup>, PO<sub>4</sub><sup>3-</sup>, CrO<sub>4</sub><sup>2-</sup>, Cl<sup>-</sup>, Br<sup>-</sup>, I<sup>-</sup>, NO<sub>3</sub><sup>-</sup>, O<sup>2-</sup>

**Suggested Reading:**

- Vogel's Textbook of Quantitative Chemical analysis|| Revised by G. H. Jeffery, J. Bassett, J.Mendham & R. C. Denney, 5/E, ELBS (English Language Book Society) Longman.
- Analytical Chemistry|| by DhruvaCharan Dash, PHI Learning Private Ltd, 2011 New Delhi. .
- Analytical Chemistry|| by Gary D. Christian, 4/E, John Wiley & Sons.
- Advanced Practical Inorganic Chemistry|| by Gurdeep Raj, 9/E, GoelPublishing House, Meerut.
- Vogel's Textbook of Macro and Semimicro Qualitative Inorganic Analysis||, 5/E, Orient Longman Ltd.

**MODE OF EVALUATION:**

Sr. No.	Exam Pattern	Internal Exam	External Exam
1	Practical/Performance	20	25
2	Attendance	5	00
	Total	<b>25 marks</b>	<b>25 marks</b>