

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

## **AHMEDABAD**

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



**(EFFECTIVE FROM JUNE 2023)**

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

**PROGRAMME SPECIFIC OUTCOMES**

A student completing this program will be able to

**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 – II 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**

<b>Course</b>	<b>Title</b>	<b>Content</b>	<b>Hours/week</b>	<b>Credit</b>
<b>DSC-1 (Theory)</b>	CH-2501 General Chemistry-2	U-1: Organic Chemistry Stereochemistry of organic compounds (Optical isomerism) (Geometric isomerism) (Conformational isomerism)  U-2: Inorganic Chemistry (A) Transition Metals (B) Co-ordination compounds  U-3: Physical Chemistry (A) Ionic equilibrium (B) Catalysis  U-4: Analytical Chemistry General Introduction of analytical chemistry	4 hrs	4
<b>DSC-1 (Lab)</b>	CH-2502L Chemistry Practicals-2	Chemistry Practicals (A) Volumetric Analysis:- (B) Organic Spotting :-	8 hrs	4
<b>Minor-1 (Theory)</b>	CH-2101 Basics of Chemistry-2 (theory)	U-1: (A) Organic Chemistry: Stereochemistry of organic compounds (B) Inorganic Chemistry: Co-ordination compounds  U-2 : (A) Physical Chemistry : Kinetics and Thermodynamics (B) Analytical Chemistry : Errors in Quantitative Analysis	2 hrs	2
<b>Minor-1 (Lab)</b>	CH-2101 Basics of Chemistry-2 (Practicals-2)	Chemistry Practicals (A) Volumetric Analysis:- (B) Organic Spotting :-	4 hrs	2
<b>Minor-1 IC</b>	IC 2101 Selected Topics in Industrial Chemistry (Theory)	UNIT-1 Water Pollution and Industrial Waste and Treatment Process  UNIT-2 Basics concept of industrial material	2 hrs	2

<b>Minor-1 IC Lab</b>	IC 2101 Selected Topics in Industrial Chemistry (Practical)	Practical based as per Theory syllabus	4 hrs	2
<b>SEC</b>	Basic of analytical chemistry for lab practices.	U-1: Good Laboratory practice U-2: Basic lab practice and SOP for instruments.	4 hrs	2
<b>MDC (Theory)</b>	MDC Chemistry CH-2201 Integrated Chemistry-2	U-1 : (a) Green and Sustainable Chemistry (b) Bio inorganic Chemistry: U-2: (a) Water chemistry (b) Soap and detergents.	2 hrs	2
<b>MDC (Practical)</b>	MDC Chemistry CH-2201(practical)	CH-2201(Practical) Practical based on theory aspects. Integrated Chemistry-2	2 hrs	2
<b>MDC (Theory)</b>	MDC-IC (Theory)	Unit -1- Biogeochemical cycles and Green chemistry Unit -2- Environmental Analysis and Water analysis	2 hrs	2
<b>MDC (Practical)</b>	MDC-IC (Practical)	Sustainable Environment	2 hrs	2
<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**

**Major Course – 1: General Chemistry - II**

**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		
General Chemistry - II (CH-2501)	4	0	0	10 + 2 from a recognized board in any stream	Basic Knowledge of Chemistry

**LEARNING OBJECTIVES (LO)**

**LO 1:** To be acquainted with basic concepts of stereochemical and conformational analysis to identify the configuration and conformation of the given organic compounds

**LO 2:** To understand the Basic Concept of and apply the principles of Werner's theory and VB theory to understand bonding in co-ordination complexes formed by transition metals

**LO3:** To understand and apply basic concept /laws and conditions governing ionic equilibria, hydrolysis of various types of salts, catalysis including mechanism and derivation for enzyme catalysed reactions

**LO 4:** To know and apply basics knowledge of titrimetric analysis to find solutions to simple analytical problems.

**COURSE OUTCOMES (CO)**

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

**CO1:** Use the fundamentals of stereochemical and conformational analysis to identify the configuration and conformation of the given organic compounds

**CO2:** Recognize and apply the principles of Werner's theory and VB theory to understand bonding in co-ordination complexes formed by transition metals

**CO3:** Interpret the basic laws and conditions governing ionic equilibrium, hydrolysis of various types of salts, catalysis including mechanism and derivation for enzyme catalyzed reactions

**CO4:** Apply the basics of titrimetric analysis to find solutions to simple analytical problems

**Unit-1**

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## Stereochemistry of organic compounds

(A) **Optical isomerism** — elements of symmetry, molecular chirality, enantiomers, stereogeniccentre, optical activity, properties of enantiomers, chiral and achiral molecules with two stereogeniccentres, diastereomers, threo and erythrodiastereomers, meso compounds, resolution of enantiomers, inversion, retention and racemization.

Relative and absolute configuration, sequence rules, D & L and R & S systems of nomenclature.

(B) **Geometric isomerism** — determination of configuration of geometric isomers. E & Z system of nomenclature, geometric isomerism in oximes and alicyclic compounds.

(C) **Conformational isomerism** — Difference between configuration and conformation. conformational analysis of ethane and n-butane. Newman projection and Sawhorse formulae, Fischer and flying wedge formulae and their interconversion for ethane and n-butane.

## Unit-2

### Inorganic Chemistry

#### (A) Transition Metals

Characteristic properties of 3d elements, Ionic radii, oxidation states, complexation tendency, Magnetic behavior and electronic spectral properties, Spectrophotometric estimation of metal ions.

#### (B) Co-ordination compounds

(1) Werner's theory, nomenclature, chelates

(2) Valence Bond theory of co-ordination compounds, stereochemistry of numbers 4, 5 and 6.

(3) Crystal Field Theory for octahedral compounds

(4) Various types of isomerism in co-ordination complexes.

## Unit-3 Physical Chemistry

#### (A) Ionic equilibrium

Definition ionic equilibrium, Ostwald's dilution law and its limitations, ionic product of water ( $K_w$ ), pH scale, hydrolysis reaction and relations between  $K_w$ ,  $K_a$ ,  $K_b$ , and  $K_h$  for all types of salts, Buffer solution (Handerson- Hasselbalch equation), buffer capacity. Indicator theories- Ostwald's and modern quinonoid theory.

#### (B) Adsorption

Definition of terms, Types of adsorption (physical, chemical and their difference), Types of adsorption isotherms (5 types), Derivation of Freundlich adsorption isotherm, Derivation of Langmuir adsorption isotherm, Applications of adsorption. Factors affecting adsorption of gases on solids.

#### Suggestive Reading:

- (1) "Elements of Quantum Mechanics" by Michael D. Fayer, Oxford University Press, Indian Edition,
- (2) "Concise Inorganic Chemistry" by J. D. Lee, 5/E, Oxford University Press, Indian Edition.
- (3) "Basic Inorganic Chemistry" by F. A. Cotton and G. Wilkinson, Wiley publication.
- (4) "Inorganic Chemistry" by Shriver & Atkins, 4/E, Oxford University Press, Indian Edition.
- (5) "Introductory Quantum Chemistry" by A. K. Chandra, 4/E, Tata MacGraw Hill Publishing Company Limited New Delhi.
- (6) "Organic Chemistry" by G. Marc Loudon, 4/E, 2010, Oxford University Press, Indian Edition.
- (7) "Organic Chemistry" by Robert Thornot Morrison, Robert Neilson Boyd, 6/E, 1992, Prentice Hall of India Pvt Ltd, New Delhi.
- (8) "Text book of Organic Chemistry" by P. L. Soni and H. M. Chawla, 26/E, 1995, Sultan Chand & Sons Publication, New Delhi.
- (9) "Text book of Organic Chemistry" by P. S. Kalsi, 1999, MacMillan of India Pvt. Ltd.
- (10) "Organic Chemistry" by Bhupinder Mehta, Manju Mehta, Prentice Hall of India Pvt.Ltd, New Delhi.

- (11) “Elements of Physical Chemistry” by Peter Atkins & Julio De Paula, 5/E, Oxford University Press, Indian Edition.
- (12) “Physical Chemistry” by P. W. Atkins, 7/E, 2002, Oxford University Press, Indian Edition.
- (13) “Physical Chemistry” by W. J. Moore, MacGraw Hill Publication, 1996, 6/E.
- (14) “Principle of Physical Chemistry” by Puri, Sharma & Pathania, 41/E, Vishal Publishers.
- (15) “Essentials of Physical Chemistry” by Bahl & Tuli. 22/E, S. Chand publication New Delhi.
- (16) “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:**

Evaluation will be divided in two parts.

ASSESSMENT	MARKS
INTERNAL	
Attendance	05
Research Assignment	10
Continuous Internal Assessment I and II	35
TOTAL	50 marks
EXTERNAL	
End Semester Exam	50 marks

Students will prepare and submit hard copy of synopsis of the topic of Research Assignment on allotted topics. These Submission will be evaluated on the basis of personal viva on the synopsis submitted by each student. On the bases of synopsis submitted+ Viva + overall impressions they will be marked out of 10 marks). A short discussion for moderation of the marks by staff involved before submission is done.

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## FACULTY OF SCIENCE

### DEPARTMENT OF CHEMISTRY

BSc. (Hons.) Chemistry  
Category – IV

**Major Course – II: CH-2502L Chemistry Practicals-2**

#### **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 Botany Practicals - I (CH-2502 L)	0	0	4	10 + 2 from a recognized board in any stream	Basic Knowledge of Chemistry Laboratory work

#### **LEARNING OBJECTIVES (LO)**

**LO1:** To acquire knowledge and apply the principles of organic separation and functional group reactivity to identify qualitatively of the organic compounds.

**LO2:** To acquire knowledge and use the principles of titrimetric analysis to determine the concentration.

#### **COURSE OUTCOMES (CO):**

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

**CO1:** Apply the principles of organic separation and functional group reactivity to identify qualitatively the given organic compound

**CO2:** Use the principles of titrimetric analysis to determine the concentration of unknown metal solution and redox reagents



**(A) Organic Spotting :-** ( 11 Solids and 05 Liquids).

List organic compounds having different mono functional groups:

**Solids : Acids :** (i) Benzoic acid (ii) Oxalic acid (iii) Succinic acid (iv) Cinnamic Acid, (v) Phthalic acid,

**Base:** P-toludine

**Phenols:** (i)  $\beta$ -Naphthol (ii)  $\alpha$ -Naphthol (iii) Resorcinol (iv) Phenol

**Neutral:** (i) Urea (ii) Thiourea (iii) Benzamide (iv) Napthalene (v) Acetanilide

**Liquids:** (i) Aniline (ii) Nitrobenzene (iii) Benzaldehyde (iv) methyl acetate

(v) Ethyl acetate (vi)  $\text{CCl}_4$  (vii) Chlorobenzene (viii) Acetone

**(B) Oxidation-Reduction Titrimetry:**

(i) Estimation of Fe(II) and oxalic acid using standardized  $\text{KMnO}_4$  solution.

(ii) Estimation of oxalic acid and sodium oxalate in a given mixture.

(iii) Estimation of Fe(II) with  $\text{K}_2\text{Cr}_2\text{O}_7$  using internal (diphenylamine, anthranilic acid) and external indicator.

(iv) Estimation of oxalic acid using standardized  $\text{KMnO}_4$  solution.

(v) Complex metric Titration by EDTA:-

(1) Estimation of  $\text{Ca}^{+2}$  /  $\text{Mg}^{+2}$ ..... EDTA

**Applied experiments (Investigatory project)**

1. Citric acid in lemon using standardized sodium hydroxide solution

2. Ascorbic acid in citrus fruit juices

**Suggested Reading:**

- (1) "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.
- (2) "Analytical Chemistry" by Dhruva Charan Dash, PHI Learning Private Ltd, 2011, New Delhi,
- (3) "Analytical Chemistry" by Gary D. Christian, 4/E, John Wiley & Sons.
- (4) "Comprehensive Practical Organic Chemistry – Qualitative Analysis" by V. K. Ahluwalia, Sunita Dhingra, First Indian Reprint 2010, University Press (India) Private Limited, Hyderabad,
- (5) "Organic Analytical Chemistry theory and Practice" by Mohan Jag, Narosa

**MODE OF EVALUATION: (To be finalise)**

SR. NO.	EXAM PATTERN	INTERNAL EXAM		EXTERNAL EXAM	
		SESSION I	SESSION II	SESSION I	SESSION II
1	Practical/Performance	25	20	20 (Volu) +5 Que slip = 25	20 (Org +5 Journal) =25
2	Attendance	0	05	00	00
	Total	25	25	25	25
	Grand Total	25+25= 50 marks		25+25= 50 marks	