Syllabus

First Semester Courses in Chemistry

2023-2024

Contents:

- Syllabus for Core Course
  - USCHE4501CR1- FUNDAMENTALS OF ORGANIC CHEMISTRY AND PERIODICITY OF ELEMENTS
- Evaluation and Assessment guidelines

© St. Xavier's College (Autonomous), Mumbai, INDIA

APPROVED SYLLABUS

PRINCIPAL
ST. XAVIER'S COLLEGE
AUTONOMOUS
MUMBAI - 400 001.

F.Y. B.Sc.- Semester I **Course Code: USCHE4501CR1**

Title: FUNDAMENTALS OF ORGANIC CHEMISTRY AND PERIODICITY OF ELEMENTS

Credits: 4 [(Theory 3 credits (Total 45 hours) and Practical 1 credit (Total 30 hours)]

COURSE OBJECTIVES:

1. To understand the concepts of electronic displacement and reactive intermediates in organic reaction.
2. To identify aromatic, non-aromatic and anti-aromatic compounds and study the preparation and reactions of various hydrocarbons.
3. To understand the mechanism of elimination reaction and aromatic electrophilic substitution reaction.
4. To reinforce the basics of Inorganic Chemistry with special reference to atomic structure, periodic table and periodicity of properties.
5. To study the trends in physical and chemical properties of the 's' and 'p' block elements.
6. To explore the diagonal relationship and anomalous behaviour of the first member of each group in the periodic table.
7. To learn to perform experiments that have specific aims with correct techniques.
8. To develop skills of observation, recording, analysing data and present the experimental work in a systematic manner

COURSE OUTCOMES:

After completing the course, the student will be able to –

1. Explain the effect of electronic displacement and stability of different reactive intermediates.
2. Represent the reaction mechanism.
3. Identify aromatic, anti-aromatic and non-aromatic compounds.
4. Relate quantum numbers and atomic orbitals.
5. Correlate the chemical and physical properties of elements and their compounds with their positions in the periodic table.
6. Purify and identify given organic compounds using appropriate experimental techniques.

ST. XAVIER'S COLLEGE-AUTONOMOUS MUMBAI-400 001

© St. Xavier's College (Autonomous), Mumbai, INDIA

UNIT-1 BASIC CONCEPTS OF ORGANIC CHEMISTRY AND CHEMISTRY OF HYDROCARBONS- I (15 L)

1 Fundamental Concepts

- Description of Molecular Structure Using VBT: Covalent bond, hybridization and shapes of molecules, Geometry and structure of sp^3, sp^2 and sp hybridized carbon, nitrogen and oxygen atoms and some common functional groups (e.g. carbonyl and cyano), influence of hybridization on bond properties, inter and intramolecular hydrogen bonding.
- Electronic displacements and their applications: Inductive, electromeric, resonance and mesomeric effects and hyperconjugation. Concept of dipole moment.
- Representations in organic chemistry: Homolytic and heterolytic fission with suitable examples, curly arrow rules, formal charges, electrophiles and nucleophiles. Types of organic reactions.

2 Reactive Intermediates

- Types of reactive intermediate. Generation, shape and relative stability of different reactive intermediates namely carbocation, carbanion and carbon radicals involved in organic reactions.
- Carbocations: Different types of carbocations such as alkyl, allyl, benzyl carbocation. SN1 reaction, Wagner-Meerwein rearrangement.
- Carbanions: Concept of carbon acid, alkylation of carbon acids (active methylene compounds and terminal alkynes) using alkyl halides and synthetic applications of these reactions.
- Carbon free radicals: addition of HBr to alkenes in presence of peroxide. General reactions of radicals including polymerization reactions (initiation, propagation and termination by abstraction, combination, and disproportionation).

UNIT-II CHEMISTRY OF HYDROCARBONS (15 L)

1 Chemistry of Hydrocarbons- I

- Introduction to Hydrocarbons: Classification of hydrocarbons (up to aromatic hydrocarbons).
- Introduction to Aromaticity: Electronic structure and Huckel's Rule of aromaticity. Study of aromaticity in carbocyclic / heterocyclic compounds; benzenoid / non-benzenoid compounds and cyclic cations / anions. Anti-aromaticity and non-aromaticity. Nomenclature of mono and di substituted benzene.
- Carbon-Carbon Sigma bond (Alkanes): Preparation and Reactions: Wurtz and Wurtz-Fittig reaction, Corey House synthesis, physical and chemical properties of alkanes, free radical substitutions and halogenation reactions.

2 Chemistry of Hydrocarbons - II

- **Carbon-Carbon Double Bonds (Alkenes)**
- Alkenes: IUPAC nomenclature, formation of alkenes by elimination reactions, Mechanism of E1, E2, E1cb reactions, Saytzeff rule and Hofmann elimination reaction.
- Reactions of alkenes: Electrophilic additions mechanism, Markovnikov/Anti Markovnikov addition and hydroboration oxidation.
- Conjugated diene reactions: 1,2-and 1,4-addition reactions in conjugated dienes.

ST. XAVIER'S COLLEGE-AUTONOMOUS * MUMBAI-400001

© St. Xavier's College (Autonomous), Mumbai, INDIA

- **Carbon-Carbon Triple Bonds (Alkynes)**
- Alkynes: IUPAC nomenclature, acidity and preparation.
- Reactions of alkynes: electrophilic and nucleophilic additions, hydration reaction and alkylation of terminal alkynes.

UNIT-III ATOMIC STRUCTURE AND PERIODICITY (15 L)

1 Atomic Structure

- Bohr's theory, Heisenberg's uncertainty principle and its significance, quantum numbers and their significance, sign of wave functions, shapes of s, p, d and f orbitals.
- Pauli's Exclusion Principle, Hund's rule of maximum multiplicity, Aufbau's principle and its limitations.

2 Periodicity of Elements

- Classification of s, p, d, f block elements, the long form of periodic table.
- Detailed discussion of the following properties of the elements with reference to s & p block:
  (a) Effective nuclear charge and its variation in periodic table, shielding or screening effect, calculation of $Z_{eff.}$ using Slater rules.
  (b) Atomic radii (van der Waals)
  (c) Ionic and crystal radii.
  (d) Covalent radii (octahedral and tetrahedral)
  (e) Ionization enthalpy/energy, successive ionization enthalpies and factors affecting ionization enthalpy. Applications of ionization enthalpy.
  (f) Electron gain enthalpy, trends of electron gain enthalpy.
  (g) Electronegativity, Pauling's/ Mulliken's/ and Allred Rochow's/ electronegativity scales (Numerical problems expected).
  (h) Metallic and Non-metallic character, melting and boiling points, oxidation states and polarisability (Fajan's Rule)

3 Chemistry of s and p Block Elements

- Inert pair effect, relative stability of different oxidation states, diagonal relationship and anomalous behaviour of first member of each group. Allotropy and catenation, physical/chemical properties and complex formation tendency. Hydrides and their classification- ionic, covalent and interstitial hydrides. Physical properties of hydrides of elements of group 15 and 16 with respect to hydrogen bonding.

REFERENCES

1. Organic Chemistry, Morrison & Boyd, Prentice Hall, 2010.
2. Organic Chemistry, Paula Y. Bruice, Pearson Education, 2008.
3. Organic Chemistry, Francis A Carey, Pearson Education, 6th Edition, Special Indian Education, 2008.
4. Organic Chemistry, T.W.G. Solomon and C.B. Fryhle, 8th Edition, John Wiley & Sons, 2004.
5. Basic Inorganic Chemistry, F.A.Cotton,G.Wilkinson and P.L.Gauss, 3rd Edition, J.Wiley and Sons, Inc.(1995).

ST. XAVIER'S COLLEGE-AUTONOMOUS MUMBAI-400 001

© St. Xavier's College (Autonomous), Mumbai, INDIA

APPROVED SYLLABUS

6. Inorganic Chemistry, James E. Huheey, 3rd edition, Harper & Row Publishers, Asia, Pvt Ltd., 1983.
7. A TextBook of Organic Chemistry: K. S. Tiwari, S. N. Mehrotra and N. K. Vishnoi.
8. Organic Reaction Mechanism,V.K. Ahluwalia and R.K. Parashar, 3rd Ed Narosa Publications.
9. Concise Inorganic Chemistry , J.D.Lee, 5th Edition ,Oxford University press.
10. Shriver Atkins Inorganic Chemistry, P. W. Atkins, Overton, Rourke Weller, Armstrong, 5th edition, Oxford University Press.

PRACTICAL:

EXPERIMENTS:

1. a. Measurement of physical constants (melting point & boiling point).
   b. Determination of mixed melting points using urea and cinnamic acid mixtures of given compositions.
2. Purification of organic compounds by crystallization method (charcoal as impurity) and sublimation.
3. Characterization of organic compounds containing C, H, (O), N, S elements (no elemental analysis): solubility, chemical nature and detection of functional groups

Evaluation (Core Theory): Total marks per course - 100.

I. Formative Assessment 'for' Learning (continuous internal assessment - CIA to improve learning).
   CIA- 40 marks
   CIA I: Objective and short answer questions- 20 marks
   CIA II: MCQ- 20 marks

II. Summative Assessment 'of' Learning (focus on outcomes, quantitative data for outcomes of instruction).

End Semester Examination – 60 marks

Total number of questions: 3 [all compulsory] of 20 marks each.
1 Question per unit.
Question set out of 30 marks [50% internal choice].
Sub questions will not exceed 5 marks.

Evaluation of (Practical) Total marks Practical course - 50.
Journal: 05 marks
CIA: 15 marks
End Semester Examination: 30 marks (25 marks experiment and 5 marks viva)
Total Marks: 50

ST. XAVIER'S COLLEGE-AUTONOMOUS MUMBAI-400001

© St. Xavier's College (Autonomous), Mumbai, INDIA

APPROVED SYLLABUS

Template for the Core course End Semester examination in Semester I

FUNDAMENTAL OF ORGANIC CHEMISTRY AND PERIODICITY OF ELEMENTS

UNIT	KNOWLEDGE	UNDERSTANDING	APPLICATION	TOTAL MARKS
I	06	07	07	20
II	07	08	05	20
III	08	06	06	20
TOTAL MARKS PER OBJECTIVE	21	21	18	60
% WEIGHTAGE	35	35	30	100

****

© St. Xavier's College (Autonomous), Mumbai, INDIA

APPROVED SYLLABUS

Syllabus

First Semester Courses in Chemistry

2023-2024

Contents:

- Syllabus for Vocational Skill course (VSC)
  - USCHE4501VS1- ICT TOOLS IN CHEMISTRY
- Evaluation and Assessment guidelines

PRINCIPAL
ST. XAVIER'S COLLEGE
AUTONOMOUS
MUMBAI - 400 001.

APPROVED SYLLABUS

ST. XAVIER'S COLLEGE-AUTONOMOUS * MUMBAI-400 001 *

© St. Xavier's College (Autonomous), Mumbai, INDIA

Course: USCHE4501VS1

F.Y. B.Sc.- Semester I

Title: ICT TOOLS IN CHEMISTRY

Credits: 2 [(Theory 1 credit (Total 15 hours) and Practical 1 credit (30 hours)]

COURSE OBJECTIVES:

1. To use software for drawing 2D and 3D chemical structures and generating IUPAC names.
2. To utilize different templates and reaction symbols in reaction / mechanisms.
3. To obtain information about predicted physical constants of molecules.
4. To present and process data in the form of charts.
5. To familiarize students with simulations in chemistry.
6. To represent basic mathematical equations.

COURSE OUTCOMES:

After completing the course, the student will be able to

1. Draw 2D and 3D structures of molecules.
2. Represent chemical reactions and mechanisms.
3. Insert, convert and export the mathematical expressions.
4. Organize, process and present the scientific data.
5. Use Latex software for better management of documents like research papers.

ST. XAVIER'S COLLEGE-AUTONOMOUS MUMBAI-400 001

© St. Xavier's College (Autonomous), Mumbai, INDIA

APPROVED SYLLABUS

UNIT - I Data Management system (Excel, Origin Pro) and AI, MathType, Simulations in chemistry, LaTeX, ChemSketch, ChemDraw, ISIS (Integrated Scientific Information System) Draw and ChemDoodle (15L)

1 Data Management system: Introduction and Importance

- **Data Management system:**
  - **a.** Create and format an excel chart
  - **b.** Charts Styles and Layouts
  - **c.** Chart Titles and Series Titles
  - **d.** Create charts like Pie, Line, Column, Bar in excel
  - **e.** Format charts
  - **f.** Mathematical calculations

2 Simulations in chemistry, drawing experimental setups in chemistry laboratory: Introduction and Importance

- **Simulations**
  - **a.** Atomic model
  - **b.** Interaction of light and matter
  - **c.** States of matter and laws
  - **d.** Heat and energy
  - **e.** Molecules in motion
  - **f.** Solutions
  - **g.** Chemical reactions
  - **h.** Chemical bonding
  - **i.** Electrochemistry
  - **j.** Wolfram and Desmos
- **Drawing experimental setups in chemistry laboratory**
  - **a.** Containers
  - **b.** Filtering
  - **c.** Metallic
  - **d.** Ceramic
  - **e.** Devices
  - **f.** Chromatography
  - **g.** Storage

3 LaTeX: Introduction and Importance

- **LaTeX Basics**
- **Figures and tables**
- **Document structure, formatting and fonts**
- **Chemistry in LaTeX**
- **References and Citations**

4 ChemSketch, ChemDraw, ISIS Draw and ChemDoodle: Introduction and Importance

- **Drawing chemical structures, templates, text and labels-**
  - **a.** Aliphatic molecules
  - **b.** Aromatic molecules

ST. XAVIER'S COLLEGE-AUTONOMOUS MUMBAI-400 001

© St. Xavier's College (Autonomous), Mumbai, INDIA

APPROVED SYLLABUS

c. Long chain molecules
d. Chiral molecule
e. Polycyclic molecule
f. Resonance structures
g. Lewis structures
h. Templates

- **Representation of reaction schemes and mechanisms**
  a. Reaction arrows
  b. Half head and curly arrows, bonds
  c. Radical, nucleophilic and electrophilic mechanisms
- **Nomenclature, properties and 3D structures**
  a. IUPAC names from structures
  b. Obtaining physical properties
  c. Importing Structures from 2D to 3D and different representations of the 3D molecules
  d. Calculating bond lengths and bond angles
  e. Configurational Isomers

REFERENCES

1. Microsoft Excel 2019 Formulas and Functions, Paul McFedries, 2019.
2. LaTeX for Complete Novices: Nicola L. C. Talbot, Dickimaw LaTeX Series, Volume:1, Version:1.4, 2012.

PRACTICAL:

30 hours of Hands on practical for all the above-mentioned topics from Unit I

UNIT-II Data Management system (Excel, Origin Pro) and AI, MathType, Simulation in Chemistry, LaTeX, ChemSketch, ChemDraw, ISIS Draw and ChemDoodle (30 hours)

1 Data Management System:

a. Create and format an excel chart
b. Charts Styles and Layouts
c. Chart Titles and Series Titles
d. Create charts like Pie, Line, Column, Bar in excel
e. Format charts
f. Mathematical calculations

2 Simulations in chemistry drawing, experimental setups in chemistry laboratory

- **Simulations**
  a. Atomic model
  b. Interaction of light and matter
  c. States of matter and laws
  d. Heat and energy
  e. Molecules in motion
  f. Solutions
  g. Chemical reactions
  h. Chemical bonding
  i. Electrochemistry

ST. XAVIER'S COLLEGE-AUTONOMOUS MUMBAI-400001

j. Wolfram and Desmos

- **Drawing experimental setups in chemistry laboratory**
  a. Containers
  b. Filtering
  c. Metallic
  d. Ceramic
  e. Devices
  f. Chromatography
  g. Storage

3 LaTeX

- **LaTeX Basics**
- **Figures and tables**
- **Document structure, formatting and fonts**
- **Chemistry in LaTeX**
- **References and Citations**

4 ChemSketch, ChemDraw, ISIS Draw and ChemDoodle:

- **Drawing chemical structures, templates, text and labels-**
  a. Aliphatic molecules
  b. Aromatic molecules
  c. Long chain molecules
  d. Chiral molecule
  e. Polycyclic molecule
  f. Resonance structures
  g. Lewis structures
  h. Templates
- **Representation of reaction schemes and mechanisms-**
  a. Reaction arrows
  b. Half head and curly arrows, bonds
  c. Radical, nucleophilic and electrophilic mechanisms
- **Nomenclature and properties-**
  a. IUPAC names from structures
  b. Obtaining physical properties
- **3D Structures**
  a. Importing Structures from 2D to 3D and different representations of the 3D molecules
  b. Calculating bond lengths and bond angles
  c. Configurational Isomers

Evaluation (VSC) (Only Practical): Total marks per course – 50

I. Formative Assessment 'for' Learning (continuous internal assessment - CIA to improve learning).
CIA- 20 marks

II. Summative Assessment 'of' Learning (focus on outcomes, quantitative data for outcomes of instruction).
End Semester Examination – 30 marks

****

ST. XAVIER'S COLLEGE AUTONOMOUS MUMBAI-400 001

© St. Xavier's College (Autonomous), Mumbai, INDIA

APPROVED SYLLABUS

Syllabus

First Semester Courses in Chemistry

2023-2024

Contents:

© St. Xavier's College (Autonomous), Mumbai, INDIA

APPROVED SYLLABUS

PRINCIPAL
ST. XAVIER'S COLLEGE
AUTONOMOUS
MUMBAI - 400 001.

F.Y. B.Sc.- Semester I

Course Code: USCHE4501OE1

Title: CHEMISTRY IN SPORTS, PHYSIOLOGY AND HEALTH

Credits: 2 [(Theory 2 credits (Total 30 hours)]

COURSE OBJECTIVES:

1. To understand the relationship between nutrition and exercise.
2. To evaluate supplements and nutraceuticals used to enhance performance in sports.
3. To assess the link between improved sporting equipment and record breaking performances.

COURSE OUTCOMES:

After completing the course, the student will be able to

1. Apply knowledge of chemistry to sports related issues.
2. Explore how changes in materials technology have improved athletes' performance.
3. Relate dietary and physiological aspects affecting physical activity and performance.
4. Analyse doping in sports and its impact on individuals, organisations and society.

© St. Xavier's College (Autonomous), Mumbai, INDIA

ST. XAVIER'S COLLEGE-AUTONOMOUS MUMBAI-400001

APPROVED SYLLABUS

UNIT- I CHEMISTRY IN SPORTS EQUIPMENTS (15 L)

1 Chemistry of sports materials- Racquets, Balls, Courts, Bicycles, rafts etc.
2 Olympic motto "citius, altius, fortius"- Does Chemistry make sportsmen faster, higher, stronger?
3 Innovations in sports apparel
4 Materials for injury prevention
5 Use of performance enhancing drugs in sports: anabolic steroids, stimulants, hormones, narcotics etc.
6 Doping scandals

UNIT- II CHEMISTRY IN SPORTS NUTRITION (15 L)

1 Nutritional supplements: Protein supplements, Creatine, caffeine etc
2 Role of water and electrolytes in sports performance,
3 Recovery products: sports drinks/energy drinks etc
4 Regulations of dietary supplements
5 Chemistry in drug monitoring

REFERENCES

1. Doping, Performance-Enhancing Drugs, and Hormones in Sport: Mechanisms of Action and Methods of Detection by Anthony C Hackney, 2008.

Evaluation (OE): Total marks per course – 50

I. Formative Assessment 'for' Learning (continuous internal assessment - CIA to improve learning).
CIA- Poster, Assignments, Presentations- 20 marks

II. Summative Assessment 'of' Learning (focus on outcomes, quantitative data for outcomes of instruction).
End Semester Examination -30 marks

Template for Open Elective course End Semester Examination in Semester I

CHEMISTRY IN SPORTS, PHYSIOLOGY AND HEALTH

UNITS	KNOWLEDGE	UNDERSTANDING	APPLICATION ANALYSES	TOTAL MARKS- Per unit
1	9	10	6	25
2	08	10	7	25
TOTAL Marks Per objective	17	20	13	50
% WEIGHTAGE	34	40	26	100%

****

© St. Xavier's College (Autonomous), Mumbai, INDIA

APPROVED SYLLABUS

Syllabus

First Semester Courses in Chemistry

2023-2024

Contents:

© St. Xavier's College (Autonomous), Mumbai, INDIA

APPROVED SYLLABUS

PRINCIPAL
ST. XAVIER'S COLLEGE
AUTONOMOUS
MUMBAI - 400 001.

SXCM/Department of Chemistry/NEP/2023-2024

F.Y. B.Sc.- Semester I

Course Code: USCHE4502OE1

Title: SCIENCE OF FOOD AND COOKING

Credits: 2 [(Theory 2 credits (Total 30 hours)]

COURSE OBJECTIVES:

1. To understand the principles of chemical preservation of foods.
2. To appreciate the role of food additives in improving shelf life, quality and texture of foods.
3. To know the monitoring agencies and regulations for controlling safe use of additives.
4. To explore the reactions that food undergoes during cooking and the chemical properties of food.

COURSE OUTCOMES:

After completing the course, the student will be able to –

1. Identify the benefits and limitations of food processing techniques and food additives.
2. Read food labels, analyse nutritional content claims on labels and make informed choices when
3. buying processed foods.
4. Explore applications of various principles of chemistry in cooking.
5. Relate and describe the properties of ingredients to their functional aspects in food.
6. Use appropriate terminology in the context of food chemistry

© St. Xavier's College (Autonomous), Mumbai, INDIA

APPROVED SYLLABUS

UNIT- I FOOD ADDITIVES AND FOOD PROCESSING

(15 L)

1 Food processing, fortification and enrichment.
2 Reading food labels
3 Food preservation: ancient and modern methods of food preservation, use of preservatives.
4 Food additives: emulsifiers, artificial sweeteners, colouring and flavouring agents – permitted and non-permitted.
5 Food Adulteration: Some common adulterants and the use of chemistry in detecting adulterants in food products.
6 Food safety: food additives, regulations and monitoring agencies.

UNIT- II CHEMISTRY OF COOKING

(15 L)

1 Cooking techniques
2 Ingredients: Flour, sugar, eggs, spices, leavening agents etc.
3 Maillard reaction
4 Oxidation and Browning of foods: enzymatic vs non-enzymatic
5 Fermentation
6 Baking
7 Enhancing taste and flavour
8 Microwaving

REFERENCES

1. E for Additives, Maurice Hanssen, Thorsons, 2011.
2. Chemistry of Cooking, Sorangel Rodriguez-Velazquez, 2009.
3. Food Additives, A. Larry Branen, P. Michael Davidson, Seppo Salminen, John Thorngate CRC Press, 2003.
4. The Science of Cooking: Understanding the Biology and Chemistry Behind Food and Cooking, Joseph J. Provost, Keri L. Colabroy, Brenda S. Kelly, Mark A. Wallert, Wiley, 1996.

Evaluation (OE): Total marks per course – 50

Mode of Evaluation: Continuous Assessment (No end semester examination)

Poster Presentation/Project/Presentation/Assignment/ Crossword/MCQs

Total Marks: 50

****

ST. XAVIER'S COLLEGE-AUTONOMOUS MUMBAI-400 001

© St. Xavier's College (Autonomous), Mumbai, INDIA

APPROVED SYLLABUS

Syllabus

First Semester Courses in Chemistry

2023-2024

Contents:

© St. Xavier's College (Autonomous), Mumbai, INDIA

APPROVED SYLLABUS

PRINCIPAL
ST. XAVIER'S COLLEGE
AUTONOMOUS
MUMBAI - 400 001.

F.Y. B.Sc.- SEMESTER - I **COURSE CODE: USCHE4501SE1**

Title: ICT TOOLS IN SCIENCE

Credits: 2 [(Theory 1 credit (15 hours), Practical 1 credit (30 Hours)]

COURSE OBJECTIVES:

1. To use software for drawing 2D and 3D chemical structures and generating IUPAC names.
2. To utilize different templates and reaction symbols in reaction / mechanisms.
3. To obtain information about predicted physical constants of molecules.
4. To present and process data in the form of charts.
5. To familiarize students with simulations in chemistry.
6. To represent basic mathematical equations.

COURSE OUTCOMES:

After completing the course, the student will be able to

1. Draw 2D and 3D structures of molecules.
2. Represent chemical reactions and mechanisms.
3. Insert, convert and export the mathematical expressions.
4. Organize, process and present the scientific data.
5. Use Latex software for better management of documents like research papers.

ST. XAVIER'S COLLEGE-AUTONOMOUS MUMBAI-400 001

© St. Xavier's College (Autonomous), Mumbai, INDIA

APPROVED SYLLABUS

UNIT - I: Data Management System (Excel, Origin Pro, Anaconda, GeoGebra) and AI, MathType, LaTeX, Drawing tools in Sciences (ChemSketch) (15 L)

1 Data Management System: Introduction and importance

- **Data Management System:**
  a. Create and format an excel chart
  b. Charts Styles and Layouts
  c. Chart Titles and Series Titles
  d. Create charts like Pie, Line, Column, Bar in excel
  e. Format charts
  f. Mathematical calculations

2 LaTeX: Introduction to LaTeX, Understanding LaTeX

- **LaTeX Basics**
- **Figures and tables**
- **Document structure, formatting and fonts**
- **Use of LaTeX in Mathematics and Sciences**
- **References and Citations**

3 Drawing tools in sciences (ChemSketch): Introduction and Importance

- **Drawing chemical structures, templates, text and labels-**
  a. Aliphatic molecules
  b. Aromatic molecules
  c. Long chain molecules
  d. Chiral molecule
  e. Polycyclic molecule
  f. Resonance structures
  g. Templates

REFERENCES

1. **LaTeX for Complete Novices: Nicola L. C. Talbot, Dickimaw LaTeX Series, Volume:1, Version:1.4, 2012.**

2. **Microsoft Excel 2019 Formulas and Functions, Paul McFedries, 2019.**

© St. Xavier's College (Autonomous), Mumbai, INDIA

APPROVED SYLLABUS

PRACTICAL:

30 hours of Hands on practical for all the above-mentioned topics from Unit I

UNIT - II: Data Management System (Excel, Origin Pro, Anaconda, GeoGebra) and AI, MathType, LaTeX, Drawing tools in Sciences (ChemSketch) (30 Hours)

1 Data Management System

a. Create and format an excel chart
b. Charts Styles and Layouts
c. Chart Titles and Series Titles
d. Create charts like Pie, Line, Column, Bar in excel
e. Format charts
f. Mathematical calculations

2 LaTeX

- **LaTeX Basics**
- **Figures and tables**
- **Document structure, formatting and fonts**
- **Use of LaTeX in Mathematics and Sciences**
- **References and Citations**

3 Drawing tools in sciences (ChemSketch)

- **Drawing chemical structures, templates, text and labels-**
  a. Aliphatic molecules
  b. Aromatic molecules
  c. Long chain molecules
  d. Chiral molecule
  e. Polycyclic molecule
  f. Resonance structures
  g. Templates

Evaluation (SEC) (Only Practical): Total marks per course – 50

I. Formative Assessment 'for' Learning (continuous internal assessment - CIA to improve learning).
CIA- 20 marks

II. Summative Assessment 'of' Learning (focus on outcomes, quantitative data for outcomes of instruction).
End Semester Examination – 30 marks.

****

ST. XAVIER'S COLLEGE-AUTONOMOUS * MUMBAI-400 001 *

© St. Xavier's College (Autonomous), Mumbai, INDIA

APPROVED SYLLABUS

Syllabus

First Semester Courses in Chemistry

2023-2024

Contents:

ST. XAVIER'S COLLEGE-AUTONOMOUS MUMBAI-400001

PRINCIPAL
ST. XAVIER'S COLLEGE
AUTONOMOUS
MUMBAI - 400 001.

© St. Xavier's College (Autonomous), Mumbai, INDIA

APPROVED SYLLABUS

F.Y.B.Sc.-SEMESTER - I

COURSE CODE: UXEVS4501VE1

Title: ENVIRONMENTAL STUDIES

Credits: 2 [(Theory 2 credits (Total 30 hours)]

COURSE OBJECTIVES:

1. To gain insights into natural resources and factors affecting their availability.
2. To grasp the significance of ecosystems, biodiversity and conservation.
3. To make students aware of pollution, its types and sources.
4. To develop a critical understanding of the environmental issues of concern.
5. To comprehend broad aspects of environmental management systems.
6. To introduce the major international treaties and our country's stand on and responses to the major international agreements.
7. To appreciate the role of major international organizations in environmental policies.

COURSE OUTCOMES:

After completing this course, students will be able to:

1. Outline the types of natural resources, their conservation and management.
2. Identify the types of pollutants and sensitize themselves to adverse health impacts of pollution.
3. Explain sustainable development, its goals, challenges and global strategies.
4. Describe the factors impacting biodiversity loss and ecosystem degradation in India and the world.
5. Assess environmental quality and associated risks.
6. Explain major conservation strategies and policies

ST. XAVIER'S COLLEGE-AUTONOMOUS MUMBAI-400

© St. Xavier's College (Autonomous), Mumbai, INDIA

UNIT- I FUNDAMENTALS OF ENVIRONMENTAL STUDIES (15 L)

1 Introduction to Environmental Studies

- Scope and importance.
- Concept of sustainability and sustainable development

2 Ecosystems

- Definition and concept of Ecosystem.
- Structure of ecosystem (biotic and abiotic components);
- Functions of Ecosystem: Physical (energy flow), Biological (food chains, food web, ecological succession), ecological pyramids and homeostasis.
- Types of Ecosystems.

3 Natural Resources

- **Land resources and land-use changes**: Definition and types, Land degradation, soil erosion and desertification; Impacts of mining and dam building on environment;
- **Water resources**: Definition and types; Natural and man-made sources; Uses of water; Over exploitation of surface and ground water resources; Floods, droughts;
- **Energy resources**: Definition and types; Renewable and non-renewable energy sources; Use of alternate energy sources
- **Disaster management:** Definition and types (Natural and Man-made); Self-protection during disasters (Fire, Floods, Earthquakes, landslides.

4 Biodiversity and Conservation

- **Biodiversity**: Definition and Levels of biological diversity
- Biodiversity hotspots and Endemic and endangered species of India, IUCN Red list criteria and categories, Threats to biodiversity
- **Biodiversity conservation strategies:** in-situ and ex-situ methods of conservation

UNIT- II POLLUTION AND POLICIES (15 L)

1 Environmental Pollution, global issues and management

- **Environmental pollution:** Types, causes, effects and controls; Air, water, soil and noise pollution, Pollutants and its types, Urbanization/Industrialization/Nuclear hazards and human health risks
- **Global Environmental Issues**: Climate change, Global warming, Ozone layer depletion, and Acid rain
- **Pollution control and management:**
- **Waste Management-** Concept of 3R (Reduce, Recycle and Reuse) and sustainability; Ecolabeling /Ecomark scheme
- **Solid waste management:** Control measures of urban and industrial waste.

© St. Xavier's College (Autonomous), Mumbai, INDIA

APPROVED SYLLABUS

2 **Environmental Treaties and Legislation**

- **Environment movements** – Chipko, Narmada Bachao Andolan, Silent valley, Bishnois of Rajasthan
- **Environment legislation in India:** Constitutional provisions- Article 48A, Article 51A (g) and other derived environmental rights; Wildlife Protection Act, 1972; Water (Prevention and Control of Pollution) Act, 1974; Forest (Conservation) Act 1980; Air (Prevention & Control of Pollution) Act, 1981; Environment Protection Act, 1986; Scheduled Tribes and other Traditional Forest Dwellers (Recognition of Forest Rights) Act, 2006, Biodiversity Act (2002); National Environmental Policy, 2006 – Provisions and importance
- **International agreements** – Montreal and Kyoto protocols. India's status as a party to major conventions.
- **Environmental Impact Assessment** – Concept; Swachh Bharat Mission– Objectives
- **Major International organizations and initiatives**: United Nations Environment Programme (UNEP), International Union for Conservation of Nature (IUCN), World Commission on Environment and Development (WCED), United Nations Educational, Scientific and Cultural Organization (UNESCO), Intergovernmental Panel on Climate Change (IPCC), and Man and the Biosphere (MAB) programme.

REFERENCE BOOKS

1. Richard A. Marcantonio, Marc Lame (2022). Environmental Management: Concepts and Practical Skills. Cambridge University Press
2. Varghese, Anita, Oommen, Meera Anna, Paul, Mridula Mary, Nath, Snehlata (Editors) (2022) Conservation through Sustainable Use: Lessons from India. Routledge.
3. Manahan, S.E. (2022). Environmental Chemistry (11th ed.). CRC Press. https://doi.org/10.1201/9781003096238
4. Kanchi Kohli and Manju Menon (2021) Development of Environment Laws in India, Cambridge University Press.
5. Theodore, M. K. and Theodore, Louis (2021) Introduction to Environmental Management, 2nd Edition. CRC Press.
6. John W. Twidell and Anthony D. (2015). Renewable Energy Sources, 3rd Edition, Weir Publisher (ELBS)
7. Ahluwalia, V. K. (2015). Environmental Pollution, and Health. The Energy and Resources Institute (TERI).
8. Harris, Frances (2012) Global Environmental Issues, 2nd Edition. Wiley- Blackwell.
9. Rajagopalan, R. (2011). Environmental Studies: From Crisis to Cure. India: Oxford University Press
10. Chiras, D. D and Reganold, J. P. (2010). Natural Resource Conservation: Management for a Sustainable Future.10th edition, Upper Saddle River, N. J. Benjamin/Cummins/Pearson.
11. Pittock, Barrie (2009) Climate Change: The Science, Impacts and Solutions. 2nd Edition. Routledge.
12. Basker, Sushmitha & Bhasker, R. (2007) Environmental Studies for Undergraduate Courses, New Delhi, Unicorn Books.
13. Singh, J.S., Singh, S.P. & Gupta, S.R. 2006. Ecology, Environment and Resource Conservation. Anamaya Publications https://sdgs.un.org/goals

© St. Xavier's College (Autonomous), Mumbai, INDIA

14. World Commission on Environment and Development. (1987). Our Common Future. Oxford University Press

Links for Reference:

1. Ministry of Environment, Forest and Climate Change (2019) A Handbook on International Environment Conventions & Programmes: https://moef.gov.in/wp-content/uploads/2020/02/convention-V-16-CURVE-web.pdf
2. Central Pollution Control Board Web page for various pollution standards. https://cpcb.nic.in/standards/
3. India Code – Digital repository of all Central and State Acts: https://www.indiacode.nic.in/

Evaluation (VEC): Total marks per course - 50

I. Formative Assessment 'for' Learning (continuous internal assessment - CIA to improve learning).
CIA- Assignment/ Project/ Poster/ Model making/ Case study/ Seminar/ Field visit/ Beach cleanup/ Presentation - 20 marks

II. Summative Assessment 'of' Learning (focus on outcomes, quantitative data for outcomes of instruction).
End Semester Examination -30 marks
Multiple Choice based questions / SAQ- 30 marks

Template for Value Enhancement Course End Semester Examination in Semester I

ENVIRONMENTAL STUDIES

UNITS	KNOWLEDGE	UNDERSTANDING	APPLICATION ANALYSES	TOTAL MARKS- Per unit
1	8	10	7	25
2	10	10	5	25
TOTAL Marks Per objective	18	20	12	50
% WEIGHTAGE	36	40	24	100%

****

© St. Xavier's College (Autonomous), Mumbai, INDIA

Syllabus

Second Semester Courses in Chemistry

2023-2024

Contents:

- Syllabus for Core Course
  - USCHE4502CR1 - Essentials of Physical and Analytical Chemistry- I
- Evaluation and Assessment guidelines

© St. Xavier's College (Autonomous), Mumbai, INDIA

APPROVED SYLLABUS

PRINCIPAL
ST. XAVIER'S COLLEGE
AUTONOMOUS
MUMBAI - 400 001.

F.Y. B.Sc.- Semester II

Course Code: USCHE4502CR1

Title: Essentials of Physical and Analytical Chemistry- I

Credits: 4 [(Theory 3 credits (Total 45 hours) and Practical 1 credit (Total 30 hours)]

COURSE OBJECTIVES:

1. To explore stoichiometric relations in different types of chemical reactions.
2. To apply interconversions relating various concentration units in commercial samples.
3. To analyze the significance of buffers and solubility product in solutions.
4. To understand the fundamentals involved in various titrimetric analysis.
5. To appreciate the role of kinetic studies in Industry and life processes.
6. To apply kinetic concepts to various categories of catalysed reactions.
7. To learn to perform experiments that have specific aims with correct techniques.
8. To develop skills of observation, recording and analysing data.

COURSE OUTCOMES:

After completing the course, the student will be able to

1. Perform stoichiometric calculations for different types of chemical reactions.
2. Inter-convert different concentration units used in solutions.
3. Relate use of buffer solutions and solubility product principles in analytical chemistry and biological systems.
4. Recognise appropriate titrimetric method and suitable indicator.
5. Understand the kinetics of different types of reactions and role of catalysis in the industry and life processes.
6. Present the experimental work in a systematic manner.

© St. Xavier's College (Autonomous), Mumbai, INDIA

APPROVED SYLLABUS

UNIT-I CHEMICAL CALCULATIONS AND STOICHIOMETRY (15 L)

1 Mole concept, determination of molecular mass by gram molecular volume relationship for chemical reactions, problems based on mole concept.

2 Methods of expressing concentration of solutions: molarity, normality, molality, mole fraction, formality, comparative significance and limitations of these concentration units, dilution of solutions, inter-conversion between different concentration units, concept of milliequivalents, millimoles, ppm and ppb. Relevance of different concentration units in scientific studies and industry.

3 Quantitative Analysis: Basic concepts involved in Gravimetric and Volumetric analysis: Calibration of glassware, pipette, burette and volumetric flask.

4 Analysis of Commercial Samples: primary and secondary standards, calculation of concentration of commercial samples of acids and bases like HCl, H_2SO_4, acetic acid and ammonia.

5 Importance of accuracy, precision and sources of error in analytical measurements, presentation of experimental data and results from the point of view of significant figures

UNIT-II SOLUTION DYNAMICS (15 L)

1 **Important concepts:** Buffer solutions: types of buffers, derivation of Henderson–Hasselbalch equation and its applications; buffer capacity, buffer range, buffer action and applications of buffers (numerical problems expected). Solubility product, factors affecting precipitation equilibria (solubility product) in qualitative analysis: common ion effect, pH, complexation, diverse ion effect, oxidation states (numerical problems expected).

2 **Titrimetric Methods - Types of titrations and indicators:**

- Acid-base titrations: Theory of indicators, theory of acid base indicators, mixed and universal indicators, explanation of the shapes of neutralisation curves for strong acid - strong base, weak acid - strong base, weak base - strong acid, weak acid - weak base, choice of indicators (numerical problems expected on strong acid- strong base and weak acid-strong base).
- Oxidation-Reduction Titration: Principle and only theoretical discussion (using suitable examples), types of redox indicators, detection of end point.
- Iodometry and Iodimetry: General discussion, detection of end point, difference between iodometry and iodimetry
- Complexometric Titration: familiarisation with some basic terms: ligands, chelates, metallochrome indicators, Principle of complexometric titrations (using suitable examples), role of pH, masking, demasking agents, detection of end point.
- Precipitation Titration: Principle and theoretical discussion (using suitable examples), end point detection through different methods.

UNIT-III Kinetics and Catalysis (15 L)

1 Rate and Order of reaction: zero, first order and second order reactions (equal and unequal reactant concentration, pseudo-first order reaction, Integrated rate law expressions for different order reactions,

© St. Xavier's College (Autonomous), Mumbai, INDIA

APPROVED SYLLABUS

Methods to determine order of reactions, variation of concentration with time in zero, first and second order reaction, half- life period and its significance, Effect of temperature on reaction rates: Arrhenius equation and significance of Arrhenius parameters, experimental techniques to study slow and fast biochemical reactions.

2 Theories of reaction rates (Only Postulates and Limitations, no derivation): Collision theory of bimolecular reactions, Lindemann theory of unimolecular reactions, Activated Complex theory.

3 Catalyst and catalysis: positive and negative catalysis, type of catalysis, characteristics of catalytic reactions, promoters, catalytic poisoning, autocatalysis. Activation energy and catalysis, theories of catalysis, active centre on catalyst surface, adsorption theory and catalytic activity (theoretical aspect only), Acid – Base catalysis and its applications in industry, Enzyme catalysis; Michaelis-Menten equation (No derivation), mechanism of enzyme catalysis, characteristics of enzyme catalysis, effect of temperature on enzyme catalysis (qualitative approach only), applications.

REFERENCES

1. Textbook of Physical Chemistry, Sharma and Puri, 2022.
2. A Textbook of Physical Chemistry, Vol 1, 5th Ed., Kapoor, K.L, McGraw Hill Education, 2018.
3. Physical Chemistry 9th Ed., Atkins, P. W. & Paula, J. de Atkins Oxford University Press 2011.
4. Fundamentals of analytical chemistry, 8th edition, Skoog, West, Holler and Crouch, 2008.
5. Physical Chemistry, G.M. Barrow, 6th Edition, Tata McGraw Hill Publishing Co. Ltd. New Delhi, 2006.
6. Physical Chemistry, 4th Ed., Castellan, G. W. Narosa 2004.
7. Chemical Kinetics, J. Laidler, K. Pearson Education: New Delhi 2004.

PRACTICAL:

EXPERIMENTS:

A. VOLUMETRIC ESTIMATIONS

1. Calibration of glassware.
2. Determination of strength and percentage composition of a mixture of Na_2CO_3 and $NaHCO_3$.
3. Determination of strength and percentage composition of a mixture of Oxalic acid and Potassium oxalate.
4. Estimation of Fe^{2+} versus $K_2Cr_2O_7$ using an internal indicator (diphenylamine).
5. Complexometry: Estimation of Mg^{2+}, Cu^{2+} using EDTA

B. COMMERCIAL ANALYSIS (Minimum 2)

To determine the strength of commercial samples of antacid, vinegar, acetic acid and HCl [standard succinic acid solution to be prepared by the students to standardize the given NaOH solution]

C. CHEMICAL KINETICS

1. To investigate the hydrolysis of methyl acetate in HCl and identify the rate constant graphically as well as by calculations. (Pseudo first order reaction)

ST. XAVIER'S COLLEGE-AUTONOMOUS MUMBAI-400 001

© St. Xavier's College (Autonomous), Mumbai, INDIA

APPROVED SYLLABUS

2. To study the reaction between KI and $K_2S_2O_8$ using equal concentrations. (Second order reaction with equal concentration)

Evaluation (Core Theory): Total marks per course – 100

I. Formative Assessment 'for' Learning (continuous internal assessment - CIA to improve learning).

CIA- 40 marks

CIA I: Short answer questions and crossword- 20 marks

CIA II: MCQ- 20 marks

II. Summative Assessment 'of' Learning (focus on outcomes, quantitative data for outcomes of instruction).

End Semester Examination – 60 marks

Total number of questions: 3 [all compulsory] of 20 marks each.
One Question per unit.
Question set out of 30 marks [50% internal choice].
Sub questions will not exceed 5 marks.

Evaluation of (Practical) Total marks Practical course - 50.
Journal: 05 marks
CIA: 15 marks
End Semester Examination: 30 marks (25 marks experiment and 5 marks viva)
Total Marks: 50

Template for the Core course End Semester Examination in Semester II

ESSENTIALS OF PHYSICAL AND ANALYTICAL CHEMISTRY- AN INTRODUCTION

UNIT	KNOWLEDGE	UNDERSTANDING	APPLICATION	TOTAL MARKS
I	04	06	10	20
II	04	07	09	20
III	06	07	07	20
TOTAL MARKS PER OBJECTIVE	14	20	26	60
% WEIGHTAGE	23	33	44	100

****

ST. XAVIER'S COLLEGE-AUTONOMOUS MUMBAI-400 001

© St. Xavier's College (Autonomous), Mumbai, INDIA

Syllabus

Second Semester Courses in Chemistry

2023-2024

Contents:

- Syllabus for Vocational Skill course (VSC)
  - USCHE4501VS1 - ICT TOOLS IN CHEMISTRY
- Evaluation and Assessment guidelines

© St. Xavier's College (Autonomous), Mumbai, INDIA

APPROVED SYLLABUS

PRINCIPAL
ST. XAVIER'S COLLEGE
AUTONOMOUS
MUMBAI - 400 001.

F.Y. B.Sc.- Semester II

Course: USCHE4501VS1

Title: ICT TOOLS IN CHEMISTRY

Credits: 2 [(Theory 1 credit (Total 15 hours) and Practical 1 credit (30 hours)]

COURSE OBJECTIVES:

1. To use software for drawing 2D and 3D chemical structures and generating IUPAC names.
2. To utilize different templates and reaction symbols in reaction / mechanisms.
3. To obtain information about predicted physical constants of molecules.
4. To present and process data in the form of charts.
5. To familiarize students with simulations in chemistry.
6. To represent basic mathematical equations.

COURSE OUTCOMES:

After completing the course, the student will be able to

1. Draw 2D and 3D structures of molecules.
2. Represent chemical reactions and mechanisms.
3. Insert, convert and export the mathematical expressions.
4. Organize, process and present the scientific data.
5. Use Latex software for better management of documents like research papers.

© St. Xavier's College (Autonomous), Mumbai, INDIA

APPROVED SYLLABUS

UNIT - I Data Management system (Excel, Origin Pro) and AI, MathType, Simulations in chemistry, LaTeX, ChemSketch, ChemDraw, ISIS (Integrated Scientific Information System) Draw and ChemDoodle **(15L)**

1 Data Management system: Introduction and Importance

- **Data Management system:**
  a. Create and format an excel chart
  b. Charts Styles and Layouts
  c. Chart Titles and Series Titles
  d. Create charts like Pie, Line, Column, Bar in excel
  e. Format charts
  f. Mathematical calculations

2 Simulations in chemistry, drawing experimental setups in chemistry laboratory: Introduction and Importance

- **Simulations**
  a. Atomic model
  b. Interaction of light and matter
  c. States of matter and laws
  d. Heat and energy
  e. Molecules in motion
  f. Solutions
  g. Chemical reactions
  h. Chemical bonding
  i. Electrochemistry
  j. Wolfram and Desmos
- **Drawing experimental setups in chemistry laboratory**
  a. Containers
  b. Filtering
  c. Metallic
  d. Ceramic
  e. Devices
  f. Chromatography
  g. Storage

3 LaTeX: Introduction and Importance

- **LaTeX Basics**
- **Figures and tables**
- **Document structure, formatting and fonts**
- **Chemistry in LaTeX**
- **References and Citations**

4 ChemSketch, ChemDraw, ISIS Draw and ChemDoodle: Introduction and Importance

- **Drawing chemical structures, templates, text and labels-**

ST. XAVIER'S COLLEGE-AUTONOMOUS MUMBAI-400

© St. Xavier's College (Autonomous), Mumbai, INDIA

APPROVED SYLLABUS

a. Aliphatic molecules
b. Aromatic molecules
c. Long chain molecules
d. Chiral molecule
e. Polycyclic molecule
f. Resonance structures
g. Lewis structures
h. Templates

- **Representation of reaction schemes and mechanisms**
  a. Reaction arrows
  b. Half head and curly arrows, bonds
  c. Radical, nucleophilic and electrophilic mechanisms
- **Nomenclature, properties and 3D structures**
  a. IUPAC names from structures
  b. Obtaining physical properties
  c. Importing Structures from 2D to 3D and different representations of the 3D molecules
  d. Calculating bond lengths and bond angles
  e. Configurational Isomers

REFERENCES

1. Microsoft Excel 2019 Formulas and Functions, Paul McFedries, 2019.
2. LaTeX for Complete Novices: Nicola L. C. Talbot, Dickimaw LaTeX Series, Volume:1, Version:1.4, 2012.

PRACTICAL:

30 hours of Hands on practical for all the above-mentioned topics from Unit I

UNIT-II Data Management system (Excel, Origin Pro) and AI, MathType, Simulation in Chemistry, LaTeX, ChemSketch, ChemDraw, ISIS Draw and ChemDoodle (30 hours)

1 Data Management System:

a. Create and format an excel chart
b. Charts Styles and Layouts
c. Chart Titles and Series Titles
d. Create charts like Pie, Line, Column, Bar in excel
e. Format charts
f. Mathematical calculations

2 Simulations in chemistry drawing, experimental setups in chemistry laboratory

- **Simulations**
  a. Atomic model
  b. Interaction of light and matter
  c. States of matter and laws
  d. Heat and energy

© St. Xavier's College (Autonomous), Mumbai, INDIA

APPROVED SYLLABUS

e. Molecules in motion
f. Solutions
g. Chemical reactions
h. Chemical bonding
i. Electrochemistry
j. Wolfram and Desmos

- **Drawing experimental setups in chemistry laboratory**
  a. Containers
  b. Filtering
  c. Metallic
  d. Ceramic
  e. Devices
  f. Chromatography
  g. Storage

3 LaTeX

- **LaTeX Basics**
- **Figures and tables**
- **Document structure, formatting and fonts**
- **Chemistry in LaTeX**
- **References and Citations**

4 ChemSketch, ChemDraw, ISIS Draw and ChemDoodle:

- **Drawing chemical structures, templates, text and labels-**
  a. Aliphatic molecules
  b. Aromatic molecules
  c. Long chain molecules
  d. Chiral molecule
  e. Polycyclic molecule
  f. Resonance structures
  g. Lewis structures
  h. Templates
- **Representation of reaction schemes and mechanisms-**
  a. Reaction arrows
  b. Half head and curly arrows, bonds
  c. Radical, nucleophilic and electrophilic mechanisms
- **Nomenclature and properties-**
  a. IUPAC names from structures
  b. Obtaining physical properties
- **3D Structures**
  a. Importing Structures from 2D to 3D and different representations of the 3D molecules
  b. Calculating bond lengths and bond angles
  c. Configurational Isomers

ST. XAVIER'S COLLEGE-AUTONOMOUS * MUMBAI-400 001 *

© St. Xavier's College (Autonomous), Mumbai, INDIA

APPROVED SYLLABUS

Evaluation (VSC) (Only Practical): Total marks per course – 50

I. Formative Assessment 'for' Learning (continuous internal assessment - CIA to improve learning).
CIA- 20 marks

II. Summative Assessment 'of' Learning (focus on outcomes, quantitative data for outcomes of instruction).
End Semester Examination – 30 marks

****

© St. Xavier's College (Autonomous), Mumbai, INDIA

APPROVED SYLLABUS

Syllabus

Second Semester Courses in Chemistry

2023-2024

Contents:

© St. Xavier's College (Autonomous), Mumbai, INDIA

APPROVED SYLLABUS

PRINCIPAL
ST. XAVIER'S COLLEGE
AUTONOMOUS
MUMBAI - 400 001.

F.Y. B.Sc.- Semester II **Course Code: USCHE4501OE1**

Title: CHEMISTRY IN SPORTS, PHYSIOLOGY AND HEALTH

Credits: 2 [(Theory 2 credits (Total 30 hours)]

COURSE OBJECTIVES:

1. To understand the relationship between nutrition and exercise.
2. To evaluate supplements and nutraceuticals used to enhance performance in sports.
3. To assess the link between improved sporting equipment and record-breaking performances.

COURSE OUTCOMES:

After completing the course, the student will be able to

1. Apply knowledge of chemistry to sports related issues.
2. Explore how changes in materials technology have improved athletes' performance.
3. Relate dietary and physiological aspects affecting physical activity and performance.
4. Analyse doping in sports and its impact on individuals, organisations and society.

ST. XAVIER'S COLLEGE-AUTONOMOUS MUMBAI-400 001

© St. Xavier's College (Autonomous), Mumbai, INDIA

UNIT- I CHEMISTRY IN SPORTS EQUIPMENTS (15 L)

1 Chemistry of sports materials- Racquets, Balls, Courts, Bicycles, rafts etc.
2 Olympic motto "citius, altius, fortius"- Does Chemistry make sportsmen faster, higher, stronger?
3 Innovations in sports apparel
4 Materials for injury prevention
5 Use of performance enhancing drugs in sports: anabolic steroids, stimulants, hormones, narcotics etc.
6 Doping scandals

UNIT- II CHEMISTRY IN SPORTS NUTRITION (15 L)

1 Nutritional supplements: Protein supplements, Creatine, caffeine etc
2 Role of water and electrolytes in sports performance,
3 Recovery products: sports drinks/energy drinks etc
4 Regulations of dietary supplements
5 Chemistry in drug monitoring

REFERENCES

1. Doping, Performance-Enhancing Drugs, and Hormones in Sport: Mechanisms of Action and Methods of Detection by Anthony C Hackney, 2008.

Evaluation (OE): Total marks per course – 50

I. Formative Assessment 'for' Learning (continuous internal assessment - CIA to improve learning).
CIA- Poster, Assignments, Presentations- 20 marks

II. Summative Assessment 'of' Learning (focus on outcomes, quantitative data for outcomes of instruction).
End Semester Examination -30 marks

Template for Open Elective course End Semester Examination in Semester II

CHEMISTRY IN SPORTS, PHYSIOLOGY AND HEALTH

UNITS	KNOWLEDGE	UNDERSTANDING	APPLICATION ANALYSES	TOTAL MARKS- Per unit
1	9	10	6	25
2	08	10	7	25
TOTAL Marks Per objective	17	20	13	50
% WEIGHTAGE	34	40	26	100%

****

© St. Xavier's College (Autonomous), Mumbai, INDIA

APPROVED SYLLABUS

Syllabus

Second Semester Courses in Chemistry

2023-2024

Contents:

- Syllabus for Open Elective/s (OE)
  - USCHE4502OE1 - SCIENCE OF FOOD AND COOKING
- Evaluation and Assessment guidelines

© St. Xavier's College (Autonomous), Mumbai, INDIA

APPROVED SYLLABUS

PRINCIPAL
ST. XAVIER'S COLLEGE
AUTONOMOUS
MUMBAI - 400 001.

SXCM/Department of Chemistry/NEP/2023-2024

F.Y. B.Sc.- Semester II

Course Code: USCHE4502OE1

Title: SCIENCE OF FOOD AND COOKING

Credits: 2 [(Theory 2 credits (Total 30 hours)]

COURSE OBJECTIVES:

1. To understand the principles of chemical preservation of foods.
2. To appreciate the role of food additives in improving shelf life, quality and texture of foods.
3. To know the monitoring agencies and regulations for controlling safe use of additives.
4. To explore the reactions that food undergoes during cooking and the chemical properties of food.

COURSE OUTCOMES:

After completing the course, the student will be able to –

1. Identify the benefits and limitations of food processing techniques and food additives.
2. Read food labels, analyse nutritional content claims on labels and make informed choices when
3. buying processed foods.
4. Explore applications of various principles of chemistry in cooking.
5. Relate and describe the properties of ingredients to their functional aspects in food.
6. Use appropriate terminology in the context of food chemistry

© St. Xavier's College (Autonomous), Mumbai, INDIA

APPROVED SYLLABUS

UNIT- I FOOD ADDITIVES AND FOOD PROCESSING (15 L)

1 Food processing, fortification and enrichment.
2 Reading food labels
3 Food preservation: ancient and modern methods of food preservation, use of preservatives.
4 Food additives: emulsifiers, artificial sweeteners, colouring and flavouring agents – permitted and non-permitted.
5 Food Adulteration: Some common adulterants and the use of chemistry in detecting adulterants in food products.
6 Food safety: food additives, regulations and monitoring agencies.

UNIT- II CHEMISTRY OF COOKING (15 L)

1 Cooking techniques
2 Ingredients: Flour, sugar, eggs, spices, leavening agents etc.
3 Maillard reaction
4 Oxidation and Browning of foods: enzymatic vs non-enzymatic
5 Fermentation
6 Baking
7 Enhancing taste and flavour
8 Microwaving

REFERENCES

1. E for Additives, Maurice Hanssen, Thorsons, 2011.
2. Chemistry of Cooking, Sorangel Rodriguez-Velazquez, 2009.
3. Food Additives, A. Larry Branen, P. Michael Davidson, Seppo Salminen, John Thorngate CRC Press, 2003.
4. The Science of Cooking: Understanding the Biology and Chemistry Behind Food and Cooking, Joseph J. Provost, Keri L. Colabroy, Brenda S. Kelly, Mark A. Wallert, Wiley, 1996.

Evaluation (OE): Total marks per course – 50

Mode of Evaluation: Continuous Assessment (No end semester examination)

Poster Presentation/Project/Presentation/Assignment/ Crossword/MCQs

Total Marks: 50

****

© St. Xavier's College (Autonomous), Mumbai, INDIA

ST. XAVIER'S COLLEGE-AUTONOMOUS MUMBAI-400 001

APPROVED SYLLABUS

Syllabus

Second Semester Courses in Chemistry

2023-2024

Contents:

- Syllabus for Skill Enhancement Course/s (SEC)
  - USCHE4501SE1 - ICT TOOLS IN SCIENCE
- Evaluation and Assessment guidelines

© St. Xavier's College (Autonomous), Mumbai, INDIA

APPROVED SYLLABUS

PRINCIPAL
ST. XAVIER'S COLLEGE
AUTONOMOUS
MUMBAI - 400 001.

F.Y. B.Sc.- SEMESTER - II

COURSE CODE: USCHE4501SE1

Title: **ICT TOOLS IN SCIENCE**

Credits: 2 [(Theory 1 (15 hours), Practical 1 (30 Hours)]

COURSE OBJECTIVES:

1. To use software for drawing 2D and 3D chemical structures and generating IUPAC names.
2. To utilize different templates and reaction symbols in reaction / mechanisms.
3. To obtain information about predicted physical constants of molecules.
4. To present and process data in the form of charts.
5. To familiarize students with simulations in chemistry.
6. To represent basic mathematical equations.

COURSE OUTCOMES:

After completing the course, the student will be able to

1. Draw 2D and 3D structures of molecules.
2. Represent chemical reactions and mechanisms.
3. Insert, convert and export the mathematical expressions.
4. Organize, process and present the scientific data.
5. Use Latex software for better management of documents like research papers.

© St. Xavier's College (Autonomous), Mumbai, INDIA

APPROVED SYLLABUS

UNIT - I: Data Management System (Excel, Origin Pro, Anaconda, GeoGebra) and AI, MathType, LaTeX, Drawing tools in Sciences (ChemSketch) **(15 L)**

1 Data Management System: Introduction and importance

- **Data Management System:**
  - **a.** Create and format an excel chart
  - **b.** Charts Styles and Layouts
  - **c.** Chart Titles and Series Titles
  - **d.** Create charts like Pie, Line, Column, Bar in excel
  - **e.** Format charts
  - **f.** Mathematical calculations

2 LaTeX: Introduction to LaTeX, Understanding LaTeX

- **LaTeX Basics**
- **Figures and tables**
- **Document structure, formatting and fonts**
- **Use of LaTeX in Mathematics and Sciences**
- **References and Citations**

3 Drawing tools in sciences (ChemSketch): Introduction and Importance

- **Drawing chemical structures, templates, text and labels-**
  - **a.** Aliphatic molecules
  - **b.** Aromatic molecules
  - **c.** Long chain molecules
  - **d.** Chiral molecule
  - **e.** Polycyclic molecule
  - **f.** Resonance structures
  - **g.** Templates

REFERENCES

1. LaTeX for Complete Novices: Nicola L. C. Talbot, Dickimaw LaTeX Series, Volume:1, Version:1.4, 2012.

2. Microsoft Excel 2019 Formulas and Functions, Paul McFedries, 2019.

ST. XAVIER'S COLLEGE-AUTONOMOUS MUMBAI-400 001

© St. Xavier's College (Autonomous), Mumbai, INDIA

APPROVED SYLLABUS

PRACTICAL:

30 hours of Hands on practical for all the above-mentioned topics from Unit I

UNIT - II: Data Management System (Excel, Origin Pro, Anaconda, GeoGebra) and AI, MathType, LaTeX, Drawing tools in Sciences (ChemSketch) **(30 Hours)**

1 **Data Management System**

a. Create and format an excel chart
b. Charts Styles and Layouts
c. Chart Titles and Series Titles
d. Create charts like Pie, Line, Column, Bar in excel
e. Format charts
f. Mathematical calculations

2 **LaTeX**

- **LaTeX Basics**
- **Figures and tables**
- **Document structure, formatting and fonts**
- **Use of LaTeX in Mathematics and Sciences**
- **References and Citations**

3 **Drawing tools in sciences (ChemSketch)**

- **Drawing chemical structures, templates, text and labels-**
  a. Aliphatic molecules
  b. Aromatic molecules
  c. Long chain molecules
  d. Chiral molecule
  e. Polycyclic molecule
  f. Resonance structures
  g. Templates

Evaluation (SEC) (Only Practical): Total marks per course – 50

I. Formative Assessment 'for' Learning (continuous internal assessment - CIA to improve learning).
CIA- 20 marks

II. Summative Assessment 'of' Learning (focus on outcomes, quantitative data for outcomes of instruction).
End Semester Examination – 30 marks.

****

ST. XAVIER'S COLLEGE-AUTONOMOUS * MUMBAI-400 001 *

© St. Xavier's College (Autonomous), Mumbai, INDIA

APPROVED SYLLABUS

Syllabus

Second Semester Courses in Chemistry

2023-2024

Contents:

PRINCIPAL
ST. XAVIER'S COLLEGE
AUTONOMOUS
MUMBAI - 400 001.

© St. Xavier's College (Autonomous), Mumbai, INDIA

APPROVED SYLLABUS

F.Y.B.Sc.-SEMESTER - II **COURSE CODE: UXEVS4501VE1**

Title: ENVIRONMENTAL STUDIES

Credits: 2 [(Theory 2 credits (Total 30 hours)]

COURSE OBJECTIVES:

1. To gain insights into natural resources and factors affecting their availability.
2. To grasp the significance of ecosystems, biodiversity and conservation.
3. To make students aware of pollution, its types and sources.
4. To develop a critical understanding of the environmental issues of concern.
5. To comprehend broad aspects of environmental management systems.
6. To introduce the major international treaties and our country's stand on and responses to the major international agreements.
7. To appreciate the role of major international organizations in environmental policies.

COURSE OUTCOMES:

After completing this course, students will be able to:

1. Outline the types of natural resources, their conservation and management.
2. Identify the types of pollutants and sensitize themselves to adverse health impacts of pollution.
3. Explain sustainable development, its goals, challenges and global strategies.
4. Describe the factors impacting biodiversity loss and ecosystem degradation in India and the world.
5. Assess environmental quality and associated risks.
6. Explain major conservation strategies and policies

ST. XAVIER'S COLLEGE-AUTONOMOUS MUMBAI-400

© St. Xavier's College (Autonomous), Mumbai, INDIA

APPROVED SYLLABUS

UNIT- I FUNDAMENTALS OF ENVIRONMENTAL STUDIES (15 L)

1 Introduction to Environmental Studies

- Scope and importance.
- Concept of sustainability and sustainable development

2 Ecosystems

- Definition and concept of Ecosystem.
- Structure of ecosystem (biotic and abiotic components);
- Functions of Ecosystem: Physical (energy flow), Biological (food chains, food web, ecological succession), ecological pyramids and homeostasis.
- Types of Ecosystems.

3 Natural Resources

- **Land resources and land-use changes**: Definition and types, Land degradation, soil erosion and desertification; Impacts of mining and dam building on environment;
- **Water resources**: Definition and types; Natural and man-made sources; Uses of water; Over exploitation of surface and ground water resources; Floods, droughts;
- **Energy resources**: Definition and types; Renewable and non-renewable energy sources; Use of alternate energy sources
- **Disaster management:** Definition and types (Natural and Man-made); Self-protection during disasters (Fire, Floods, Earthquakes, landslides.

4 Biodiversity and Conservation

- **Biodiversity**: Definition and Levels of biological diversity
- Biodiversity hotspots and Endemic and endangered species of India, IUCN Red list criteria and categories, Threats to biodiversity
- **Biodiversity conservation strategies:** in-situ and ex-situ methods of conservation

UNIT- II POLLUTION AND POLICIES (15 L)

1 Environmental Pollution, global issues and management

- **Environmental pollution:** Types, causes, effects and controls; Air, water, soil and noise pollution, Pollutants and its types, Urbanization/Industrialization/Nuclear hazards and human health risks
- **Global Environmental Issues**: Climate change, Global warming, Ozone layer depletion, and Acid rain
- **Pollution control and management:**
- **Waste Management-** Concept of 3R (Reduce, Recycle and Reuse) and sustainability; Ecolabeling /Ecomark scheme
- **Solid waste management:** Control measures of urban and industrial waste.

2 Environmental Treaties and Legislation

- **Environment movements** – Chipko, Narmada Bachao Andolan, Silent valley, Bishnois of Rajasthan

© St. Xavier's College (Autonomous), Mumbai, INDIA

APPROVED SYLLABUS

- **Environment legislation in India:** Constitutional provisions- Article 48A, Article 51A (g) and other derived environmental rights; Wildlife Protection Act, 1972; Water (Prevention and Control of Pollution) Act, 1974; Forest (Conservation) Act 1980; Air (Prevention & Control of Pollution) Act, 1981; Environment Protection Act, 1986; Scheduled Tribes and other Traditional Forest Dwellers (Recognition of Forest Rights) Act, 2006, Biodiversity Act (2002); National Environmental Policy, 2006 – Provisions and importance
- **International agreements** – Montreal and Kyoto protocols. India's status as a party to major conventions.
- **Environmental Impact Assessment** – Concept; Swachh Bharat Mission– Objectives
- **Major International organizations and initiatives**: United Nations Environment Programme (UNEP), International Union for Conservation of Nature (IUCN), World Commission on Environment and Development (WCED), United Nations Educational, Scientific and Cultural Organization (UNESCO), Intergovernmental Panel on Climate Change (IPCC), and Man and the Biosphere (MAB) programme.

REFERENCE BOOKS

1. Richard A. Marcantonio, Marc Lame (2022). Environmental Management: Concepts and Practical Skills. Cambridge University Press
2. Varghese, Anita, Oommen, Meera Anna, Paul, Mridula Mary, Nath, Snehlata (Editors) (2022) Conservation through Sustainable Use: Lessons from India. Routledge.
3. Manahan, S.E. (2022). Environmental Chemistry (11th ed.). CRC Press. https://doi.org/10.1201/9781003096238
4. Kanchi Kohli and Manju Menon (2021) Development of Environment Laws in India, Cambridge University Press.
5. Theodore, M. K. and Theodore, Louis (2021) Introduction to Environmental Management, 2nd Edition. CRC Press.
6. John W. Twidell and Anthony D. (2015). Renewable Energy Sources, 3rd Edition, Weir Publisher (ELBS)
7. Ahluwalia, V. K. (2015). Environmental Pollution, and Health. The Energy and Resources Institute (TERI).
8. Harris, Frances (2012) Global Environmental Issues, 2nd Edition. Wiley- Blackwell.
9. Rajagopalan, R. (2011). Environmental Studies: From Crisis to Cure. India: Oxford University Press
10. Chiras, D. D and Reganold, J. P. (2010). Natural Resource Conservation: Management for a Sustainable Future.10th edition, Upper Saddle River, N. J. Benjamin/Cummins/Pearson.
11. Pittock, Barrie (2009) Climate Change: The Science, Impacts and Solutions. 2nd Edition. Routledge.
12. Basker, Sushmitha & Bhasker, R. (2007) Environmental Studies for Undergraduate Courses, New Delhi, Unicorn Books.
13. Singh, J.S., Singh, S.P. & Gupta, S.R. 2006. Ecology, Environment and Resource Conservation. Anamaya Publications https://sdgs.un.org/goals
14. World Commission on Environment and Development. (1987). Our Common Future. Oxford University Press

© St. Xavier's College (Autonomous), Mumbai, INDIA

APPROVED SYLLABUS

Links for Reference:

1. Ministry of Environment, Forest and Climate Change (2019) A Handbook on International Environment Conventions & Programmes: https://moef.gov.in/wp-content/uploads/2020/02/convention-V-16-CURVE-web.pdf
2. Central Pollution Control Board Web page for various pollution standards. https://cpcb.nic.in/standards/
3. India Code – Digital repository of all Central and State Acts: https://www.indiacode.nic.in/

Evaluation (VEC): Total marks per course - 50

I. Formative Assessment 'for' Learning (continuous internal assessment - CIA to improve learning).
CIA- Assignment/ Project/ Poster/ Model making/ Case study/ Seminar/ Field visit/ Beach cleanup/ Presentation - 20 marks

II. Summative Assessment 'of' Learning (focus on outcomes, quantitative data for outcomes of instruction).
End Semester Examination -30 marks
Multiple Choice based questions / SAQ- 30 marks

Template for Value Enhancement Course End Semester Examination in Semester II

ENVIRONMENTAL STUDIES

UNITS	KNOWLEDGE	UNDERSTANDING	APPLICATION ANALYSES	TOTAL MARKS- Per unit
1	8	10	7	25
2	10	10	5	25
TOTAL Marks Per objective	18	20	12	50
% WEIGHTAGE	36	40	24	100%

****

© St. Xavier's College (Autonomous), Mumbai, INDIA

ST. XAVIER'S COLLEGE – MUMBAI
(Est. 1869)
(An Autonomous College affiliated with the University of Mumbai)

Syllabus for Undergraduate Programme as per National Education Policy (NEP-2020)

Programme: B.Sc. in Chemistry

The academic year 2023–2024

© St. Xavier's College (Autonomous), Mumbai, INDIA

ST. XAVIER'S COLLEGE AUTONOMOUS MUMBAI-400 001

APPROVED SYLLABUS

PRINCIPAL
ST. XAVIER'S COLLEGE
AUTONOMOUS
MUMBAI - 400 001.

Preamble:
The foundational principles of the National Education Policy 2020 (NEP 2020) released by MHRD are:

- Multidisciplinary and holistic education (student-centred), encompassing courses from multiple disciplines across the sciences, social sciences, arts, humanities, and commerce for a multidisciplinary world, with emphasis on outcome-based learning.
- 50-50 formulation, where 50% of the credits must be from the core discipline and the rest 50% from other disciplines. Also, 50% of the course must be conceptual and theory based and the rest 50% must be the application of the concepts into practice through student engagement in activities/apprenticeship and internship. Pedagogic methods must be problem-centred/ based and project-based learning and activities.
- Integration of technology into teaching-learning-evaluation resources, blended teaching-learning (face-to-face, online collaborative learning, hands-on and practicum and flipped learning), strengthening research pedagogy of the discipline.
- Integrating skilling and employability with curriculum and teaching-learning across disciplinary, inter-disciplinary, and multi-disciplinary studies.
- Multiple entry and exit options for students within an academic programme of study with credit transfer and accumulation of credits in the Academic Bank of Credits (ABC).
- Equality is the Goal, and Equity is a process to achieve equality and inclusion to promote students' sense of belonging.

The framework of the choice-based credit system

Major Subject: A single subject course of study pursued by a student as a mandatory requirement of the programme of study. Indian knowledge system (IKS) to be included in the core courses.

Elective Course: An elective course could be a project designed to acquire skills to supplement the major study.

Minor Subject: A second subject of study pursued by a student as an additional requirement of the programme of study.

OE: Open Elective - An elective course chosen generally from an unrelated discipline/subject, to seek multidisciplinary exposure.

AEC: Ability Enhancement Course - Mandatory Courses on content related to Language, and Literature (i) Compulsory – English communication (ii) Elective – any Indian language other than English.

IKS: Indian Knowledge System (Generic) – Mandatory course - an overview of the contribution of India towards multidisciplinary research and development.

VSC: Vocational Skill Course – Courses aimed at imparting practical skills, hands-on training, and soft skills to increase the employability of students. Specific or supporting the major subject is to be chosen from a basket/pool offered by the college.

SEC: Skill Enhancement Course – Courses aimed at imparting practical skills, hands-on training, and soft skills to increase students' employability. It could be chosen from a basket/pool offered by the college or a MOOC on Swayam or NPTEL platforms.

On-Job Training (OJT)/Internship/Field Project (FP)/Community Engagement Programme (CEP) Research Project (RP): Application of knowledge/concepts in solving or analyzing a real-life problem. All these are related to the major subject.

© St. Xavier's College (Autonomous), Mumbai, INDIA

ST. XAVIER'S COLLEGE AUTONOMOUS MUMBAI-400 001

APPROVED SYLLABUS

CC: Co-curricular Course – For the holistic development of students through Cultural activities such as performing art, visual art, NCC, NSS, Yoga, etc.

VEC: Value Education Course – Compulsory courses on (i) The Constitution of India and (ii) Environmental Education.

FYUGP Credit Structure with number of courses 2023-24													
Level	Sem	Sub-1/Major	Elective	Sub-2/Minor	OE	VSC	SEC	IKS generic	AEC	VEC	OJT, FP, RP, CEP, CC	Total	Degree/Cum Cr
4.5/100-199 (2023-24) First Year	Sem 1	1	0	1	2	1	1	1	1	1	0	9	44 credits UG certificate
	Sem 2	1	0	1	2	1	1	0	1	1	CC 1	9	
Introductory	Courses	2	0	2	4	2	2	1	2	2	1	18	
Exit option with a UG Certificate in Major &/or Minor with an additional 4 credits NSQF course/internship OR continue with Major & Minor													
5/200-299 (2024-25) Second Year	Sem 3	2	0	1	1	1	0	0	1	0	FP/CEP 1 (Sci) & CC 1	8	88 credits UG Diploma
	Sem 4	2	0	1	1	0	1	0	1	0	FP/CEP 1 (Art/Com) & CC 1	8	
Intermediate	Courses	6	0	4	6	3	3	1	4	2	5	34	
Exit option with a UG Diploma in Major & Minor with an additional 4 credits NSQF course/internship OR continue with Major & Minor													
5.5/300-399 (2025-26) Third Year	Sem 5	3	1	1	0	1	0	0	0	0	FP 1	7	132 credits UG Degree
	Sem 6	3	1	1	0	0	0	0	0	0	OJT 1 Internship	6	
Higher	Courses	12	2	6	6	4	3	1	4	2	7	47	
Exit option with a Three-Year Bachelor Degree with Major and Minor OR continue with Major & Minor (Fourth year by Papers)													
6/400-499 (2026-27) Fourth Year	Sem 7	3	1	RM 1	0	0	0	0	0	0	FP 1	6	176 credits UG Honours
	Sem 8	3	1	0	0	0	0	0	0	0	OJT 1 Internship	5	
Advanced	Courses	18	4	7	6	4	3	1	4	2	9	58	
Exit option with a Three-Year Bachelor Degree with Major and Minor OR continue with Major & Minor (Fourth year by Research)													
6/400-499 (2026-27) Fourth Year	Sem 7	3	1	RM 1	0	0	0	0	0	0	RP 1	6	176 credits UG Honours with Research
	Sem 8	3	1	0	0	0	0	0	0	0	RP 1	5	
Advanced	Courses	18	4	7	6	4	3	1	4	2	9	58	
Four-Year UG Honours with Research Degree with Major and Minor													

FYUGP Credit Structure from 2023-24 (Sci-Arts)										
Level	Sem	Major (Sub-1)	Elective	Minor (Sub-2)	OE	VSC / SEC	IKS Generic / AEC, VEC	OJT, FP, RP, CEP / CC	Cum Cr/Sem	Degree/Cum Cr
4.5 (2023-24)	Sem 1	4	0	4	4	4	6	0	22	44 UG certificate
	Sem 2	4	0	4	4	4	4	2	22	
	Cum Cr	8	0	8	8	8	10	2	44	
A student will decide which of the 2 subjects (Sub-1 or Sub-2) will be major and minor at the end of the second semester (ie the first year) Major subject-specific IKS of 2 credits must be done as 2 units (could be 1 unit + 1 unit) from Sem 3 to Sem 6 Exit option with a UG Certificate in Major with an additional 4 credits core NSQF course/internship OR continue with Major & Minor										
5 (2024-25)	Sem 3	8	0	4	2	2	2	4	22	88 UG Diploma
	Sem 4	8	0	4	2	2	2	4	22	
	Cum Cr	24	0	16	12	12	14	10	88	
Exit option with a UG Diploma in Major & Minor with an additional 4 credits core NSQF course/internship OR continue with Major & Minor										
5.5 (2025-26)	Sem 5	12	4	2	0	2	0	2	22	132 UG Degree
	Sem 6	12	4	2	0	0	0	4	22	
	Cum Cr	48	8	20	12	14	14	16	132	
6 (2026-27)	Sem 7	12	4	4	0	0	0	2	22	176 UG Honours
	Sem 8	12	4	0	0	0	0	6	22	
	Cum Cr	72	16	20	12	14	14	24	176	
Exit option with a Three-Year Bachelor Degree with Major and Minor OR continue with Major & Minor										
6 (2026-27)	Sem 7	10	4	4	0	0	0	4	22	176 UG Honours with Research
	Sem 8	10	4	0	0	0	0	8	22	
	Cum Cr	68	16	20	12	14	14	28	176	
Four-Year UG Honours with Research Degree with Major and Minor										

Programme Outcomes aligned to the Vision and Mission of St. Xavier's College (Autonomous), Mumbai (Bachelor's degree programme)

The students who complete three years of an undergraduate programme will be able to manifest skills and competencies in the following areas:

1. **Disciplinary knowledge and Core competencies/skills:**
   Demonstrate (i) a lucid understanding of the fundamentals of the subject-related curriculum and (ii) basic and global skills in the academic field of study.
2. **Critical and Creative thinking:**

© St. Xavier's College (Autonomous), Mumbai, INDIA

ST. XAVIER'S COLLEGE-AUTONOMOUS * MUMBAI-400001 *

APPROVED SYLLABUS

(i) Critically reflect on acquired knowledge and skills in areas of core competencies (ii) Explore new possibilities and be resourceful by generating relevant and practical ideas

3. **Problem-solving and Analytical reasoning:**
   Demonstrate skills in identifying and investigating a problem. Collect relevant qualitative and quantitative data and analyze the results meaningfully.
4. **Research-related skills:**
   (i) Apply comprehensive research-based knowledge and skills required for identifying issues, interpreting results, and synthesis of valid information. (ii) Communicate results of studies undertaken in an academic field effectively and accurately.
5. **Social Application of research and development:**
   Employ core competencies and skills to develop solutions for the improvement of social and environmental conditions.
6. **Industry-related skills:**
   Employ skills that are relevant to the industry and commit to strong work ethics and professionalism.
7. **Ethical and Moral Integrity:**
   Practice values such as honesty, transparency, and accountability and commit to interpersonal and social ethics.
8. **Empathy and Social Intelligence:**
   Cultivate and demonstrate affective, interpersonal, social, and spiritual intelligence.
9. **Collaboration, Teamwork, and Multidisciplinary competence:**
   Apply knowledge and skills as an individual, team member or leader to manage ventures in monodisciplinary and interdisciplinary settings.
10. **Leadership and Management:**
    Demonstrate effective strategic planning, and efficient organizational and transformational leadership skills to manage a mission embarked upon.
11. **Social Concern:**
    Demonstrate (i) empathy and care for the marginalized and disadvantaged, (ii) respect, compassion, and concern for others.
12. **Social responsibility and inclusion:**
    (i) Strive for social justice, harmony, and solidarity (ii) Value cultural pluralism and diversity.
13. **Environmental Wellbeing**
    Investigate and design strategies to care for and enhance the well-being of the environment.
14. **Self-motivation and Lifelong learning:**
    Develop a passion for ongoing personal and professional growth.

Abbreviations:

- OE: Open Electives
- AEC: Ability Enhancement Course
- VSC: Vocational Skill Course
- SEC: Skill Enhancement Course

© St. Xavier's College (Autonomous), Mumbai, INDIA

ST. XAVIER'S COLLEGE-AUTO... MUMBAI

APPROVED SYLLABUS

List of Courses offered from Semesters 1-8 in Chemistry

Level	Semester	Major (Sub-1) Course titles	Minor (Sub-2) Course titles	OE Course title/s	VSC Course title/s	SEC
4.5 100-199	Sem 1	Fundamentals of Organic Chemistry and Periodicity of Elements	-	1.Chemistry in Sports, Physiology and Health 2. Science of Food and Cooking	ICT Tools in Chemistry	ICT Tools in Science
	Sem 2	Essentials of Physical and Analytical Chemistry- I	-	1.Chemistry in Sports, Physiology and Health 2. Science of Food and Cooking	ICT Tools in Chemistry	ICT Tools in Science

Composition of the Board of Studies in Chemistry, 2023 – 2024

Sr.No.	Name of the BoS member	Designation
1	Prof. Marazban Kotwal	Head, Department of Chemistry, Chairperson, BoS
2	Dr. Pradip Tekade	Subject Expert outside the parent University
3	Prof. Deepa Khushalani	Subject Expert outside the parent University
4	Ms. Padmaja Vinay	Industry Representative
5	Mr. Clinton Fernandes	Meritorious Alumni
6	Dr. Sreela Dasgupta	Subject expert (Co-opted)
7	Dr. Ashma Aggarwal	Associate Professor
8	Dr. Geeta Kotian	Associate Professor
9	Ms. Saima Khan	Associate Professor
10	Dr. Abhilasha Jain	Assistant Professor
11	Dr. Pralhad Rege	Assistant Professor
12	Dr. Himanshu Gupta	Assistant Professor
13	Dr. Manik Rathod	Assistant Professor
14	Ms. Maria Gomes	Assistant Professor
15	Dr. Niraj Bahuguni	Assistant Professor

©St. Xavier's College (Autonomous), Mumbai, INDIA

ST. XAVIER'S COLLEGE-AUTONOMOUS * MUMBAI-400 001 *

APPROVED SYLLABUS

Four-Year Undergraduate Programme in Chemistry

Year of Implementation	Semester	Course Code	BOS Date	Academic Council Date
2023-2024	1	USCHE4501CR1, USCHE4501VS1, USCHE4501SE1, USCHE4501OE1, USCHE4502OE1, UXEVS4501VE1	11/04/2023	21/04/2023
2023-2024	2	USCHE4502CR1, USCHE4501VS1, USCHE4501SE1, USCHE4501OE1, USCHE4502OE1, UXEVS4501VE1	14/09/2023	06/10/2023

Chemistry is a central science as it involves almost all facets of life like the environment around us, life processes driving our existence, food that we consume, the energy sources that drive the devices that we use, and the pharmaceuticals that has immensely contributed to an improved lifespan and quality of life.

Chemistry is the science of matter, interaction between them as well as the transformations that matter can undergo. This makes Chemistry an important, relevant, exciting and essential branch of science.

The chemistry BSc course under NEP 2020 has been designed to focus on teaching students to continuously think, apply concepts learnt to the real-world scenario as well as to help students develop analytical skills, improve critical thinking, induce strong mind-hand coordination and gain sound knowledge of chemistry and its applications.

The core courses in the BSc Chemistry program are organized to integrate topics from all the disciplines of chemistry namely physical chemistry, inorganic chemistry, organic chemistry and analytical chemistry. The BSc Chemistry program has incorporated a strong experimental component in all the courses that will inculcate in students the art and science of observation and will serve to instil in learners' experimentation skills, ability to analyse errors through statistical treatment of data and propose newer experimentation designs as a culmination. Students will work in laboratories equipped with appropriate laboratory apparatus and instruments in their coursework. They will also be exposed to ICT tools used in chemistry experimentation, research and representation.

Exposure to project-based research and experimentation in the program will equip students with the capacity to be self-directed learners and excel in the scientific world. Imparting context-based education is inherent in the program design.

© St. Xavier's College (Autonomous), Mumbai, INDIA

XAVIER'S COLLEGE-AU MUMBAI-400 001

APPROVED SYLLABUS

Several electives and skill-based courses will be taught in the application related areas such as medicine, environmental science, colour chemistry, novel energy sources, polymers, forensic sciences and the functional materials.

Chemistry, however, cannot be isolated from the environmental and social consequences of its applications. The effect of man-made chemicals on the surroundings, the principles of green chemistry and the general awareness on safety methods are intricately woven in the program structure which will address and alleviate the environmental and social concerns.

Interdisciplinary chemistry-based courses offered as general or open electives are designed to instil scientific fervour amongst the students and activate scientific reasoning in students with varied interests and open up a range of future options for them in areas like nutrition, sports, fitness, cooking, art conservation, and cosmetics.

Programme Specific Outcomes (PSOs) for B.Sc. Chemistry

A student completing B.Sc. Chemistry will be able to:

PSO 1- Have sound knowledge, strong foundation and the ability to understand essential facts, concepts, principles, phenomena and current scientific theories in different branches of chemistry.

PSO 2- Apply the knowledge acquired to understand, interpret, analyse mathematical derivations, numericals and solve qualitative and quantitative problems.

PSO 3- Demonstrate skills in the evaluation and interpretation of chemical information and data.

PSO 4- Know the properties and behavior of matter, elements in the periodic table, commonly used chemicals in industry and laboratories, speciality materials and their uses.

PSO 5- Predict the structures of compounds, separate and characterize them; understand the mechanism of reactions of chemical compounds and their synthesis.

PSO 6- Have knowledge of working of various instruments used in chemical analysis and the skills in the operation of standard instruments used in chemistry.

PSO 7- Understand the causes of environmental pollution and methods for environmental pollution control.

PSO 8 - Possess skills in the safe-handling of chemical materials, taking into account their physical and chemical properties including specific hazards associated with their use and the ability to conduct risk assessments.

PSO 9- Have the capabality of monitoring, by observation and measurement, chemical properties, events or changes, and demonstrate the ability of systematic and reliable recording of data and carry out documentation thereof in a clear scientific format.

PSO 10- Acquire the laboratory skills needed to design and interpret chemical research in laboratories and industries.

PSO 11- Analyse the chemistry of various biomolecules, natural products and their functioning and roles in the living system.

PSO 12 - Understand and analyse the biological systems and the chemical interactions of neurons, neurotransmitters and salts.

PSO 13- Demonstrate an understanding of the applications of electrical potential signals in biological systems and the instrumental methods of to identify them.

© St. Xavier's College (Autonomous), Mumbai, INDIA

ST. XAVIER'S COLLEGE - AUTONOMOUS * MUMBAI-400 001 *