



**Anekant Education Society's**

**Tuljaram Chaturchand College of Arts, Science & Commerce,  
Baramati**

**(Autonomous)**

**Three/Four Year Honours/Honours with Research B.Sc. Degree**

**Program in Chemistry**

**(Faculty of Science)**

**CBCS Syllabus**

**FYBSc (Chemistry)**

**For Department of Chemistry**

**NEP-2.0**

**Choice Based Credit System Syllabus**

**(2024 Pattern)**

**(As Per NEP-2020)**

**To be implemented from Academic Year 2024-2025**

**Title of the Programme: FYBSc (Chemistry)****Preamble**

AES's Tuljaram Chaturchand College has made the decision to change the syllabus of across various faculties from June, 2023 by incorporating the guidelines and provisions outlined in the National Education Policy (NEP), 2020. The NEP envisions making education more holistic and effective and to lay emphasis on the integration of general (academic) education, vocational education and experiential learning. The NEP introduces holistic and multidisciplinary education that would help to develop intellectual, scientific, social, physical, emotional, ethical and moral capacities of the students. The NEP 2020 envisages flexible curricular structures and learning based outcome approach for the development of the students. By establishing a nationally accepted and internationally comparable credit structure and courses framework, the NEP 2020 aims to promote educational excellence, facilitate seamless academic mobility, and enhance the global competitiveness of Indian students. It fosters a system where educational achievements can be recognized and valued not only within the country but also in the international arena, expanding opportunities and opening doors for students to pursue their aspirations on a global scale.

In response to the rapid advancements in science and technology and the evolving approaches in various domains of Chemistry and related subjects, the Board of Studies in Chemistry at Tuljaram Chaturchand College, Baramati - Pune, has developed the curriculum for the first semester of F.Y.B.Sc. Chemistry, which goes beyond traditional academic boundaries. The syllabus is aligned with the NEP 2020 guidelines to ensure that students receive an education that prepares them for the challenges and opportunities of the 21st century. This syllabus has been designed under the framework of the Choice Based Credit System (CBCS), taking into consideration the guidelines set forth by the National Education Policy (NEP) 2020, LOCF (UGC), NCrF, NHEQF, Prof. R.D. Kulkarni's Report, Government of Maharashtra's General Resolution dated 20th April and 16<sup>th</sup> May 2023, and the Circular issued by SPPU, Pune on 31<sup>st</sup> May 2023.

The CBCS Course curriculum of the discipline of Chemistry is well designed and very promising. A degree in Chemistry subject equips students with the knowledge and skills necessary for a diverse range of fulfilling career paths. The core course would help to enrich the subject knowledge of the students and increase their confidence level in the field of both academia and industry. Open electives (OE) make sustainable integration among the various interdisciplinary courses to fulfill the vision and mission of designing the course. The

introduction of Skill Enhancement Courses (SEC) would help to gain more powerful knowledge not only in their core Chemistry subject but also in interrelated multidisciplinary subjects both theoretically and practically. The inclusion of Skill Enhancement Course (SEC) and Vocational Skill Course (VSC) has brought an opportunity in front of students to gain knowledge on various naturally and industrially important useful materials and also helps them to familiar and expert in handling different chemistry based software after proper training. In brief the student graduated with this type of curriculum would be able to disseminate subject knowledge along with necessary skills to suffice their capabilities for academia, research, entrepreneurship and industry. By acquiring these comprehensive skills and knowledge, graduates are well-prepared to embark on rewarding careers that contribute to a better understanding of the subject and address the challenges of our ever-changing lifestyle.

Overall, revising the Chemistry syllabus in accordance with the NEP 2020 ensures that students receive an education that is relevant, comprehensive, and prepares them to navigate the dynamic and interconnected world of today. It equips them with the knowledge, skills, and competencies needed to contribute meaningfully to society and pursue their academic and professional goals in a rapidly changing global landscape.

## Programme Specific Outcomes (PSOs)

**PSO1: Core competency:** The chemistry graduates are expected to gain knowledge of the fundamental concepts of chemistry and applied chemistry through theory and practical. These fundamental concepts would be reflected in the latest understanding of the field to keep continues its progression.

**PSO2: Communication skills:** Chemistry graduates are expected to possess minimum standards of communication skills to read and understand documents so that they can solve their problems very methodically, independently and with logical argument. Graduates are expected to build good communication skill so that they can easily share their idea/finding/concepts to others.

**PSO3: Critical thinking:** Chemistry graduates are expected to achieve critical thinking ability to design, carry out, record and analyze the results of chemical reactions. They can have that much potential and confidence that they can overcome many difficulties with the help of their sharp scientific knowledge and logical approaches.

**PSO4: Psychological skills:** Chemistry graduates are expected to possess basic psychological skills so that they can deal with individuals and students of various socio-cultural, economic and educational levels. Psychological skills are very important for proper mind setting during performing, observing and giving conclusion of a particular reaction. It is also important for self-compassion, self-reflection, interpersonal relationships, and emotional management.

**PSO5: Problem-solving:** Graduates are expected to be well trained with problem-solving philosophical approaches that are pertinent across the disciplines.

**PSO6: Analytical skill development and job opportunity:** Chemistry graduates are expected to possess sufficient knowledge how to synthesize a chemical compound and perform necessary characterization and analysis in support of the formation of the product by using modern analytical tools and advanced technologies. Because of this course curriculum chemistry graduates have lot of opportunity to get job not only in academic and administrative field but also in industry.

**PSO7: Research motivation:** Chemistry graduates are expected to be technically well trained with modern devices and Chemistry based software and has powerful knowledge in different disciplines of Chemistry so they can easily involve themselves in theory and laboratory-based research activities.

**PSO8: Teamwork:** Graduates are expected to be team players, with productive co-operations involving members from diverse socio-cultural backgrounds.

**PSO9: Digital Literacy:** Graduates are expected to be digitally literate for them to enroll and increase their core competency via e-learning resources such as MOOC and other digital tools for lifelong learning.

**PSO10: Social Awareness:** As an inhabitant of this green world it is our duty to make our planet clean and suitable for living to all. In this context Chemistry graduates are expected to be more aware about finding green chemical reaction routes for sustainable development. They are expected to maintain good laboratory practices and safety.

**Anekant Education Society's**  
**Tuljaram Chaturchand College, Baramati**  
(Autonomous)

**Board of Studies (BOS) in Chemistry**

From 2022-23 To 2024-25

Sr.No.	Name	Designation
1.	Prof. Dr. Sanjay R. Kale	Chairman
2.	Mr. Shrikrushna T. Salunke	Member
3.	Mr. Bhimrao R. Torane	Member
4.	Mr. Maharudra A. Dudhe	Member
5.	Mr. Ravikiranamrut R. Gandhi	Member
6.	Dr. Vaibhav P. Landge	Member
7.	Dr. Yogesh N. Indulkar	Member
8.	Dr. Rahul S. Bhondwe	Member
9.	Dr. Nilam C. Dige	Member
10.	Prof. Dr. Namdev M. Bhujbal	Vice-Chancellor Nominee
11.	Prof. Dr. Dattaprasad M. Pore	Expert from other University
12.	Dr. Vijay T. Vader	Expert from other University
13.	Mr. Nitin B. Gawade	Industry Expert
14.	Dr. Hanmant R. Gurav	Meritorious Alumni
15.	Ms. Dhanashree S. Wayase	Student Representative
16.	Ms. Alfiya M. Tamboli	Student Representative

**Credit Distribution Structure for Three/Four Year Honours/Honours with Research Degree Programme  
With Multiple Entry and Exit options as per National Education Policy (2024 Pattern as per NEP-2020)**

Level/ Difficulty	Sem	Subject DSC-1	Subject DSC-2	Subject DSC-3	GE/OE	SEC	IKS	AEC	VEC	CC	Total			
4.5/100	I	2(T)+2(P)	2(T)+2(P)	2(T)+ 2(P)	2(T)	2 (T/P)	2(T) (Generic)	2(T)	2(T)	--	22			
	II	2(T)+2(P)	2(T)+2(P)	2(T)+2(P)	2(P)	2 (T/P)	--	2(T)	2(T)	2(T)	22			
<b>Exit option:</b> Award of UG Certificate in Major with 44 credits and an additional 4 credits core NSQF course/Internship OR Continue with Major and Minor <b>Continue option:</b> Student will select one subject among the (subject 1, subject 2 and subject 3) as major and other as minor and third subject will be dropped.														
Level/ Difficulty	Sem	Credits Related to Major				Minor	--	GE/OE	SEC	IKS	AEC	VEC	CC	Total
		Major Core	Major Elective	VSC	FP/OJT/CE P/RP									
5.0/200	III	4(T)+2(P)	--	2 (T/P)	2(FP)	2(T)+2(P)	--	2(T)	--	2(T)	--	2(T)	22	
	IV	4(T)+2(P)	--	2 (T/P)	2(CEP)	2(T)+2(P)	--	2(P)	2 (T/P)	--	2(T)	--	2(T)	22
<b>Exit option:</b> Award of UG Diploma in Major and Minor with 88 credits and an additional 4credits core NSQF course/Internship OR Continue with Major and Minor														
5.5/300	V	8(T)+4(P)	2(T)+2(P)	2 (T/P)	2(FP/CEP)	2(T)	--	--	--	--	--	--	22	
	VI	8(T)+4(P)	2(T)+2(P)	2 (T/P)	4 (OJT)	--	--	--	--	--	--	--	22	
<b>Total 3Years</b>		<b>44</b>	<b>8</b>	<b>8</b>	<b>10</b>	<b>18</b>	<b>8</b>	<b>8</b>	<b>6</b>	<b>4</b>	<b>8</b>	<b>4</b>	<b>6</b>	<b>132</b>
<b>Exit option:</b> Award of UG Degree in Major with 132 credits OR Continue with Major and Minor														
6.0/400	VII	6(T)+4(P)	2(T)+2 (T/P)	--	4(RP)	4(RM)(T)	--	--	--	--	--	--	22	
	VIII	6(T)+4(P)	2(T)+2 (T/P)	--	6(RP)	--	--	--	--	--	--	--	22	
<b>Total 4Years</b>		<b>64</b>	<b>16</b>	<b>8</b>	<b>22</b>	<b>22</b>	<b>8</b>	<b>8</b>	<b>6</b>	<b>4</b>	<b>8</b>	<b>4</b>	<b>6</b>	<b>176</b>
<b>Four Year UG Honours with Research Degree in Major and Minor with 176 credits</b>														
6.0/400	VII	10(T)+4(P)	2(T)+2 (T/P)	--	--	4(RM) (T)	--	--	--	--	--	--	22	
	VIII	10(T)+4(P)	2(T)+2 (T/P)	--	4 (OJT)	--	--	--	--	--	--	--	22	
<b>Total 4Years</b>		<b>72</b>	<b>16</b>	<b>8</b>	<b>14</b>	<b>22</b>	<b>8</b>	<b>8</b>	<b>6</b>	<b>4</b>	<b>8</b>	<b>4</b>	<b>6</b>	<b>176</b>
<b>Four Year UG Honours Degree in Major and Minor with176 credits</b>														
<b>T = Theory P = Practical DSC = Discipline Specific Course OE = Open Elective SEC = Skill Enhancement Course</b> <b>IKS = Indian Knowledge System AEC = Ability Enhancement Course VEC = Value Education Course CC = Co-curricular Course VSC= Vocational Skill Course OJT=</b> <b>On Job Training CEP= Community Engagement Project FP= Field Project RP= Research Project</b>														

## Course and Credit Distribution Structure for BSc (Chemistry)-2024-2025

Level	Semester	Sub. DSC-I Languages	Sub. DSC-II Social Science-I	Sub. DSC-III Social Science-II	OE	SEC	IKS	AEC	VEC	CC	Degree/Cum.Cr.
4.5	I	2 T + 2 T / P	2 T + 2 T / P	2 T + 2 T / P	2 T (from other faculty)	2 T / P	2 T (Generic)	2 T (C. Eng.)	2 T	--	22
	I	2 T + 2 T / P	2 T + 2 T / P	2 T + 2 T / P	2 T / P (from other faculty)	2 T / P	--	2 T (C. Eng.)	2 T	2 T YOG/PES/ CUL/NSS/ NCC	22
<b>Total Credits</b>											<b>44</b>

\* T = Theory      \* P = Practical      \* DSC = Discipline Specific Course

\* OE = Open Elective      \* SEC = Skill Enhancement Course      \* IKS = Indian Knowledge System

\* AEC = Ability Enhancement Course      \* VEC = Value Education Course      \* CC = Cocurricular Courses



## F.Y.B.Sc. Chemistry

## NEP-2.0

## Course Structure for F.Y.B.Sc. Chemistry (2024 Pattern)

SEM	Course Type	Course Code	Course Title	Theory / Practical	Credit Point
I	DSC-I(General)	101-GEN and 102-GEN	--	Theory and Practical	04
	DSC-II(General)	101-GEN and 102-GEN	--	Theory and Practical	04
	DSC-III(General)	CHE-101-GEN	Fundamentals of Chemistry - I	Theory	02
		CHE-102-GEN	Chemistry Practical -I	Practical	02
	Open Elective (OE)	CHE-103-OE	Chemistry of Soil and Water	Theory	02
	Skill Enhancement Course (SEC)	CHE-104-SEC	Chemistry Laboratory Techniques	Practical	02
	Ability Enhancement Course (AEC)	ENG-104-AEC	--	Theory	02
	Value Education Course (VEC)	-105-VEC	--	Theory	02
	Generic Indian Knowledge System (GIKS)	GEN-106-IKS	---	Theory	02
Total Credit					22
II	DSC-I(General)	151-GEN and 152-GEN	--	Theory and Practical	04
	DSC-II(General)	151-GEN and 152-GEN	--	Theory and Practical	04
	DSC-III(General)	CHE-151-GEN	Fundamentals of Chemistry - II	Theory	02
		CHE-152-GEN	Chemistry Practical -II	Practical	02
	Open Elective (OE)	CHE-153-OE	Chemical Analysis of Soil and Water	Practical	02
	Skill Enhancement Course (SEC)	CHE-154-SEC	Chemistry Laboratory Instrumental Techniques	Practical	02
	Ability Enhancement Course (AEC)	ENG-104-AEC	--	Theory	02
	Value Education Course (VEC)	-105-VEC	--	Theory	02
	Generic Indian Knowledge System (GIKS)	GEN-106-IKS	---	Theory	02
Total Credit					22

**CBCS Syllabus as per NEP- 2.0 for F.Y.B.Sc Chemistry (2024 Pattern)**

<b>Name of the Programme</b>	: B.Sc. Chemistry
<b>Program Code</b>	: USCH
<b>Class</b>	: F.Y.B.Sc
<b>Semester</b>	: I
<b>Course Type</b>	: Theory
<b>Course Name</b>	: Fundamentals of Chemistry - I
<b>Course Code</b>	: CHE-101-GEN
<b>No. of Lectures</b>	: 30
<b>No. of Credits</b>	: 2 credits

**Course Objectives:**

1. To understand the states of matter and their properties.
2. To explain critical constants and their correlation with van der Waal's constants.
3. To describe properties of liquids, vapor pressure, and methods for measuring vapor pressure and viscosity.
4. To trace the development of the periodic table from Dobereiner's Triads to the Modern periodic table.
5. To classify elements into s, p, d, and f-blocks based on electronic configuration and to analyze trends in properties such as atomic and ionic size, ionization potential, electron affinity, and electronegativity.
6. To apply the functional group approach to study the structure, nomenclature, and properties of alkanes, alkenes, and alkynes.
7. To describe the preparations of alkanes, alkenes, and alkynes through various methods such as catalytic hydrogenation, Wurtz reaction, Kolbe's synthesis, and from Grignard reagent.

**Course Outcomes:**

After completion of this course students will be able

- CO1. To understand the fundamental principles governing the behavior of gases and liquids.
- CO2. To interpret critical constants and their significance in the behavior of gases.
- CO3. To conduct experiments to measure vapor pressure and viscosity of liquids.
- CO4. To describe the historical development of the periodic table and its impact on the understanding of chemical elements.
- CO5. To explain the periodic trends in the properties of elements based on their positions in the periodic table and classify elements into s, p, d, and f-blocks based on their electronic configurations.
- CO6. To apply the functional group approach to identify and classify aliphatic hydrocarbons.
- CO7. To perform synthesis of alkanes, alkenes, and alkynes using appropriate methods as well as to understand and predict the reactivity of alkanes, alkenes, and alkynes in various reactions.

**Topics and Learning Points****Unit 1: Gaseous and Liquid States****(10 L)**

Introduction: States of matter and their properties.

Gaseous state : Significance of ideal and kinetic gas equation (no derivation), Real gases, Compressibility factor, van der Waal's equation of state, critical constants, correlation between critical constants and van der Waal's constants.

Liquid state: Properties of liquids, vapor pressure and its measurement by isoteniscope method, Viscosity and its measurements by Ostwald's viscometers.

**Unit 2: Introduction to the Periodic table****(10 L)**

Development of the periodic table- Dobereiner's Triads, Newland's Law of Octaves, Mendeleev's periodic table and Modern periodic table (Theories and limitations), Classification of the elements into s, p, d and f -block on the basis of electronic configuration, Anomalous behaviour and Diagonal relationship in periodic table. Trends in properties like atomic and ionic size, oxidation states, ionization potential, electron affinity, electronegativity.

**Unit 3: Aliphatic Hydrocarbons****(10 L)**

Functional group approach for the following reactions (preparations & reactions) to be studied in context to their structure.

Alkanes (Up to 5 Carbons): Nomenclature and properties; Preparation: Catalytic hydrogenation, Wurtz reaction, Kolbe's synthesis from Grignard reagent. Reactions: Free radical Substitution: Halogenation.

Alkenes (Up to 5 Carbons): Nomenclature and properties; Preparation: Elimination reactions: Dehydration of alkenes and dehydrohalogenation of alkyl halides (Saytzeff's rule); cis alkenes (Partial catalytic hydrogenation) and trans alkenes (Birch reduction). Reactions: cis-addition (alk.  $\text{KMnO}_4$ ) and trans-addition (bromine), Addition of HX (Markownikoff's and anti-Markownikoff's addition).

Alkynes (Upto 5 Carbons): Nomenclature and properties; Preparation: Acetylene from  $\text{CaC}_2$  and conversion into higher alkynes; by dehalogenation of tetra halides and dehydrohalogenation of vicinal-dihalide; Reactions: formation of metal acetylides, addition of bromine and alkaline  $\text{KMnO}_4$ , ozonolysis and oxidation with hot alk.  $\text{KMnO}_4$ .

**References:**

1. Principles of Physical Chemistry, S. H. Marron and C. F. Pruton, 6<sup>th</sup> edn.
2. Essentials of Physical Chemistry, Bahl, Tuli, Revised multicolour edn. 2009
3. Physical Chemistry, G. M. Barrow, Tata McGraw-Hill (2007)
4. Concise inorganic chemistry 5<sup>th</sup>, 6<sup>th</sup> 7<sup>th</sup> edition .J.D.Lee
5. Principles of inorganic chemistry .B.K.Sharma
6. Modern Inorganic chemistry .Revised edition. Dr.R.D.Brown
7. Organic Chemistry. Morrison and Boyd, 6<sup>th</sup>Ed Prentice Hall, NewDelhi-2001.
8. Organic Chemistry- Clayden, Oxford Uni. Press.

### Mapping of Program Out comes with Course Outcomes

**Class:**F.Y.B.Sc. (Sem I)

**Subject:** Chemistry

**Course:**Fundamentals of Chemistry - I

**Course Code:**CHE-101-GEN

Weightage: 1=weak or low relation, 2=moderate or partial relation, 3=strong or direct relation

CO \ PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
<b>CO1</b>	3	2	2	3	2	3	2	1	3
<b>CO2</b>	3	3	1	3	1	2	1	2	2
<b>CO3</b>	2	2	2	2	3	1	2	3	1
<b>CO4</b>	3	3	1	3	2	2	1	2	2
<b>CO5</b>	1	1	2	1	3	2	2	3	2
<b>CO6</b>	2	2	2	2	2	3	2	1	3
<b>CO7</b>	3	2	1	3	2	3	1	3	3

#### Justification for the mapping

##### **PO1 (Disciplinary Knowledge):**

CO1: focusing on comprehensive knowledge of basic chemistry principles.

CO4: focusing on understanding the theoretical foundations of chemistry.

CO5: involving understanding molecular structures and their interdisciplinary applications.

CO6: focusing on applying chemical principles to analyze reactions and Stoichiometry.

CO7: involving understanding the environmental impact and sustainability of chemical substances.

##### **PO2 (Critical Thinking and Problem solving):**

CO3: involving analytical and problem-solving skills in chemical calculations.

CO6: focusing on applying chemical principles to analyze reactions and Stoichiometry.

##### **PO4 (Research-related skills and Scientific temper):**

CO2: emphasizing practical experimentation and laboratory techniques.

##### **PO5 (Trans-disciplinary knowledge):**

CO5: involving understanding molecular structures and their interdisciplinary applications.

##### **PO8 (Environment and Sustainability):**

CO7: involving understanding the environmental impact and sustainability of chemical substances.

**CBCS Syllabus as per NEP for F.Y.B.Sc Chemistry (2024 Pattern)**

<b>Name of the Programme</b>	: B.Sc. Chemistry
<b>Program Code</b>	: USCH
<b>Class</b>	: F.Y.B.Sc
<b>Semester</b>	: I
<b>Course Type</b>	: Practical
<b>Course Name</b>	: Chemistry Practical - I
<b>Course Code</b>	: CHE-102-GEN
<b>No. of Lectures</b>	: 60
<b>No. of Credits</b>	: 2 credits

**Course Objectives:**

1. To introduce chemical and laboratory safety.
2. To adequate students with graph of various functions.
3. To learn basic of chemistry practical from all the discipline of chemistry.
4. To learn the estimation of compounds.
5. To know the synthesis of derivatives.
6. To learn the volumetric analysis.
7. To know the preparation of solutions.

**Course Outcomes:**

**By the end of the course, students will be able to:**

**CO1.** Students will get advantage while performing experiment in laboratory interms of safety.

**CO2.** Students will be able to apply mathematical knowledge in graphicalrepresentation of experimental data.

**CO3.** Basic experiments in all discipline of chemistry gives understanding ofapplications of theory which is learn in theory courses.

**CO4.** Students should able to prepare the organic derivatives.

**CO5.** Students should able to estimate the organic compounds volumetrically.

**CO6.** Develop the ability of solution preparation.

**CO7.** Develop the experimental skills.

**Topics and Learning Points****Teaching Hours = Total 60****UNIT 1: Chemical and Lab Safety**

1. Introduction to laboratory. (Do's and Don'ts in laboratory)
2. Precautions in handling of hazardous substances.
3. Safety symbols on label of pack of chemicals and its meaning.
4. Understanding of MSDS of few hazardous chemicals.

**UNIT 2: Physical chemistry**

1. Determine the gas constant R in various units by eudiometer method.
2. Determination of co-efficient of viscosity of two unknown aqueous solution.
3. Determine the relative viscosity of given organic liquids by viscometer.
4. Study the variation of viscosity with different concentration of sugar solutions.
5. Study the effect of the addition of solutes such as (i) polymer (ii) ethanol (iii) sodium chloride on the viscosity of water at room temperature and explain the observations in terms of molecular interactions

**UNIT 3: Inorganic chemistry**

1. Standardization of NaOH solution and find the strength of given HCl solution.
2. Standardization of HCl solution and find the strength of given NaOH solution.
3. Standardization of  $\text{KMnO}_4$  solution and find the strength of given solution.
4. Determine the hardness of water from a given water sample by EDTA method.
5. Determine the number of water molecules of  $\text{BaCl}_2 \cdot 2\text{H}_2\text{O}$ / $\text{MgSO}_4 \cdot 7\text{H}_2\text{O}$ .

**UNIT 4: Organic chemistry**

1. Organic qualitative analysis of water soluble/ miscible compounds (Four compounds 2S, 2L)  
Nature, Type, Preliminary Test, Physical Constant
2. Organic qualitative analysis of water insoluble/ Immiscible compounds (Two compounds 1S, 1L)  
Nature, Type, Preliminary Test, Physical Constant

**References:**

1. J.N. Gurthu and R. Kapoor, *Advanced Experimental Chemistry (Organic)*, S. Chand and Co., 1987.
2. B.S. Furniss, A.J. Hannaford, P.W. G. Smith and A.R. Tatchell, *Vogel's Text Book of Practical Organic Chemistry*. 5th Edn., Pearson Education, 2005.
3. Practical Physical Chemistry, J B Yadav.
4. Essentials practical Physical Chemistry, Rajboj and Chandhekar.
5. *Vogel's Text Book of Practical Inorganic Chemistry*. 5th Edn., Pearson Education, 2005.

### Mapping of Program Out comes with Course Outcomes

**Class:**F. Y. B. Sc. (Sem I)

**Subject:** Chemistry

**Course:**Chemistry Practical - I

**Course Code:**CHE-102-GEN

Weightage: 1=weak or low relation, 2=moderate or partial relation, 3=strong or direct relation

CO\PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	3	3	1	3	2	1	2	1	1
CO2	2	2	2	3	1	2	1	2	2
CO3	1	1	3	2	3	1	2	3	1
CO4	3	3	2	3	2	2	1	2	2
CO5	2	2	3	1	3	2	2	3	2
CO6	1	1	1	2	2	3	2	1	3
CO7	3	3	2	3	2	2	1	3	2

#### Justification for the mapping

**PO1 (Disciplinary Knowledge):**

CO1: focusing on comprehensive knowledge of analytical techniques.

**PO2 (Critical Thinking and Problem solving):**

CO4: involving analytical and problem-solving skills in data analysis.

**PO3 (Social competence):**

CO5: emphasizing effective communication and presentation skills in analytical findings.

**PO4 (Research-related skills and Scientific temper):**

CO2: emphasizing practical application and experimentation in analytical methods.

CO3: focusing on applying laboratory techniques and instrumentation for chemical analysis.

**PO5 (Trans-disciplinary knowledge):**

CO6: focusing on applying analytical chemistry in interdisciplinary contexts.

**PO7 (Effective Citizenship and Ethics):**

CO7: involving ethical responsibility and quality assurance in analytical practices.



**CBCS Syllabus as per NEP for F.Y.B.Sc Chemistry (2024 Pattern)**

<b>Name of the Programme</b>	: B.Sc. Chemistry
<b>Program Code</b>	: USCH
<b>Class</b>	: F.Y.B.Sc
<b>Semester</b>	: I
<b>Course Type</b>	: Theory
<b>Course Name</b>	: Chemistry of Soil and Water
<b>Course Code</b>	: CHE-103-OE
<b>No. of Lectures</b>	: 30
<b>No. of Credits</b>	: 2 credits

**Course Objectives:**

1. To know the chemistry and composition of soil.
2. To introduce the classical concepts of soil chemistry and to familiarize students with modern developments in chemistry of soils
3. To impart basic knowledge about soil physical properties
4. To impart knowledge about soil fertility and its control.
5. To know the concept of physical and chemical properties of water.
6. To create awareness among the students about the pollution of soil and water
7. To understand the importance of purification and conservation of water

**Course Outcomes:**

**By the end of the course, students will be able to:**

- CO1.** Gain knowledge on concepts and principles of Soil chemistry
- CO2.** Understand various soil physical, chemical and biological properties and their impact.
- CO3.** Aware on Soil quality and health
- CO4.** Imparts knowledge on essential nutrients, soil fertility, nutrient transformations in soil
- CO5.** To know the chemistry and composition of water.
- CO6.** To explain the importance of maintaining fresh, unpolluted drinking water supplies.
- CO7.** List and describe new and existing water remediation technologies.

**Topics and Learning Points****Teaching Hours****UNIT 1: Introduction of Soil****05**

Origin and nature of soils. Physical properties of soil; soil colour, texture, structure, pore size, bulk density, water holding capacity. Soil types and their distribution.

**UNIT 2: Soil chemistry and fertility****05**

Soil colloids, cation exchange, organic carbon, Carbon - Nitrogen ratio, soil fertility. Soil reaction: acidity, alkalinity, conductivity, redox - potential.

**UNIT 3: Soil erosion****05**

Definition, Control of erosion, Soil conservation practices, Soil pollution causes and remedies.

**UNIT 4: Chemistry of water****05**

The water molecule, properties of pure water, fresh water and sea water.

Composition of waters: surface water, ground water and sea water. Dissolved gases: Factors affecting natural waters. Acid, base, salts: Hydrogen ions, modern concept of pH and buffer.

**UNIT 5: Water pollution****05**

Definition of water pollution, types of water pollutants, sources of water pollutants, trace element in water, water quality parameters and standards

**UNIT 6: Purification of water****05**

Drinking water, treatment of domestic and industrial water.

**References:**

1. Analytical Chemistry-Alka Gupta (Pragati Prakashan)
2. Soil chemicals Analysis - P.R. Hesse
3. Soil testing manual by department of agriculture and cooperation, India
4. Fundamentals of Soil --- V.N.Sahai
5. Text book of Soil science—R.K.Mehra
6. Mark M. Benjamin, 2015, Water chemistry, Waveland Press, second edition
7. Water Chemistry, Vernon L. Snoeyink and David Jenkins, John Wiley & Sons, 1980.

### Mapping of Program Out comes with Course Outcomes

**Class:** F.Y.B.Sc. (Sem I)

**Subject:** Chemistry

**Course:** Chemistry of Soil and Water **Course Code:** CHE-103-OE

Weightage: 1=weak or low relation, 2=moderate or partial relation, 3=strong or direct relation

CO\PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	3	2	2	3	2	1	2	1	2
CO2	2	3	1	3	1	2	1	2	1
CO3	1	2	3	2	3	2	2	3	3
CO4	3	3	2	3	2	1	1	2	2
CO5	2	1	3	1	3	3	2	3	2
CO6	1	2	1	2	2	2	2	1	3
CO7	3	2	2	3	2	2	1	3	3

#### Justification for the mapping

**PO1 (Disciplinary Knowledge):**

CO1: focusing on comprehensive knowledge of soil and water chemistry.

**PO2 (Critical Thinking and Problem solving):**

CO6: involving analytical skills in interpreting environmental impact assessments.

**PO4 (Research-related skills and Scientific temper):**

CO2: emphasizing practical application and experimentation in environmental sampling techniques.

**PO8 (Environment and Sustainability):**

CO3: focusing on understanding environmental impacts and applying chemistry to environmental issues.

CO4: involving understanding the impact of pollutants on soil and water quality.

CO5: focusing on sustainable practices for soil and water conservation.

CO7: emphasizing sustainable management and continuous learning in environmental chemistry

**PO9 (Self-directed and Life-long learning):**

CO7: emphasizing sustainable management and continuous learning in environmental chemistry

**CBCS Syllabus as per NEP for F.Y.B.Sc Chemistry (2024 Pattern)**

<b>Name of the Programme</b>	: B.Sc. Chemistry
<b>Program Code</b>	: USCH
<b>Class</b>	: F.Y.B.Sc
<b>Semester</b>	: I
<b>Course Type</b>	: Practical SEC
<b>Course Name</b>	: Chemistry Laboratory Techniques
<b>Course Code</b>	: CHE-104-SEC
<b>No. of Lectures</b>	: 60
<b>No. of Credits</b>	: 2 credits

**Course Objectives:**

1. To develop knowledge of basic techniques in chemistry laboratory
2. To develop scientific attitude.
3. Student will understand and analyze current event and issues regarding routine laboratory practices.
4. Students will able to develop problem solving skill.
5. The students should be able to execute the analysis.
6. To learn a suitable method of purification of organic compound.
7. To enable to perform the analysis in micro scale level.

**Course Outcomes:****By the end of the course, students will be able to:**

- CO1. Students are able to understand in details about general laboratory practices
- CO2. To learn the preparation of various laboratory solutions
- CO3. Students will gains the knowledge on basic concept of laboratory techniques.
- CO4. Students will learns about applying practical skills in chemistry
- CO5. Students are able to create data from experiments and report it
- CO6. Purify the organic compounds by using suitable method with their conformation
- CO7. Develop the ability to know the hazardous and non-hazardous chemical compounds
- CO8. Understand the importance of wastage of organic compound
- .

**Topics and Learning Points****UNIT 1: Common practices in Chemistry**

1. Determination of molecular weight for four substances
2. Determination of equivalent weight for four substances
3. Understanding the details of labels on reagent bottles

**UNIT 2: Preparation of solutions**

1. Preparation of two molar solutions
2. Preparation of two normal solutions
3. Preparation of solution by diluting corresponding concentrated solutions

**UNIT 3: Purification of Organic compounds and record it MP/BP (02 compounds of each technique)**

1. Crystallization
2. Sublimation
3. Distillation

**UNIT 4: Determination of types and Separation of Organic compounds from mixture of solid and record it MP. (Four mixtures)****References:**

1. Senior Practical Physical Chemistry, Khosla, Garg & Gulati, R, Chand & Co
2. Practical Physical Chemistry, A M. Jemes, F. E. Prichard, 3<sup>rd</sup> edn, Longman.
3. Advanced Practical Physical Chemistry, J. B. Yadav, Goel Publishing house
4. Organic Qualitative Analysis – A. I. Vogel
5. Vogel's Qualitative Inorganic Analysis, Svehla G. Pearson Education, 2012
6. Vogel's Quantitative Inorganic Analysis, Mendham J.2012

### Mapping of Program Out comes with Course Outcomes

**Class:**F. Y. B. Sc. (Sem I)

**Subject:** Chemistry

**Course:**Chemistry Laboratory Techniques

**Course Code:**CHE-104-SEC

Weightage: 1=weak or low relation, 2=moderate or partial relation, 3=strong or direct relation

CO\PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	2	1	3	1	3	2	2	3	2
CO2	2	3	2	3	1	2	1	2	2
CO3	1	2	3	2	3	1	2	3	1
CO4	3	3	2	3	2	2	1	2	2
CO5	1	2	3	2	3	1	2	3	1
CO6	1	2	1	2	2	3	2	1	3
CO7	3	2	2	3	2	2	1	3	3

#### Justification for the mapping

**PO1 (Disciplinary Knowledge):**

CO6: involving the application of theoretical chemistry knowledge in practical experiments.

**PO2 (Critical Thinking and Problem solving):**

CO4: involving problem-solving skills in experimental setups.

CO5: focusing on analytical skills and interpretation of experimental results.

**PO3 (Social competence):**

CO7: emphasizing effective communication and presentation skills in laboratory reporting.

**PO4 (Research-related skills and Scientific temper):**

CO1: focusing on practical skills and experimental techniques in chemistry.

CO2: involving the application of instrumentation for chemical analysis.

**PO7 (Effective Citizenship and Ethics):**

CO3: emphasizing ethical responsibility and safety in laboratory practices.

**CBCS Syllabus as per NEP for F.Y.B.Sc Chemistry (2024 Pattern)**

<b>Name of the Programme</b>	: B.Sc. Chemistry
<b>Program Code</b>	: USCH
<b>Class</b>	: F.Y.B.Sc
<b>Semester</b>	: II
<b>Course Type</b>	: Theory
<b>Course Name</b>	: Fundamentals of Chemistry - II
<b>Course Code</b>	: CHE-151-GEN
<b>No. of Lectures</b>	: 30
<b>No. of Credits</b>	: 2 credits

**Course Objectives:**

1. To introduce basic concepts in atomic structure: Bohr model, energy level diagrams, hydrogen spectra, basic of quantum chemistry.
2. To identify the basics of mole concept and requirements in Chemical Stoichiometry
3. To aware the students about methods of expressing concentration of solution and principle of standardization of solution
4. To learn basic of redox reactions and balancing of them by different methods
5. To know the fundamental concepts which govern the structure, bonding, properties and reactivity of organic molecules.
6. To learn covalent character, hybridization, bond angles, bond energies, bond polarities and shapes of molecules.
7. Students are expected to know common and IUPAC names.

**Course Outcomes:**

**By the end of the course, students will be able to:**

**CO1.** This course makes understanding of assumptions of Bohr model, atomic spectra, and related mathematical calculations.

**CO2.** Student should able to understand the principles of quantum mechanics and its applications.

**CO3.** Student will be able to analyze failure of classical mechanics and importance of quantum mechanics

**CO4.** Students should able to know concepts like mole, molecular weight, equivalent weight, GMV relationship and their applications in chemistry.

**CO5.** Student will be understand the balancing the redox reactions by different methods.

**CO6.** This course makes understanding of structure, bonding, and reactivity of organic molecules.

**CO7.** Students are able to draw of organic molecules, and organic compounds.

### Topics and Learning Points

#### Unit 1: Atomic structure (10 L)

Historical perspectives of the atomic structure; Bohr's theory, Derivation of atomic radius and energy, energy level diagram of hydrogen atom and limitations of Bohr's theory, atomic spectrum of hydrogen atom, Origin of Quantum Mechanics: Failure of Classical mechanics- black body radiation, photoelectric effect, electron diffraction, Quantization of energy, de Broglie's hypothesis, Heisenberg's uncertainty principle, Numerical

#### Unit 2: Chemical Stoichiometry and Oxidation–Reduction (10 L)

Mole Concept-Determination of molecular weight by gram molecular volume relationship, problems based on mole concept. Methods of expressing concentration-strength, normality, molarity, molality, mole fraction, % w/v, % w/w, % v/v, ppt, ppm, ppb, Standardization of solutions, primary and secondary standard substances, preparation of standard solutions of acids and bases, problems based on acid-base titrations only

Definitions to related terms like oxidation, reduction, oxidizing agent, reducing agent, oxidation number, valency, Balancing of redox reactions using oxidation number method and ion electron method, Problems based on equivalent weight of oxidant and reductant.

#### Unit 3: Essentials of organic chemistry (10 L)

Organic Compounds:

Structure and reactivity of organic molecules, Structural effects- Inductive Effect, Resonance Effect, Hyper conjugation Effect, Steric Effect, Hydrogen bonding and Tautomerism. Comparative study of strength of acids and bases based on Inductive and Resonance effect. Curved arrow notation, drawing electron movements with arrows, half-headed and double-headed arrows, homolytic and heterolytic bond fission,

#### References:

1. Principles of Physical Chemistry, S. H. Marron and C. F. Pruton, 6<sup>th</sup> edn.
2. Essentials of Physical Chemistry, Bahl, Tuli, Revised multicolour edn. 2009
3. Physical Chemistry, G. M. Barrow, Tata McGraw-Hill (2007)
4. Concise inorganic chemistry 5<sup>th</sup>, 6<sup>th</sup> 7<sup>th</sup> edition .J.D.Lee
5. Principles of inorganic chemistry .B.K.Sharma
6. Modern Inorganic chemistry .Revised edition. Dr.R.D.Brown
7. Organic Chemistry. Morrison and Boyd, 6<sup>th</sup>Ed Prentice Hall, NewDelhi-2001.
8. Organic Chemistry- Clayden, Oxford Uni. Press



### Mapping of Program Out comes with Course Outcomes

**Class:**F. Y. B. Sc. (Sem II)

**Subject:** Chemistry

**Course:**Fundamentals of Chemistry - II

**Course Code:**CHE-151-GEN

Weightage: 1=weak or low relation, 2=moderate or partial relation, 3=strong or direct relation

CO\PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	3	2	1	3	2	1	2	1	3
CO2	3	3	2	3	1	2	1	2	2
CO3	2	2	1	2	3	1	2	3	1
CO4	3	3	2	3	2	2	1	2	2
CO5	1	1	1	1	3	2	2	3	2
CO6	2	2	2	2	2	3	2	1	3
CO7	3	2	2	3	2	2	1	3	3

#### Justification for the mapping

##### **PO1 (Disciplinary Knowledge):**

CO1: focusing on comprehensive knowledge of physical chemistry principles.

CO3: focusing on understanding quantum principles and their application in molecular systems.

CO4: involving understanding chemical equilibrium and its interdisciplinary applications.

CO5: focusing on the principles and applications of electrochemical reactions.

CO7: involving theoretical understanding and application of statistical principles in physical chemistry.

##### **PO2 (Critical Thinking and Problem solving):**

CO2: involving problem-solving and analytical skills in physical chemistry calculations

CO6: involving analytical skills in interpreting spectroscopic results.

##### **PO5 (Trans-disciplinary knowledge):**

CO4: involving understanding chemical equilibrium and its interdisciplinary applications.

##### **PO4 (Research-related skills and Scientific temper):**

CO7: involving theoretical understanding and application of statistical principles in physical chemistry.

**CBCS Syllabus as per NEP for F.Y.B.Sc Chemistry (2024 Pattern)**

<b>Name of the Programme</b>	: B.Sc. Chemistry
<b>Program Code</b>	: USCH
<b>Class</b>	: F.Y.B.Sc
<b>Semester</b>	: II
<b>Course Type</b>	: Practical
<b>Course Name</b>	: Chemistry Practical - II
<b>Course Code</b>	: -CHE-152-GEN
<b>No. of Lectures</b>	: 60
<b>No. of Credits</b>	: 2 credits

**Course Objectives:**

1. To introduce chemical and laboratory safety.
2. To adequate students with graph of various functions.
3. To learn basic of chemistry practical from all the discipline of chemistry.
4. To learn the estimation of compounds.
5. To know the synthesis of derivatives.
6. To learn the volumetric analysis.
7. To know the preparation of solutions.

**Course Outcomes:**

**By the end of the course, students will be able to:**

**CO1.** Students will get advantage while performing experiment in laboratory interms of safety.

**CO2.** Students will be able to apply mathematical knowledge in graphical representation of experimental data.

**CO3.** Basic experiments in all discipline of chemistry gives understanding of applications of theory which is learn in theory courses.

**CO4.** Students should able to prepare the organic derivatives.

**CO5.** Students should able to estimate the organic compounds volumetrically.

**CO6.** Develop the ability of solution preparation.

**CO7.** Develop the experimental skills.

**Topics and Learning Points****Teaching Hours = Total 60****UNIT 1: Physical chemistry and Analytical Chemistry**

1. Estimation of aspirin from given tablet.
2. Balancing of chemical equation using titration data between Oxalic acid and  $\text{KMnO}_4$ .
3. Determination of oxidation state and equivalent weight of magnesium and zinc metals by Eudiometric method..
4. Polar plots of s and p orbitals.
5. Determination of heat capacity of calorimeter for different volumes.

**UNIT 2: Inorganic chemistry**

1. Estimation of copper iodometrically from given sample solution.
2. Estimation of Calcium from calcium supplementary tablet /Milk power by complex -metric titration.
3. Estimation of water of crystallization in Mohr's salt by titrating with  $\text{KMnO}_4$ .
4. Determine chloride ion concentration in a given sample of water by Mohr's method.
5. Synthesis of tetramine Copper(II) Sulphate.

**UNIT 3: Organic chemistry**

1. Organic qualitative analysis (Five compounds 3S, 2L)

Determination of elements, functional group and physical constant of the organic compound (acidic, basic, phenolic or neutral compound).

**References:**

1. J.N. Gurthu and R. Kapoor, *Advanced Experimental Chemistry (Organic)*, S. Chand and Co., 1987.
2. B.S. Furniss, A.J. Hannaford, P.W. G. Smith and A.R. Tatchell, *Vogel's Text Book of Practical Organic Chemistry*. 5th Edn., Pearson Education, 2005.
3. Practical Physical Chemistry, J B Yadav.
4. Essentials practical Physical Chemistry, Rajboj and Chandhekar.
5. *Vogel's Text Book of Practical Inorganic Chemistry*. 5th Edn., Pearson Education, 2005.

### Mapping of Program Out comes with Course Outcomes

**Class:**F. Y. B. Sc. (Sem II)

**Subject:** Chemistry

**Course:**Chemistry Practical - II

**Course Code:**CHE-152-GEN

Weightage: 1=weak or low relation, 2=moderate or partial relation, 3=strong or direct relation

CO \ PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
<b>CO1</b>	3	2	1	3	2	1	2	1	3
<b>CO2</b>	3	3	2	3	1	2	1	2	2
<b>CO3</b>	2	2	1	2	3	1	2	3	1
<b>CO4</b>	3	3	2	3	2	2	1	2	2
<b>CO5</b>	1	1	1	1	3	2	2	3	2
<b>CO6</b>	2	2	2	2	2	3	2	1	3
<b>CO7</b>	3	2	2	3	2	2	1	3	3

#### Justification for the mapping

##### **PO1 (Disciplinary Knowledge):**

CO1: focusing on comprehensive knowledge of organic chemistry principles.

CO3: involving the application of spectroscopic methods for organic compound characterization.

CO4: focusing on understanding the mechanisms and stereochemistry of organic reactions.

CO5: involving the principles and applications of aromatic compounds in organic chemistry.

##### **PO2 (Critical Thinking and Problem solving):**

CO6: involving analytical skills in predicting

##### **PO4 (Research-related skills and Scientific temper):**

CO2: emphasizing practical application and experimentation in organic synthesis techniques.

**CBCS Syllabus as per NEP for F.Y.B.Sc Chemistry (2024 Pattern)**

<b>Name of the Programme</b>	: B.Sc. Chemistry
<b>Program Code</b>	: USCH
<b>Class</b>	: F.Y.B.Sc
<b>Semester</b>	: II
<b>Course Type</b>	: Practical OE
<b>Course Name</b>	: Chemical Analysis of Soil and Water
<b>Course Code</b>	: CHE-153-OE
<b>No. of Lectures</b>	: 60
<b>No. of Credits</b>	: 2 credits

**Course Objectives:**

1. To inculcate the importance of safety in chemical laboratory
2. To educate the students about units of measurements and its applications.
3. To develop the skill about preparation of solutions and handling the apparatus
4. To develop basic understanding regarding soil testing in the students.
5. To enhance their skills about water analysis.
6. To gain theoretical as well as practical knowledge on soil health and soil quality indices
7. To educate the students on the subject of significance of water and soil in human ecology

**Course Outcomes:**

**By the end of the course, students will be able to:**

- CO1.** Understand importance of chemical safety and Lab safety while performing experiments in laboratory
- CO2.** Learn units and its conversions and apply in experimental analysis.
- CO3.** Prepare solutions by dissolving solute in solvent and by diluting the stock solution
- CO4.** Know the process of collection of soil and water samples
- CO5.** Learn the different techniques to prepare and analyze the soil samples
- CO6.** Learn various soil test methods and Clear understanding of soil health and soil quality indices
- CO7.** Understand the role of water testing in water quality parameters like pH, ECD, Hardness, alkalinity, TDS etc.

**Topics and Learning Points****Teaching Hours = Total 60****Experiments/Practicals**

1. Introduction to laboratory and apparatus used for analysis
2. Safety rules and regulations to be follow in laboratory
3. Units of measurements and its inter conversions
4. Preparation of some basic solutions by weighing solid solutes and dissolving in solvents
5. Preparation of some solutions by diluting stock solutions with solvents
6. Collection of soil samples from fields and study of soil sampling tools. (Field work)
7. Soil sample preparation
8. Determination of maximum water holding capacity of soil
9. Determination of bulk density of soil
10. Determination of pH of soil and classification as acidic or basic soils
11. Determination of conductivity of soil and hence total soluble salt contents
12. Collection of water samples (Field work)
13. Determination of total hardness of water
14. Determination of alkalinity of water
15. Determination of pH of water
16. Determination of conductivity of water and hence total soluble salt contents
17. Determination of TDS in water

**References:**

1. Laboratory Manual of Water and Wastewater Analysis, D.R. Khanna, R. Bhutiani, Daya Publishing House, Delhi, 2008
2. Chemical and Biological Methods for Water Pollution Studies, R.K. Trivedy, P.K.Goel, Oriental Printing Press, Aligarh, 1986
3. Practical Methods in Ecology and Environmental Science, R.K.Trivedy, P.K.Goel, C.L.Trishal, Environmental Publications, Arad (India) 1987
4. Practical Manual on Soil Physics– A method manual, Kadam, J. R., Shinde P. B., 2005, Department of Agricultural Chemistry and Soil Science
5. Basic Principles of Practical Chemistry, V. Venkateswaran, R. Veeraswamy, A. R. Kulandaivelu, Sultan Chand & Sons, New Delhi, 2nd Ed., 2004.

### Mapping of Program Out comes with Course Outcomes

**Class:**F. Y. B. Sc. (Sem II)

**Subject:** Chemistry

**Course:**Chemical Analysis of Soil and Water

**Course Code:**CHE-153-OE

Weightage: 1=weak or low relation, 2=moderate or partial relation, 3=strong or direct relation

CO \ PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	3	2	2	3	2	1	2	1	2
CO2	2	3	1	3	1	2	1	2	1
CO3	1	2	3	2	3	2	2	3	3
CO4	3	3	2	3	2	1	1	2	2
CO5	2	1	3	1	3	3	2	3	2
CO6	1	2	1	2	2	2	2	1	3
CO7	3	2	2	3	2	2	1	3	3

#### Justification for the mapping

**PO1 (Disciplinary Knowledge):**

CO1: focusing on comprehensive knowledge of soil and water chemistry.

**PO2 (Critical Thinking and Problem solving):**

CO6: involving analytical skills in interpreting environmental impact assessments.

**PO4 (Research-related skills and Scientific temper):**

CO2: emphasizing practical application and experimentation in environmental sampling techniques.

**PO8 (Environment and Sustainability):**

CO3: focusing on understanding environmental impacts and applying chemistry to environmental issues.

CO4: involving understanding the impact of pollutants on soil and water quality.

CO5: focusing on sustainable practices for soil and water conservation.

CO7: emphasizing sustainable management and continuous learning in environmental chemistry.

**PO9 (Self-directed and Life-long learning):**

CO7: emphasizing sustainable management and continuous learning in environmental chemistry.

**CBCS Syllabus as per NEP for F.Y.B.Sc Chemistry (2024 Pattern)**

<b>Name of the Programme</b>	: B.Sc. Chemistry
<b>Program Code</b>	: USCH
<b>Class</b>	: F.Y.B.Sc
<b>Semester</b>	: II
<b>Course Type</b>	: Practical
<b>Course Name</b>	: Chemistry Laboratory Instrumental Techniques
<b>Course Code</b>	: CHE-154-SEC
<b>No. of Lectures</b>	: 60
<b>No. of Credits</b>	: 2 credits

**Course Objectives:**

1. To develop scientific attitude.
2. Student will understand and analyze current event and issues regarding routine laboratory practices.
3. Students will able to develop problem solving skill.
4. To develop the knowledge about operation of fundamental instruments used in laboratory.
5. Students will able to understand the applications of instruments in chemistry.
6. To develop knowledge about reporting of experimental data.
7. To learn regular operation and standardization of instruments.

**Course Outcomes:**

**By the end of the course, students will be able to:**

**CO1.** Students are able to understand in details about general laboratory practices

**CO2.** To learn the preparation of various laboratory solutions

**CO3.** Students will gains the knowledge on basic concept of instrumentation.

**CO4.** Students will learns about applying theoretical skills of instruments theory in laboratory.

**CO5.** Students are able to create data from experiments and report it in proper statistical treatments

**CO6.** Understand the data in form of graph and reading of graph to create data.



CO7. Apply the skill in operation of different fundamental instruments.

### Topics and Learning Points

#### UNIT 1: pH metry

1. Standardization of pH meter.
2. Determination of pH of given laboratory solutions.
3. Determination of pH of different commercial soft drinks.
4. Simple acid base titration by pH metry.

#### UNIT 2: Potentiometry

1. Standardization of Potentiometer.
2. Determination of  $E_{cal}$ .
3. Determination of pH of given acidic buffer solution.
4. Determination of pH of given basic buffer solution.

#### UNIT 3: Colorimetry

1. Determination of  $\lambda_{max}$  of given solution.
2. Determination of unknown concentration of  $KMnO_4$  by Colorimetry.
3. Determination of unknown concentration of  $CuSO_4$  by Colorimetry
4. Estimation of  $Cu^{2+}$  ion using EDTA by calorimetrically.

#### UNIT 4: Conductometry

1. Standardization of conductivity meter and to determine cell constant.
2. Measurement of conductance of given laboratory solution.
3. Determination of dissociation constant of given weak acid.
4. Simple acid base titration by conductometry.

#### References:

1. J.N. Gurthu and R. Kapoor, *Advanced Experimental Chemistry (Organic)*, S. Chand and Co., 1987.
2. B.S. Furniss, A.J. Hannaford, P.W. G. Smith and A.R. Tatchell, *Vogel's Text Book of Practical Organic Chemistry*. 5th Edn., Pearson Education, 2005.
3. Practical Physical Chemistry, J B Yadav.
4. Essentials practical Physical Chemistry, Rajboj and Chandhekar.
5. *Vogel's Text Book of Practical Inorganic Chemistry*. 5th Edn., Pearson Education, 2005.

### Mapping of Program Outcomes with Course Outcomes

**Class:**F.Y.B.Sc. (Sem II)

**Subject:** Chemistry

**Course:**Chemistry Laboratory Instrumental

**Course Code:**CHE-154-SEC

Weightage: 1=weak or low relation, 2=moderate or partial relation, 3=strong or direct relation

CO \ PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	3	2	1	3	2	1	2	1	3
CO2	3	2	2	3	2	3	2	1	3
CO3	1	2	3	2	3	1	2	3	1
CO4	3	3	2	3	2	2	1	2	2
CO5	2	1	3	2	2	3	2	3	2
CO6	1	2	1	2	2	3	2	1	3
CO7	3	2	2	3	2	2	1	3	3

#### Justification for the mapping

##### PO1 (Disciplinary Knowledge):

CO7: involving the application of theoretical chemistry knowledge in troubleshooting and optimizing advanced instrumentation.

##### PO2 (Critical Thinking and Problem solving):

CO4: involving problem-solving skills in designing experiments using advanced instruments.

CO5: focusing on analytical skills and interpretation of results obtained from advanced instruments.

##### PO3 (Social competence):

CO7: emphasizing effective communication and presentation skills in reporting experimental findings using advanced instrumentation.

##### PO4 (Research-related skills and Scientific temper):

CO1: focusing on practical skills and experimental techniques in advanced chemical analysis.

CO2: involving the application of advanced laboratory instrumentation principles.

##### PO7 (Effective Citizenship and Ethics):

CO3: emphasizing ethical responsibility and safety in laboratory practices with advanced instrumentation.