



**Anekant Education Society's**

**Tuljaram Chaturchand College, Baramati**

**(Autonomous)**

**Four Year B.Sc. Degree Program in CHEMISTRY**

**(Faculty of Science & Technology)**

**F.Y.B.Sc. (Chemistry) Semester -II**

**Department of Chemistry**

**Tuljaram Chaturchand College, Baramati**

**Choice Based Credit System Syllabus (2023 Pattern)**

**(As Per NEP 2020)**

**To be implemented from Academic Year 2023-2024**

**Title of the Programme: F.Y.B.Sc. (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 16th May 2023, and the Circular issued by SPPU, Pune on 31st 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 fulfil 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 analyse 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.	Dr. 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.	Mr. Ajay C. Pomane	Student Representative
16.	Mr. Prathamesh P. Bhosale	Student Representative

### Credit Distribution Structure for F.Y.B.Sc.-2023-2024 (Chemistry)

Level	Semester	Major		Minor	OE	VSC, SEC, (VSEC)	AEC, VEC, IKS	OJT, FP, CEP, CC, RP	Cum. Cr/Sem	Degree/Cum. Cr.
		Mandatory	Electives							
4.5	I	<b>CHE-101-MJM</b> Physical and Inorganic Chemistry – I (2 credits)	--	--	<b>CHE-116-OE</b> Chemistry of Soil and Water (2 credits)	<b>CHE-121-VSC</b> Introduction to Agricultural Chemistry (2 credits)	<b>ENG-131-AEC</b> Functional English-I (2 credit)	<b>CC1</b> (2 credit)	22	UG Certificate 44 credits
		<b>CHE-102-MJM</b> Organic and Inorganic Chemistry – I (2 credits)			<b>CHE-117-OE</b> Chemical analysis of Soil and Water (2 credits)	<b>CHE-126-SEC</b> Organic Qualitative Analysis (2 credits)	<b>CHE-135-VEC</b> Environmental Science (2 credits)			
		<b>CHE-103-MJM</b> Chemistry Practical – I (2 credits)				<b>CHE-137-IKS</b> Indian Heritage of Chemistry (2 credits)				
	II	<b>CHE-151-MJM</b> Physical and Inorganic Chemistry – II (2 credits)	--	<b>CHE-161-MIN</b> General Chemistry (2 credits)	<b>CHE-166-OE</b> Introduction to Dairy Chemistry (2 credits)	<b>CHE-171-VSC</b> Good Lab Practices and Mathematics for Chemist (2 credits)	<b>ENG-181-AEC</b> Functional English-II (2 credit)	<b>CC2</b> (2 credit)	22	
		<b>CHE-152-MJM</b> Organic and				<b>CHE-176-SEC</b>	<b>COS-185-VEC</b>			

		Inorganic Chemistry – II (2 credits)				Inorganic Qualitative Analysis (2 credits)	Digital and Technological Solutions (2 credits)			
		<b>CHE-153-MJM</b> Chemistry Practical – II (2 credits)			<b>CHE-167-OE</b> Chemical analysis of Milk and Milk products (2 credits)					
	Cum Cr.	<b>12</b>	--	<b>02</b>	<b>08</b>	<b>08</b>	<b>10</b>	<b>04</b>	<b>44</b>	

### Course Structure for F.Y.B.Sc..Chemistry(2023 Pattern)

Sem	Course Type	Course Code	Course Name	Theory / Practical	Credits
I	Major Mandatory	CHE-101-MJM	Physical and Inorganic Chemistry –I	Theory	02
	Major Mandatory	CHE-102-MJM	Organic and Inorganic Chemistry – I	Theory	02
	Major Mandatory	CHE-103-MJM	Chemistry Practical – I	Practical	02
	Open Elective (OE)	CHE-116-OE	Chemistry of Soil and Water	Theory	02
	Open Elective (OE)	CHE-117-OE	Chemical analysis of Soil and Water	Practical	02
	Vocational Skill Course (VSC)	CHE-121-VSC	Introduction to Agricultural Chemistry	Theory	02
	Skill Enhancement Course (SEC)	CHE-126-SEC	Organic Qualitative Analysis	Practical	02
	Ability Enhancement Course (AEC)	ENG-131-AEC	Functional English-I	Theory	02
	Value Education Course (VEC)	CHE-135-VEC	Environmental Science	Theory	02
	Indian Knowledge System (IKS)	CHE-137-IKS	Indian Heritage of Chemistry	Theory	02
	Co-curricular Course (CC)	CC1	To be selected from the Basket	Theory	02
<b>Total Credits Sem I</b>					<b>22</b>
II	Major Mandatory	CHE-151-MJM	Physical and Inorganic Chemistry –II	Theory	02
	Major Mandatory	CHE-152-MJM	Organic and Inorganic Chemistry –II	Theory	02
	Major Mandatory	CHE-153-MJM	Chemistry Practical – II	Practical	02
	Minor	CHE-161-MN	General Chemistry-I	Theory	02
	Open Elective (OE)	CHE-166-OE	Introduction to Dairy Chemistry	Theory	02
	Open Elective (OE)	CHE-167-OE	Chemical analysis of Milk and Milk products	Practical	02
	Vocational Skill Course (VSC)	CHE-171-VSC	Good Lab Practices and Mathematics for Chemist	Practical	02
	Skill Enhancement Course (SEC)	CHE-176-SEC	Inorganic Qualitative Analysis	Practical	02
	Ability Enhancement Course (AEC)	ENG-181-AEC	Functional English-II	Theory	02
	Value Education Course (VEC)	COS-185-VEC	Digital and Technological Solutions	Theory	02
	Co-curricular Course (CC)	CC2	To be selected from the Basket	Theory	02
<b>Total Credits Semester II</b>					<b>22</b>
<b>Cumulative Credits Semester I and Semester II</b>					<b>44</b>



**CBCS Syllabus as per NEP 2020 for F.Y.B.Sc Chemistry  
(2023 Pattern)****Name of the Programme:** B.Sc. Chemistry**Programme Code:** USCH**Class:** F.Y.B.Sc**Semester:** II**Course Type:** Major Mandatory (Theory)**Course Code:** CHE-151-MJM**Course Title:** Physical and Inorganic Chemistry II**No. of Credits:** 02**No. of Teaching Hours:** 30**Course Objectives:**

1. To introduce basic concepts in Chemical Thermodynamics: System, surrounding, thermodynamic processes, equilibrium and non-equilibrium states
2. To adequate students with concept conversion of energy into work under different thermodynamic conditions.
3. To learn details about internal energy, maximum work, first law of thermodynamics.
4. To understand details about enthalpy of the system, molar heat capacities.
5. To identify the basics of thermo chemistry, thermo chemical equations, and type of heat of reaction.
6. To aware the students about details of ionic equilibrium, ionization of electrolytes, dissociation constant and degree of dissociation.
7. To learn basic of types and theories of bonding and overlap with examples, and details of principle and types of hybridization.

**Course Outcomes:****By the end of the course, students will be able to:****CO1.** This course makes understanding of basis of chemical Energetics**CO2.** Student should able to understand the principles of first law of thermodynamics with conversion of energy into work.**CO3.** Student will be able to analyze the processes under different thermodynamic conditions for maximum work**CO4.** Student should able to explain the different types of heats of reaction and their calculations.

**CO5.** Student will be familiar to Hess`s law of constant heat summation.

**CO6.** Students should able to know concepts strong / weak electrolytes, degree of ionization and ionization constant.

**CO7.** Student should be aware with types of chemical bandings and theories associated with it.

**CO8.** Student will understand the concept of hybridization and covalancy and types of hybridization with examples.

### Topics and Learning Points

#### Teaching Hours

#### UNIT 1: Chemical Energetics- I

[08]

Thermodynamic terms, system ,boundary, surroundings, homogenous and heterogeneous system, types of thermodynamic system, intensive and extensive properties, state of a system, equilibrium and non-equilibrium state, thermodynamic processes, reversible and irreversible processes, nature of heat and work, isothermal reversible expansion work of an ideal gas, isothermal irreversible expansion work of an ideal gas, maximum work done in reversible expansion, internal energy, units of internal energy, first law of thermodynamics, enthalpy of a system, molar heat capacities, joule-Thomson effect, adiabatic expansion of an ideal gas ,work done in adiabatic reversible expansion, Numerical.

#### UNIT 2: Thermo chemistry

[06]

Units of energy changes, enthalpy of a reaction, exothermic and endothermic reactions, thermo-chemical equations, heat of reaction, enthalpy of reaction, variation of heat (or enthalpy) of reaction with temperature, different type of heat (enthalpy) of reaction, heat of combustion, heat of solution, heat of neutralisation, energy changes during transitions or phase changes, heat of fusion, heat of vaporisation, heat of sublimation, heat of transition, Hess`s law of constant heat summation, applications of Hess`s law, bond energy measurement of the heat of reaction. Numerical.

#### UNIT 3: Ionic equilibrium- I

[06]

Strong, moderate and weak electrolytes, degree of ionization, factors affecting degree of ionization, ionization constant and ionic product of water. Ionization of weak acids and bases, pH scale, common ion effect, dissociation constants of mono- and diprotic acids.

**UNIT 4: Chemical bonding and Structure****[04]**

Recapitulation: Ionic, Covalent, Coordinate and Metallic bonds,

Types of overlaps: s-s, s-p, p-p, p-d, d-d with examples, Formation of sigma and pi bond,

Theories of bonding: Valance bond theory, Heitler-London theory, Pauling Slater theory.

**UNIT 5: Concept of Hybridization****[06]**

Definition and need of Hybridization, steps involved in hybridization, explanation of covalency of atoms in the molecules based on hybridization, types of hybridization involving in s, p and d orbital.

**References:**

1. Physical Chemistry, P. W. Atkins, ELBS, 5th Edition.
2. Principles of Physical Chemistry, Marron and Prutton, 4th Edition.
3. Physical Chemistry, G. M. Barrow 4th Edition.
4. Quantum Chemistry, I. Levine, 5th Edition.
5. Essentials of Physical Chemistry, Bahl and Tuli,
6. Principles of Physical Chemistry, Puri, Sharma and Phathania
7. Mathematical Preparation of Physical Chemistry, F. Daniel, McGraw Hill.
8. Concise Inorganic Chemistry, J. D. Lee, 5th Edition
9. Concept and Models of Inorganic Chemistry, Douglus and Daniel, 3rd Edition
10. Inorganic Chemistry, James Hughey 1.

**CBCS Syllabus as per NEP 2020 for F.Y.B.Sc Chemistry  
(2023 Pattern)**

**Name of the Programme:** B.Sc. Chemistry

**Programme Code:** USCH

**Class:** F.Y.B.Sc

**Semester:** II

**Course Type:** Major Mandatory (Theory)

**Course Code:** CHE-152-MJM

**Course Title:** Organic and Inorganic Chemistry I I

**No. of Credits:** 02

**No. of Teaching Hours:** 30

**Course Objectives:**

1. To understand concept of isomerism, types of isomers and their stereochemistry.
2. To understand concept of R/S configuration in compounds containing one Chiral centers.
3. To use different reagents in organic synthesis.
4. To know silent features of periodic table with reference to P-block elements
5. Students are know the symbols electronic configuration, trends and properties Structures of compounds.
6. Students know the applications of inter halogen compounds.
7. To learn applications of P block elements.
8. Students should know details about P- block elements

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

1. The students are expected to understand the fundamentals, principles, and recent developments in the subject area.
2. It is expected to inspire and boost the interest of the students towards chemistry as the main subject.
3. To familiarize with current and recent developments in Chemistry.
4. To create a foundation for research and development in Chemistry.
5. This course makes understanding the concept of isomerism, types of isomers
6. Students should know details about stereochemistry of acyclic molecule
7. Students are able to assign R/S configuration in compounds containing one Chiral centers.
8. Students are able to use different reagents in organic synthesis.
9. Students are able to features of periodic table with reference to P-block elements

**Topics and Learning Points****Teaching Hours****UNIT 1: Stereochemistry****[11]**

Concept of isomerism, types of isomers, representation of organic molecules (Projection formulae), Conformational isomerism in alkanes (Ethane, propane and n-butane) with energy profile diagrams, Geometrical isomerism -definition, conditions for geometrical isomers, physical and chemical properties, E/Z nomenclature of geometrical isomers. Optical isomers, chirality, optical isomerism with one asymmetric carbon atom, specific rotation, enantiomerism, R/S nomenclature, R/S system nomenclature with wedge and Fischer representation of one chiral centres.and diastereomers  
Ref. 1, 2, 3.

**UNIT 2: Reagents in Organic Synthesis****[09]**

Reducing agents: Catalyst (Ni/Pd/Pt) and H<sub>2</sub>, Birch reduction, NaBH<sub>4</sub>, LiAlH<sub>4</sub>  
Oxidizing agents: K<sub>2</sub>Cr<sub>2</sub>O<sub>7</sub>, Jones reagent, PCC, per acids and OSO<sub>4</sub>.

Ref. 1 &amp; 3

**UNIT 3: Chemistry of P-Block Elements****[10]**

Position of elements in the periodic table, electronic configuration of elements, trends in properties like: atomic size, ionization potential, electro negativity.

Structure and Properties of -

- 1) Borates and Halides of Aluminium
- 2) Allotropes of Carbon
- 3) Oxyacids of Phosphorous
- 4) Interhalogen compounds

Ref. 1, 4, 6, 7

**References:**

1. Organic Chemistry-. Morrison and Boyd, 6th edition, prentice hall, 2001.
2. Stereochemistry of carbon compounds - E. L. Eliel
3. Reactions, rearrangements and reagents – S N Sanyal
4. Inorganic Chemistry-James Hughey
5. General Chemistry - Raymond Chang
6. Concise Inorganic Chemistry-J.D. Lee, 5th Edition-Relevant pages.
7. Concept & model of Inorganic Chemistry-Douglas Mc Daniels, 3rd edition.

**CBCS Syllabus as per NEP 2020 for F.Y.B.Sc Chemistry  
(2023 Pattern)****Name of the Programme:** B.Sc. Chemistry**Programme Code:** USCH**Class:** F.Y.B.Sc**Semester:** II**Course Type:** Major Mandatory (Practical)**Course Code:** CHE-153-MJM**Course Title:** Chemistry Practical II**No. of Credits:** 02**No. of Teaching Hours:** 60**Course Objectives:**

1. To learn basic of chemistry practical from all the discipline of chemistry.
2. To introduce the different types of chemical reactions for their enthalpy evaluation.

3. To adequate students with calculations of heats of reaction.
4. To learn basic of pH of solution and its determination.
5. To learn the estimation of elements from the given samples
6. To know the synthesis of compounds/ complexes.
7. To learn the different chromatographic techniques..
8. To know the purification of liquids by distillation method

### Course Outcomes:

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

- CO1.** Students will get advantage while performing experiment in laboratory in terms of qualitative and quantitative skills.
- CO2.** Students will be able to apply mathematical knowledge in evaluating 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 inorganic compounds/complexes.
- CO5.** Students should able to estimate the samples volumetrically for their composition.
- CO6.** Develop the ability of preparation of solution of desire concentrations.
- CO7.** Develop the chromatography skills for identification of substance.

### Topics and Learning Points

**Teaching Hours = Total 60**

#### UNIT 1: Physical chemistry

1. Determination of heat of neutralization for HCl and NaOH reaction.
2. Determine the heat of ionization of acetic acid.
3. To determine heat of solution of KNO<sub>3</sub>/NH<sub>4</sub>Cl
4. To determine heat of dissolution of NaCl / KCl
5. Determine  $\Delta H$  for the following chemical reactions
 
$$3\text{Mg (s)} + 2\text{FeCl}_3 \text{ (aq)} \rightarrow 2\text{Fe(s)} + 3\text{MgCl}_2 \text{ (aq)}$$
6. Determination of enthalpy of hydration of copper sulphate.
7. To determine and compare the pH of given sample by pH paper, universal indicator method and pH meter.

#### UNIT 2: Inorganic chemistry

1. Estimation of copper iodometrically from given sample solution.

2. Estimation of Calcium from calcium supplementary tablet /Milk powder by complex -metric titration.
3. Estimation of water of crystallization in Mohr's salt by titrating with  $\text{KMnO}_4$ .
4. Synthesis of tetramine Copper(II) Sulphate
5. Synthesis of Potash Alum from aluminum metal ( Scrap Aluminum metal)
6. Determine chloride ion concentration in a given sample of water by Mohr's method.
7. Separation of binary mixture of cations by paper chromatography ( $\text{Mn}^{2+}$ ,  $\text{Fe}^{2+}$ ,  $\text{Cu}^{2+}$ ,  $\text{Zn}^{2+}$ ,  $\text{Cd}^{2+}$ ).

### UNIT 3: Organic chemistry

1. Bromination of Cinnamic acid by using sodium bromide and sodium bromate.
2. Measure the  $R_f$  values by Thin layer chromatographic method.
3. Purification of compounds by distillation method.
4. Estimation of Aspirin from APC tablet.
5. Oxime derivatives of aldehydes and ketones.
6. Estimation of Saponification value of oil/fat.
7. Separation of amino acids by paper chromatographic method.

### 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.

**CBCS Syllabus as per NEP 2020 for F.Y.B.Sc Chemistry  
(2023 Pattern)****Name of the Programme:** B.Sc. Chemistry**Programme Code:** USCH**Class:** F.Y.B.Sc**Semester:** II**Course Type:** Minor Mandatory (Theory)**Course Code:** CHE-161-MN**Course Title:** General Chemistry-I**No. of Credits:** 02**No. of Teaching Hours:** 30**Course Objectives:**

1. To introduce new branch of chemistry.
2. To adequate students with new methods for chemical analysis.
3. To learn basic of safety in the Chemistry Laboratory, Laboratory Operations and Practices.
4. To know the preparation of solutions for volumetric analysis
5. To learn about errors and their determination.
6. To know the basis and procedures involved in volumetric analysis
7. To learn more about acid base titrations and related numerical.
8. To know the different parameters of water pollution and methods of water analysis.

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

- CO1.** Students will get advantage while learning with new branch of chemistry.
- CO2.** Students will be able to apply new methods for chemical analysis.
- CO3.** Basic chemistry gives understanding of applications of theory in laboratory.
- CO4.** Students should able to prepare the organic derivatives.
- CO5.** Students should able to estimate the samples volumetrically.
- CO6.** Develop the ability of identification of water pollutants.
- CO7.** Develop the experimental skills required for water analysis.



**Topics and Learning Points****UNIT 1: INTRODUCTIN TO ANALYTICAL CHEMISTRY [8]**

Analytical Chemistry: Role, Types of Analysis, Classification of Analytical Methods, Selecting an Analytical Method, Factors Affecting the Analytical Methods, Cleanliness and Neatness in Analytical Laboratory, Laboratory Note-book, Safety in the Analytical Laboratory, Laboratory Operations and Practices, Analytical Balance, Errors in weighing: Personal Error, Cleaning of Glassware's, Calibration of Glassware, Preparation before Calibration Operation, Sample Preparation, Decomposition and Dissolution, Selecting and Handling of Reagents

**UNIT 2: ERRORS AND EVALUATION [6]**

Central Value, Mean Arithmetic Mean, Median, Accuracy and precision, Standard Deviation, Types of Errors Minimization of Errors Significant Figures and Computations, Numerical problems

**UNIT 3: INTRODUCTION TO VOLUMETRIC ANALYSIS [8]**

Calibration of Apparatus, Preparation of Standard solutions, Concentrations express in different units (Normality, Molarity, Molality, percentage, ppm, ppb, ppt, w/w, w/v, v/v. Classification of Volumetric analysis. Acid-Base titration, Numerical Problems

**UNIT 4: ANALYSIS OF WATER [8]**

Water Analysis : Colour, Turbidity ,Total Dissolved Solids Total solids, Conductivity, Acidity, Alkalinity, Hardness, Chlorides, Sulphates, Fluorides, Silica, Phosphates, Different Forms of Nitrogen Organic Nitrogen, Nitrite, Nitrate, Total Organic Nitrogen, Dissolved Organic Nitrogen, Particulate Organic Nitrogen, Heavy Metal pollution, Analysis of Heavy Metals in Aqueous System, Analysis of total heavy metals (Zn Fe, Cu, Mn, Cd, Cr, Ni, Pb), Dissolved Oxygen, Biochemical Oxygen Demand, Test of COD, Separation, Detection and Estimation of Herbicides, Water Pollution Laws, Water Quality Water Standards,

**References:**

1. Analytical Chemistry Alka L Gupta, Pragati Prakashna.
2. Analytical Chemistry, Dhruva Charan Dash, 2<sup>nd</sup> Ed, PHI Learning Pvt. Ltd., Delhi.
3. Analytical Chemistry, G.D. Christian, et al, Wiley, 6<sup>th</sup> Ed.
4. Manual on soil, plant and water analysis, Singh, Dhyan; Chhonkar, P.K. et al
5. Handbook of Water and Wastewater Analysis, Kanwaljit Kaur.

**CBCS Syllabus as per NEP 2020 for F.Y.B.Sc Chemistry  
(2023 Pattern)****Name of the Programme:** B.Sc. Chemistry**Programme Code:** USCH**Class:** F.Y.B.Sc**Semester:** II**Course Type:** Open Elective (Theory)**Course Code:** CHE-166-OE**Course Title:** Introduction to Dairy Chemistry**No. of Credits:** 02**No. of Teaching Hours:** 30**Course Objectives:**

1. To inculcate the importance of dairy food and diet
2. To educate the students about dairy food and milk products.
3. To develop the skill about preparation of milk samples.
4. To develop basic understanding regarding milk testing in the students.
5. To enhance their skills about detection of Preservatives and Adulterants.
6. To gain theoretical as well as practical knowledge on hygiene and handling of milk products.
7. To educate the students on the subject of significance of milk and milk product inhuman health.

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

- CO1. Knowing importance of the subject from the point of rural economy
- CO2. Knowing the composition of milk, its food & nutritive value
- CO3. Understanding the Microbiology of the milk
- CO4. Understanding various preservation and adulterants, various milk proteins and their role for the human body.
- CO5. Knowing various milk products, their composition, manufacture and uses.
- CO6. Learn various tests for detection of Preservatives and Adulterants.
- CO7. Understand the testing of milk and milk products.

**Topics and Learning Points****UNIT I – Introduction (10 L)**

Introduction, Definition, constituents of milk of different species such as cow, buffalo, goat, etc., Chemical composition of milk, factor affecting composition of milk and characteristics of milk of different mammals, physicochemical properties of milk, acidity, pH, density, specific gravity, color and flavor of milk, food and nutritive value of milk. Microbiology of milk, growth of microorganism, stages of growth, product of microbial growth, destruction of microorganisms growth.

**UNIT II- Preservatives & Adulterants in Milk (05 L)**

Preservation of milk- Introduction, Common preservatives are used. 2. Adulterants Introduction, Modes of Adulteration and their detection such as skimming, addition of separated milk, skim milk, Water, Starch and cane sugar..

**UNIT III- Milk proteins, Carbohydrates and Vitamins (07 L)**

1) **Milk proteins**- importance of proteins found in the milk-casein, albumin and globulin, composition, nomenclature, properties and uses.

2) **Carbohydrates**- importance of lactose, classification, properties, nutritive value of lactose use of lactose.

3) **Vitamins**- importance, definition, properties nutritive value of vitamins like A, B, B2, B6, B12, C (Ascorbic acid) & Vitamin-D.

4) **Food and nutritive** value of milk, milk & public health.

**UNITIV- Milk Products (08 L)**

Cream, Butter, Cheese and Ice-Cream.

1.**Cream**- Definition, Classification, Composition, Food & Nutritive value, Physicochemical properties, Manufacture and uses of cream.

2.**Butter**- Definition, Classification, Composition, Food & nutritive value, Physicochemical properties, Manufacture and uses of Butter selection of milk/cream. Preheating of milk, Separating of milk, neutralization of cream, Pasteurization of cream, Cooking & ageing, repending of cream, salting of butter, washing of butter, packaging & Storage, use of butter.

3. **Cheese**- Definition, Classification, Food & nutritive value, properties, Manufacture

and uses of cheese.

**4.Ice-cream-** Definition, Classification, Composition, Food & Nutritive value, Manufacture, packing, hardening & Storage, uses of Ice-cream

### References:

1. Outline of Dairy Technology- Oxford University press By- Sukumar De. (Edition-1983), 75
2. Dairy Chemistry and Animal Nutrition- M.M. Rai, Kalyani, Publishers, New Delhi 3<sup>rd</sup> Edition, 1980
3. Fundamentals of Dairy Chemistry- B.H. Webb, A.H. Hohnson, J.A. Alford, CBB Publishers and Distributors.
4. Milk and Milk Products- C.H. Eckles, H. Macy, Tata McGraw Hikk Publishing Company Ltd.
5. Chemistry and Testing of Dairy Products- H.V. Atherton, J.A. New Lander, CBS, Publishers and Distributors.
6. Dairy Microbiology, Dr. K.C. Mahanta Omsons Publication New Delhi.
7. Water Chemistry, Vernon L. Snoeyink and David Jenkins, John Wiley & Sons, 1980.

## CBCS Syllabus as per NEP 2020 for F.Y.B.Sc Chemistry (2023 Pattern)

**Name of the Programme:** B.Sc. Chemistry

**Programme Code:** USCH

**Class:** F.Y.B.Sc

**Semester:** II

**Course Type:** Open Elective (Practical)

**Course Code:** CHE-167-OE

**Course Title:** Chemical analysis of Milk and Milk products

**No. of Credits:** 02

**No. of Teaching Hours:** 60

### Course Objectives:

1. To inculcate the importance of composition and adulteration of milk
2. To educate the students to find out the different chemical content in milk.
3. Study to determine the boric acid and borate content in milk.

4. To develop basic understanding regarding amount of salt and sugar present in milk.
5. To enhance their skills about different oils present in milk.
6. To gain theoretical as well as practical knowledge on Testing the ice cream, butter, cheese and ghee
7. To educate the students on the subject of significance of milk and milk product in human health.

### Course Outcomes:

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

- CO1. Understand importance of dairy food and diet
- CO2. Determine different milk constituents.
- CO3. Analyse different milk products for their quality
- CO4. Analyse the water used in dairy plant for different attributes.
- CO5. Learn the different techniques to prepare and analyse the soil samples
- CO6. Learn various tests for detection of Preservatives and Adulterants.
- CO7. Understand the testing of milk and milk products.

### Topics and Learning Points

Teaching Hours = Total 60

#### Experiments/ Practicals

1. Determine heat stability of milk
2. Determine of Formaldehyde (Hehner Test)
3. Determine of Boric Acid and Borates
4. Determine of Urea
5. Determine of Starch
6. Determine of Sugar
7. Determine of Salt
8. Determine of Mineral Oil (Holde's Test)
9. Determine of Determination of Milk Fat
10. Testing of ice cream
11. Testing of butter
12. Testing of crude

13. Testing of paneer
14. Testing of cheese
15. Testing of Ghee
16. Testing of flavoured milk

### References:

1. Outline of Dairy Technology- Oxford University press By- Sukumar De. (Edition-1983), 75
2. Dairy Chemistry and Animal Nutrition- M.M. Rai, Kalyani, Publishers, New Delhi 3<sup>rd</sup> Edition, 1980
3. Fundamentals of Dairy Chemistry- B.H. Webb, A.H. Hohsson, J.A. Alford, CBB Publishers and Distributors.
4. Milk and Milk Products- C.H. Eckles, H. Macy, Tata McGraw Hikk Publishing Company Ltd.
5. Chemistry and Testing of Dairy Products- H.V. Athertion, J.A. New Lander, CBS, Publishers and Distributors.
6. Dairy Microbiology, Dr. K.C. Mahanta Omsons Publication New Delhi.

**CBCS Syllabus as per NEP 2020 for F.Y.B.Sc Chemistry  
(2023 Pattern)****Name of the Programme:** B.Sc. Chemistry**Programme Code:** USCH**Class:** F.Y.B.Sc**Semester:** II**Course Type:** Vocational Skill Course (Practical)**Course Code:** CHE-171-VSC**Course Title:** Good Lab Practices and Mathematics for Chemist.**No. of Credits:** 02**No. of Teaching Hours:** 60**Course Objectives:**

1. To develop knowledge of mathematical concepts in chemistry
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. To develop the knowledge about graphical representation of data.
6. Students will able to understand the applications of calculus in chemistry.
7. To develop knowledge about mathematical Chemistry

**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 mathematics.**CO4.** Students will learns about applying practical skills in chemistry**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 mathematical concepts in chemistry**CO8.** Solve problem of mathematical chemistry by using computer

## 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: Introduction to lab instruments and its working

1. pH meter
2. Conductivity meter
3. Potentiometer

### UNIT 4: Statistical treatment to chemical data

1. Determination of mean, median and standard deviation for data obtained in practical (MJM course)
2. Determination of mean, median and standard deviation for given data

### UNIT 5: Finding and plotting the graph of linear function from given data

1. Graph of two function if slope and intercept are given.
2. Graph of two function if slope and point are given.
3. Graph of two function if two points are given.
4. Graph of two function if two intercepts are given.

### UNIT 6: Calculus

1. Solving four derivatives problem in context to chemistry
2. Solving four integration problem in context to chemistry

### References:

1. J. P. Seiler, Good laboratory practice : the why and the how, 2<sup>nd</sup> edition,



Publisher: Springer, Berlin, 2005

2. Garner, W.Y., M.S. Barge and J.P. Ussary (eds.). 1992. Good laboratory practice standards. Applications for field and laboratory studies. American Chem. Soc
3. Erich Steiner, The Chemistry Maths Book 2e, Oxford University press
4. Martin Cockett, Graham Doggett, Maths for Chemists 2nd Edition, The Royal Society of Chemistry,
5. Farrington Daniels, Mathematical Preparation for Physical Chemistry. McGraw-Hill book Company, Incorporated, 1928
6. Hirst D. M. Mathematics for Chemists, Chemical Publishing Co Inc., U.S.

**CBCS Syllabus as per NEP 2020 for F.Y.B.Sc Chemistry  
(2023 Pattern)****Name of the Programme:** B.Sc. Chemistry**Programme Code:** USCH**Class:** F.Y.B.Sc**Semester:** II**Course Type:** Skill Enhancement Course (Practical)**Course Code:** CHE-176-SEC**Course Title:** Inorganic Qualitative Analysis**No. of Credits:** 02**No. of Teaching Hours:** 60**Course Objectives:**

1. To learn practical skills in inorganic qualitative analysis.
2. To perform practical techniques for the identification of unknown cations and anions from single salt/ mixture.
3. To enable the students to take confirmatory test for cations and anions identification.
4. The students should be able to plan the experimental analysis.
5. The students should be able to execute the analysis.
6. To enable to perform the analysis in micro scale.
7. To create a good analysis pathway for accurate identification of constituent in given mixture.

**Course Outcomes:****By the end of the course, students will be able to:****CO1.** Apply the methods for identification of cations and anions.**CO2.** Develop experimental skills.**CO3.** Analyze the inorganic salt / mixture by taking all the necessary precautions**CO4.** Ensure the presence of cations and anions by taking confirmatory test.**CO5.** Develop the ability to know the hazardous and non-hazardous chemical / reagent.**CO6.** Understand the impact of wastage of inorganic salt/ reagent.**CO7.** Learn the suitable method for analyze inorganic ions.

### Topics and Learning Points

**UNIT 1:** Inorganic qualitative analysis of single water soluble compound (Six compounds)

Preliminary Tests, Dry tests for Basic radical, Preparation of solution, Analysis of basic radicals into group with confirmatory tests

Preliminary Tests, Dry tests for Acidic radical, Preparation of solution, detection of acidic radicals and confirmatory tests.

**UNIT 2:** Inorganic qualitative analysis of single water insoluble compound (two salts)

**UNIT 3:** Inorganic qualitative analysis of water soluble mixture for two basic and two acidic radicals, (two mixtures)

### References:

1. Vogel's text book of quantitative chemical analysis G.H. Jeffery and J. Basset.
2. General chemistry experiments by Anil J. Elias (University press).
3. Practical chemistry by K. K. Sharma and D.S. Sharma (Vikas publication)
4. Quantitative chemical analysis by S. Sahay ( S. Chand and CO).

Choice Based Credit System Syllabus (2023 Pattern)  
(As Per NEP 2020)

**Mapping of Program Outcomes with Course Outcomes**

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

**Subject:** Chemistry

**Course:** Physical and Analytical Chemistry II

**Course Code:** CHE-151-MJM

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

CO \ PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9
CO 1	3	0	0	0	0	0	0	0	0
CO 2	3	3	0	0	0	0	0	0	0
CO 3	0	0	3	0	0	0	0	0	0
CO 4	0	0	0	3	0	0	0	0	0
CO 5	0	0	0	0	3	0	0	0	0
CO 6	0	0	0	0	0	3	0	0	0
CO 7	0	0	0	0	0	0	3	0	0
CO 8	0	0	0	0	0	0	0	3	0

**Program Outcome 1 (PO 1: Disciplinary Knowledge):**

- **CO 1:** This course makes understanding the basis of chemical energetics, allowing students to acquire in-depth knowledge of the principles of chemical energetics.

**Program Outcome 2 (PO 2: Critical Thinking and Problem Solving):**

- **CO 2:** Students should be able to understand the principles of the first law of thermodynamics with the conversion of energy into work, demonstrating critical thinking and problem-solving skills in the context of thermodynamics.

**Program Outcome 3 (PO 3: Social Competence):**

- **CO 3:** Students will be able to analyze processes under different thermodynamic conditions for maximum work, contributing to social competence through understanding and applying thermodynamic principles.

**Program Outcome 4 (PO 4: Research-Related Skills and Scientific Temper):**

- **CO 4:** Students should be able to explain the different types of heats of reaction and their calculations, enhancing research-related skills and scientific temper in the domain of thermochemistry.

**Program Outcome 5 (PO 5: Trans-Disciplinary Knowledge):**

- **CO 5:** Students will be familiar with Hess's law of constant heat summation, demonstrating trans-disciplinary knowledge by integrating principles of thermochemistry.

**Program Outcome 6 (PO 6: Personal and Professional Competence):**

- **CO 6:** Students should be able to know concepts of strong and weak electrolytes, degree of ionization, and ionization constants, enhancing personal and professional competence in understanding solutions and ionization processes.

**Program Outcome 7 (PO 7: Effective Citizenship and Ethics):**

- **CO 7:** Students should be aware of types of chemical bonding and theories associated with it, contributing to effective citizenship through ethical conduct and understanding chemical principles.

**Program Outcome 8 (PO 8: Ethical and Legal Awareness):**

- **CO 8:** Students will understand the concept of hybridization, covalency, and types of hybridization with examples, enhancing ethical and legal awareness through knowledge of chemical concepts and structures.

Choice Based Credit System Syllabus (2023 Pattern)  
(As Per NEP 2020)

**Mapping of Program Out comes with Course Outcomes**

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

**Subject:** Chemistry

**Course:** Organic and Inorganic Chemistry II

**Course Code:** CHE-152-MJM

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

CO \ PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9
CO 1	3	0	0	0	0	0	0	0	0
CO 2	3	3	0	0	0	0	0	0	0
CO 3	0	0	3	0	0	0	0	0	0
CO 4	0	0	0	3	0	0	0	0	0
CO 5	0	0	0	0	3	0	0	0	0
CO 6	0	0	0	0	0	3	0	0	0
CO 7	0	0	0	0	0	0	3	0	0
CO 8	0	0	0	0	0	0	0	3	0
CO 9	0	0	0	0	0	0	0	0	3

**Program Outcome 1 (PO 1: Disciplinary Knowledge):**

- **CO 1:** The students are expected to understand the fundamentals, principles, and recent developments in the subject area, demonstrating their grasp of disciplinary knowledge in chemistry.

**Program Outcome 2 (PO 2: Critical Thinking and Problem Solving):**

- **CO 2:** It is expected to inspire and boost the interest of the students towards chemistry as the main subject, showcasing critical thinking and problem-solving skills in chemistry.

**Program Outcome 3 (PO 3: Social Competence):**

- **CO 3:** To familiarize with current and recent developments in chemistry, contributing to social competence through awareness of contemporary chemistry advancements.

**Program Outcome 4 (PO 4: Research-Related Skills and Scientific Temper):**

- **CO 4:** To create a foundation for research and development in chemistry, enhancing research-related skills and scientific temper in chemistry.

**Program Outcome 5 (PO 5: Trans-Disciplinary Knowledge):**

- **CO 5:** This course makes understanding the concept of isomerism, types of isomers, demonstrating trans-disciplinary knowledge by integrating principles of structural chemistry.

**Program Outcome 6 (PO 6: Personal and Professional Competence):**

- **CO 6:** Students should know details about stereochemistry of acyclic molecules, enhancing their personal and professional competence in understanding organic chemistry.

**Program Outcome 7 (PO 7: Effective Citizenship and Ethics):**

- **CO 7:** Students are able to assign R/S configuration in compounds containing one chiral center, contributing to effective citizenship through the understanding of stereochemistry and chiral compounds.

**Program Outcome 8 (PO 8: Ethical and Legal Awareness):**

- **CO 8:** Students are able to use different reagents in organic synthesis, enhancing ethical and legal awareness through the application of safe and responsible chemical practices.

**Program Outcome 9 (PO 9: Advanced Research Skills):**

- **CO 9:** Students are able to understand the features of the periodic table with reference to P-block elements, contributing to advanced research skills in understanding the properties and trends of elements.

Choice Based Credit System Syllabus (2023 Pattern)  
(As Per NEP 2020)

**Mapping of Program Out comes with Course Outcomes**

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

**Subject:** Chemistry

**Course:** Chemistry Practical II

**Course Code:** CHE-153-MJM

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

CO \ PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9
CO 1	3	0	0	0	0	0	0	0	0
CO 2	3	3	0	0	0	0	0	0	0
CO 3	0	0	3	0	0	0	0	0	0
CO 4	0	0	0	3	0	0	0	0	0
CO 5	0	0	0	0	3	0	0	0	0
CO 6	0	0	0	0	0	3	0	0	0
CO 7	0	0	0	0	0	0	3	0	0
CO 8	0	0	0	0	0	0	0	3	0
CO 9	0	0	0	0	0	0	0	0	3

**Program Outcome 1 (PO 1: Disciplinary Knowledge):**

- **CO 1:** Students will get an advantage while performing experiments in the laboratory in terms of qualitative and quantitative skills, demonstrating their disciplinary knowledge and practical laboratory skills.

**Program Outcome 2 (PO 2: Critical Thinking and Problem Solving):**

- **CO 2:** Students will be able to apply mathematical knowledge in evaluating experimental data, showcasing critical thinking and problem-solving skills in laboratory experiments.

**Program Outcome 3 (PO 3: Social Competence):**

- **CO 3:** Basic experiments in all disciplines of chemistry give an understanding of the applications of theory learned in theory courses, contributing to social competence by bridging theory and practice.

**Program Outcome 4 (PO 4: Research-Related Skills and Scientific Temper):**

- **CO 4:** Students should be able to prepare inorganic compounds/complexes, enhancing their research-related skills and scientific temper in experimental synthesis.

**Program Outcome 5 (PO 5: Trans-Disciplinary Knowledge):**

- **CO 5:** Students should be able to estimate samples volumetrically for their composition, demonstrating trans-disciplinary knowledge by applying quantitative analysis techniques.

**Program Outcome 6 (PO 6: Personal and Professional Competence):**

- **CO 6:** Develop the ability to prepare solutions of desired concentrations, enhancing personal and professional competence in laboratory preparation and analysis.

**Program Outcome 7 (PO 7: Effective Citizenship and Ethics):**

- **CO 7:** Develop chromatography skills for the identification of substances, contributing to effective citizenship through ethical and accurate analytical practices.



Choice Based Credit System Syllabus (2023 Pattern)  
(As Per NEP 2020)

**Mapping of Program Out comes with Course Outcomes**

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

**Subject:** Chemistry

**Course:** General Chemistry I

**Course Code:** CHE-161-MN

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

CO \ PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9
CO 1	3	0	0	0	0	0	0	0	0
CO 2	3	3	0	0	0	0	0	0	0
CO 3	0	0	3	0	0	0	0	0	0
CO 4	0	0	0	3	0	0	0	0	0
CO 5	0	0	0	0	3	0	0	0	0
CO 6	0	0	0	0	0	3	0	0	0
CO 7	0	0	0	0	0	0	3	0	0
CO 8	0	0	0	0	0	0	0	3	0
CO 9	0	0	0	0	0	0	0	0	3

**Program Outcome 1 (PO 1: Disciplinary Knowledge):**

- **CO 1:** Students will get an advantage while learning a new branch of chemistry, showcasing their grasp of disciplinary knowledge in general chemistry.

**Program Outcome 2 (PO 2: Critical Thinking and Problem Solving):**

- **CO 2:** Students will be able to apply new methods for chemical analysis, demonstrating critical thinking and problem-solving skills in chemical analysis.

**Program Outcome 3 (PO 3: Social Competence):**

- **CO 3:** Basic chemistry gives an understanding of the applications of theory in the laboratory, contributing to social competence by bridging theory and practice.

**Program Outcome 4 (PO 4: Research-Related Skills and Scientific Temper):**

- **CO 4:** Students should be able to prepare organic derivatives, enhancing their research-related skills and scientific temper in chemical synthesis.

**Program Outcome 5 (PO 5: Trans-Disciplinary Knowledge):**

- **CO 5:** Students should be able to estimate samples volumetrically, demonstrating trans-disciplinary knowledge by applying quantitative analysis techniques.

**Program Outcome 6 (PO 6: Personal and Professional Competence):**

- **CO 6:** Develop the ability to identify water pollutants, enhancing personal and professional competence in environmental analysis.

**Program Outcome 7 (PO 7: Effective Citizenship and Ethics):**

- **CO 7:** Develop the experimental skills required for water analysis, contributing to effective citizenship through ethical and accurate analytical practices.

Choice Based Credit System Syllabus (2023 Pattern)  
(As Per NEP 2020)

**Mapping of Program Out comes with Course Outcomes**

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

**Subject:** Chemistry

**Course:** Introduction to Dairy Chemistry

**Course Code:** CHE-166-MN

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

CO \ PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9
CO 1	3	0	0	0	0	0	0	0	0
CO 2	3	3	0	0	0	0	0	0	0
CO 3	0	0	3	0	0	0	0	0	0
CO 4	0	0	0	3	0	0	0	0	0
CO 5	0	0	0	0	3	0	0	0	0
CO 6	0	0	0	0	0	3	0	0	0
CO 7	0	0	0	0	0	0	3	0	0
CO 8	0	0	0	0	0	0	0	3	0
CO 9	0	0	0	0	0	0	0	0	3

**Program Outcome 1 (PO 1: Disciplinary Knowledge):**

- **CO 1:** Knowing the importance of the subject from the point of rural economy, demonstrating an understanding of the discipline of dairy chemistry and its significance in the context of rural economies.

**Program Outcome 2 (PO 2: Critical Thinking and Problem Solving):**

- **CO 2:** Knowing the composition of milk, its food and nutritive value, showcasing critical thinking and the ability to analyze the nutritional aspects of milk.

**Program Outcome 3 (PO 3: Social Competence):**

- **CO 3:** Understanding the microbiology of milk, contributing to social competence by recognizing the role of microbiology in dairy science and its impact on society.

**Program Outcome 4 (PO 4: Research-Related Skills and Scientific Temper):**

- **CO 4:** Understanding various preservation and adulterants, various milk proteins, and their role for the human body, enhancing research-related skills and scientific temper in the field of dairy chemistry.

**Program Outcome 5 (PO 5: Trans-Disciplinary Knowledge):**

- **CO 5:** Knowing various milk products, their composition, manufacture, and uses, demonstrating trans-disciplinary knowledge by integrating principles of dairy product technology.

**Program Outcome 6 (PO 6: Personal and Professional Competence):**

- **CO 6:** Learning various tests for the detection of preservatives and adulterants, developing personal and professional competence in quality control and assurance in dairy products.

**Program Outcome 7 (PO 7: Effective Citizenship and Ethics):**

- **CO 7:** Understanding the testing of milk and milk products, contributing to effective citizenship by promoting the ethical and safe production and consumption of dairy products.

**Choice Based Credit System Syllabus (2023 Pattern)**  
**(As Per NEP 2020)**

**Mapping of Program Out comes with Course Outcomes**

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

**Subject:** Chemistry

**Course:** Chemistry Analysis of Milk & Milk Products

**Course Code:** CHE-167-OE

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

CO \ PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9
CO 1	3	0	0	0	0	0	0	0	0
CO 2	3	3	0	0	0	0	0	0	0
CO 3	0	0	3	0	0	0	0	0	0
CO 4	0	0	0	3	0	0	0	0	0
CO 5	0	0	0	0	3	0	0	0	0
CO 6	0	0	0	0	0	3	0	0	0
CO 7	0	0	0	0	0	0	3	0	0
CO 8	0	0	0	0	0	0	0	3	0
CO 9	0	0	0	0	0	0	0	0	3

**Program Outcome 1 (PO 1: Disciplinary Knowledge):**

- **CO 1:** Understand the importance of dairy food and diet, demonstrating an understanding of the discipline of dairy science and its relevance to nutrition.

**Program Outcome 2 (PO 2: Critical Thinking and Problem Solving):**

- **CO 2:** Determine different milk constituents, showcasing critical thinking and problem-solving skills in the analysis of milk composition.

**Program Outcome 3 (PO 3: Social Competence):**

- **CO 3:** Analyze different milk products for their quality, contributing to social competence by ensuring the quality of dairy products for consumers.

**Program Outcome 4 (PO 4: Research-Related Skills and Scientific Temper):**

- **CO 4:** Analyze the water used in a dairy plant for different attributes, enhancing research-related skills and scientific temper in water quality analysis.

**Program Outcome 5 (PO 5: Trans-Disciplinary Knowledge):**

- **CO 5:** Learn different techniques to prepare and analyze soil samples, demonstrating trans-disciplinary knowledge by integrating soil analysis techniques into dairy science.

**Program Outcome 6 (PO 6: Personal and Professional Competence):**

- **CO 6:** Learn various tests for the detection of preservatives and adulterants, developing personal and professional competence in quality control and safety.

**Program Outcome 7 (PO 7: Effective Citizenship and Ethics):**

- **CO 7:** Understand the testing of milk and milk products, contributing to effective citizenship by ensuring ethical and safe production and consumption of dairy products.

**Choice Based Credit System Syllabus (2023 Pattern)**  
**(As Per NEP 2020)**

**Mapping of Program Outcomes with Course Outcomes**

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

**Subject:** Chemistry

**Course:** Good Lab Practices & Mathematics for Chemistry

**Course Code:** CHE-171-VSC

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

CO \ PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9
CO 1	3	0	0	0	0	0	0	0	0
CO 2	3	3	0	0	0	0	0	0	0
CO 3	0	0	3	0	0	0	0	0	0
CO 4	0	0	0	3	0	0	0	0	0
CO 5	0	0	0	0	3	0	0	0	0
CO 6	0	0	0	0	0	3	0	0	0
CO 7	0	0	0	0	0	0	3	0	0
CO 8	0	0	0	0	0	0	0	3	0
CO 9	0	0	0	0	0	0	0	0	3

**Program Outcome 1 (PO 1: Disciplinary Knowledge):**

- **CO 1:** Students are able to understand in detail about general laboratory practices, demonstrating a comprehensive knowledge of laboratory procedures in the discipline of chemistry.

**Program Outcome 2 (PO 2: Critical Thinking and Problem Solving):**

- **CO 2:** To learn the preparation of various laboratory solutions, showcasing critical thinking and problem-solving skills in experimental setup and solution preparation.

**Program Outcome 3 (PO 3: Social Competence):**

- **CO 3:** Students will gain knowledge of basic concepts of mathematics, contributing to social competence by understanding the importance of mathematical skills in the scientific community.

**Program Outcome 4 (PO 4: Research-Related Skills and Scientific Temper):**

- **CO 4:** Students will learn about applying practical skills in chemistry, enhancing research-related skills and scientific temper in laboratory experiments.

**Program Outcome 5 (PO 5: Trans-Disciplinary Knowledge):**

- **CO 5:** Students are able to create data from experiments and report it in proper statistical treatments, demonstrating trans-disciplinary knowledge by applying statistical methods to experimental data.

**Program Outcome 6 (PO 6: Personal and Professional Competence):**

- **CO 6:** Understand the data in the form of a graph and reading of the graph to create data, developing personal and professional competence in data interpretation.

**Program Outcome 7 (PO 7: Effective Citizenship and Ethics):**

- **CO 7:** Apply mathematical concepts in chemistry, contributing to effective citizenship by applying ethical and accurate mathematical principles in chemical analysis.

**Program Outcome 8 (PO 8: Environment and Sustainability):**

- **CO 8:** Solve problems of mathematical chemistry by using a computer, enhancing knowledge and skills related to computer-based problem solving.

**Choice Based Credit System Syllabus (2023 Pattern)**  
**(As Per NEP 2020)**

**Mapping of Program Out comes with Course Outcomes**

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

**Subject:** Chemistry

**Course:** Inorganic Qualitative analysis

**Course Code:** CHE-176-SEC

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

CO \ PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9
CO 1	3	0	0	0	0	0	0	0	0
CO 2	0	3	0	0	0	0	0	0	0
CO 3	0	0	3	0	0	0	0	0	0
CO 4	0	0	0	3	0	0	0	0	0
CO 5	0	0	0	0	3	0	0	0	0
CO 6	0	0	0	0	0	3	0	0	0
CO 7	0	0	0	0	0	0	3	0	0
CO 8	0	0	0	0	0	0	0	3	0
CO 9	0	0	0	0	0	0	0	0	3

**Program Outcome 1 (PO 1: Disciplinary Knowledge):**

- **CO 1:** Apply the methods for identification of cations and anions, demonstrating a comprehensive knowledge of inorganic qualitative analysis in the discipline of chemistry.

**Program Outcome 2 (PO 2: Critical Thinking and Problem Solving):**

- **CO 2:** Develop experimental skills, showcasing critical thinking and problem-solving skills in qualitative analysis experiments.

**Program Outcome 3 (PO 3: Social Competence):**

- **CO 3:** Analyse inorganic salt/mixture by taking all necessary precautions, contributing to social competence by ensuring safe and accurate analysis.

**Program Outcome 4 (PO 4: Research-Related Skills and Scientific Temper):**

- **CO 4:** Ensure the presence of cations and anions by taking confirmatory tests, enhancing research-related skills and scientific temper in qualitative analysis.

**Program Outcome 5 (PO 5: Trans-Disciplinary Knowledge):**

- **CO 5:** Develop the ability to know hazardous and non-hazardous chemicals/reagents, demonstrating trans-disciplinary knowledge by understanding chemical safety.

**Program Outcome 6 (PO 6: Personal and Professional Competence):**

- **CO 6:** Understand the impact of wastage of inorganic salt/reagents, developing personal and professional competence by promoting efficient and responsible chemical usage.

**Program Outcome 7 (PO 7: Effective Citizenship and Ethics):**

- **CO 7:** Learn the suitable method for analysing inorganic ions, contributing to effective citizenship by promoting ethical and accurate chemical analysis.