



Anekant Education Society's

Tuljaram Chaturchand College
of Arts, Science, Commerce, Baramati
(Autonomous)

DEPARTMENT OF CHEMISTRY

(Faculty of Science and Technology)

Three Year BSc Degree Program
Chemistry

BSc Chemistry 2022 Pattern CBCS Credit
Structure and Syllabus
(To be implemented from June 2022)

Credit Structure B.Sc. 2022 Pattern

Class	Pattern	Semester	Course Code	Course Title	Course Type	No. of Credits
First Year						
F.Y.B.Sc	2022	I	USCH111	Physical and Inorganic Chemistry I	Theory	02
F.Y.B.Sc	2022	I	USCH112	Organic and Inorganic Chemistry I	Theory	02
F.Y.B.Sc	2022	I	USCH113	Chemistry Practical I	Practical	02
F.Y.B.Sc	2022	II	USCH121	Physical and Inorganic Chemistry II	Theory	02
F.Y.B.Sc	2022	II	USCH122	Organic and Inorganic Chemistry II	Theory	02
F.Y.B.Sc	2022	II	USCH123	Chemistry Practical II	Practical	02
			Certificate Course			
Second Year						
S.Y.B.Sc	2022	III	USCH231	Physical and Analytical Chemistry I	Theory	03
S.Y.B.Sc	2022	III	USCH232	Organic and Inorganic Chemistry I	Theory	03
S.Y.B.Sc	2022	III	USCH233	Chemistry Practical III	Practical	02
S.Y.B.Sc	2022	III	Certificate Course	1. Soil and Water Analysis, 2. Instrumental Techniques		02
S.Y.B.Sc	2022	IV	USCH241	Physical and Analytical Chemistry I	Theory	03
S.Y.B.Sc	2022	IV	USCH242	Organic and Inorganic Chemistry I	Theory	03
S.Y.B.Sc	2022	IV	USCH243	Chemistry Practical IV	Practical	02
S.Y.B.Sc	2022	IV	Certificate Course	Titrimetric Analysis		02

Third Year						
T.Y.B.Sc	2022	V	USCH351	Physical Chemistry I	Theory	03
T.Y.B.Sc	2022	V	USCH352	Inorganic Chemistry I	Theory	03
T.Y.B.Sc	2022	V	USCH353	Organic Chemistry I	Theory	03
T.Y.B.Sc	2022	V	USCH354	Analytical Chemistry I	Theory	03
T.Y.B.Sc	2022	V	USCH355	Industrial Chemistry I	Theory	03
T.Y.B.Sc	2022	V	USCH356A	Nuclear Chemistry I	Elective Theory	03
T.Y.B.Sc	2022	V	USCH356B	Polymer Chemistry I	Elective Theory	03
T.Y.B.Sc	2022	V	USCH356C	Introduction to Biochemistry and Molecular Biology I	Elective Theory	03
T.Y.B.Sc	2022	V	USCH356D	Environmental and Green Chemistry I	Elective Theory	03
T.Y.B.Sc	2022	V	USCH356E	Agriculture Chemistry	Elective Theory	03
T.Y.B.Sc	2022	V	USCH356F	Synthesis of Nanomaterials and Nano toxicology	Elective Theory	03
T.Y.B.Sc	2022	V	USCH357	Physical Chemistry Practical I	Practical	02
T.Y.B.Sc	2022	V	USCH358	Inorganic Chemistry Practical I	Practical	02
T.Y.B.Sc	2022	V	USCH359	Organic Chemistry Practical I	Practical	02
T.Y.B.Sc	2022	VI	USCH361	Physical Chemistry II	Theory	03
T.Y.B.Sc	2022	VI	USCH362	Inorganic Chemistry II	Theory	03
T.Y.B.Sc	2022	VI	USCH363	Organic Chemistry II	Theory	03
T.Y.B.Sc	2022	VI	USCH364	Analytical Chemistry II	Theory	03

T.Y.B.Sc	2022	VI	USCH365	Industrial Chemistry II	Theory	03
T.Y.B.Sc	2022	VI	USCH366A	Nuclear Chemistry II	Elective Theory	03
T.Y.B.Sc	2022	VI	USCH366B	Polymer Chemistry II	Elective Theory	03
T.Y.B.Sc	2022	VI	USCH366C	Introduction to Biochemistry and Molecular Biology II	Elective Theory	03
T.Y.B.Sc	2022	VI	USCH366D	Environmental and Green Chemistry II	Elective Theory	03
T.Y.B.Sc	2022	VI	USCH366E	Dairy Chemistry	Elective Theory	03
T.Y.B.Sc	2022	VI	USCH366F	Environmental Nanotechnology and Applications	Elective Theory	03
T.Y.B.Sc	2022	VI	USCH367	Physical Chemistry Practical II	Practical / Project	02
T.Y.B.Sc	2022	VI	USCH368	Inorganic Chemistry Practical II	Practical / Project	02
T.Y.B.Sc	2022	VI	USCH369	Organic Chemistry Practical II	Practical / Project	02

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.

Name of the Programme: B.Sc. Chemistry
Programme Code : USCH
Class : F.Y.B.Sc.
Semester : I
Course Name : Physical and Inorganic Chemistry
Course Code : USCH111
No. of Lecture 36

Course Objectives:

1. To develop knowledge of mathematical concepts in chemistry.
2. To develop the knowledge about graphical representation of data.
3. To adequate students with different states of matter and their properties.
4. To enhance problem solving skill in regards to state of matter.
5. To learn basic of chemical Energetics and properties of different systems.
6. To demonstrate chemical Stoichiometry and learn different methods for expression of concentration of solutions.
7. To learn basic of redox reactions and balancing of them by different methods

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

1. Students will be able to use mathematical calculations to understand concepts in chemistry.
2. Student should able to plots linear functions to shows the effect of independent variable on dependent variable.
3. Student will be able to analyze the use of calculus in chemistry.
4. Student should able to explain the different states of matter with their properties and will be familiar to liquid crystals and their applications.
5. Student should able to apply thermodynamics principles to various physical and chemical processes.
6. Students should able to determine the concentration of solutions in different units such as, molarity, normality, percentage and many more.
7. Student should able to balance the different redox reaction by using oxidation number method and ion electron method.

**SECTION I:
PHYSICAL CHEMISTRY (24 L)**

Unit I: Chemical Mathematics (8 L)

Functions and variables, variables used in chemistry

Logarithm- Rules of logarithm, Problems based on pH and pOH calculations. Derivative: Rules of differentiation, partial differentiation, problems related to chemistry, Integration: Rules of integration, definite and indefinite, problems related to chemistry.

Graph of linear function: Equation of straight line, equation from data of graph, plotting the graph from the data of chemical properties, problems.

Unit II: Gaseous and Liquid States (8 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 isothermometric method, Viscosity and its measurements by Ostwald's viscometers,

Liquid crystals: Introduction, their types and applications in various fields.

Unit III: Chemical Energetics (8 L)

Definitions of thermodynamic terms: System, surroundings etc. Types of systems, intensive and extensive properties, State and path functions, Thermodynamic processes, concept of heat and work, First Law of Thermodynamics: Statement, definition of internal energy and enthalpy, Heat capacity, heat capacities at constant volume and pressure and their relationship, work done in reversible isothermal expansion, work done in reversible adiabatic expansion, Joule-Thomson effect, Joule-Thomson coefficient and inversion temperature. Calculation of w , q , dE & dH
Zeroth law of thermodynamics

SECTION II: INORGANIC CHEMISTRY (12 L)**Unit IV: Chemical Stoichiometry (5 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

Unit V: Oxidation-Reduction (7 L)

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.

References:

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

Class: F.Y.B.Sc. (SEM I)

Subject: Chemistry

Course: Physical and Inorganic Chemistry- I

Course Code: USCH111

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

Mapping of Course Outcomes with Program Outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	3	0	0	0	0	0	0	0	0
CO2	0	3	0	0	0	0	0	0	0
CO3	0	0	3	0	0	0	0	0	0
CO4	0	0	0	3	0	0	0	0	0
CO5	0	0	0	0	3	0	0	0	0
CO6	0	0	0	0	0	3	0	0	0
CO7	0	0	0	0	0	0	3	0	0

Justification of Mapping

PO1: Disciplinary Knowledge:

CO1: Using mathematical calculations to understand chemistry concepts

PO2: Critical Thinking and Problem Solving:

CO2: Ability to plot linear functions to demonstrate cause and effect

PO3: Social Competence:

CO3: Analyzing the use of calculus in chemistry, enhancing competence in theoretical understanding

PO4: Research-Related Skills and Scientific Temper:

CO4: Explaining states of matter and understanding liquid crystals with their applications

PO5: Trans-Disciplinary Knowledge:

CO5: Applying thermodynamics principles to physical and chemical processes

PO6: Personal and Professional Competence:

CO6: Determining concentrations of solutions in different units, showcasing competence in laboratory skills

PO7: Effective Citizenship and Ethics:

CO7: Balancing different redox reactions using various methods

Name of the Programme	: B.Sc. Chemistry
Programme Code	: USCH
Class	: F.Y.B.Sc.
Semester	: I
Course Name	: Organic and Inorganic Chemistry
Course Code	: USCH112
No. of Lecture	:36

A. Learning Objective:

1. To impart the understanding of fundamental principles, and the technological aspects of modern chemistry.
2. To impart knowledge about chemical bonding hybridization of organic and inorganic molecules.
3. To become familiar with drawing of organic molecules and arrow pushing concept.
4. Students are expected to know common and IUPAC names, methods of preparation and
5. chemical reactions of aliphatic and aromatic hydrocarbons.
6. To understand the use of possible reagents to bring about the given conversion with possible
7. product and identify the major and minor products.
8. To know silent features of periodic table with reference to S-block elements.
9. The students are expected to know separation method by using crown ether, compounds and applications of S block elements.

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

1. This course makes understanding of structure, bonding, and reactivity of organic molecules.
2. Students are able to draw of organic molecules, and organic compounds.
3. Students are expected to methods of preparation and chemical reactions of alkanes, alkenes, alkynes and aromatic hydrocarbons and application of Huckels rule.
4. Students should understand the basic properties of organic compounds
5. Students should know the method of naming organic compounds
6. To understand the aliphatic and aromatic hydrocarbons.
7. Students should know details about S block elements.

SECTION-I: ORGANIC CHEMISTRY (24L)

Unit I: Chemical Bonding and Reactivity of Organic Molecules

(6L)

Covalent bond, Hybridization- sp, sp² and sp³ hybridization, Bond length, Bond angle, Bond energy, Inter and Intra molecular forces. Structural effects –Inductiveeffect, Resonance effect and hyper conjugation.

Unit II: Chemistry of Hydrocarbons (8L)

Aliphatic Hydrocarbons:

Alkanes-Preparations-Catalytic hydrogenation, Wurtz reaction and from Grignard reagent. Reactionsof alkanes- halogenation by free radical and pyrolysis.

Alkenes- Preparations- Dehydration, dehydrohalogenation (Saytzeff's limination), hydrogenation of alkynes –Cis and trans- alkene. Reactions of alkenes- addition of KMnO_4 , addition of Br_2 , addition of HX (Morkovnikoff's and anti- Morkovnikoff's addition), hydration, ozonolysis and hydroboration- oxidation.

Alkynes-Preparations- Dehalogenation, dehydrohalogenation, from CaC_2 and higher alkynes.Reactions-Formation of metal acetylides, addition of Br_2 and ozonolysis.

Aromatic hydrocarbons:

Benzene-Huckel's rule of aromaticity. Reactions of benzene–Sulphonation, Nitration, Halogenation,Friedel Craft reactions.

Unit III: Chemistry of functional groups (10L)

Alkyl halides, Alcohols, Ethers, Carboxylic acids and Phenols- Physical properties, generalmethods for preparation and reactions.

SECTION II: INORGANIC CHEMISTRY (12 L)

Unit IV: Chemistry of s-block elements (12 L)

Recapitulation of periodic table, special position of Hydrogen in the long form of periodic table, properties of S -block elements with reference to electronic configuration, extraction, trends and properties.

Introduction to crown ether and cryptans, separation of s- block elements usingcrown ethers. Compounds of s-block elements: oxides, hydroxides, peroxides, superoxide, and halides.

Applications of s-block elements in industrial, biological and agricultural field.

References

1. Organic Chemistry- Clayden ,Oxford Uni. Press
2. Organic Chemistry- Morrison and Boyd,6thEdn.
3. A guide book to Mechanism in Organic Chemistry-Peter Syke, 6thEdn.
4. Bahl A. and Bahl B.S. Advanced Organic Chemistry (2010)
5. Concise Inorganic Chemistry- J. D. Lee, 2nd Edition- Relevant pages.
6. Concept & model of Inorganic Chemistry- Douglas McDoniels, 3rd Edn.
7. New guide to Modern Valance Theory- G. I. Brown, 3rd Edn.
8. Inorganic Chemistry –James Hughey

Class: F.Y.B.Sc. (SEM I)

Subject: Chemistry

Course: Organic and Inorganic Chemistry II

Course Code: USCH 112

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

Mapping of Course Outcomes with Program Outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	3	0	0	0	0	0	0	0	0
CO2	0	3	0	0	0	0	0	0	0
CO3	0	0	3	0	0	0	0	0	0
CO4	0	0	0	3	0	0	0	0	0
CO5	0	0	0	0	3	0	0	0	0
CO6	0	0	0	0	0	3	0	0	0
CO7	0	0	0	0	0	0	3	0	0

Justification of Mapping:

PO1: Disciplinary Knowledge:

CO1: Understanding the structure, bonding, and reactivity of organic molecules (Strong Relation: 3)

PO2: Critical Thinking and Problem Solving:

CO2: Ability to draw organic molecules and compounds (Strong Relation: 3)

PO3: Social Competence:

CO3: Knowledge of methods of preparation and chemical reactions of organic compounds (Strong Relation: 3)

PO4: Research-Related Skills and Scientific Temper:

CO4: Understanding basic properties of organic compounds (Strong Relation: 3)

PO5: Trans-Disciplinary Knowledge:

CO5: Familiarity with naming methods for organic compounds (Strong Relation: 3)

PO6: Personal and Professional Competence:

CO6: Understanding aliphatic and aromatic hydrocarbons (Strong Relation: 3)

PO7: Effective Citizenship and Ethics:

CO7: Knowledge about S block elements.

Name of the Programme : B.Sc. Chemistry
Programme Code : USCH
Class : F.Y.B.Sc.
Semester : I
Course Name : Chemistry Practical
Course Code : USCH113
No. of Practical : 12

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 Outcome:

1. Student should aware about use of chemicals.
 2. Student should aware about laboratory safety and safe working methods.
 3. Basic experiments in all discipline of chemistry gives understanding of applications of theory which islearn in theory courses.
 4. Students will get advantage of learning theory in laboratory through experiments.
 5. To adequate students with graph of various mathematical functions.
 6. Students will be able to apply mathematical knowledge in graphical representation of experimental data.
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I: Chemical and Lab Safety (Compulsory)

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.

II: Physical chemistry (3 Practical)

1. Plotting of function (linear/logarithm/exponential function).
2. Determine the gas constant R in various units by eudiometer method.
3. Determine the relative viscosity of given organic liquids by viscometer.
4. Determine ΔH for the following chemical reactions
$$\text{Zn (s)} + \text{CuSO}_4 \text{ (aq)} \rightarrow \text{Cu(s)} + \text{ZnSO}_4 \text{ (aq)}$$
$$3\text{Mg (s)} + 2\text{FeCl}_3 \text{ (aq)} \rightarrow 2\text{Fe(s)} + 3\text{MgCl}_2 \text{ (aq)}$$
5. Determination of heat capacity of calorimeter for different volumes.

III: Inorganic chemistry (3 Practical)

1. Standardization of NaOH solution and find the strength of given HCl solution.
2. Standardization of KMnO_4 solution and find the strength of given solution.
3. Determine the hardness of water from a given water sample by EDTA method.
4. Analysis of mixed alkali by volumetric method.
5. Determine the number of water molecules of $\text{BaCl}_2 \cdot 2\text{H}_2\text{O}$ / $\text{MgSO}_4 \cdot 7\text{H}_2\text{O}$.

IV: Organic chemistry (3 Practical)

1. Determine the amount of acetic acid in commercial vinegar volumetrically.
2. Techniques: (Micro scale)
 - i. Crystallization
 - ii. Sublimation
3. Organic Qualitative analysis of single solid compound: Type, Preliminary tests and Physical constant
4. organic Qualitative analysis of single liquid compound: Type, Preliminary tests and Physical constant
5. Measure the R_f values by Thin layer chromatographic method.

References:

1. Senior practical Physical chemistry, B.D.Khosla and V.S.Garg.
2. Textbook of practical Inorganic Chemistry, A.I.Vogel.
3. Textbook of practical Organic Chemistry, A.I.Vogel.

Class: F.Y.B.Sc. (SEM I)

Subject: Chemistry

Course: Practical course

Course Code: USCH-113

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

Mapping of Course Outcomes with Program Outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	3	0	0	0	0	0	0	0	0
CO2	3	0	0	0	0	0	0	0	0
CO3	0	3	0	0	0	0	0	0	0
CO4	0	3	0	0	0	0	0	0	0
CO5	0	0	3	0	0	0	0	0	0
CO6	0	0	0	3	0	0	0	0	0
CO7	0	0	0	0	3	0	0	0	0

Justification of Mapping

PO1: Disciplinary Knowledge:

CO1: Advantage in laboratory experiments concerning safety

CO2: Knowledge of basic chemistry practical from various disciplines

PO2: Critical Thinking and Problem Solving:

CO3: Skills related to different types of heat reactions and their calculations

CO4: Developing problem-solving skills through experimental skills

PO3: Social Competence:

CO5: Learning to interpret and report experimental data properly

PO4: Research-Related Skills and Scientific Temper:

CO6: Development of chromatography skills for substance identification

PO5: Trans-Disciplinary Knowledge:

CO7: Ability to carry out chemical analysis by volumetric and instrumental techniques while considering social and legal ethics