Abeda Inamdar Senior College of Arts, Science and Commerce, Pune 411 001
(Autonomous)

Chemistry Syllabus

Second Year Bachelor of Science (S.Y. B. Sc.)

Under NEP Guidelines
To be Implemented from
Academic Year 2024-25

Board of Studies (Chemistry)
Post Graduate Department of Chemistry and Research Center
Abeda Inamdar Senior College of Arts, Science and Commerce, Pune-411001

Second Year Bachelor of Science (S.Y. B. Sc.)
Chemistry

Preamble:

The syllabus of Chemistry for Second year has been redesigned for Choice Based Credit System (CBCS) under the guidelines of NEP, to be implemented form 2024-25. As per NEP, Chemistry department has adopted Major Discipline Specific Course (DSC) pattern and hence offering Chemistry as Major Subject at the UG Level. In addition, Chemistry department has offered OE, SEC, and VSC courses for the undergraduate students from the basket of six verticals as per NEP.

The fundamental structure of the B.Sc. Program will follow the CBCS pattern. For all the courses examination pattern will follow Continuous Internal Evaluation (CIE) constituting to 40% of the total marks in each theory and practical course and End Semester Examination (ESE) amounting to 60% of the total marks in each theory and practical course.

Syllabus for Chemistry Major (5 Theory, 3 Practical, Field Project and Community Engagement Program), for S.Y.B.Sc. is to be implemented from the year 2024-25 as per approved structure.

Syllabus of Autonomy as per NEP [2024-25]
Structure of S. Y. B. Sc. Chemistry

Semester	Offered as	Course code	Title of course	No. of Credits
III	Major	23SBCH31MM	Physical and Analytical Chemistry III	2
III	Major	23SBCH32MM	Inorganic and Organic Chemistry III	2
III	Major	23SBCH33MM	Environmental Chemistry	2
III	Major	23SBCH34MM	Chemistry Practical-III	2
III	Major	23SBCH3FP	Field Project	2
IV	Major	23SBCH41MM	Physical and Analytical Chemistry IV	2
IV	Major	23SBCH42MM	Inorganic and Organic Chemistry IV	2
IV	Major	23SBCH43MM	Chemistry Practical-IV	2
IV	Major	23SBCH44MM	Chemistry Practical-V	2
IV	Major	23SBCH4CEP	Community Engagement Program	2

Preface:

As per National Credits Framework (NCrF), the required learner's engagement time (including direct contact hours) for 40 credits for 1200 hours.

i. **Theory Courses:** A minimum of 15 hours of teaching per credit is required in a semester.

ii. **Laboratory Courses:** A minimum of 30 hours in laboratory activities per credit is required in a semester.

iii. **Internship/on Job Training (OJT)/ Apprenticeship:** Credits for internship shall be one credit per one week of internship (or 30 hours of engagement), subject to a maximum of 4 credits per Semester. The internship shall be monitored jointly by the faculty and Industry/ Organization Mentor.

iv. **Field-based Learning/ Practices:** These are the courses requiring students to participate in field-based learning/projects generally under the supervision of faculty. A minimum of 30 hours of learning activities per credit in a semester is required.

v. **Community engagements and services:** These are the courses requiring students to participate in field-based learning/projects generally under the supervision of faculty. The curricular component of 'community engagement and service' will involve activities that would expose students to the socio-economic issues in society so that the theoretical learnings can be supplemented by actual life experiences to generate solutions to real-life problems. 30 hours of contact time per credit in a semester along with 15 hours of activities such as preparation for community engagement and service, preparation of reports, etc., and independent reading and study. Thus, the total learner engaged time would be 90 hours for a 2-credit course.

vi. **Theory and practical:** Each lecture (L) will be of 1 Hr. Each practical of 4 Hr., For details refer UGC-NEP-2020 guidelines.

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SEMESTER-III

Course/ Paper Title	**Physical and Analytical Chemistry-III**
Course Code	**23SBCH31MM**
Semester	**III**
No. of Credits	**2 (30 Hours)**

Sr. No.	Chapter Title	No. of Hours
1.	Chemical Kinetics	10
2.	Surface Chemistry	05
3.	Volumetric Quantitative Analysis	15

Aims & Objectives of the Course: The student should learn:

Sr. No.	Objectives
1	Fundamentals of chemical kinetics, integral equations, characteristics of different order of reaction and its determination.
2	Types of isotherms, its characteristics applications including surface area determination of adsorbent.
3	Fundamental's principle and applications of different common types of quantitative volumetric analysis in analytical chemistry.

Expected Course Specific Learning Outcomes

Sr. No.	Specific Learning Outcomes
1	**Unit 1:** After Studying chemical kinetics student will able to learn: - 1. The concept of kinetics, terms used, rate laws, molecularity, order. 2. Explain factors affecting rate of reaction. 3. Explain / discuss / derive integrated rate laws, characteristics, expression for half-life and examples of zero order, first order, and second order reactions. 4. Determination of order of reaction by integrated rate equation method, graphical method, half-life method and differential method. 5. Explain / discuss the term energy of activation with the help of energy diagram. 6. Explanation for temperature coefficient and effect of temperature on rate constant

	7. Derivation of Arrhenius equation and evaluation of energy of activation graphically. 8. Solve / discuss the problem based applying kinetic equations.
2	**Unit 2:** After Studying surface chemistry student will able to learn: - 1. Define / explain adsorption, classification of given processes into physical and chemical adsorption. 2. Discuss factors influencing adsorption, its characteristics, concept of physisorption and Chemisorption 3. IUPAC Classification of Adsorption Isotherms. 4. Explanation of adsorption results in the light of Langmuir adsorption isotherm, Freundlich's adsorption Isotherm and BET theory. 5. Apply BET isotherm for surface area determination of adsorbent in the adsorption process to real life problem. 6. Solve / discuss problems using theory.
3	**Unit 3:** After studying the Volumetric Quantitative Analysis student will able to learn: - 1. Explain / define different terms in volumetric analysis such as units of concentration, indicator, equivalence point, end point, standard solutions, primary and secondary standards, complexing agent, precipitating agent, oxidizing agent, reducing agent, redox indicators, acid base indicators, metallochromic indicators, etc. 2. Perform calculations involved in volumetric analysis. 3. Explain why indicator show colour change and pH range of colour change. 4. To prepare standard solution and b. perform standardization of solutions. 5. To construct acid – base titration curves and performs choice of indicator for particular titration. 6. Explain / discuss acid-base titrations, complexometric titration / precipitation titration / redox titration. 7. Apply volumetric methods of analysis to real problem in analytical chemistry / industry.

Syllabus

Unit No.	Title with Contents	No. of Hours
I	**Chemical Kinetics:** Introduction to kinetics, the rates of chemical reactions – definition of rates, rate laws, rate constants and its significance, factors affecting reaction rates, reaction order and molecularity, determination of rate law, integrated rate laws; zero-order reactions, first-order reactions, second-order reactions (with equal and unequal initial concentration of reactants), Third order reaction (only equal initial concentrations), half-life period, Examples of zero, first and second order reaction, methods for determination order of a reactions,	**10**

	Arrhenius equation- temperature dependence of reaction rates, interpretation of Arrhenius parameters. Numerical Problems. **Ref. No: 1- 725-728, 731-733, 741-742, 780-784.** **Ref. No: 2- 1033- 1067.**	
II	**Surface Chemistry:** Introduction to surface chemistry - some basic terms related to surface chemistry, adsorption, adsorption materials, factors affecting on adsorption, characteristics of adsorption, types of adsorptions, Langmuir adsorption isotherm, Freundlich's adsorption isotherm, BET theory (no derivation), determination of surface area of adsorbent by BET adsorption isotherm, IUPAC classification of adsorption isotherms, adsorption isobars, application of adsorption, problems. **Ref. No:1- 824-826, 832-837.** **Ref. No: 2- 1251-1264.** **Ref. No: 3- 932-938.**	**05**
III	**Volumetric Quantitative Analysis:** Introduction to volumetric analysis, classification of reactions in volumetric analysis, standard solutions, preparation of standard solutions, primary and secondary standards. **Ref 4: Pg. No. 257 -260 Ref 5 Pg. No. 166-169** Types of Volumetric Analysis methods: **1. Neutralization titrations**: Theory of indicators, neutralization curves for strong acid strong base, weak acid strong base, weak base strong acid. Preparation of approximate 0.1 M HCl and standardization against anhydrous sodium carbonate, determination of Na_2CO_3 content in washing soda. **Ref 4: Pg No. 262 -274, 286, 295, Ref 5: Pg No. 282-296** **2. Complexometric Titrations:** Definition of complexing agent and complexometric titration, EDTA-as complexing agent (structure of EDTA and metal ion EDTA complex), Types of EDTA titration (direct and back titration), pH adjustment and amount of indicator in EDTA	**15**

	titration, metal ion indicators (general properties, solochrome black – T, Patton and Reeder's indicator only), standard EDTA solution, determination of Ca (II) and Mg (II), total hardness of water. **Ref 4: Pg No. 309-311, 314, 321-328, 332 Ref 5 Pg No. 322-334** **3. Redox Titrations**: Definition of oxidation, reduction, oxidizing agent, reducing agent, oxidation state, redox titration, $K_2Cr_2O_7$ and $KMnO_4$ as oxidizing agents, 1,10- phenanthroline as indicator in reduction titration, diphenyl amine as oxidation indicator, $KMnO_4$ as self-indicator, Standard $KMnO_4$ solution and standardization with sodium oxalate, Determination of H_2O_2. **Ref 4: Pg No. 364-372. Ref 5: Pg No. 437-445, 452-456.** **4. Precipitation titrations:** precipitation reactions, determination of end point (formation of coloured ppt, formation of soluble coloured compound, adsorption indicator), standard $AgNO_3$ soln., standardization of $AgNO_3$ soln. – potassium chromate indicator- Mohr's titration, determination of chloride and bromide, determination of iodide. Problems based on analysis. **Ref 4 Pg No : 340-351. Ref 5 Pg No. 366-374.**	

Reference Books:

1. Atkins' Physical Chemistry by Peter Atkins, Julio de Paula, James Keeler -11th edition
2. Principles of physical chemistry by B.R. Puri, L.R. Sharma, M.S. Pathania
3. Essentials of Physical chemistry by Bahl Tuli-Revised Multicolour Edition 2009, S. Chand and Company Ltd.
4. Vogel's Textbook of quantitative Chemical Analysis, 5th Ed. G. H. Jeffry, J. Basset, J. Mendham, R. C. Denney, Longman Scientific and Technical, 1989.
5. Analytical Chemistry, G. D. Christian, P. K. Dasgupta, K. A. Schug, 7th Ed, Wily, 2004.

Additional References:

6. Principles of Chemical Kinetics-2nd Edition- James E. House
7. Physical Chemistry by Thomas Engel, Philip Reid, Warren Hehre.
8. Fundamentals of Analytical Chemistry- Skoog, west, Holler, Crouch, 9th Ed. Brooks / Cole, 2014/2004.

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SEMESTER-III

Course/ Paper Title	**Inorganic and Organic Chemistry -III**
Course Code	**23SBCH32MM**
Semester	**III**
No. of Credits	**2 (30 Hours)**

Unit No.	Chapter Title	No. of Hours
I	Introduction to Coordination Chemistry	06
II	Isomerism in Coordination Complexes	04
III	Valance Bond Theory of Coordination Compounds	05
IV	Alkyl Halides	08
V	Alcohol Phenol and Ether	07

Aims & Objectives of the Course: The student should learn:

Sr. No.	Objectives
1.	The meaning of terms associated with coordination compounds and give IUPAC Names of Coordination Compounds,
2.	To Explain Werner's theory of coordination compounds. Differentiate between primary and secondary valency. Correlate coordination number and structure of complex ion.
3.	Functional Group Chemistry of Alkyl and Aryl Halides, Alcohol, Ether and Amines with mechanistic aspects of important reactions
4.	The skills required for converting a given molecule into a target molecule through multiple step reaction

Expected Course Specific Learning Outcomes

Sr. No.	Outcomes
1.	Understanding of all the basic concepts related to co-ordination compounds, IUPAC Nomenclature, Conceptual perception of related theories.
2.	Mechanistic understanding of nature and reactivity of alkyl halides, alcohol, ether, phenol, aldehydes, ketones, carboxylic acids and its derivatives, amines and aryl diazonium salts
3.	The ability to think and utilize the knowledge of organic reactions of various functional groups to suggest simple synthetic methodology

Syllabus

Unit No.	Title With Content	No. of Hours
I	**Introduction to Coordination Compounds:** Double salt and coordination compound, basic definitions: coordinate bond, ligand, types of ligands, chelate, central metal ion, charge on complex ion, calculation of oxidation state of central metal ion, metal ligand ratio; Werner's work and theory, Effective atomic number, equilibrium constant, chelate effect, IUPAC nomenclature **(Ref.-1: 194-200, 222-224; Ref-4: 483-492) (Ref-6: 138-140)**	06
II	**Isomerism in Coordination Complexes:** Introduction, polymerization isomerism, ionization isomerism, hydrates isomerism, linkage isomerism, coordination isomerism, coordination position isomerism, geometric isomerism, optical isomerism. **(Ref-1: 232-236)**	04
III	**Valance Bond Theory of Coordination Compounds:** Aspects and assumptions of VBT, applications of VBT on the basis of hybridization to explain the structure and bonding in $[Ag(NH_3)_2]^+$, $[Ni(Cl_4)]^{2-}$, $[Ni(CN)_4]^{2-}$, $[Cr(H_2O)_6]^{3+}$, $[Fe(CN)_6]^{3-}$ (Inner orbital complex) and [FeF6]3-(outer orbital complex). Spin only formula, definitions of paramagnetic, diamagnetic. Use of observed magnetic moment in deciding the geometry in complexes with C.N.4, limitations of VBT. **(Ref-2: 592-597, Ref-3:350-351).**	05
IV	**Alkyl Halides:** Introduction and IUPAC nomenclature, Preparation; from alkanes, alkenes and alcohols Reactions: Hydrolysis, nitrite and nitro formation, nitrile and iso nitrile formation. Williamson's synthesis: Types of Nucleophilic Substitution reactions (SN^1, SN^2 and SNi) and Mechanism Elimination Reactions of Alkyl halides with mechanism (E_1, E_2 and E_1CB). Elimination vs. substitution and factors affecting these reactions. **(Ref.-7: 165-211 and 943-967)**	08
V	**Alcohols, Phenols and Ethers (Up to 5 Carbons):**	07

	Alcohols: Introduction and IUPAC nomenclature, Preparation: Preparation of 1º, 2º and 3° alcohols using Grignard reagent, ester hydrolysis, reduction of aldehydes, ketones, carboxylic acid and esters. Reactions with sodium, HX (Lucas Test), esterification, Oxidation (with PCC, alc. $KMnO_4$, acidic dichromate, conc. HNO_3,) **Ethers (Aliphatic and Aromatic):** Classification, IUPAC nomenclature, Preparation: Williamson's Synthesis, Continuous Etherification Process, Diazomethane, Preparation Cleavage of ethers with HI. **Phenols (Phenol Case):** Introduction and IUPAC nomenclature, Preparation: From Cumene, diazonium salts. Reactions Electrophilic substitution: Nitration, halogenation and sulphonation. Reimer-Tiemann Reaction, **(Ref-7:213-244 and 889-912)**	

Reference Books: (Inorganic Chemistry)

1. Concise Inorganic Chemistry, J. D. Lee, 5th Ed (1996) Blackwell Science
2. Inorganic Chemistry, James E. House, Academic Press (Elsevier), 2008
3. Inorganic Chemistry by Miessler and Tarr, Third Ed. (2010), Pearson.
4. Principles of Inorganic Chemistry, Brian W. Pfennig, Wiley (2015)
5. Inorganic Chemistry, Catherine Housecroft, Alan G. Sharpe, Pearson Prentis Hall, 2008.
6. Basics Inorganic Chemistry, Cotton and Wilkinson

Reference Books: (Organic Chemistry)

7. Morrison, R.T. and Boyd, R. N Organic Chemistry, Prentice Hall of India, 6th Edition, 2002, 283-308

Additional Reading

8. A Guidebook to Mechanism in Organic Chemistry, by Peter Sykes, 6th Edn.
9. Bahl, A. & Bahl, B.S. Advanced Organic Chemistry, S. Chand, 2010.

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SEMESTER-III

Course/ Paper Title	**Environmental Chemistry**
Course Code	**23SBCH33MM**
Semester	**III**
No. of Credits	**2 (30 Hours)**

Content

Unit No.	Title of Unit	No. of Hours
I	**Concepts and Scope of Environmental Chemistry**	**5**
II	**Hydrosphere and Water Pollution**	**8**
III	**Analytical Techniques in water Analysis**	**8**
IV	**Water pollution and treatment**	**9**

Aims & Objectives of the Course: The student should learn:

Sr. No.	Objectives
1.	Importance and conservation of environment. Importance of biogeochemical cycles
2.	Water resources Hydrological Cycle Organic and inorganic pollutants.
3.	Parameters of water quality. Methods and Techniques used in water analysis.
4.	Types of Water pollution. To remove pollutants from wastewater at their sources.

Expected Course Specific Learning Outcomes

Sr. No.	Specific Learning Outcomes
1.	Water should be conserved to get ready for future disaster like drought. Importance of biogeochemical cycles as they help how the planet conserves matter and uses energy.
2.	Water cycle is essential for the maintenance of most life and ecosystems on the planet. Types of pollutants and how to treat them.
3.	The parameters of water quality and analytical methods can detect and measure all the natural elements and their inorganic compounds and organic chemical species.
4.	Importance of treatment of water pollution as water pollutants may cause various diseases and pollute environment.

Syllabus

Unit No.	Title with Contents	No. of Hours
I	**Concepts and Scope of Environmental Chemistry:** Introduction, Environmental Pollution and Classification, Units of concentration, Segments of Environment, Biogeochemical cycles of C, N, P, S and O system **Ref. No: 2 Pg No.: 1-2,6-10,16-32** **Ref. No.:4 Pg No.: 13-14,23-24**	**05**
II	**Hydrosphere and Water Pollution:** Water resources, Hydrological Cycle: stages of hydrological cycle and chemical composition of water bodies, Microbially mediated aquatic reactions, Classification of water pollutants Organic and Inorganic pollutants, Sewage and Domestic waste, Sediments, Detergents, Pesticides, Eutrophication, Sampling and monitoring water quality parameters: pH, D.O. (Winkler Method), COD, TOC, Total hardness, free chlorine. **Ref. No:1-Pg. No. 47-62,** **Ref.No.:2-Pg.No.: 219-244, 459-491:** **Ref. No.4 70-77,133-147, 244,342-417,434-458**	**08**
III	**Analytical Techniques in water Analysis:** Water quality parameters and standards, domestic water quality parameters, surface water, sampling, preservation, Monitoring techniques and methodology (pH, conductance, DO, ammonia, nitrate and nitrite, Cl, F, CN, sulphate, phosphate, total hardness, boron, metals and metalloids- Cd Cr, Cu, Fe, Pb, Hg (Exclude polarographic and AAS methods), COD, BOD, TOC, phenols, pesticides, surfactants, tannis and lignin. Case studies of water pollution **Ref.2 Pg No.:453-454, 461-462, 471-474, 477-493**	**08**

	Ref.4 Pg No.: 430-462	
IV	**Water pollution and treatment:** Water pollutants, Eutrophication, Wastewater treatment (domestic waste water, aerobic treatment, anaerobic treatment, up-flow aerobic sludge bed, industrial waste water treatment, drinking water supplies, Trace elements in water, chemical speciation (Hg, As, Se, Cr) **Ref-1: Pg. No. 167-225** **Ref.2 Pg. No. 273** **Ref.4 Pg No.419-435,451-453,457-453**	**09**

Reference Books:

1. Environmental Chemistry – A. K. De, Third Edition (Wiley)
2. Environmental Chemistry – A. K. Bhagi and C. R. Chatwal (Himalaya Publishing House)
3. Environmental Chemistry – H. Kaur 2nd Edition 2007, Pragati Prakashan, Meerut, India
4. Environmental chemistry with Green chemistry – Asim K.Das
5. Environmental Chemistry – J. W. Moore and E. A. Moore (Academic Press, New York)
6. Basic Concepts of Analytical Chemistry: S. M. Khopkar, Wiley Eastern (1995)
7. Environmental Chemistry – A. K. De, 5th Edition (New age international publishers)

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SEMESTER-III

Course/ Paper Title	**Chemistry Practical-III**
Course Code	**23SBCH34MM**
Semester	**III**
No. of Credits	**2 (60 Hours)**

Aims & Objectives of the Course: The student should learn:

Sr. No.	Objectives
1	Experimental methods to study the kinetics of chemical reactions
2	Adsorption phenomena through the specific experiment
3	Volumetric Estimations and significance in quantitative analysis
4	To carry out organic synthesis and analysis

Expected Course Specific Learning Outcomes

Sr. No.	Specific Learning Outcomes
1	To estimate the rate constant, order of reaction and energy of activation
2	To investigate the role of surface chemistry by the adsorption phenomena
3	To understand the principles of volumetric analysis.
4	Student should be able to understand principles of Organic Qualitative Analysis

Syllabus

Sr. No.	Title with Contents	Practical Sessions
	Section A: Chemical Kinetics: (Any Four)	
1.	To Study the acid catalysed hydrolysis of an ester (methyl Acetate) and determine the rate constant (k).	1
2.	To study the kinetics of saponification reaction between sodium hydroxide and ethyl acetate.	1
3.	To compare the relative strength of HCl and H_2SO_4 by studying the kinetics of hydrolysis of methyl acetate.	1
4.	To determine the order of the reaction with respect to $K_2S_2O_8$ by fractional life method following the kinetics of per sulphate-iodide reaction.	1

5.	To determine the energy of activation of the reaction between $K_2S_2O_8$ and KI with unequal initial concentration.	1
	Section B: Surface Chemistry (Any One)	
6.	Adsorption of a textile dye on commercial activated carbon: A Simple Experiment: To Explore the Role of Surface Chemistry (Ref. 4, Page No. 143-147)	1
7.	Adsorption of acetic acid on activated charcoal: To verify the Freundlich and Langmuir's adsorption isotherms	1
	Section C: Volumetric Quantitative Analysis (Any Two)	
8.	Estimation of Aspirin from a given tablet and find errors in quantitative analysis. (Standardization of acid must be performed with standard Na_2CO_3 solution, prepared from dried anhydrous AR grade Na_2CO_3)	1
9.	Determination of acetic acid in commercial vinegar by titrating with standard NaOH. Express your results as average ± standard deviation. (Standardization of base must be performed with standard KHP)	1
10.	Determination of Hardness of water from given sample by complexometric titration (Using E.D.T.A.) method and total dissolve solids by conductometry. Express your results as average ± standard deviation. (Standardization of Na_2EDTA must be performed with standard Zn (II) solution)	1
	Section D: Inorganic qualitative/quantitative experiments (Any Four)	
11.	Estimation of Fe(III) from given solution by converting it to Fe(II) using Zn metal and then by titrating with standard solution of $K_2Cr_2O_7$ -A Green Approach (Ref.-5,7).	1
12.	To determine the equivalent weight of a metal using eudiometric method	1
13.	Determination of $BaCO_3$ content in a given sample by precise determination of volume of CO_2 (Ref. 6)	1
14.	Separation and Identification of metal ions by Paper Chromatography (Ref.,7,8)	2
	Section E: Organic Qualitative Analysis (Four)	
15.	Solid-Solid Binary Mixture (two mixture)	2
16.	Liquid-Solid Binary Mixture (two mixture)	2

References:

1. Practical physical chemistry, A. Findlay, T.A. Kitchner (Longmans, Green and Co.)
2. Systematic experimental physical chemistry, S. W. Rajbhoj, T. K. Chondekar, Anjali publication.
3. Senior Practical Physical Chemistry, B.D. Khosla and V.S. Garg (R. Chand and Co., Delhi.)
4. Journal of Chemical Education, 2015, volume-92, Issue-1, Page No. 143-147 (Laboratory Experiment)
5. Iron Analysis by Redox Titration, A General Chemistry Experiment, Journal of Chemical Education, Volume 65, Number 2, February 1988.183.
6. A Precise Method for Determining the CO_2 Content of Carbonate Materials, Journal of Chemical Education, Vol. 75, No. 12, December 1998.
7. Vogel's Textbook Quantitative Chemical Analysis, 3rd and 6th Ed.

8. Advanced Practical Chemistry, Jagdamba Sing et al, Pragati Prakashan, Merrut. Practical Chemistry, Panday, Bajpai, Giri, S.Chand and Co
9. College Practical Chemistry by H. N. Patel, S.P. Turakhia, S. S. Kelkar, N. S. Israney, S. R. Puniyani (Himalaya Publishing House, Mumbai)

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SEMESTER III

Course Title: Field Projects		**Semester:** III
Course Code: 23SBCH3FP		**No. of Credits:** 02
Nature of Course: Field Project		**60 Hrs**

The field projects assigned to the students will be essentially focus on the quality of food products, bakery products, water quality from various sources and agricultural soil from nearby localities. This will help the student to develop an insight into the potential health risks associated with contaminated water sources and soil samples which is discussed in theory paper (23SBCH33MM-Environmental Chemistry) and the significance of soil quality required for healthy agricultural practices.

Under the supervision of staff, the students will collect water and soil samples by following the standard protocols from various locations, determine quality with respect to various parameters, record and analyse datasets.

Course Objectives	
1.	Field Project is an experiential learning method. It allows students to apply theoretical knowledge in real-world scenarios
2.	Physical engagement with equipment, samples, and data collection tools enhances practical skills.
3.	Field projects involve collaboration with peers, professors, and sometimes professionals.
4.	Students gain experience in collecting raw data, understanding its significance, and processing it for analysis.
5.	Students become more aware of environmental issues and learn the importance of sustainable practices in their field.

Course Outcome	
1.	Students will gain practical experience and understanding of scientific concepts.
2.	They will learn to adapt and troubleshoot in real-time helps and develop critical thinking abilities.
3.	They will learn skills in data collection and data analysis.

List of Experiments for Field Projects

Sr. No.	Content
	In situ Measurement
1.	Colour, Odour and Temperature
2.	Hydrogen Ion Concentration (pH)
3.	Electrical Conductivity (EC)
4.	Redox Potential (Eh)
5.	Turbidity
6.	Total Dissolved Solids
	Determination of Inorganic Constituents
7.	Carbonate and Bicarbonate
8.	Chloride
9.	Sulphate and Sulphide
10.	Phosphate
11.	Calcium and Magnesium
12.	Sodium and Potassium
13.	Aluminium
14.	Chromium
15.	Iron
16.	Nickel
17.	Determination of Dissolved Gases
18.	Oxygen
19.	Ammonia
20.	Nitrate and Nitrite
21.	Phenols
22.	Surfactants
23.	Tannin and Lignin
	Food Adulteration Testing
24.	Testing of Milk and Milk Products
25.	Testing of Oils and Fats
26.	Testing of Sugars and Confectionary
27.	Testing of Food Grain and its Products
28.	Testing of Salt, Spices and Condiments
29.	Testing of Fruits and Vegetables
30.	Testing of Beverages

	Phytochemical Analysis of Medicinally Important Plants
31.	Selection of Plant, Taxonomical Classification and Identification, Sample Preparation, Soxhlet Extraction, Qualitative Analysis for Identification of constituents and determination of biological activities

References:

1. Standard method of examination of water and waste water, 23rd Edition, APHA
2. Simplified Procedures for Water Examination, 6th Edition, American Water Works Association
3. Chemical Methods for Environmental Analysis, Water and Sediments, R. Ramesh and M. Anbu, McMillan India Limited.
4. Detect Adulteration with Rapid Test (DART), Food Safety and Standards Authority of India, Ministry of Health and Family Welfare, Government of India
5. General Techniques Involved in Phytochemical Analysis, K.Sahira Banu, Dr. L.Cathrine, International Journal of Advanced Research in Chemical Science (IJARCS), April 2015, Volume 2, Issue 4, PP 25-32
6. Preliminary Analysis of Phytoconstituents and Evaluation of Anthelminthic Property of Cayratia auriculata (In Vitro), Nagaraju K, Anusha D, K Chitra, Ravi Babu, Maedica (Bucur). December 2019; 14(4): 350–356.
7. Preliminary Phytochemical Screening (Qualitative Analysis) of Cacao Leaves (Theobroma Cacao L.), H Parbuntari, Y Prestica, R Gunawan, M N Nurman, F Adella, EKSAKTA October 2018, Vol. 19 Issue 2/30

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SEMESTER-IV

Course/ Paper Title	**Physical and Analytical Chemistry-IV**
Course Code	**23SBCH41MM**
Semester	**IV**
No. of Credits	**2 (30 Hours)**

Unit No.	Chapter Title	No. of Hours
I	Phase Equilibrium	07
II	Ideal and Real Solutions	08
III	Conductometry	08
IV	Colorimetry	07

Aims & Objectives of the Course: The student should learn:

Sr. No.	Objectives
1	Different phase diagrams for one component systems
2	Concepts and properties of completely miscible and partially miscible binary solutions.
3	Fundamentals of conductometry with respect to analysis
4	Fundamentals of colorimetry with respect to analysis

Expected Course Specific Learning Outcomes

Sr. No.	Specific Learning Outcomes
1	**Unit I:** After Studying Phase equilibrium student will able to learn: - 1. Terms in phase equilibria such as- system, phase in system, components in system, degree of freedom, one / two component system, phase rule, etc. 2. Meaning and types of equilibrium such as true or static, metastable and unstable equilibrium. 3. Meaning of phase, component and degree of freedom. 4. Derivation of phase rule. 5. Description of one component system with respect to: Description of the curve, Phase rule relationship and typical features for i) Water system ii) Carbon dioxide system iii) Sulphur system

2	**Unit II:** After Studying Ideal and real solution student will able to learn: - Various terms, laws, difference between ideal and non-ideal solutions. 1. Discuss / explain thermodynamic aspects of Ideal solutions-Gibbs free energy change, Volume change, Enthalpy change and entropy change of mixing of Ideal solution. 2. Differentiate between ideal and non-ideal solutions and can apply Raoult's law and Henrys law. 3. Interpretation of i) vapour pressure–composition diagram ii) temperature-composition diagram. 4. Explain distillation of liquid solutions from temperature – composition diagram. 5. Explain / discuss azeotropes, Lever rule, Henrys law and its application. 6. Discuss / explain solubility of partially miscible liquids- systems with upper critical. Solution temperature, lower critical solution temperature and having both UCST and LCST. 7. Explain / discuss concept of distribution of solute amongst pair of immiscible solvents. 8. Derive distribution law and its thermodynamic proof. 9. Apply solvent extraction to separate the components of from mixture interest. 10. Solve problem by applying theory.
3	**Unit III:** After Studying Conductometry student will able to learn: - 1. Explain / define different terms in conductometry such as electrolytic conductance, resistance, conductance, Ohm's law, cell constant, specific and equivalent conductance, molar conductance, Kohlrausch's law, etc. 2. Discuss / explain Kohlrausch's law and its Applications, Conductivity Cell, Conductivity Meter, Whetstone Bridge. 3. Explain / discuss conductometric titrations. 4. Apply conductometric methods of analysis to real problem in analytical laboratory. 5. Solve problems based on theory / equations. 6. Correlate different terms with each other and derive equations for their correlations.
4	**Unit IV:** After Studying Colorimetry student will able to learn: - 1. Explain / define different terms in Colorimetry such as radiant power, transmittance, absorbance, molar, Lamberts Law, Beer's Law, molar absorptivity 2. Discuss / explain / derive Beer's law of absorptivity. 3. Explain construction and working of colorimeter. 4. Apply colorimetric methods of analysis to real problem in analytical laboratory. 5. Solve problems based on theory / equations. 6. Correlate different terms with each other and derive equations for their correlations.

Syllabus

Unit No.	Title with Contents	No. of Hours
I	**Phase Equilibrium**: Introduction; definitions of phase, components and degrees of freedom of a system; stability of phases, criteria of phase equilibrium. Gibbs phase rule and its thermodynamic derivation, phase diagrams of one- component systems- water, carbon dioxide and sulphur systems, problems. **Ref. No: 1, Page No- 119 - 126,** **Ref. No: 2, Page No – 661-675,** **Ref. No: 3, Page No 344- 354.**	**07**
II	**Ideal and Real Solutions:** Introduction, chemical potential of liquids - ideal solutions, ideal dilute solutions - Raoult's and Henry's Law, liquid mixtures, phase diagram of binary systems: liquids - vapour pressure diagrams, temperature composition diagrams, liquid-liquid phase diagrams, solubility of partially miscible liquids-critical solution temperature, effect of impurity on partially miscible liquids, Problems. **Ref. No: 1, Page Nos- 150-153, 155-157, 166 – 175,** **Ref. No: 2, Page No. - 750-775, 696-705** **Ref. No: 3, Page No. 261-292, 298- 302.**	**08**
III	**Conductometry:** Introduction, Electrolytic Conductance, Resistance, conductance, Ohm's law, cell constant, specific and equivalent conductance, molar conductance, variation of equivalent and specific conductance with concentrations, Kohlrausch's law and its applications, conductivity cell, conductivity meter, Whetstone Bridge, determination of cell constant, conductometric titrations (strong acid-strong base, strong acid-weak base, weak acid strong base) and Numerical. **Ref-4: 398-402, 414-423, 433-434,** **Ref-5: 519-527** **Ref-6: 528-532**	**08**
IV	**Colorimetry:** Introduction, interaction of electromagnetic radiation with matter, essential terms: radiant power, transmittance, absorbance, molar, Lamberts Law, Beer's Law, Lambert-Beer's Law, molar absorptivity, deviations from Beer's Law, Colorimeter: Principle, Construction and components, Working. Applications–unknown conc. By calibration curve method, Determination of unknown concentration of Fe(III) by thiocyanate method, Numerical. **Ref 5: 645-651, 658-661, 690,** **Ref-6: 144-153, 157-160,**	**07**

Reference Books:

1. Atkins' Physical Chemistry by Peter Atkins, Julio de Paula, James Keeler -11th edition
2. Principles of physical chemistry by B.R. Puri, L.R. Sharma, M.S. Pathania
3. Essentials of Physical chemistry by Bahl Tuli-Revised Multicolour Edition 2009, S. Chand and Company Ltd.

4. Principles of Physical Chemistry, S.H. Marron and C. F. Pruton4th ed., Oxford and IBH publishing company / CBS, new Delhi.
5. Vogel's Textbook of quantitative Chemical Analysis, 5th Ed. G. H. Jeffry, J. Basset, J. Mendham, R. C. Denney, Longman Scientific and Technical, 1989.
6. Basic Concept of Analytical Chemistry- S. M. Khopkar
7. Vogel's Text Book of Practical Organic Chemistry, Furniss, Hannaford, Smith, Tatchel, 5th Ed., Longman Scientific and Technical, 2004.

Additional References:

8. Analytical Chemistry, G.R. Chatwal, Sham Anand.
9. Principles of Chemical Kinetics-2nd Edition- James E. House
10. Physical Chemistry by Thomas Engel, Philip Reid, Warren Hehre.

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SEMESTER IV

Course/ Paper Title	**Inorganic and Organic Chemistry-IV**
Course Code	**23SBCH42MM**
Semester	**IV**
No. of Credits	**2 (30 Hours)**

Unit No.	Chapter Title	No. of Hours
I	Crystal Field Theory	07
II	Molecular Orbital Theory of Covalent Bonding	08
III	Aldehydes and Ketones	07
IV	Carboxylic acids and their derivatives	04
V	Amines and Diazonium Salts	04

Aims & Objectives of the Course: The student should learn:

Sr. No.	Objectives
1.	The theoretical and conceptual understanding of CFT and Splitting of Energy Levels
2.	Understanding of concepts of MOT, formation of diatomic molecules and their bond order
3.	Functional Group Chemistry of Aldehydes, Ketones, Carboxylic acids and derivatives, Amines and Diazonium salts
4.	The skills required for converting a given molecule into a target molecule through multiple step reaction

Expected Course Specific Learning Outcomes

Sr. No.	Specific Learning Outcomes
1.	Ability to explain CFT and its conceptual aspects with examples
2.	Mechanistic understanding of nature and reactivity of aldehydes, ketones, carboxylic acids and its derivatives, amines and aryl diazonium salts
3.	The ability to think and utilize the knowledge of organic reactions of various functional groups to suggest simple synthetic methodology

Syllabus

Unit No.	Title With Content	No. of Hours
I	**Crystal Field Theory:** Shapes of d-orbitals, Crystal field Theory (CFT): Assumptions, Application of CFT to i) Octahedral complexes (splitting of 'd' orbitals in Oh ligand field, effect of weak and strong ligand fields, colour absorbed and spectrochemical series, crystal splitting energy, Crystal field stabilization energy and factors affecting it, tetragonal distortion in Cu(II) complexes) ii) Square planar complexes and iii) Tetrahedral complexes; spin only magnetic moment of Oh and Td complexes. **(Ref-1:194-225)**	**07**
II	**Molecular Orbital Theory of Covalent Bonding:** Introduction to Molecular Orbital Method (MOT) and postulates of MO theory, LCAO approximation, s-s combination of orbitals, s-p combination of orbitals, p-p combination of orbitals, p-d combination of orbitals, d-d combination of orbitals, non-bonding combination of orbitals, Rules for linear combination of atomic orbitals, example of molecular orbital treatment for homonuclear diatomic molecules: Explain following molecules with respect to MO energy level diagram, bond order and magnetism: H2+ molecule ion, H2 molecule, He2+ molecule ion, He2 molecule, Li2 molecule, Be2 molecule, B2 molecule, C2 molecule, N2 molecule, O2 molecule, O2- and O22- ion, F2 molecule, Heteronuclear diatomic molecules: NO, CO, HF. **(Ref.-1:89-112, Ref-4: 278-292, Ref-5: 33-38)**	**08**
III	**Aldehydes and Ketones:** Aliphatic and aromatic (Formaldehyde, acetaldehyde, acetone and benzaldehyde) Introduction and IUPAC nomenclature, Preparation: from alcohols, acid chlorides and from Grignard reagent (nitriles). Reaction with HCN, $NaHSO_3$, NH_2-G derivatives. Aldol Condensation, Cannizzaro's reaction, Wittig reaction, Clemenson's and Wolff Kishner reduction. **(Ref-7: 657-700 and 797-816)**	**05**

IV	**Carboxylic acids and their derivatives:** Carboxylic acids (aliphatic and aromatic): Introduction and IUPAC nomenclature, Preparation: Acidic and Alkaline hydrolysis of esters. Reactions: Hell–Vohlard-Zelinsky Reaction. Carboxylic acid derivatives (aliphatic): (up to 5 carbons) Preparation: Acid chlorides, Anhydrides, Esters and Amides from acids and their inter conversion. Reformatsky Reaction, Perkin Condensation **(Ref-7: 713-745 and 753-785)**	**05**
V	**Amines and Diazonium Salts:** **Amines (Aliphatic and Aromatic):** Introduction and IUPAC nomenclature, Preparation from alkyl halides, Gabriel's Phthalimide synthesis, Hofmann Bromamide reaction. Electrophilic substitution (Case Aniline): nitration, bromination, sulphonation. Diazonium salts: Preparation from aromatic amines. **(Ref-7: 821-877)**	**05**

References:

Reference Books: (Inorganic Chemistry)

1. Concise Inorganic Chemistry, J. D. Lee, 5th Ed (1996) Blackwell Science
2. Inorganic Chemistry, James E. House, Academic Press (Elsevier), 2008
3. Inorganic Chemistry by Miessler and Tarr, Third Ed. (2010), Pearson.
4. Principles of Inorganic Chemistry, Brian W. Pfennig, Wiley (2015)
5. Inorganic Chemistry, Catherine Housecroft, Alan G. Sharpe, Pearson Prentis Hall, 2008.
6. Basics Inorganic Chemistry, Cotton and Wilkinson

Reference Books: (Organic Chemistry)

7. Morrison, R.T. and Boyd, R. N Organic Chemistry, Prentice Hall of India, 6th Edition, 2002, 283-308

Additional Reading

8. A Guidebook to Mechanism in Organic Chemistry, by Peter Sykes, 6th Edn.
9. Bahl, A. & Bahl, B.S. Advanced Organic Chemistry, S. Chand, 2010.

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SEMESTER IV

Course/ Paper Title	**Chemistry Practical-IV**
Course Code	**23SBCH43MM**
Semester	**IV**
No. of Credits	**2 (60 Hours)**

Aims & Objectives of the Course: The student should be

Sr. No.	Objectives
1	Able to learn all the necessary laboratory skills needed for analysis and synthesis.
2	Able to grasp the correlation of theoretical and experimental aspects
3	Able to handle basic instruments and perform various laboratory techniques
4	Able to explain the outcomes/results of the experiments and systematically present the experimental findings with the help of graph, observation table, results, calculations and graph as per requirement.

Expected Course Specific Learning Outcomes

Sr. No.	Specific Learning Outcomes
1	The student will be equipped with knowledge and skills required in Chemistry Laboratory
2	Student will be able to understand, execute and conclude the outcomes of a given experimental procedure
3	Student will be able handle instruments, synthesize and analyze organic and inorganic compounds and complexes respectively.
4	Develop consciousness towards green chemistry practices

Syllabus

Sr. No.	Title with Contents	Practical Sessions
	Section A: Ideal and Real solutions (Any One)	
1.	To study the variation of mutual solubility temperature with % concentration for the phenol - water system	1
2.	To study the effect of added electrolyte on the critical solution temperature of phenol-water system and to determine the concentration of the given solution of electrolyte	1
	Section B: Conductometry (Any Three)	

3.	To determine the cell constant of the given cell using 0.01 M KCl solution and determine dissociation constant of a given monobasic weak acid.	1
4.	To investigate the conductometric titration of strong acid against strong base.	1
5.	To investigate the conductometric titration of weak acid against strong base.	
6.	To determine the concentration of acetic acid in commercial vinegar by conductometric titration.	1
	Section C: Inorganic Synthesis and Analysis (Any Three)	1
7.	Synthesis of sodium cobaltinitrite (a laboratory chemical) from Co (II) salt and $NaNO_2$ salts and the qualitative analysis of the ions. (Ref.-6, 7)	1
8.	Synthesis of potassium Tris(oxalate) aluminium (III) using Al metal powder (Scrap aluminium) and the qualitative analysis of the ions. (Ref-7, 8,9)	1
9.	Synthesis of Tris(acetylacetone)iron (III) by green chemistry method by reaction between $Fe(OH)_3$ and acac and the qualitative analysis of the ions. (Ref.- 10,11).	1
10.	Synthesis of Tris(ethylenediamine)nickel (II) from Ni(II) salt, ethylediamine and sodium thiosulfate and the qualitative analysis of the ions.. (Ref.-12)	1
11.	Synthesis of Tetraammine Copper (II) and the qualitative analysis of the ions. (Ref.13)	1
	Section D: Inorganic Colorimetric Investigations (Any Three)	
12.	Verification of Beer's Law with $KMnO_4$ / $CuSO_4$ Solutions and determination of molar absorptivity.	1
13.	Determination of λmax and concentration of Cu-ammonia complex by colorimetry.	1
14.	Determination of the Iron (III)-Thiocyanate Reaction Equilibrium Constant by Colorimetry (Ref.-14,15)	1
15.	Determination of metal to ligand ratio in Fe(III) / Cu(II)–Salicylic acid complex by colorimetry (Ref.-16, 17,18)	1
	Section E: Organic Estimations (Any Three)	
14.	Determination of Molecular Weight of Monobasic Acid	1
15.	Determination of Molecular Weight of Dibasic Acid	1
16.	Estimation of amount of acetamide	1
17.	Estimation of Vitamin C using ceric ammonium sulphate	1
	Section F: Organic Synthesis (Green Approach) (Any Two)	
18.	Acetylation of primary amine (Green Approach)	1
19.	Base catalyzed Aldol condensation (Green Approach) LiOH	1
20.	Bromination of acetamide by ferric ammonium nitrate and KBr in aqueous medium	1

References:

1. Practical Physical Chemistry, A. Findlay, T.A. Kitchner (Longmans, Green and Co.)
2. Experiments in Physical Chemistry, J.M. Wilson, K.J. Newcombe, A.r. Denko. R.M.W. Richett (Pergamon Press)
3. Senior Practical Physical Chemistry, B.D. Khosla and V.S. Garg (R. Chand and Co., Delhi.)
4. Experiments in Chemistry, D. V. Jahagirdar, Himalaya Publishing House
5. Practical Physical Chemistry, B. Vishwanathan and P. S. Raghwan, Viva Books
6. Handbook of Preparative Inorganic Chemistry, Volume 2, Second Edition, Edited By Georg Braue R, Academic Press, New York, London, 1965. (Page-1541)
7. Practical Chemistry, Panday, Bjpai, Giri, S. Chand and Co.
8. McNeese, T.J.; Wierda, D.A. Synthesis of Potassium Tris(oxalato)aluminate(III) Trihydrate. Journal of Chemical Education,1983, 60(11), 1001.
9. Inorganic Syntheses Vol -1 by H S Booth. First Ed, 1939. (page-36).
10. Novel Synthesis of Tris(acetylacetonato)-iron(III), Journal of Chem. Soc. Dalton Trans. 1983
11. Metal Acetylacetonate Synthesis Experiments: Which Is Greener?, Journal of Chemical Education, 2011, 88, 947–953, dx.doi.org/10.1021/ed100174f.
12. Experimental Inorganic/Physical Chemistry: An Investigative, Integrated Approach to Practical Project Work, Mounir A. Malati, Woodhead Publishing Limited, 1999.
13. Vogel's Textbook Quantitative Chemical Analysis, 6th Ed.
14. Colorimetric Determination of the Iron (III)-Thiocyanate Reaction Equilibrium Constant with Calibration and Equilibrium Solutions Prepared in a Cuvette by Sequential Additions of One Reagent to the Other, Journal of Chemical Education, Vol.88 No.3 March 2011.
15. Experiments in chemistry, D. V. Jahagirdar, Himalaya publication.
16. A spectrophotometric study of complex formation between Fe(III) and salicylic acid, Kinya Ogawa, Nobuko Tobe, Bulletin of chemical society of Japan, 39, 227-232, 1966.
17. Salicylate determination by complexation with Fe (III) and optical absorbance spectroscopy
18. Determination of Equilibrium Constants of Metal Complexes from Spectrophotometric Measurements: An Undergraduate Laboratory Experiment, Journal of Chemical Education, Vol. 76, No. 9, September 1999.
19. College Practical Chemistry by H. N. Patel, S.P. Turakhia, S. S. Kelkar, N. S. Israney, S. R. Puniyani (Himalaya Publishing House, Mumbai)
20. Vogel's Textbook of Practical Organic Chemistry
21. T.Y.B.Sc. Practical Chemistry (2019 Pattern), Manali Prakashan
22. Comprehensive Practical Organic Chemistry by V.K. Ahluwalia and Renu Aggarwal

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SEMESTER IV

Course/ Paper Title	**Chemistry Practical-V**
Course Code	**23SBCH44MM**
Semester	**IV**
No. of Credits	**2 (60 Hours)**

Aims & Objectives of the Course: The student should be

Sr. No.	Objectives
1	Able to learn all the necessary laboratory skills needed for analysis and synthesis.
2	Able to grasp the correlation of theoretical and experimental aspects
3	Able to handle basic instruments and perform various laboratory techniques
4	Able to explain the outcomes/results of the experiments and systematically present the experimental findings with the help of graph, observation table, results, calculations and graph as per requirement.

Expected Course Specific Learning Outcomes

Sr. No.	Specific Learning Outcomes
1	Know basic application of computer apps such as word, Excel, Power Point and other Chemistry and data analysis software
2	Understand the significance of computer and its apps in collections and analysis of Chemistry-related information.
3	Collect, validate, organize, process the data using different software.
4	Compare the results of processed data using software with the raw data related to Chemistry.
5	Evaluate the results of processed data with other resources.
6	Write a scientific report or perform calculations, on Chemistry topics using different computer applications.

Syllabus

• All experiments are compulsory.

• Students should submit the colored hard copy of each experiment in a file for evaluation.

Sr. No.	Title with Contents	Practical Sessions
	Section A: MS Office Tools for Chemists	
1.	Basic and advanced features of Microsoft Word Preparation of 3 to 5 pages document on topic related to chemistry. Documents should contain tables, figures, equations, and symbols	1
2.	Basic and advanced features of Microsoft Excel Calculate percentage of Phenol and Water in Excel by using formula. Prepare word document for the above calculations.	1
3.	Make graph of phenol water system and Conductometric Titration from the readings. Assignments on making graphs on Chemical Kinetics Experiments. Prepare word document of above graphs with appropriate captions.	2
4.	Basic and advanced features of Microsoft Power Point. Preparation of 10-15 slides on topic related to chemistry. Give Seminar. Documents should contain tables, figures, equations, symbols, images, videos, links and e-resources	2
	Section B: Application of Google Tools in Chemistry	
5.	Mastering Google forms Conduct a survey on topics related to Chemistry using google form.	1
6.	How to use Google documents and google drive. Prepare and save google documents in drive.	1
	Section C: Online Knowledge Resources in Chemistry	
7.	Introduction to Google scholar Prepare google scholar account. Search literature on topic related to chemistry on google scholar. Prepare a word document of the same.	1
8.	Preparation of report on various Chemistry e-resources. Preparation of 2 to 3 pages document. Prepare a table indicating the name of the e-resource, link and information about the e-resource.	1
	Section D: Drawing Tools in Chemistry	
9.	Introduction to Chem Office 2004 Making of Structures by using tool bar Making of Structure by IUPAC Name Installation of Mobile app KingDraw and its applications for Drawing Structures	2
10.	Advance Level Chem Office Drawing of Reactions with Mechanism with arrows Prepare Animated Reaction Mechanism in Power point presentation Convert 2-D structure into 3-D structure, use of SMILE format	3

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SEMESTER IV

Course Title: Community Engagement Program		**Semester:** IV
Course Code: 23SBCH4CEP		**No. of Credits:** 02
Nature of Course: Community Engagement Services		**90 Hrs**

The Community Engagement Services is an idea of extending the role of educational institutions beyond the campus. It can play a meaningful role in outreaching the society and educating the general population, foster collaboration with the society and study the community concerns, needs and interests.

Identifying issues of stakeholders serves as a foundational step in establishing relationships, crucial not only for effective community engagement but also for the successful development of projects.

Course Objectives	
1.	Enriching the undergraduate students through experiential learning method. It allows students to apply theoretical knowledge in real-world scenarios
2.	The participation in community engagement services will help to inculcate Civic responsibility, Interpersonal Skills, Leadership Qualities, Critical Thinking and Problem-Solving and overall personality improvement in the students.
3.	The community will be enriched though the knowledge shared by the students and various productive ideas will percolate in the society through the institution.
4.	These engagement services will help towards overall improvement in the community through various aspects like food quality and its concerns, waste management and recycling, social awareness, health and hygiene and promotion of science amongst school students.

Course Outcome	
1.	Holistic Development of undergraduate students through various aspects of personality development will be achieved through their participation in community engagement services.
2.	The students will learn to adapt and troubleshoot in real-time and develop critical thinking abilities. They will learn skills in data collection and data analysis.
3.	Overall improvement in the community with respect to Health, Hygiene, Healthy Food Practices, Waste Recycle and Environmental Awareness, Social Awareness against superstitions and promotion of science amongst students can be achieved through such services.

Proposed Community Engagement Services:

1.	**Food Adulteration Awareness:** To create a consumer awareness on food adulteration, Harmful effect of food adulterants and methods for detection of some adulterants through the community engagement services. The students shall be trained in testing protocols as described by FSSAI and they will reach out into their neighbourhood and create awareness about the various type of adulterations, their harmful effects on health and methods to recognize such adulterations. Students will make record of activities and number of families approached by them. Record videos and images of the demonstrations and share with the community members.
2.	**Waste Recycling and Reduction:** Very large quantity of waste is generated in urban areas. The students shall be trained to reach out in the community to promote the idea of waste recycling including plastics, glass, and electronic waste. Students will educate the community about the environmental and commercial advantages of waste recycling and promote waste reduction and recycling practices. Students will make record of activities and number of families approached by them. Record videos and images of the demonstrations and share with the community members.

3.	**Anti-Superstition Awareness Program** In view of the widespread superstition and incidents of unaware public getting exploited by conmen, it is a program which is relevant and as per the need of the community. Most of the tricks shown by these conmen are small Chemistry experiments through which the people get impressed and believe in the supernatural powers of these conmen. Students will be trained in various experiments and demonstrations through which they will create awareness in the community against superstition. Students will make record of activities and number of families approached by them. Record videos and images of the demonstrations and share with the community members. They will collect the feedback from community members.
4.	**Awareness program on Health and Hygiene:** The promotion of Physical, Social, Emotional, and Mental well-being is another important aspect of overall growth of community. The educational institutions can play an important role in the promotion of awareness and educate the community about various aspects of health and hygiene. The students will promote the idea of cleanliness, balanced diet, nutritional value of various food items, vitamin deficiency and methods to overcome the deficiency, significance of physical activities, sports, Yoga, drawbacks of sedentary lifestyles, increasing mobile overuse amongst children and its effects, disorders caused by stress and stress management. The students will prepare charts and talk to community members to promote the idea of healthy life style and dos and don'ts. The student will be asked to collect feedback after two weeks from the community members and analyse the responses to track the changes. If needed students can give more suggestions after the feedback.
5.	**Chemistry Education Outreach:** In order to spark the interest in student community in Chemistry, college can collaborate with local schools to organize science education outreach programs. Conduct chemistry demonstrations, experiments, and interactive sessions to spark interest in science among students.

	The college students will be trained to talk and demonstrate various interesting experiments, design games and activities for the students and increase their learning through participative and experiential learning. The students from schools will be invited to the institutional laboratories and learn to conduct experiments under the supervision of under graduate students. This exposure will help to increase the interest of students towards science.

Dr. Khursheed Ahmed
Chairman, BOS, Chemistry