

University of Mumbai, Mumbai

R.E. Society's

R.P. Gogate College of Arts and Science &

R.V. Jogalekar College of Commerce

(Autonomous)

Ratnagiri



Syllabus for T.Y.B.Sc.

(Chemistry)

Semester V & VI

Under Choice Based Credit System (CBCS)

As Per framework of NEP 2020 with effect

from Academic Year 2025 - 26

Name of Programme	B.Sc.
Level	UG
No of Semesters	06
Year of Implementation	2025-2026
Programme Specific Outcomes (PSO)	<p>Upon completion of this programme learners will be able to</p> <ul style="list-style-type: none"> • Understand the fundamental concepts of theoretical and experimental aspects of physical, organic, inorganic, analytical and allied chemistry subjects. • Explain and clarify the understanding of thermodynamic, spectroscopic, quantum models, stereochemistry and mechanism of organic reactions, chemical bonding and structure elucidation, analytical techniques and solving numerical problems. • Correlate and apply the theoretical chemistry knowledge in explaining practical schemes • Solve numerical problems, mechanisms, analytical interpretation using chemistry concepts and knowledge. • Interpret spectroscopic data to identify basic organic compounds • Analyse chemical species qualitatively and quantitatively using appropriate analytical techniques. • Understand and explain the processes needed in domain related industries and write their general aspects. • Apply information related to material safety data sheets (MSDS) needed in various industries. • Adopt reduce, recycle and restore chemicals (3R's) approach and gain the sense of ethical, social and environmental awareness and responsibility.
Relevance of PSOs to the local, regional, national, and global developmental needs (200 words)	<ul style="list-style-type: none"> • Graduates with strong chemical knowledge and laboratory skills can support industries, research institutions, and local communities in solving local environmental issues, water purification, waste management, and sustainable resource utilization. • Chemistry graduates can foster economic growth by driving innovation and entrepreneurship. They can contribute to regional research and development initiatives, enhance product quality, and support industries in adopting green practices. Additionally, their expertise in chemical safety and ethics can promote responsible industrial practices and environmental protection, benefiting the region. • A skilled chemistry workforce is essential for the development of key sectors like pharmaceuticals, agriculture, energy, and materials. Graduates can participate in groundbreaking research, contributing to advancements that positively impact society's well-being. Their knowledge of interdisciplinary connections can aid in addressing national challenges, such as climate change, health issues, and sustainable development.

Revised Scheme of Examination
Faculty of Science
(Under-graduate Programmes)
Choice Based Credit System
(CBCS) Scheme of Examination
Bachelor of Science (B.Sc.) Programme

The performance of the learners shall be evaluated into two parts. The learner's performance shall be assessed by Internal Assessment with 40% marks and by conducting the Semester End Examinations with 60% marks. The allocation of marks for the Internal Assessment and Semester End Examinations are as shown below –

- A. Internal Assessment: 40% (20 marks)
- B. Semester End Examination: 60% (30 marks)

Internal Assessment

Sr. No.	Particulars	Marks
01	Unit Test (MCQ / Descriptive – Based on Theory and/or Problems - Online/Offline – 1 unit test of 10 marks	10
02	Assignment / seminar / class test / worksheets	05
03	Active participation in routine class instructional deliveries and Overall conduct as a responsible learner.	05

Semester End Examination

- 30 Marks per paper for Semester End Theory Examination
- Duration - These examinations shall be of one hours duration.
- Theory question paper pattern:
 - a) There shall be 02 questions each of 10 marks on each unit and one question of 10 marks on both units.
 - b) All questions shall be compulsory with internal choice within the questions.

Standard of Passing

The learner to pass a course shall have to obtain a minimum of 40% marks in aggregate for each course where the course consists of Internal Assessment and Semester End Examination. The learner shall obtain minimum of 40% marks (i.e. 8 out of 20) in the Internal Assessment and 40% marks in Semester End Examination (i.e. 12 out of 30) separately, to pass the course and minimum of Letter Grade “P” in the project component, wherever applicable to pass a particular semester. A learner will be said to have passed the course if the learner passes the Internal Assessment and Semester End Examination together.

Performance Grading
Letter grades and Grade Points

Semester GPA/ Program CGPA Semester/Program	% of Marks	Alpha-Sign / Letter Grade Result
9.00-10.00	90.0 -100	O (Outstanding)
$8.00 \leq 9.00$	$80.0 \leq 90.0$	A+ (Excellent)
$7.00 \leq 8.00$	$70.0 \leq 80.0$	A (Very Good)
$6.00 \leq 7.00$	$60.0 \leq 70.0$	B+ (Good)
$5.50 \leq 6.00$	$55.0 \leq 60.0$	B (Above Average)
$5.00 \leq 5.50$	$50.0 \leq 55.0$	C (Average)
$4.00 \leq 5.00$	$40.0 \leq 50.0$	P (Pass)
Below 4.00	Below 40	F (Fail)
Ab (Absent)	-	Absent

Third Year B.Sc. (CBCS)
Course Structure as Per NEP 2020

Course Code	Semester V	Credits	Course Code	Semester VI	Credits		
Discipline Specific Course (DSC)			Discipline Specific Course (DSC)				
Major Mandatory			Major Mandatory				
25_USCHM501	Physical Chemistry	02	25_USCHM601	Physical Chemistry	02		
25_USCHM502	Inorganic Chemistry	02	25_USCHM602	Inorganic Chemistry	02		
25_USCHM503	Organic Chemistry	02	25_USCHM603	Organic Chemistry	02		
25_USCHM504	Chemistry Practical-I (Physical and Inorganic Chemistry)	02	25_USCHM604	Chemistry Practical-III (Physical and Inorganic Chemistry)	02		
25_USCHM505	Chemistry Practical-II (Organic and Inorganic Chemistry)	02	25_USCHM605	Chemistry Practical-IV (Organic and Inorganic Chemistry)	02		
Major Elective (Any one)			Major Elective (Any one)				
25_USCHE506	Drugs and Dyes	02	04	25_USCHE606	Drugs and Dyes	02	04
25_USCHE507	Drugs and Dyes practical	02		25_USCHE607	Drugs and Dyes practical	02	
OR			OR				
25_USCHE508	Industrial Chemistry	02	04	25_USCHE608	Industrial Chemistry	02	04
25_USCHE509	Industrial Chemistry Practical	02		25_USCHE609	Industrial Chemistry Practical	02	
Vocational Skill Course			Vocational Skill Course				
25_USCHV510	Analytical chemistry	02	25_USCHV610	Analytical chemistry	02		
25_USCHV511	Analytical chemistry Practical	02	25_USCHV611	Analytical chemistry practical	02		
Field Project (FP)			On Job Training (OJT)				
25_USCHF512	Field Project	04	25_USCHJ612	On Job Training	04		
Total Credits		22	Total Credits		22		

Syllabus for B.Sc. Chemistry from the year 2025-26

Name of the Course	B.Sc.
Course Code	25_USCHM501
Nomenclature	Physical Chemistry
Class	T.Y. B.Sc.
Semester	V
No of Credits	02
Nature	Theory
Type	Major Mandatory
Highlight revision specific to employability/ entrepreneurship/ skill development (if any) 100 words	Spectroscopy plays important role in spectral identification of organic molecules also it has role in quantification. Lerner with knowledge of spectroscopy is more suitable in industry. Electrochemistry offers entrepreneurs to create environmentally friendly and sustainable solutions such as water purification system and renewable energy technologies.

Course Outcomes: On completing the course, the learner will be able to –

- CO 1 Understand the concept of dipole moment, bond polarization, and molecular structure. vibrational motion, degrees of freedom, and normal modes of vibration, study combined vibrational-rotational energy levels, selection rules, and spectral features, electromagnetic radiation scattering, Rayleigh and Raman scattering, the principles of NMR, including nuclear spin, magnetic moment, and energy levels.
- CO 2 Understand vapour pressure and its relative lowering in solutions, Differentiate between physical and chemical adsorption and their characteristics, the apply the concepts of ionic strength, activity, activity coefficient, and electrochemical cell classification to analyze and solve problems related to electrolytes and electrochemical reactions, electrolyte concentration cells with and without transference

Curriculum:

UNIT	TITLE	LEARNING POINTS	hours
I	Molecular Spectroscopy	<p>Rotational Spectrum: Introduction to dipole moment, polarization of a bond, bond moment, molecular structure, Rotational spectrum of a diatomic molecule, rigid rotor, moment of inertia, energy levels, conditions for obtaining pure rotational spectrum, selection rule, nature of spectrum, determination of internuclear distance and isotopic shift.</p> <p>Vibrational spectrum: Vibrational motion, degrees of freedom, modes of vibration, vibrational spectrum of a diatomic molecule, simple harmonic oscillator, energy levels, zero-point energy, conditions for obtaining vibrational spectrum, selection rule, nature of spectrum.</p> <p>Vibrational-Rotational spectrum of diatomic molecule: Energy levels, selection rule, nature of spectrum, P and R branch lines. Anharmonic oscillator - energy levels, selection rule, fundamental band, overtones. Application of vibrational-rotational spectrum in determination of force constant and its significance. Infrared spectra of simple molecules like H₂O and CO₂.</p> <p>Raman Spectroscopy: Scattering of electromagnetic radiation, Rayleigh scattering, Raman scattering, nature of Raman spectrum, Stoke's lines, anti-Stoke's lines, Raman shift, quantum theory of Raman spectrum, comparative study of IR and Raman spectra, rule of mutual exclusion- CO₂ molecule.</p> <p>NMR Spectroscopy: Principle : Nuclear spin, magnetic moment, nuclear "g" factor, energy levels, Larmor precession, Relaxation processes in NMR (spin - spin relaxation and spin - lattice relaxation), NMR Spectrometer</p>	15
II	Chemical Thermodynamics, Adsorption and Electrochemistry	<p>Chemical thermodynamics</p> <p>Colligative properties: Vapour pressure and relative lowering of vapour pressure. Elevation in boiling point of a solution, thermodynamic derivation relating elevation in boiling point of the solution and molar mass of non-volatile solute. Depression in freezing point of a solution, thermodynamic derivation relating the depression in the freezing point of a solution and the molar mass of the non-volatile solute.</p>	7

	<p>Beckmann Method and Rast Method. Osmotic pressure, Van't Hoff's equation, and Van't Hoff's factor and its significance</p> <p>Adsorption: Physical and Chemical Adsorption, types of adsorption isotherms. Freundlich adsorption Langmuir's adsorption isotherm (Postulates and derivation expected). B.E.T. equation for multilayer adsorption, (derivation not expected). Determination of surface area of an adsorbent using B.E.T. equation</p> <p>Electrochemistry Activity and Activity Coefficient: Lewis concept, ionic strength, Mean ionic activity and mean ionic activity coefficient of an electrolyte, expression for activities of electrolytes. Debye – Huckel limiting law (No derivation). Classification of cells: Chemical cells and Concentration cells. Chemical cells with and without transference, Electrode concentration cells, electrolyte concentration cells with and without transference (derivations are expected).</p>	4
		4

References:

1. Physical Chemistry, Ira Levine, 5th Edition, 2002 Tata McGraw Hill Publishing Co. Ltd.
2. Physical Chemistry, P.C. Rakshit, 6th Edition, 2001, Sarat Book Distributors, Kolkota.
3. Physical Chemistry, R.J. Silbey, & R.A. Alberty, 3rd edition, John Wiley & Sons, Inc [part 1]
4. Physical Chemistry, G. Castellan, 3rd edition, 5th Reprint, 1995 Narosa Publishing House.
5. Modern Electrochemistry, J.O.M Bockris & A.K.N. Reddy, Maria Gamboa – Aldeco 2nd Edition, 1st Indian reprint, 2006 Springer
6. Fundamental of Molecular Spectroscopy, 4th Edn. Colin N Banwell and Elaine M McCash Tata McGraw Hill Publishing Co. Ltd. New Delhi, 2008.
7. Physical Chemistry, G.M. Barrow, 6th Edition, Tata McGraw Hill Publishing Co. Ltd. New Delhi.
8. The Elements of Physical Chemistry, P.W. Atkins, 2nd Edition, Oxford Universtity Press Oxford.
9. Physical Chemistry, G.K. Vemullapallie, 1997, Prentice Hall of India, Pvt.Ltd. New Delhi.
10. Principles of Physical Chemistry B.R. Puri, L.R. Sharma, M.S. Pathania, VISHAL PUBLISHING Company, 2008.

Evaluation Pattern: 50 marks

A) Continuous Internal Evaluation (CIE) (40%): 20 Marks

Sr. No.	Particulars	Marks
01	Unit Test (MCQ / Descriptive – Based on Theory and/or Problems - Online/Offline – 1 unit test of 10 marks	10
02	Assignment / seminar / worksheets	05
03	Active participation in routine class instructional deliveries and Overall conduct as a responsible learner.	05

B) Semester End Evaluation (SEE) (Paper Pattern) (60%): 30 Marks

Guidelines for paper pattern for Semester End Evaluation:

1. 30 Marks per paper Semester End Theory Examination
2. Duration - These examinations shall be of one hour duration
3. Theory question paper pattern:
 - a) There shall be two questions, each of 10 marks on each unit and one question of 10 marks on both the unit.
 - b) All questions shall be compulsory with internal choice within the questions.

Question Number	Unit	Marks
01	I	10
02	II	10
03	I & II	10

CIE	SEE	Total Marks
20	30	50

Name of the Course	B.Sc.
Course Code	25_USCHM502
Nomenclature	Inorganic Chemistry
Class	T. Y. B.Sc.
Semester	V
No of Credits	02
Nature	Theory
Type	Major Mandatory
Highlight revision specific to employability/ entrepreneurship/ skill development (if any) 100 words	Inorganic chemistry plays a significant role in employability, entrepreneurship and skill development due to its wide ranging applications and relevance in various industries, such as material science, electronics, ceramics, pharmaceuticals, and environmental science. Entrepreneurs in fields like material science and nanotechnology rely on inorganic chemistry principles to innovate. Thus a course provides Graduates with analytical skills, problem solving skills, research capabilities which empower them to pursue a diverse path career.

Course Outcomes: On completing the course, the learner will be able to –

CO 1	Learners will develop a comprehensive understanding of molecular symmetry, point groups, and their significance in chemistry, apply Molecular Orbital Theory to heteronuclear diatomic molecules, and analyze the structural aspects of solids, including crystal lattices, packing efficiency, and point defects.
CO 2	Understand the unique chemistry of lanthanides and actinides: This includes their position in the periodic table, electronic configurations, lanthanide contraction, oxidation states, complex formation, magnetic and spectral properties, and their applications, with a comparative analysis of the two series along with various physico-chemical properties of group 16 and 17 elements.

Curriculum:

UNIT	TITLE	LEARNING POINTS	HOURS
I	Molecular Symmetry and Molecular Orbital Theory for heteronuclear diatomic molecules	Molecular Symmetry: Introduction and importance of symmetry in Chemistry. Symmetry elements and symmetry operations. Concept of a Point group with illustrations using the following point groups: (i) $C_{\infty v}$ (ii) $D_{\infty h}$ (iii) C_{2v} (iv) C_{3v} (v) C_{2h} and (vi) D_{3h} . Molecular Orbital Theory for heteronuclear diatomic molecules: Comparison between homonuclear and heteronuclear diatomic molecules. Heteronuclear diatomic molecules like CO, NO and HCl.	09

	Solid state chemistry	<p>Structures of Solids: Explanation of terms viz. crystal lattice, lattice point, unit cell and lattice constants. Closest packing of rigid spheres (hcp, ccp), packing density in simple cubic, bcc and fcc lattices.</p> <p>Relationship between density, radius of unit cell and lattice parameters, stoichiometric point defects in solids (discussion on Frenkel and Schottky defects expected).</p>	06
II	Chemistry of Inner Transition Elements	<p>Lanthanides & Actinides: Introduction: Position in periodic table and electronic configuration of lanthanides and actinides.</p> <p>Chemistry of Lanthanides with reference to (i) lanthanide contraction and its consequences (ii) oxidation states (iii) ability to form complexes (iv) magnetic and spectral properties. Similarities and comparison between Lanthanides & Actinides. Applications of Lanthanides.</p>	09
	Selected topics of 'p' block elements	<p>Comparative Chemistry of Group 16: Electronic configurations, trends in physical properties, allotropy. Manufacturing sulphuric acid by Contact process.</p> <p>Comparative Chemistry of Group 17: Electronic configuration, General characteristics, anomalous properties of fluorine, comparative study of acidity of oxyacids of chlorine with respect to acidity, oxidizing power and structures (on the basis of VSEPR theory).</p> <p>Chemistry of interhalogens with reference to preparations, properties and structures (on the basis of VSEPR theory).</p>	06

References:

1. Derek W. Smith, Molecular orbital theory in Inorganic Chemistry Publisher: Cambridge University Press.
2. C. J. Ballhausen, Carl Johan Ballhausen, Harry B. Gray Molecular Orbital Theory: An Introductory Lecture Note and Reprint Volume Frontiers in Chemistry Publisher W.A.
3. Lesley E. Smart, Elaine A. Moore, Solid State Chemistry: An Introduction, 2nd Edition CRC Press.
4. R. Gopalan, Inorganic Chemistry for Undergraduates, Universities Press India.
5. Cotton, Wilkinson, Murillo and Bochmann, Advanced Inorganic Chemistry, 6th Edition.

6. J. E. Huheey, Inorganic Chemistry, Prentice Hall, 1993.
7. G. Singh, Chemistry of Lanthanides and Actinides, Discovery Publishing House.
8. Simon Cotton, Lanthanide and Actinide Chemistry Publisher: Wiley-Blackwell.
9. J. D. Lee, Concise Inorganic Chemistry, 4th Edn. ELBS.
10. D. F. Shriver and P. W. Atkins, Inorganic chemistry, 3rd edition, Oxford University Press.

Evaluation Pattern: 50 marks

A) Continuous Internal Evaluation (CIE) (40%): 20 Marks

Sr. No.	Particulars	Marks
01	Unit Test (MCQ / Descriptive – Based on Theory and/or Problems - Online/Offline – 1 unit test of 10 marks	10
02	Assignment / seminar / worksheets	05
03	Active participation in routine class instructional deliveries and Overall conduct as a responsible learner.	05

B) Semester End Evaluation (SEE) (Paper Pattern) (60%): 30 Marks

Guidelines for paper pattern for Semester End Evaluation:

1. 30 Marks per paper Semester End Theory Examination
2. Duration - These examinations shall be of one hour duration
3. Theory question paper pattern:
 - a) There shall be two questions, each of 10 marks on each unit and one question of 10 marks on both the unit.
 - b) All questions shall be compulsory with internal choice within the questions.

Question Number	Unit	Marks
01	I	10
02	II	10
03	I & II	10

CIE	SEE	Total Marks
20	30	50

Name of the Course	B.Sc.
Course Code	25_USCHM503
Nomenclature	Organic Chemistry
Class	T.Y. B.Sc.
Semester	V
No of Credits	02
Nature	Theory
Type	Major Mandatory
Highlight revision specific to employability/ entrepreneurship/ skill development (if any) 100 words	Organic chemistry plays a significant role in employability, entrepreneurship and skill development due to its wide ranging applications and relevance in various industries, such as polymer, pharmaceuticals, petrochemicals, agrochemicals, cosmetics, and environmental science. Understanding Organic reactions and synthesis is essential for designing and creating new compound with specific properties. Learner can apply organic chemistry knowledge to develop innovative products such as specialty chemicals, natural based products to meet specific market demand

Course Outcomes: On completing the course, the learner will be able to –

- CO 1 Understand and analyse the fundamental mechanisms of organic reactions, including nucleophilic substitution, acyl nucleophilic substitution, and rearrangement reactions, along with their stereochemical aspects. Apply the principles of synthesis, green chemistry, and natural product chemistry to design efficient and sustainable organic transformations.
- CO 2 Analyse and apply the principles of stereochemistry, spectroscopy, IUPAC nomenclature, and heterocyclic chemistry to determine molecular structures, predict chemical reactivity, and design organic syntheses

Curriculum:

UNIT	TITLE	LEARNING POINTS	Hours
I	1.1 Mechanism of organic reactions	<p>1.1.1 The basic terms and concepts: bond fission, reaction intermediates, electrophiles and nucleophiles, ligand, base, electrophilicity vs. acidity and nucleophilicity vs basicity (Revision)</p> <p>1.1.2 Neighbouring group participation in nucleophilic substitution reactions: participation of lone pair of electrons, kinetics and stereochemical outcome.</p> <p>1.1.3 Acyl nucleophilic substitution (Tetrahedral mechanism): Acid catalyzed esterification of Carboxylic acids (AAC2) and base promoted hydrolysis of esters (BAC2)</p> <p>1.1.4 Mechanism of the following rearrangements with examples and stereochemistry wherever applicable. a) Migration to the electron deficient carbon: Pinacol-pinacolone rearrangement. b) Migration to the electron deficient nitrogen: Beckmann rearrangement. c) Migration involving a carbanion: Favorski rearrangement.</p>	07
	1.2 Synthesis of organic compounds	<p>1.2.1 Introduction: Linear and convergent synthesis, criteria for an ideal synthesis, concept of chemo selectivity and regioselectivity with examples, calculation of yields.</p> <p>1.2.2 Multicomponent Synthesis: Mannich reaction and Biginelli reaction. Synthesis with examples (no mechanism)</p> <p>1.2.3 Green chemistry and synthesis: Introduction: Twelve principles of green Chemistry (for internal work), concept of atom economy and E-factor, calculations and their significance. i) Green reagents: dimethyl carbonate. ii) Green starting materials: D-glucose iii) Green solvents: supercritical CO₂ iv) Green catalysts: Bio catalysts.</p>	05
	1.3 Natural Product	<p>1.3.1. Terpenoids: Introduction, Isoprene rule, special isoprene rule and the gem-dialkyl rule.</p> <p>1.3.2 Citral: a) Structural determination of citral. b) Synthesis of citral from methyl heptanone c) Isomerism in citral (cis and trans form)</p>	03
II	2.1 Stereochemistry I	Molecular chirality and elements of symmetry: Mirror plane symmetry, inversion center, rotation - reflection (alternating) axis. Chirality of compounds without a stereogenic center: cummulenes and biphenyls	03
	2.2 Spectroscopy I	<p>2.2.1 Introduction: Electromagnetic spectrum, units of wavelength and frequency</p> <p>2.2.2 UV – Visible spectroscopy: Basic theory, solvents, nature of UV-Visible spectrum, concept of chromophore, auxochrome, bathochromic and hypochromic shifts,</p>	04

		hyperchromic and hypochromic effects, chromophore-chromophore and chromophore-auxochrome interaction 2.2.3 Mass spectrometry: Basic theory. Nature of mass spectrum. General rules of fragmentation. Importance of molecular ion peak, isotopic peaks, base peak, nitrogen rule, rule of 13 for determination of empirical formula and molecular formula. Fragmentation of alkanes and aliphatic carbonyl compounds.	
	2.3 IUPAC Nomenclature	IUPAC Systematic nomenclature of the following classes of compounds (including compounds upto two substituents / functional groups): 2.3.1 Bicyclic compounds – spiro, fused and bridged (upto 11 carbon atoms) – saturated and unsaturated compounds. 2.3.2 Biphenyls 2.3.3 Cummulenes with upto 3 double bonds 2.3.4 Quinolines and isoquinolines	03
	2.4 Heterocyclic chemistry	2.4.1 Reactivity of pyridine-N-oxide, quinoline and isoquinoline. 2.4.2 Preparation of pyridine-N-oxide, quinoline (Skraup synthesis) and iso-quinoline (Bischler- Napieralski synthesis). 2.4.3 Reactions of pyridine-N-oxide: halogenation, nitration and reaction with $\text{NaNH}_2/\text{liq.NH}_3$, n-BuLi. 2.4.4 Reactions of quinoline and isoquinoline; oxidation, reduction, nitration, halogenation and reaction with $\text{NaNH}_2/\text{liq.NH}_3$, n-BuLi.	04

References:

1. Organic Chemistry: A Problem Solving Approach L. Ravishankar, G. Shridhar; Narosa publication
2. "Organic Chemistry" by Arun Bahl and B. S. Bahl, 22nd edition, S. Chand publication
3. "Organic Chemistry" by Jonathan Clayden, Nick Greeves, and Stuart Warren, Oxford Press.
4. Organic Reaction Mechanism, 4th edition, V. K. Ahluwalia, R. K. Parashar, Narosa Publication.
5. Organic reactions and their mechanisms, 3rd revised edition, P.S. Kalsi, New Age International Publishers.
6. M.B.Smith and J. March, Advanced organic chemistry- reactions mechanism and structure, 5th edition.
7. Organic Chemistry, 7th Edition, R.T. Morrison, R. N. Boyd and S. K. Bhattacharjee, Pearson.
8. Organic chemistry R.T.Morrison and R.N.Boyd, 6th edition, pearson education
9. Stereochemistry P.S.Kalsi , New Age International Ltd.,4th Edition
10. Heterocyclic Chemistry, 5th Edition, John A. Joule and Keith Mills, Wiley publication, 2010
11. IUPAC nomenclature by S.C.Pal.
12. Green chemistry: V. K. Ahluwalia (Narosa publishing house pvt. ltd.)
13. Organic chemistry: Carey and Sundberg.
14. Elementary organic spectroscopy (Third edition), Y.R.Sharma, S.Chand publication..
15. Chemistry of natural products by O.P. Agarwal

Evaluation Pattern: 50 marks**A) Continuous Internal Evaluation (CIE) (40%): 20 Marks**

Sr. No.	Particulars	Marks
01	Unit Test (MCQ / Descriptive – Based on Theory and/or Problems - Online/Offline – 1 unit test of 10 marks	10
02	Assignment / seminar / worksheets	05
03	Active participation in routine class instructional deliveries and Overall conduct as a responsible learner.	05

B) Semester End Evaluation (SEE) (Paper Pattern) (60%): 30 Marks**Guidelines for paper pattern for Semester End Evaluation:**

1. 30 Marks per paper Semester End Theory Examination
2. Duration - These examinations shall be of one hour duration
3. Theory question paper pattern:
 - a) There shall be two questions, each of 10 marks on each unit and one question of 10 marks on both the unit.
 - b) All questions shall be compulsory with internal choice within the questions.

Question Number	Unit	Marks
01	I	10
02	II	10
03	I & II	10

CIE	SEE	Total Marks
20	30	50

Name of the Course	B.Sc.
Course Code	25_USCHM504
Nomenclature	Chemistry Practical - I
Class	T.Y. B.Sc.
Semester	V
No of Credits	02
Nature	Practical
Type	Major Mandatory
Highlight revision specific to employability/ entrepreneurship/ skill development (if any) 100 words	Practical Skills of physical and inorganic chemistry experiments involve wide range of laboratory techniques like Synthesis/preparation, extraction and purification, Instrumental analysis. Learners who have hands on experience with these techniques are highly sought in industries like pharmaceuticals, fine chemicals, ceramics. Product development and analytical method development knowledge can be valuable for entrepreneurs looking for to develop new products and its analytical method development.

Course Outcomes: On completing the course, the learner will be able to –

- CO 1 The Rast method for determining molar mass of compound.
- CO 2 Experimental determination of order of reaction by fractional change method.
- CO 3 validation of Freundlich adsorption isotherm
- CO 4 Determination of Solubility and Solubility product of Silver Chloride Potentiometrically
- CO 5 Determination of the velocity constant of alkaline hydrolysis of ethyl acetate by conductometric method.
- CO 6 The concept of isoelectric point, acidic and basic dissociation constants.
- CO 7 Determine % purity of given salt.
- CO 8 Detect impurity (cation and or anion) in salt qualitatively by wet analysis only.

Curriculum:

UNIT	TITLE	LEARNING POINTS	HOURS
Group A Non-instrumental	Colligative properties	<ul style="list-style-type: none"> To determine the molecular weight of compound by Rast Method 	60 hours
	Surface phenomena	<ul style="list-style-type: none"> To investigate the adsorption of oxalic acid on activated charcoal and test the validity of Freundlich and Langmuir's adsorption isotherm To investigate the adsorption of acetic acid on activated charcoal and test the validity of Freundlich and Langmuir's adsorption isotherm 	
	Estimation and Qualitative Analysis	<ul style="list-style-type: none"> Determination of percentage purity of the given water-soluble salts and qualitative detection w.r.t. added cations and /or anion only by wet tests. (Any four Salts of main group ions) 	
Group B Instrumental	Potentiometry	<ul style="list-style-type: none"> To determine the solubility product and solubility of AgCl Potentiometrically using chemical cell. Determine the standard oxidation potential of the metal ion electrode (Cu/Zn) 	
	Conductometry	<ul style="list-style-type: none"> To determine the velocity constant of alkaline hydrolysis of ethyl acetate by conductometric method. 	
	pH-metry	<ul style="list-style-type: none"> To determine acidic and basic dissociation constants of amino acid and hence to calculate isoelectric point. 	
Group C	Interpretation of spectra	<ul style="list-style-type: none"> Rotational spectra of diatomic molecules CO / HCl / HBr. 	

References:

1. Practical Physical Chemistry 3rd edition, A.M. Jones and F.E. Prichard, Longman Publications
2. Experiments in Physical Chemistry R. C. Das and B. Behra, Tata Mc Graw Hill
3. Advanced Practical Physical Chemistry J.B. Yadav, Goel Publication House
4. Advanced Experimental Chemistry Vol I J.N. Gurtu, and R. Kapoor, S Chandand Co.
5. Experimental Physical Chemistry I By V.D. Athavale

Evaluation Pattern: Practical (Total marks: 50 marks)

A) Continuous Internal Evaluation (CIE) (40%): 20 Marks

Sr. No.	Particulars	Marks
01	Performance during practical session, Skill, Accuracy, precision of measurement, Record of observation, calculations, graph, result and conclusion. Timely submission of journal	15
02	Overall performance (attendance, punctuality, interaction during Practical session throughout semester	05

B) Semester End Evaluation (SEE) (60%): 30 Marks

Sr. No.	Group	Title	Method	Marks
1.	A	Physical / Inorganic experiments	Experiment performance as per the practical slip	25
		Viva Voce and journal		05

CIE / Internal	SEE	Total Marks
20	30	50

Note: Group C practical for internal evaluation

Name of the Course	B.Sc.
Course Code	25_USCHM505
Nomenclature	Chemistry Practical - II
Class	T.Y. B.Sc.
Semester	V
No of Credits	02
Nature	Practical
Type	Major Mandatory
Highlight revision specific to employability/ entrepreneurship/ skill development (if any) 100 words	Practical Skills of organic and Inorganic chemistry experiments involve wide range of laboratory techniques Synthesis/preparation, distillation, extraction and purification, green chemistry experiments Learner who have hands on experience with these techniques are highly sought in industries like pharmaceuticals, polymers, petrochemicals. Product development and analytical method development knowledge can be valuable for entrepreneurs looking for to develop new products and its analytical method development.

Course Outcomes: On completing the course, the learner will be able to –

- CO 1 Find the chemical type of mixture in the given binary mixture.
- CO 2 Decide scheme for separation of components using proper reagents.
- CO 3 Purify separated organic compound using different purification technique.
- CO 4 Identify Organic compound.
- CO 5 Acquire skills to prepare Potassium diaquo *bis* (oxalato) cuprate (II).
- CO 6 Acquire skills to prepare Ferrous ethylene diammonium sulphate.
- CO 7 Acquire skills to prepare bis-acetylacetonato copper (II).
- CO 8 Acquire skills to prepare Magnesium oxinate.

Curriculum:

UNIT	LEARNING POINTS	hours	
Group A Separation of Binary solid-solid mixture (2.0 gms mixture to be given).	<ul style="list-style-type: none"> • Minimum four mixtures to be completed by the learners. 1. Components of the mixture should include water -soluble and water insoluble acids (carboxylic acid), water insoluble phenols (2-naphthol, 1-naphthol), water insoluble bases (nitroanilines) , water soluble neutral (thiourea) and water insoluble neutral compounds (anilides, amides, m-DNB, hydrocarbons) 2. After correct determination of chemical type, the separating reagent should be decided by the learner for separation 3. Follow separation scheme with the bulk sample of binary mixture. 4. After separation into component A and component B, one component (decided by the examiner) is to be analyzed and identified with m.p. 	60	
Group B Inorganic Preparations	<ul style="list-style-type: none"> • Preparation of Potassium diaquo <i>bis</i>- (oxalato)cuprate (II) • Preparation of Ferrous ethylenediammonium sulphate. • Preparation of <i>bis</i> acetylacetonato copper (II) • Preparation of magnesium-oxinate 		
Group C Green Chemistry Experiments	<ul style="list-style-type: none"> • Acetylation of primary amine (Green approach) • Synthesis of dihydropyrimidinone derivatives through the Biginelli reaction. • Calculation of theoretical yield, atom economy and E- factor for organic reactions. • Extraction of citral (Demonstration experiment) 		

References:

1. Practical organic chemistry – A. I. Vogel
2. Practical organic chemistry – H. Middleton.
3. Practical organic chemistry – O.P. Agarwal
4. Advanced experiments in Inorganic Chemistry., G. N. Mukherjee., 1st Edn., 2010., U. N. Dhur and Sons Pvt Ltd .
5. Vogel's. Text book of. Macro and Semi micro qualitative inorganic analysis. Fifth edition.

Evaluation Pattern: Practical (Total marks: 50 marks)

A) Continuous Internal Evaluation (CIE) (40%): 20 Marks

Sr. No.	Particulars	Marks
01	Performance during practical session, Skill, Accuracy, precision of measurement, Record of observation, calculations, graph, result and conclusion. Timely submission of journal	15
02	Overall performance (attendance, punctuality, interaction during Practical session throughout semester	05

B) Semester End Evaluation (SEE) (60%): 30 Marks

Sr. No.	Group	Title	Method	Marks
1.	A	Organic / Inorganic experiments	Experiment performance as per the practical slip	25
		Viva Voce and journal		05

CIE / Internal	SEE	Total Marks
20	30	50

Note: Group C practical for internal evaluation

Name of the Course	B.Sc.
Course Code	25_USCHE506
Nomenclature	Drugs and Dyes
Class	T.Y. B.Sc.
Semester	V
No of Credits	02
Nature	Theory
Type	Major Elective
Highlight revision specific to employability/ entrepreneurship/ skill development (if any) 100 words	The revised syllabus mainly focus on bridging the gap between theoretical knowledge and practical, market-ready skills. This would ensure that learners not only understand the chemistry and techniques involved in the production of drugs and dyes but also gain insights into the industry trends, business opportunities, and essential soft skills required for professional success.

Course Outcomes: On completing the course, the learner will be able to –

CO 1	To get comprehensive information about classification, nomenclature and various routes of drug administration and to study the synthesis of different drug intermediates and drugs, the mode of actions of drugs, the applications of analgesics, antipyretics, antidiabetic, anti-inflammatory drugs etc.
CO 2	To study the concept of dyes, its property and nomenclature dyes, the concept of natural and synthetic dyes, the types of fibers, application of dyes and how the dyes are attached to them, the concept of optical brighteners and their classes, Witt's theory and complementary colour theory.

Curriculum:

UNIT	TITLE	LEARNING POINTS	HOURS
I	General Introduction to Drugs and Selected drugs	<p>Definition of a drug, sources of drugs, requirements of an ideal drug, classification of drugs (based on therapeutic action), Nomenclature of drugs: Generic name, Brand name, Systematic name, Definition of the following medicinal terms: Pharmacopoeia, pharmacology, pharmacophore, Prodrug, Half-life efficiency, LD50, ED50, GI50 Therapeutic Index.</p> <p>Brief idea of the following terms: Receptors, Agonists, Antagonists, Drug Potency, Drug toxicity, Drug addiction, Pharmacopoeia.</p> <p>Routes of Drug Administration and Dosage Forms Oral and Parenteral routes with advantages and disadvantages.</p> <p>Pharmacodynamic agents A brief introduction of the following pharmacodynamic agents and the study with respect to their chemical structure, chemical class, therapeutic uses, and side effects.</p> <p>CNS Drugs: Classification based on pharmacological actions: CNS Depressants & CNS Stimulants. Concept of sedation and hypnosis, anesthesia. Phenytoin</p>	15

		<p>(Hydantoin), Trimethadione (Oxazolidinediones) (Synthesis from acetone)</p> <p>Analgesics and Antipyretics Tramadol (Cyclohexanols) (Synthesis from salicylic acid), Aspirin (Salicylates), Paracetamol (p-Amino phenols)</p> <p>Anti-inflammatory Drugs Mechanism of inflammation and various inflammatory conditions. Sodium Diclofenac, Aceclofenac (N- Aryl anthranilic acids) (Synthesis from 2,6-dichlorodiphenyl amine)</p> <p>Antihistaminic Drugs Diphenhydramine (Ethanol amines), Cetirizene (Piperazine) (Synthesis from 4- Chlorobenzhydryl chloride)</p> <p>Cardiovascular drugs Classification based on pharmacological action Isosorbide dinitrate (Nitrates), Atenolol (Aryloxy propanol amines) (Synthesis from 3- Hydroxy phenyl acetamide)</p> <p>Antidiabetic agents General idea and types of diabetes; Insulin therapy Glibenclamide (Sulphonyl ureas), Metformin (Biguanides) Pioglitazone (Thiazolidinediones) (Synthesis from 2-(5-ethylpyridin-2-yl) ethanol)</p> <p>Antiparkinsonism Drugs Idea of Parkinson's disease. Procyclidine hydrochloride (Pyrrolidines), Ethopropazine hydrochloride (Phenothiazines), Levodopa (Aminoacids) (Synthesis from Vanillin)</p> <p>Drugs for Respiratory System General idea of Expectorants; Mucolytes; Bronchodilators; Decongestants; Antitussives Ambroxol (Cyclohexanol) (Synthesis from paracetamol), Salbutamol (Phenyl ethyl amines), Oxymetazoline (Imidazolines), Codeine Phosphate (Opiates)</p>	
II	<p>Introduction to the dye-stuff Industry, Colour and Chemical Constitution of dyes</p>	<p>Dyes: Definition of dyes, requirements of a good dye i.e. Colour, Chromophore and Auxochrome, Solubility, Linearity, Coplanarity, Fastness, Substantivity, Economic viability. Definition of fastness and its properties and Mordants with examples. Explanation of nomenclature or abbreviations of commercial dyes with at least one example suffixes – G, O, R, B, K,L, C, S H, 6B, GK, 6GK. Naming of dyes by colour index (two examples) used in dye industries.</p> <p>Natural and Synthetic Dyes: Natural Dyes: Definition and limitations of natural dyes. Examples and uses of natural dyes w.r.t Heena, Turmeric, Saffron, Indigo, Madder,</p>	15

		<p>Chlorophyll – names of the chief dyeing material/s in each natural dye [structures not expected].</p> <p>Synthetic dyes: Definition of synthetic dyes, primaries and intermediates. Important milestones in the development of synthetic dyes- Emphasis on Name of the Scientist, dyes and the year of the discovery is required. [structure is not expected]</p> <p>Substrates for Dyes : Types of fibres</p> <p>Natural: cellulosic and proteinaceous fibres, examples – wool, silk and cotton structures and names of dyes applied on each of them.</p> <p>Semi – synthetic: definition and examples [structures not expected]</p> <p>Synthetic: Nylon, Polyesters and Polyamides structures and names of dyes applied on each of them Blended fabrics: definition and examples [structures not expected]</p> <p>Binding forces of dyes on substrate: ionic forces, covalent linkages, hydrogen bonding, vander-walls forces</p> <p>Dyeing methods Basic Operations involved in dyeing process:</p> <p>i. Preparation of fibres ii. Preparation of dye bath iii. Application of dyes iv. Finishing</p> <p>Classification of dyes based on applicability on substrates (examples with structures)</p> <p>a) Acid Dyes- Orange II, b) Basic Dyes-methyl violet, c) Direct cotton Dyes- Benzofast Yellow 5GL d) Azoic Dyes – Diazo components; Fast yellow G, Fast orange R. Coupling components. Naphthol AS, Naphthol ASG. e) Mordant Dyes-Eriochrome Black A, Alizarin. f) Vat Dyes- Indanthrene brown RRD g) Sulphur Dyes- Sulphur Black T (no structure) h) Disperse Dyes-Celliton Fast brown 3R, i) Reactive Dyes- Cibacron Brilliant Red B</p> <p>Optical Brighteners: General idea, important characteristics of optical brighteners.</p> <p>Absorption of visible light, colour of wavelength absorbed, Complementary colour.</p> <p>Relation between colour and chemical constitution. Armstrong theory (quinonoid theory) and its limitations.</p> <p>Witt's Theory: Chromophore, Auxochrome, Bathochromic & Hypsochromic Shift, Hypochromic & Hyperchromic effect</p> <p>Valence Bond theory, comparative study and relation of colour in the following classes of compounds/dyes: Benzene, Nitrobenzene, Nitroanilines, Nitrophenols.</p>	
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References:

1. Foye's principles of medicinal chemistry. 6th Edition, Edited by Davis William & Thomas Lemke, Indian edition by B I Publication Pvt Ltd, Lippincott Williams & Wilkins.
2. Text book of organic medicinal & pharmaceutical chemistry. Wilson & Gisovolds, 11th Edition by John H Block, John M Beale Jr.
3. Medicinal chemistry. Ashutosh Kar, New Age International Pvt. Ltd Publisher. 4th edition.
4. Burger's Medicinal Chemistry, Drug Discovery and Development. Abraham and Rotella. Wiley.
5. Medicinal chemistry. Ashutosh Kar, New Age International Pvt. Ltd Publisher. 4th edition.
6. Medicinal chemistry. V.K. Ahluwalia and Madhu Chopra, CRC Press.
7. Principle of medicinal chemistry. Vol 1 & 2 S. S. Kadam, K. R. Mahadik, K. G. Bothara.
8. The Art of Drug synthesis. Johnson and Li. Wiley, 2007.
9. The organic chemistry of drug design & drug action. 2nd ed. By Richard B Silvermann, Academic Press.
10. The Organic Chemistry of Drug Synthesis. Lednicer and Mitscher, Wiley.
11. Chemistry of Synthetic Dyes, Vol I – VIII, Venkatraman K., Academic Press 1972.
12. Chemistry of Dyes and Principles of Dyeing, Shenai V.A., Sevak Publications, 1973

Evaluation Pattern: 50 marks**A) Continuous Internal Evaluation (CIE) (40%): 20 Marks**

Sr. No.	Particulars	Marks
01	Unit Test (MCQ / Descriptive – Based on Theory and/or Problems - Online/Offline – 1 unit test of 10 marks	10
02	Assignment / seminar / worksheets	05
03	Active participation in routine class instructional deliveries and Overall conduct as a responsible learner.	05

B) Semester End Evaluation (SEE) (Paper Pattern) (60%): 30 Marks**Guidelines for paper pattern for Semester End Evaluation:**

- 30 Marks per paper Semester End Theory Examination
- Duration - These examinations shall be of one hour duration
- Theory question paper pattern:
 - There shall be two questions, each of 10 marks on each unit and one question of 10 marks on both the unit.
 - All questions shall be compulsory with internal choice within the questions.

Question Number	Unit	Marks
01	I	10
02	II	10
03	I & II	10

CIE	SEE	Total Marks
20	30	50

Name of the Course	B.Sc.
Course Code	25_USCHE507
Nomenclature	Drugs and Dyes Practical
Class	T.Y. B.Sc.
Semester	V
No of Credits	02
Nature	Practical
Type	Major Elective
Highlight revision specific to employability/ entrepreneurship/ skill development (if any) 100 words	-----

Course Outcomes: On completing the course, the learner will be able to –

- CO 1 Gain hands on experience to synthesize aspirin.
- CO 2 Get quantitative determination of drug ibuprofen.
- CO 3 Learn estimate acid neutralizing capacity of an antacid.
- CO 4 Understand of Tincture Iodine composition.
- CO 5 Separates natural pigments by paper chromatography.
- CO 6 Perform methylation of beta naphthol.
- CO 7 Carry out the nitration of acetanilide.
- CO 8 Assess affinity of Orange II dye and fastness towards cotton fibre..

Curriculum:

UNIT	LEARNING POINTS	HOURS
Group A Estimations	<ol style="list-style-type: none"> 1. Estimation of Ibuprofen from the commercial tablet (back titration method). 2. Estimation of Acid neutralizing capacity of a drug. 3. Estimation of Congo red by colorimetry. 4. Estimation of free acid in Coconut Oil 	60 hours
Group B Preparations	<ol style="list-style-type: none"> 1. Preparation of Aspirin from salicylic acid. 2. O-Methylation of β-naphthol 3. <i>p</i>-Nitroacetanilide from Acetanilide. 4. Extraction of Natural dye. 5. Orange II from sulphanilic acid. 6. Separation of components of natural pigments by paper chromatography (eg: chlorophylls). 	

References:

1. Practical Organic Chemistry – A. I. Vogel
2. Practical Organic Chemistry – H. Middleton.
3. Practical Organic Chemistry – O. P. Aggarwal

Evaluation Pattern: Practical (Total marks: 50 marks)**A) Continuous Internal Evaluation (CIE) (40%): 20 Marks**

Sr. No.	Particulars	Marks
01	Performance during practical session, Skill, Accuracy, precision of measurement, Record of observation, calculations, graph, result and conclusion. Timely submission of journal	15
02	Overall performance (attendance, punctuality, interaction during Practical session throughout semester	05

B) Semester End Evaluation (SEE) (60%): 30 Marks

Sr. No.	Group	Title	Method	Marks
1.	A	Estimation/ Preparation	Experiment performance as per the practical slip	25
		Viva Voce and journal		05

CIE / Internal	SEE	Total Marks
20	30	50

Name of the Course	B.Sc.
Course Code	25_USCHE508
Nomenclature	Industrial Chemistry
Class	T.Y. B.Sc.
Semester	V
No of Credits	02
Nature	Theory
Type	Major Elective
Highlight revision specific to employability/ entrepreneurship/ skill development (if any) 100 words	The revised syllabus mainly focus on providing learners with practical skills, industry insights, and entrepreneurial knowledge that enable them to thrive in the chemical industry. The syllabus should combine foundational chemistry with an understanding of industry-specific processes, regulations, and business acumen.

Course Outcomes: On completing the course, the learner will be able to –

- CO 1 Explain terms used in chemical industries and MSDS of chemicals, classify and use hazardous, inflammable and explosive chemicals; fire extinguishers, explain unit processes and unit operations
- CO 2 Classify fuels, analyze and explain properties of fuels and apply analysis of fuels, explain types of corrosion, explain factors affecting and protective methods of corrosion

Curriculum:

UNIT	TITLE	LEARNING POINTS	HOURS
I	Basics of industrial Chemistry and Unit processes	Basics of industrial Chemistry <ul style="list-style-type: none"> • Introduction, Basic requirements of chemical industries • Chemical production, Raw materials, Quality control, Quality assurance, Process control, Research and Development, Pollution control, Human resource • Conversion, Selectivity and Yield • Introduction to Copyright act, Patent act, Trademarks, MSDS. MSDS of hazardous chemicals (Benzene, Chloroform, Phenol) 	6
		1.2 Safety in laboratory <ul style="list-style-type: none"> • Handling of Hazardous Materials • Toxic Materials (Various types of toxins and their effects on humans) • Explosives and Inflammable Materials • Types of fire extinguishers 	3

		<p>1.3 Unit Processes</p> <ul style="list-style-type: none"> • Introduction to primaries and intermediates, Unit processes and unit operation: definition • brief ideas of below unit processes: (a) Nitration (b) Sulphonation (c) Halogenation (d) Diazotization: (3 different methods & its importance) (e) Ammonolysis (f) Oxidation <p>NB: Definition, Reagents, Examples of each unit processes mentioned above with reaction conditions (mechanism is not expected)</p>	6
II	Selected Topics - I	<p>2.1 Fuels</p> <ul style="list-style-type: none"> • Definition, Characteristics of good fuel. • Calorific value (Definition, Types, Determination, Dulong's formula, Numerical) • Coal: - Types, Analysis of coal – Proximate analysis, Ultimate analysis, Numerical) • Combustion of coal – Numerical 	5
		<p>2.2 Petrochemical products:</p> <ul style="list-style-type: none"> • crude oils, fuels and calorific values, • fractional distillation process and fractions, properties of fuels, compositions of fuel, • flash point, fire point, corrosion test carbon residue and impact on environment 	4
		<p>2.3 Corrosion</p> <ul style="list-style-type: none"> • Introduction: - Definition, Types of Corrosion – i) Dry or Atmospheric Corrosion, ii) Wet or Electrochemical corrosion (In Acidic medium, In Neutral medium) • Factors affecting rate of corrosion: - i) Position of metal in galvanic series, ii) Purity of Metal, iii) Nature of Corrosion product, iv) Temperature, v) pH of medium, vi) concentration of medium, vii) moisture, viii) Relative Cathodic and Anodic area, ix) overvoltage • Methods to control corrosion: - i) Selection of metal, ii) Proper Designing, iii) Cathodic protection, iv) Use of Corrosion Inhibitors, v) Metallic Coating 	6

References:

1. Industrial Chemistry - B. K. Sharma, Goyal Publishing House, Mirut
2. Shreeve's Chemical Process Industries 5th Edition, G. T. Oustin, Mc Graw Hill
3. Riegel's Handbook of Industrial Chemistry, 9th Edition, Jems A. Kent
4. Industrial Chemistry - R. K. Das, 2nd Edition, 1976.
5. Engineering Chemistry, Jain & Jain, Dhanpat Rai Publications
6. A textbook of Engineering Chemistry, S. S. Dara, S. Chand and Company

Evaluation Pattern: 50 marks**A) Continuous Internal Evaluation (CIE) (40%): 20 Marks**

Sr. No.	Particulars	Marks
01	Unit Test (MCQ / Descriptive – Based on Theory and/or Problems - Online/Offline – 1 unit test of 10 marks	10
02	Assignment / seminar / worksheets	05
03	Active participation in routine class instructional deliveries and Overall conduct as a responsible learner.	05

B) Semester End Evaluation (SEE) (Paper Pattern) (60%): 30 Marks**Guidelines for paper pattern for Semester End Evaluation:**

1. 30 Marks per paper Semester End Theory Examination
2. Duration - These examinations shall be of one hour duration
3. Theory question paper pattern:
 - a) There shall be two questions, each of 10 marks on each unit and one question of 10 marks on both the unit.
 - b) All questions shall be compulsory with internal choice within the questions.

Question Number	Unit	Marks
01	I	10
02	II	10
03	I & II	10

CIE	SEE	Total Marks
20	30	50

Name of the Course	B.Sc.
Course Code	25_USCHE509
Nomenclature	Industrial Chemistry Practical
Class	T.Y. B.Sc.
Semester	V
No of Credits	02
Nature	Practical
Type	Major Elective
Highlight revision specific to employability/ entrepreneurship/ skill development (if any) 100 words	-----

Course Outcomes: On completing the course, the learner will be able to –

- CO 1 Explain MSDS of chemicals
- CO 2 Explain principles involved in estimations of industrially important reagents
- CO 3 Perform different kinds of analyses of fuels
- CO 4 Explain principles involved in designing protective methods from corrosion
- CO 5 Interact with experts from industry

Curriculum:

UNIT	LEARNING POINTS	HOURS
Group A Non – Instrumental	1. Determination of density of fuel 2. Determination of calorific value of a fuel 3. Electroplating (anodizing / cathodizing) 4. To prepare chart for MSDS	60 hours
Group B Instrumental	1. Estimation of acetone by oxidation by using iodine and alkali 2. Estimation of phenol by brominating using brominating solution 3. Estimation of aniline by brominating using brominating solution 4. Estimation of acetamide by hydrolysis 5. Estimation of ethyl acetate by hydrolysis 6. Determination of moisture content in coal 7. Determination of ash content in coal	
	Mandatory Industrial Visit	

References:

1. Practical Organic Chemistry – A. I. Vogel
2. Practical Organic Chemistry – H. Middleton.
3. Practical Organic Chemistry – O. P. Aggarwal

Evaluation Pattern: Practical (Total marks: 50 marks)**A) Continuous Internal Evaluation (CIE) (40%): 20 Marks**

Sr. No.	Particulars	Marks
01	Performance during practical session, Skill, Accuracy, precision of measurement, Record of observation, calculations, graph, result and conclusion. Timely submission of journal	15
02	Overall performance (attendance, punctuality, interaction during Practical session throughout semester	05

B) Semester End Evaluation (SEE) (60%): 30 Marks

Sr. No.	Group	Title	Method	Marks
1.	A	Non-instrumental / Instrumental	Experiment performance as per the practical slip	25
		Viva Voce and journal		05

CIE / Internal	SEE	Total Marks
20	30	50

Name of the Course	B.Sc.
Course Code	25_USCHV510
Nomenclature	Analytical Chemistry
Class	T.Y. B.Sc.
Semester	V
No of Credits	02
Nature	Theory
Type	VSC
Highlight revision specific to employability/ entrepreneurship/ skill development (if any) 100 words	The revised mainly focus on providing Learner with both deep technical expertise in chemical analysis and the practical skills needed to excel in a variety of industries. This revision should ensure that learners are not only proficient in laboratory techniques but also possess a strong understanding of industry applications, regulatory standards, and the business aspects of analytical chemistry.

Course Outcomes: On completing the course, the learner will be able to –

- CO1 Explain the importance of quality, quality assurance, and quality control in laboratory practices, and the role of Certified Reference Materials (CRMs) in reliable chemical analyses. Understand complexometric and redox titrations in industrial applications.
- CO2 Explain principle, instrumentation, and applications of spectroscopic techniques and thermal methods, including FES, AAS, turbidimetry, nephelometry, TGA, and DTA. Differentiate between fluorescence and phosphorescence in chemical analysis.

Curriculum:

UNIT	TITLE	LEARNING POINTS	HOURS
I	Quality in analytical Chemistry and titrimetric methods	1.1 Quality Concept and method validation 1.1.1 Concepts of Quality, Quality control and Quality assurance 1.1.2 Importance of Quality concepts in Industry. 1.1.3 Chemical standards and certified Reference Materials: Importance in chemical analysis. 1.1.4 Quality of material: Various uses, grades of laboratory reagents. 1.1.5 Introduction and need for validation of a method, validation Parameters: Specificity, Selectivity, Precision, Linearity, Accuracy and Robustness.	15
		1.2 Complexometric titrations 1.2.1 Introduction construction of titration curve. 1.2.2 Use of EDTA as titrant and its Standardization, absolute and conditional formation constants of metal EDTA complexes, Selectivity of EDTA as a titrant. Factors enhancing selectivity of EDTA as a titrant with examples. Advantages and limitations of EDTA as a titrant. 1.2.3 Types of EDTA titrations. 1.2.4 Metallochromic indicators, theory, examples and applications. 1.2.5 Introduction to redox titration, construction of titration curve, theory of redox indicator, Diphenyl amine and ferroin as redox indicator.	

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<p style="text-align: center;">II</p>	<p style="text-align: center;">Optical and thermal Methods</p>	<p>2.1 Flame emission Spectroscopy 2.1.1 Introduction, Energy level diagrams, atomic spectra, Absorption and Emission Spectra. 2.1.2 Flame Photometry Principle, Instrumentation (flame atomizers, types of Burners, wavelength selectors, detectors). 2.2 Atomic Absorption Spectroscopy – 2.2.1 Principle, Instrumentation (Source, Chopper, Flame and Electro thermal Atomizer). 2.2.2 Quantification methods of FES and AAS – Calibration curve method, Standard addition method and Internal standard method. Comparison between FES and AAS. 2.3 Molecular Fluorescence Spectroscopy 2.3.1 Introduction and Principle 2.3.2 Relationship of Fluorescence intensity with concentration, 2.3.3 Factors affecting fluorescence and phosphorescence 2.3.4 Instrumentation and applications 2.4 Turbidimetry and Nephelometry 2.4.1 Introduction and Principle, 2.4.2 Factors affecting scattering of radiation: concentration, particle size, wavelength and refractive index 2.4.3 Instrumentation and Applications</p>	<p style="text-align: center;">15</p>
		<p>2.5 Thermal methods 2.5.1 Introduction to various thermal methods (TGA, DTA and Thermometric titration). 2.5.2 Thermogravimetric Analysis (TGA): Instrumentation-block diagram, thermobalance (Basic components: balance, furnace, temperature measurement and control, recorder). 2.5.3 Thermogram (TG curve) for $\text{CaC}_2\text{O}_4 \cdot \text{H}_2\text{O}$ and $\text{CuSO}_4 \cdot 5\text{H}_2\text{O}$, Factors affecting thermogram-Instrumental factors and Sample characteristics, Applications of TGA. 2.5.4 Differential Thermal Analysis (DTA): Principle, Instrumentation, and types of reference material used, Differential thermogram (DTA curve) $\text{CaC}_2\text{O}_4 \cdot \text{H}_2\text{O}$ and $\text{CuSO}_4 \cdot 5\text{H}_2\text{O}$, Applications of DTA comparison between TGA and DTA.</p>	

References:

1. 3000 solved problems in Chemistry, David E. Goldberg, Ph.D., Schaums Outline Unit/s: (1.2)
2. A guide to Quality in Analytical Chemistry: An aid to accreditation, CITAC and EURACHEM, (2002), Unit/s (1.1)
3. A premier sampling solids, liquids and gases, Smith Patricia I, American statistical association and the society for industrial and applied mathematics, (2001) Unit/s (1.3)
4. Analytical Chemistry, Gary D. Christian, 5th edition Unit/s (4.1, 4.2, 4.3)
5. Analytical Chemistry Skoog, West, Holler, 7th Edition: Unit/s (2.1)
6. Analytical Chromatography, Gurdeep R Chatwal, Himalaya Publication Unit/s (4.1, 4.2, 4.3)
7. Basic Concepts of Analytical Chemistry, by S M Khopkar, New Age International (p) Limited Unit/s (4.1, 4.2, 4.3)
8. Chemical methods of separation, J A Dean, Van Nostrand Reinhold, 1969 Unit/s (4.1, 4.2, 4.3)

R. P. Gogate College of Arts & Science and R. V. Jogalekar College of Commerce (Autonomous), Ratnagiri

9. Fundamentals of Analytical Chemistry by Skoog and West , 8th Edition Unit/s (4.1,4.2,4.3)
10. Handbook of quality assurance for the analytical chemistry laboratory, 2ndEdn., James P. DuxVanNostr and Reinhold, 1990 Unit/s (1.1)
11. Instrumental methods of Analysis, by Dr Supriya S Mahajan, Popular Prakashan Ltd Unit/s (4.1,4.2,4.3)
12. Instrumental methods Of Analysis, by Willard Merritt Dean, 7thEdition, CBS Publisher and distribution Pvt Ltd Unit/s (3.1,3.2,3.3)
13. Instrumental Methods of Chemical Analysis by B.K. Sharma Goel Publishing House Unit/s (4.1,4.2,4.3)
14. Principles of Instrumental Analysis , 5th Edition, By Skoog, Holler, Nieman Unit/s (4.1,4.2,4.3) (3.1,3.2,3.3)

Evaluation Pattern: 50 marks

A) Continuous Internal Evaluation (CIE) (40%): 20 Marks

Sr. No.	Particulars	Marks
01	Unit Test (MCQ / Descriptive – Based on Theory and/or Problems - Online/Offline – 1 unit test of 10 marks	10
02	Assignment / seminar / worksheets	05
03	Active participation in routine class instructional deliveries and Overall conduct as a responsible learner.	05

B) Semester End Evaluation (SEE) (Paper Pattern) (60%): 30 Marks

Guidelines for paper pattern for Semester End Evaluation:

1. 30 Marks per paper Semester End Theory Examination
2. Duration - These examinations shall be of one hour duration
3. Theory question paper pattern:
 - a) There shall be two questions, each of 10 marks on each unit and one question of 10 marks on both the unit.
 - b) All questions shall be compulsory with internal choice within the questions.

Question Number	Unit	Marks
01	I	10
02	II	10
03	I & II	10

CIE	SEE	Total Marks
20	30	50

Name of the Course	B.Sc.
Course Code	25_USCHV511
Nomenclature	Analytical Chemistry Practical
Class	T.Y. B.Sc.
Semester	V
No of Credits	02
Nature	Practical
Type (applicable to NEP only)	VSC
Highlight revision specific to employability/ entrepreneurship/ skill development (if any) 100 words	-----

Course Outcomes: On completing the course, the learner will be able to –

- CO 1 Explain MSDS of chemicals
- CO 2 Explain principles involved in estimations of industrially important reagents
- CO 3 Perform different kinds of analyses of fuels
- CO 4 Explain principles involved in designing protective methods from corrosion
- CO 5 Interact with experts from industry

Curriculum:

UNIT	TITLE	LEARNING POINTS	HOURS
Group A Non- Instrumental	Complexometry	<ul style="list-style-type: none"> Estimation of Calcium and magnesium content in Talcum powder complexometrically using standardized EDTA solution. 	60
	Gravimetry	<ul style="list-style-type: none"> Estimation of zinc in talcum powder gravimetrically. 	
	Redox Titration	<ul style="list-style-type: none"> Determination of COD of water sample Estimation of NO₂ - by using KMnO₄. 	
Group B Instrumental	Spectrophotometry	<ul style="list-style-type: none"> Spectrophotometric estimation of fluoride Spectrophotometric estimation of Manganese by KIO₃ method. 	
	Flame Photometry	<ul style="list-style-type: none"> To determine potassium content of a Fertilizer by Flame Photometry (Calibration curve method) Estimation of Na in soil sample by flame photometry by calibration curve method 	
	Turbidimetry	<ul style="list-style-type: none"> To determine the amount of sulphate in given water sample by turbidimetry 	
	Polarimetry	<ul style="list-style-type: none"> Determination of % of glucose in Saline sample 	
Group C	AAS	<ul style="list-style-type: none"> Demonstration experiment: Determination of copper in soil sample 	

References:

1. Vogel's Textbook of Quantitative Chemical Analysis, 5thEdn., G. H. Jeffery, J. Bassett, J. Memdham and R C Denney, ELBS with Longmann (1989)
2. Vogel's Textbook of Quantitative Chemical analysis, Sixth edition, J.Mendham et.al
3. The chemical analysis of food and food products III edition Morris Jacob

Evaluation Pattern: Practical (Total marks: 50 marks)

A) Continuous Internal Evaluation (CIE) (40%): 20 Marks

Sr. No.	Particulars	Marks
01	Performance during practical session, Skill, Accuracy, precision of measurement, Record of observation, calculations, graph, result and conclusion. Timely submission of journal	15
02	Overall performance (attendance, punctuality, interaction during Practical session throughout semester	05

B) Semester End Evaluation (SEE) (60%): 30 Marks

Sr. No.	Group	Title	Method	Marks
1.	A	Non-instrumental / Instrumental	Experiment performance as per the practical slip	25
		Viva Voce and journal		05

CIE / Internal	SEE	Total Marks
20	30	50

Note: Group C for Internal Evaluation

Field Project (FP)

Nomenclature of the Course	Field Project
Class	T. Y. B.Sc.
Semester	V
Course Code	25_USCHF512
No. of Credits	04
Nature	Project
Type	Major: Mandatory
Course Outcomes: After successful completion of this course the learner will be able to CO1: Enhance interpersonal skills by working in teams. CO2: Improve written and verbal communication by preparing reports, presentations, and discussions on project findings. CO3: Develop critical thinking through observations. CO4: Apply theoretical concepts learned in the classroom to real-world situations in their respective fields.	
Guidelines for Field Project	
<p>Course Duration:</p> <p>Learners have to work 120 hours in semester for field Project.</p> <p>30 hours for classroom activities</p> <ul style="list-style-type: none">• Project planning and preparation for the field project.• Preparation of report etc. <p>90 hours for out-of-class activities.</p> <ul style="list-style-type: none">• Implement the planned fieldwork activities according to the project schedule.• Collect data through interviews, surveys, observations, experimental work etc. <p>Project Report should be of minimum 20-40 pages.</p> <p>Report Structure:</p> <p>The learners will be required to submit a comprehensive report at the end of the Field Project (FP). A project report has to be brief in content and must include the following aspects:</p> <ol style="list-style-type: none">1. Title Page: Mentioning the title of the FP, name of the student, programme, institution, month and year.	

2. Certificate of Completion:

A certificate issued by the supervisor appointed from the department confirming the successful completion of the FP.

3. Acknowledgments:

Recognizing individuals or organizations that provided support, guidance during the FP.

4. Table of Contents:

Providing a clear outline of the report's sections and page numbers.

5. Introduction:

Background information about the FP and its significance. Objectives and scope of the project.

6. Methodology: Description of experimental procedure as per the need of the project. Designing and implementation of the project as per the objectives through theoretical, experimental or computational methods.

7. Result and Discussion:

Detailed accounts of the field visits, including locations, dates, and observations made during the visits. Photographs or visual aids to support the observations. Factual presentation of project finding including data and observations. Analysis and interpretation of finding.

8. Conclusion & Summary:

Summary of the key findings and outcomes of the FP. Reflections on the overall experience and learning during the project.

Broad guidelines for project report:

The field project report shall be prepared as per the broad guidelines given below:

- Font type and size: Times New Roman; size:13 for content and 14 for title.
- Line Space: 1.5 cm for content and 1 cm for in table work
- Paper Size: A4
- Margin: in Left-1.5cm, Up-Down-Right-1cm.

Assessment Pattern:

Sr. No	Field Project work	Distribution of Marks
1	External Evaluation (Field work and report)	60
2	Internal Evaluation (Presentation / Viva-Voce)	40

<i>Sr. No.</i>	<i>Subjects for Field Project (Suggestive list)</i>
1	Water Quality Analysis of local water bodies
2	Analyze pH, heavy metals, and pollutants in soil.
3	Study of wastewater treatment processes at municipal or industrial sites
4	Microplastic contamination study in soil or water samples
5	Chemical profiling of local groundwater sources with seasonal comparison
6	Impact of fertilizer overuse on soil chemistry
7	Analysis of pesticide residues in fruits and vegetables
8	Study of bio-composting and organic waste decomposition
9	Extract and analyze dyes from plants for eco-friendly alternatives.
10	Survey of domestic or industrial cleaning agents
11	Green chemistry practices in local industries or laboratories
12	Food adulteration detection techniques in local markets
13	Study pollutants in urban and rural environments.
14	Study the impact of climate change on local biodiversity.
15	Phytochemical screening of medicinal plants
16	Preparation and analysis of herbal soaps and detergents
17	Characterization of natural dyes from plant sources and their applications
18	Any other subjects of your choice and get it approved by the field project guide

Syllabus for B.Sc. Chemistry from the year 2025-26

Name of the Course	B.Sc.
Course Code	25_USCHM601
Nomenclature	Physical Chemistry
Class	T.Y. B.Sc.
Semester	VI
No of Credits	02
Nature	Theory
Type	Major Mandatory
Highlight revision specific to employability/ entrepreneurship/ skill development (if any) 100 words	The revised syllabus focus on bridging theoretical knowledge with practical, industry-relevant skills. These fields offer a range of opportunities across diverse sectors such as energy, polymer industry, manufacturing, and environmental sustainability. By revising the syllabus learner will be better prepared for career opportunities, and industry challenges.

Course Outcomes: On completing the course, the learner will be able to –

CO 1	Comprehensive understanding of radioactive decay, detection methods, and the application of radioisotopes, along with the principles of nuclear reactions, fission, and reactors, to analyze and apply these concepts in real-world scenarios, basic concepts of polymers, their classification, molar mass determination, and the characteristics and applications of light-emitting polymers
CO 2	The limitations of classical mechanics, and gain a foundational knowledge of quantum mechanics, including key concepts such as wave-particle duality, Heisenberg's uncertainty principle, and the Schrödinger equation, with applications to wave phenomena, the concepts of polarization, decomposition potential, and overvoltage, and apply Tafel's equation to analyze hydrogen overvoltage and the production of hydrogen through electrolysis for future energy applications

Curriculum:

UNIT	TITLE	LEARNING POINTS	HOURS
I	Nuclear Chemistry	<p>Introduction: Basic terms-radioactive constants (decay constant, half-life and average life) and units of radioactivity</p> <p>Detection and Measurement of Radioactivity: Types and characteristics of nuclear radiations, behaviour of ion pairs in electric field, detection and measurement of nuclear radiations using G. M. Counter and Scintillation Counter. Application of use of radioisotopes as Tracers: chemical reaction mechanism, age determination - dating by C14.</p> <p>Nuclear reactions: nuclear transmutation (one example for each projectile), artificial radioactivity, Q - value of nuclear reaction, threshold energy.</p> <p>Fission process: fissile and fertile material, nuclear fission, chain reaction, factors controlling fission process, Types of reactor Power reactor, production reactor</p>	8
	Polymers	<p>Basic terms: macromolecule, monomer, repeat unit, degree of polymerization.</p> <p>Classification of polymers: Classification based on source, structure, thermal response and physical properties.</p> <p>Molar masses of polymers: Number average, Weight average, Viscosity average molar mass, Monodispersity and Polydispersity</p> <p>Method of determining molar masses of polymers : Viscosity method using Ostwald Viscometer. (derivation expected)</p> <p>Light emitting polymers: Introduction, Characteristics, methods of preparation and applications</p>	7
II	Basics of Quantum Chemistry	<p>Classical mechanics: Introduction, limitations of classical mechanics, Black body radiation, photoelectric effect, Compton effect.</p> <p>Quantum mechanics: Introduction, Planck's theory of quantization, wave particle duality, de – Broglie's equation, Heisenberg's uncertainty principle.</p> <p>Progressive and standing waves- Introduction, boundary conditions, Schrodinger's time independent wave equation (No derivation expected), interpretation and properties of wave Function.</p>	7
	Applied Electro-chemistry	<p>Polarization: concentration polarization and its elimination</p> <p>Decomposition Potential and Overvoltage: Introduction, experimental determination of decomposition potential, factors affecting decomposition potential. Tafel's equation for hydrogen overvoltage, experimental determination of over –voltage Hydrogen Fuel of the future, production of hydrogen by direct electrolysis of water, advantages of hydrogen as a universal energy medium</p>	8

References:

1. Physical Chemistry, Ira Levine, 5th Edition, 2002 Tata McGraw Hill Publishing Co.Ltd.
2. Physical Chemistry, G. Castellan, 3rd edition, 5th Reprint, 1995 Narosa Publishing House.
3. Modern Electrochemistry, J.O.M Bockris and A.K.N. Reddy, Maria Gamboa – Aldeco 2nd edition, 1st Indian reprint,2006 Springer
4. Fundamental of Molecular Spectroscopy, 4th Edn., Colin N Banwell and Elaine M McCash Tata McGraw Hill Publishing Co. Ltd. New Delhi, 2008.
5. Physical Chemistry, G.M. Barrow, 6th Edition, Tata McGraw Hill Publishing Co. Ltd. New Delhi.
6. The Elements of Physical Chemistry, P.W. Atkins, 2nd Edition, Oxford University Press Oxford.
7. Physical Chemistry, G.K. Vemulla pallie, 1997, Prentice Hall of India, Pvt.Ltd. New Delhi.
8. Principles of Physical Chemistry B.R. Puri, L.R. Sharma, M.S. Pathania, VISHAL PUBLISHING Company, 2008.
9. Physical Chemistry, Ira Levine, 5th Edition, 2002 Tata McGraw Hill Publishing Co Ltd.
10. Physical Chemistry, G. Castellan, 3rd edition, 5th Reprint, 1995 Narosa Publishing House.
11. Modern Electrochemistry, J.O.M Bockris and A.K.N. Reddy, Maria Gamboa – Aldeco 2nd Edition, 1st Indian reprint,2006 Springer

Evaluation Pattern: 50 marks**A) Continuous Internal Evaluation (CIE) (40%): 20 Marks**

Sr. No.	Particulars	Marks
01	Unit Test (MCQ / Descriptive – Based on Theory and/or Problems - Online/Offline – 1 unit test of 10 marks	10
02	Assignment / seminar / worksheets	05
03	Active participation in routine class instructional deliveries and Overall conduct as a responsible learner.	05

B) Semester End Evaluation (SEE) (Paper Pattern) (60%): 30**Marks Guidelines for paper pattern for Semester End****Evaluation:**

1. 30 Marks per paper Semester End Theory Examination
2. Duration - These examinations shall be of one hour duration
3. Theory question paper pattern:
 - a) There shall be two questions, each of 10 marks on each unit and one question of 10 marks on both the unit.
 - b) All questions shall be compulsory with internal choice within the questions.

Question Number	Unit	Marks
01	I	10
02	II	10
03	I & II	10

CIE	SEE	Total Marks
20	30	50

Name of the Course	B.Sc.
Course Code	25_USCHM602
Nomenclature	Inorganic Chemistry
Class	T.Y. B.Sc.
Semester	VI
No of Credits	02
Nature	Theory
Type	Major Mandatory
Highlight revision specific to employability/ entrepreneurship/ skill development (if any) 100 words	Inorganic chemistry plays a significant role in employability, entrepreneurship and skill development due to its wide ranging applications and relevance in various industries, such as material science, electronics, ceramics, pharmaceuticals, and environmental science. Entrepreneurs in fields like material science and nanotechnology rely on inorganic chemistry principles to innovate. Thus a course provides Post Graduates with analytical skills, problem solving skills, research capabilities which empower them to pursue a diverse path career.

Course Outcomes: On completing the course, the learner will be able to –

CO 1	Understanding the limitations of Valence Bond Theory, Crystal Field Theory, and Molecular Orbital Theory, analyzing d-orbital splitting in various geometries, calculating Crystal Field Stabilization Energy (CFSE), and exploring the effects of bonding on the properties of metal complexes.
CO 2	Learners will develop a comprehensive understanding of the stability, reactivity, and electronic properties of metal complexes, including thermodynamic and kinetic aspects, ligand substitution mechanisms, electronic spectra interpretation, metallocene chemistry, catalytic applications, and the unique chemistry of Group 18 elements.

Curriculum:

UNIT	TITLE	LEARNING POINTS	HOURS
I	Theories of the metal-ligand bond (I)	<p>Limitations of Valence Bond Theory : Crystal Field Theory and effect of crystal field on central metal valence orbitals in various geometries from linear to octahedral (from coordination number 2 to coordination number 6)</p> <p>Splitting of <i>d</i> orbitals in octahedral, square planar and tetrahedral crystal fields.</p> <p>Distortions from the octahedral geometry: (i) effect of ligand field and (ii) Jahn-Teller distortions.</p> <p>Crystal field splitting parameters Δ; its calculation and factors affecting it in octahedral complexes, spectrochemical series. Crystal field stabilization energy (CFSE), calculation of CFSE for octahedral complexes with d^0 to d^{10} metal ion configurations.</p> <p>Consequences of crystal field splitting on various properties such as ionic radii, hydration energy and enthalpies of formation of metal complexes of the first transition series.</p> <p>Limitations of CFT: Evidences for covalence in metal complexes (i) Intensities of d-d transitions, (ii) ESR spectrum of $[\text{IrCl}_6]^{2-}$ (iii) Nephelauxetic effect.</p>	10
	Molecular orbital Theory for coordination compounds	<p>Identification of the central metal orbitals and their symmetry suitable for formation of σ bonds with ligand orbitals.</p> <p>Construction of ligand group orbitals.</p> <p>Construction of σ-molecular orbitals for an ML_6 complex.</p> <p>Effect of σ-bonding on complexes.</p> <p>Examples like $[\text{FeF}_6]^{4-}$, $[\text{Fe}(\text{CN})_6]^{4-}$, $[\text{FeF}_6]^{3-}$, $[\text{Fe}(\text{CN})_6]^{3-}$, $[\text{CoF}_6]^{3-}$, $[\text{Co}(\text{NH}_3)_6]^{3+}$</p>	05
II	Theories of the metal-ligand bond (II)	<p>Stability of Metal-Complexes :</p> <p>Thermodynamic and kinetic perspectives of metal complexes with examples. Stability constants: stepwise and overall stability constants and their interrelationship. Factors affecting thermodynamic stability.</p> <p>Reactivity of metal complexes :</p> <p>Comparison between inorganic and organic reactions.</p> <p>Types of reactions in metal complexes.</p> <p>Inert and labile complexes: correlation between electronic configurations and lability of complexes.</p> <p>Ligand substitution reactions: Associative and dissociative mechanisms. Acid hydrolysis, base hydrolysis and anation reactions.</p> <p>Electronic Spectra :</p> <p>Origin of electronic spectra, types of electronic transitions in coordination compounds: intra- ligand, charge transfer and intra- metal transitions.</p> <p>Selection rules for electronic transitions.</p> <p>Electronic configuration and electronic microstates,</p>	08

		terms and term symbols for transition metal ions, rules for determination of ground state term. Determination of terms for p^2 and d^1 electronic configurations.	
	Some selected topics	<i>Metalloenes</i> : Synthesis, properties, structure and bonding based on VBT Catalysis : Comparison between homogeneous and heterogeneous catalysis, Basic steps involved in homogeneous catalysis, Mechanism of Wilkinson's catalyst in hydrogenation of alkenes. Chemistry of Group 18 : Historical perspectives, physical and chemical properties. Compounds of Xenon (oxides and fluorides) with respect to preparation and structure (VSEPR).	07

References:

1. R. K. Sharma Text Book of Coordination Chemistry Discovery Publishing House.
2. R. Gopalan, V. Ramalingam Concise Coordination Chemistry, Vikas Publishing House.
3. P. R. Shukla, Advance Coordination Chemistry, Himalaya Publishing House.
4. R. K. Sharma Inorganic Reaction Mechanisms Discovery Publishing House.
5. Cotton, Wilkinson, Murillo and Bochmann, Advanced Inorganic Chemistry, 6th Edition.
6. H.W. Porterfield, Inorganic Chemistry, Second Edition, Academic Press, 2005.
7. K. F. Purecell and J.C. Kotz, Inorganic Chemistry W.B. Saunders Co. 1977.
8. R. Gopalan, Inorganic Chemistry for Undergraduates, Universities Press India.
9. D. F. Shriver and P. W. Atkins, Inorganic Chemistry, 3rd edition, Oxford University Press
10. Jack Barrett and Mounir A Malati, Fundamentals of Inorganic Chemistry, Affiliated East west Press Pvt. Ltd., New Delhi
11. N. N. Greenwood and Earnshaw, Chemistry of the Elements, Butterworth Heinemann.1997.
12. J. E. Huheey, Inorganic Chemistry, Prentice Hall, 1993.
13. Satya Prakash, G. D. Tuli, R.D. Madan, Advanced Inorganic Chemistry. S. Chand and Co. Ltd.

Evaluation Pattern: 50 marks

A) Continuous Internal Evaluation (CIE) (40%): 20 Marks

Sr. No.	Particulars	Marks
01	Unit Test (MCQ / Descriptive – Based on Theory and/or Problems - Online/Offline – 1 unit test of 10 marks	10
02	Assignment / seminar / worksheets	05
03	Active participation in routine class instructional deliveries and Overall conduct as a responsible learner.	05

B) Semester End Evaluation (SEE) (Paper Pattern) (60%):

30 Marks Guidelines for paper pattern for Semester End

Evaluation:

1. 30 Marks per paper Semester End Theory Examination
2. Duration - These examinations shall be of one hour duration
3. Theory question paper pattern:
 - a) There shall be two questions, each of 10 marks on each unit and one question of 10 marks on both the unit.
 - b) All questions shall be compulsory with internal choice within the questions.

Question Number	Unit	Marks
01	I	10
02	II	10
03	I & II	10

CIE	SEE	Total Marks
20	30	50

Name of the Course	B.Sc.
Course Code	25_USCHM603
Nomenclature	Organic Chemistry
Class	T.Y. B.Sc.
Semester	VI
No of Credits	02
Nature	Theory
Type	Major Mandatory
Highlight revision specific to employability/ entrepreneurship/ skill development (if any) 100 words	Organic chemistry plays a significant role in employability, entrepreneurship and skill development due to its wide ranging applications and relevance in various industries, such as polymer, pharmaceuticals, petrochemicals, agrochemicals, cosmetics, and environmental science. Learner can apply organic chemistry knowledge to develop innovative products such as specialty chemicals, natural based products to meet specific market demand. Learners will be able to interoperate spectra using ¹³ C NMR and Mass spectrometry.

Course Outcomes: On completing the course, the learner will be able to –

- CO 1 Demonstrate an understanding of stereochemistry, spectroscopic techniques, and biomolecules, including amino acids and proteins. Apply these principles to structural analysis, reaction mechanisms, and synthetic strategies in organic chemistry..
- CO 2 Gain an understanding of organic reagents, carbohydrate chemistry, and polymer science. Apply these principles to functional group transformations, stereochemical analysis, and polymer applications in industry and daily life.

Curriculum:

UNIT	TITLE	LEARNING POINTS	HOURS
I	1.1 Stereochemistry II	1.1.1 Stereoselectivity and stereo specificity: Idea of enantioselectivity (ee) and diastereoselectivity (de), Topicity: enantiotopic and diastereotopic atoms, groups and faces. Stereochemistry of – i) Elimination reactions: E2–Base induced dehydrohalogenation of 1-bromo-1,2-diphenylpropane. ii) Addition reactions to olefins: a) bromination (electrophilic anti addition) b) syn hydroxylation with OsO ₄ and KMnO ₄	04
	1.2 Spectroscopy II	1.2.1 IR Spectroscopy: Basic theory, nature of IR spectrum, selection rule, fingerprint region. Spectral characteristics of following classes of organic compounds, including benzene and monosubstituted benzenes, with respect to IR and (1) alkanes (2) alkenes (3) alkynes (4) haloalkanes (5) alcohols (6) carbonyl compounds (7) ethers (8) amines (broad regions characteristic of different groups are expected). 1.2.2 PMR Spectroscopy: Basic theory of PMR, nature of PMR spectrum, chemical shift (δ unit), standard for PMR, solvents used. Factors affecting chemical shift: (1) inductive effect (2) anisotropic effect (with reference to C=C, C≡C, C=O and benzene ring). Spin-spin coupling and coupling constant. Application of deuterium exchange technique. Application of PMR in structure determination.	07
	1.3 Amino acids And Proteins	1.3.1 α -Amino acids: General Structure, configuration, and classification based on structure and nutrition. Properties: pH dependency of ionic structure, isoelectric point and zwitter ion. Methods of preparations: Strecker synthesis, Gabriel phthalamide synthesis. (for internal work) 1.3.2 Polypeptides and Proteins: nature of peptide bond. Nomenclature and representation of polypeptides (di- and tri- peptides) with examples Merrifield solid phase polypeptide synthesis. Proteins: General idea of primary, secondary, tertiary and quaternary Structure	04
	2.1 Reagents in organic reactions	Study of the following reagents with respect to functional group transformations and selectivity (no mechanism). Reagents: a. LiAlH ₄ (reduction of CO, COOR, CN, NO ₂) b. NaBH ₄ (reduction of CO) c. SeO ₂ (Oxidation of CH ₂ alpha to CO) d. mCPBA (epoxidation of C=C) e. NBS (allylic and benzylic bromination)	02

II	2.2 Carbohydrates	<p>2.2.1 Introduction: classification, reducing and non-reducing sugars, DL notation</p> <p>2.2.2 Structures of monosaccharides: Fischer projection (4-6 carbon monosaccharides) and Haworth formula (furanose and pyranose forms of pentoses and hexoses)</p> <p>2.2.3 Stereoisomers of D-glucose: enantiomer, diastereomers, anomers, epimers.</p> <p>2.2.4 Mutarotation in D-glucose with mechanism</p> <p>2.2.5 Chain lengthening and shortening reactions: Modified Kiliani-Fischer synthesis (D-arabinose to D-glucose and D-mannose), Wohl method (D-glucose to D-arabinose)</p> <p>2.2.6 Reactions of D-glucose and D-fructose: (a) Osazone formation (b) reduction: H_2/Ni, NaBH_4 (c) oxidation: bromine water, HNO_3, HIO_4 (d) acetylation (e) methylation</p>	08
	2.3 Polymer	<p>2.3.1 Introduction: terms monomer, polymer, homopolymer, copolymer, thermo plastics and thermosets.</p> <p>2.3.2 Addition polymers: polyethylene, polypropylene, teflon, polystyrene, PVC, Uses.</p> <p>2.3.3 Condensation polymers: polyesters, polyamides, polyurethanes, polycarbonates, phenol formaldehyde resins. Uses</p> <p>2.3.4 Stereochemistry of polymers: Tacticity, mechanism of stereochemical control of polymerization using Ziegler Natta catalysts.</p> <p>2.3.5 Natural and synthetic rubbers: Polymerisation of isoprene: 1,2 and 1,4 addition (cis and trans), Styrene butadiene copolymer.</p> <p>2.3.6 Additives to polymers: Plasticisers, stabilizers and fillers.</p> <p>2.3.7 Biodegradable polymers: Classification and uses. polylactic acid structure, properties and use for packaging and medical purposes. (Note : Identification of monomer in a given polymer and structure of polymer for a given monomer is expected, condition for polymerization is not expected)</p>	05

References:

1. Organic Chemistry: A Problem Solving Approach L. Ravishankar, G. Shridhar; Narosa publication
2. Organic Chemistry" by Arun Bahl and B. S. Bahl, 22nd edition, S. Chand publication
3. Organic Chemistry" by Jonathan Clayden, Nick Greeves, and Stuart Warren, Oxford Press.
4. Organic Reaction Mechanism, 4th edition, V. K. Ahluwalia, R. K. Parashar, Narosa Publication.
5. Organic reactions and their mechanisms, 3rd revised edition, P.S. Kalsi, New Age International Publishers.
6. M.B.Smith and J. March, Advanced organic chemistry- reactions mechanism and structure, 5th edition.
7. Organic Chemistry, 7th Edition, R.T. Morrison, R. N. Boyd and S. K. Bhattacharjee, Pearson.
8. Elementary organic spectroscopy (Third edition), Y.R.Sharma, S.Chand publication.
9. Introduction to spectroscopy (third edition), Pavia, Lampman, Kriz, Johnvondeling, Emily Barrosse.
10. Organic chemistry R.T.Morrison and R. N. Boyd, 6th edition, pearson education
11. Polymer chemistry by M.G.Arora, K.Singh.
12. Polymer science – a text book by Ahluwalia and Mishra.

Evaluation Pattern: 50 marks**A) Continuous Internal Evaluation (CIE) (40%): 20 Marks**

Sr. No.	Particulars	Marks
01	Unit Test (MCQ / Descriptive – Based on Theory and/or Problems - Online/Offline – 1 unit test of 10 marks	10
02	Assignment / seminar / worksheets	05
03	Active participation in routine class instructional deliveries and Overall conduct as a responsible learner.	05

B) Semester End Evaluation (SEE) (Paper Pattern) (60%): 30 Marks**Guidelines for paper pattern for Semester End Evaluation:**

- 30 Marks per paper Semester End Theory Examination
- Duration - These examinations shall be of one hour duration
- Theory question paper pattern:
 - There shall be two questions, each of 10 marks on each unit and one question of 10 marks on both the units.
 - All questions shall be compulsory with internal choice within the questions.

Question Number	Unit	Marks
01	I	10
02	II	10
03	I & II	10

CIE	SEE	Total Marks
20	30	50

Name of the Course	B.Sc.
Course Code	25_USCHM604
Nomenclature	Chemistry Practical – III
Class	T.Y. B.Sc.
Semester	VI
No of Credits	02
Nature	Practical
Type	Major Mandatory
Highlight revision specific to employability/ entrepreneurship/ skill development (if any) 100 words	-----

Course Outcomes: On completing the course, the learner will be able to –

- CO 1 Interpret the order of reaction graphically
- CO 2 Determine the molecular weight of polymer by viscosity measurement.
- CO 3 Estimate the amount % of Iodide, bromide, and chloride in mixture of halide Potentiometrically.
- CO 4 Determine the number of electrons involved in redox reaction Potentiometric ally
- CO 5 Estimate the amount / % Strong acid and Weak acid in a mixture conductometrically.
- CO 6 Estimate the amount of Fe(III) in the complex formation with salicylic acid by Static method.
- CO 7 Determine % purity of given salt.
- CO 8 Detect impurity (cation and or anion) in salt qualitatively by wet analysis only.

Curriculum:

UNIT	TITLE	LEARNING POINTS	HOURS
Group A Non-instrumental	Chemical Kinetics	<ul style="list-style-type: none"> To study the kinetics of iodination of acetone 	60 hours
	Viscosity	<ul style="list-style-type: none"> To determine the molecular weight of high activity Polymer polyvinyl alcohol (PVA) by viscosity measurement 	
	Estimation and Qualitative Analysis	<ul style="list-style-type: none"> Determination of percentage purity of the given water soluble salts and qualitative detection w.r.t. added cations and /or anion only by wet tests. (Any four Salts of transition metal ions) 	
Group B Instrumental	Potentiometry	<ul style="list-style-type: none"> To determine the amount of iodide, bromide and chloride in the mixture by Potentiometric titration with silver nitrate. To determine activity coefficient in a solution of ZnCl₂. 	
		<ul style="list-style-type: none"> To determine free energy for the cell reaction To determine the number of electrons in redox reaction between ferrous ammonium sulphate. and ceric sulphate Potentiometrically 	
	Conductometry	<ul style="list-style-type: none"> To determine the strength of a given dibasic acid (oxalic / succinic acid) by conductometric titration 	
	Colorimetry	<ul style="list-style-type: none"> To estimate the amount of Fe(III) in the complex formation with salicylic acid by Static Method 	
	Polarimetry	<ul style="list-style-type: none"> To study the kinetics of Inversion of cane sugar catalyzed by HCl using Polarimeter 	
Group C		<ul style="list-style-type: none"> To interpret the order of reaction graphically from the given experimental data and calculate the specific rate constant.(No fractional order) 	

References:

1. Practical Physical Chemistry 3rd edition, A.M. Jones and F.E. Prichard, Longman Publications
2. Experiments in Physical Chemistry R.C.Das and B. Behra, Tata Mc Graw Hill
3. Advanced Practical Physical Chemistry J.B. Yadav, Goel Publication House
4. Advanced Experimental Chemistry Vol I J.N. Gurtu, and R. Kapoor, S Chand and Co.
5. Experimental Physical Chemistry I By V.D. Athavale

Evaluation Pattern: Practical (Total marks: 50 marks)

A) Continuous Internal Evaluation (CIE) (40%): 20 Marks

Sr. No.	Particulars	Marks
01	Performance during practical session, Skill, Accuracy, precision of measurement, Record of observation, calculations, graph, result and conclusion. Timely submission of journal	15
02	Overall performance (attendance, punctuality, interaction during Practical session throughout semester	05

B) Semester End Evaluation (SEE) (60%): 30 Marks

Sr. No.	Group	Title	Method	Marks
1.	A	Physical / Inorganic experiments	Experiment performance as per the practical slip	25
		Viva Voce and journal		05

CIE / Internal	SEE	Total Marks
20	30	50

Note: Group C practical for internal evaluation

Name of the Course	B.Sc.
Course Code	25_USCHM605
Nomenclature	Chemistry Practical – IV
Class	T.Y. B.Sc.
Semester	VI
No of Credits	02
Nature	Practical
Type	Major Mandatory
Highlight revision specific to employability/ entrepreneurship/ skill development (if any) 100 words	-----

Course Outcomes: On completing the course, the learner will be able to –

- CO 1 Find the chemical type of mixture in the given binary mixture.
- CO 2 Decide scheme for separation of components using proper reagents.
- CO 3 Purify separated organic compound using different purification technique
- CO 4 Identify Organic compound.
- CO 5 Acquire skills to prepare *Tris* (acetylacetonato) iron (III).
- CO 6 Acquire skills to prepare *bis* (dimethylglyoximato) nickel (II).
- CO 7 Acquire skills to prepare potassium trioxalato aluminate (III).
- CO 8 Acquire skills to prepare Hexamine nickel (II) chloride / sulphate.

Curriculum:

UNIT	LEARNING POINTS	HOURS
Group A Separation of Binary liquid-liquid and liquid- solid mixture	<p>Minimum four mixtures to be completed by the learner</p> <ul style="list-style-type: none">• Components of the liq-liq mixture should include volatile liquids like acetone, methyl acetate, ethyl acetate, isopropyl alcohol, ethyl alcohol, EMK and non-volatile liquids like chlorobenzene, bromobenzene, aniline, N,N-dimethylaniline, acetophenone, nitrobenzene, ethyl benzoate.• Components of the liq- solid mixture should include volatile liquids like acetone, methylacetate, ethylacetate, ethyl alcohol, IPA, EMK and solids such as water insoluble acids, phenols, bases, neutral, for detection of the physical type of the mixture.• After correct determination of physical type, separation of the binary mixture to be carried out by distillation method using micro scale technique.• After separation into component A and component B, the compound to be identified can be decided by examiner	60
Group B Inorganic preparations	<ol style="list-style-type: none">1. Preparation of Tris(acetylacetonato)iron(III)2. Green synthesis of bis(dimethylglyoximato) nickel(II) complex using nickel carbonate and dmg3. Preparation of potassium trioxalatoaluminate (III)4. Preparation of Hexamine nickel (II) chloride / sulphate	
Group C Spectroscopy	Problems of structure elucidation of simple organic compounds using individual or combined use of UV-Vis, IR, NMR, Mass spectroscopic techniques. (Minimum four experiments)	

References:

1. Practical Organic Chemistry – A. I. Vogel
2. Practical Organic Chemistry – O. P. Aggarwal
3. Vogel's. Text book of. Macro and semi micro qualitative inorganic analysis. Fifth edition

Evaluation Pattern: Practical (Total marks: 50 marks)

A) Continuous Internal Evaluation (CIE) (40%): 20 Marks

Sr. No.	Particulars	Marks
01	Performance during practical session, Skill, Accuracy, precision of measurement, Record of observation, calculations, graph, result and conclusion. Timely submission of journal	15
02	Overall performance (attendance, punctuality, interaction during Practical session throughout semester	05

B) Semester End Evaluation (SEE) (60%): 30 Marks

Sr. No.	Group	Title	Method	Marks
1.	A	Organic / Inorganic experiments	Experiment performance as per the practical slip	25
		Viva Voce and journal		05

CIE / Internal	SEE	Total Marks
20	30	50

Note: Group C practical for internal evaluation

Name of the Course	B.Sc.
Course Code	25_USCHM606
Nomenclature	Drugs and Dyes
Class	T.Y. B.Sc.
Semester	VI
No of Credits	02
Nature	Practical
Type	Major Elective
Highlight revision specific to employability/ entrepreneurship/ skill development (if any) 100 words	The revised syllabus mainly focus on bridging the gap between theoretical specific to knowledge and practical, market-ready skills. This would ensure that learners not only understand the chemistry and techniques involved in the production of drugs and dyes but also gain insights into the industry trends, business opportunities, and essential soft skills required for professional success.

Course Outcomes: On completing the course, the learner will be able to –

CO 1:	study the discovery of drug from different sources, the basic concept of drug designing, the different class of chemotherapeutic agents, the uses and the side effects of certain drugs for various diseases, the synthesis of drug intermediate, the importance of nanomaterial in medicinal chemistry.
CO2:	Study the classification of dyes based on chemical constitution, its synthesis and applications, create an awareness of the current concern about the toxicity of dyes and their effect on ecology, study the non-textile use of dyes and the application of dyes in medical field.

Curriculum:

UNIT	TITLE	LEARNING POINTS	HOURS
I	Drug Discovery, Design and Development	Discovery of a Lead compound: Screening, drug metabolism studies and clinical observation. Development of drug: The Pharmacophore identification, modification of structure or functional group, Structure activity relationship (Sulphonamides). Structure modification to increase potency: Homologation, Chain branching and Extension of the structure. Drug Metabolism: Introduction, Absorption, Distribution, Biotransformation, Excretion.	15
	Chemotherapeutic Agents	<p>Study of the following chemotherapeutic agents with respect to their chemical structure, therapeutic uses, side effects and introduction to MDR wherever applicable.</p> <p>Antibiotics and antivirals: Definition, Amoxicillin (β-lactum antibiotics), Cefpodoxime (Cephalosporins), Doxycycline (Tetracyclines), Levofloxacin (Quinolones) (Synthesis from 2,3,4 - Trifluoro -1-nitrobenzene)</p> <p>Anthelmintics and Antifungal agents Drugs effective in the treatment of Nematodes and Cestodes infestations. Diethyl carbamazone (Piperazines), Albendazole (Benzimidazoles) (Synthesis from 2-Nitroaniline), Clotrimazole (Imidazole), Fluconazole (Triazole) (Synthesis from 1- Bromo - 2, 4-difluorobenze.</p> <p>Antiamoebic Drugs Types of Amoebiasis, Metronidazole, Tinidazole (Imidazole), Synthesis of Metronidazole from glyoxal by Debus- Radziszewski imidazole synthesis route.</p> <p>Antitubercular and Antileprotic Drugs Types of Tuberculosis; Symptoms and diagnosis of Tuberculosis. Types of Leprosy. General idea of Antibiotics used in their treatment. PAS (Amino salicylates), Isoniazide (Hydrazides), (+) Ethambutol (Aliphatic diamines) (Synthesis from 1- Nitropropane), Dapsone (Sulphonamides) (Synthesis from 4- Chloronitrobenzene), Clofazimine (Phenazines), Bedaquiline (Quinoline)</p> <p>Anti-Neoplastic Drugs Idea of malignancy; Causes of cancer, Lomoustine (Nitrosoureas), Anastrozole (Triazoles) (Synthesis from 3,5-bis(bromo methyl) toluene), Cisplatin (Chloro Platinum).</p>	

		<p>Anti-HIV Drugs Idea of HIV pathogenicity, Symptoms of AIDS, AZT/Zidovudine, Lamivudine, DDI (Purines).</p> <p>Drug Intermediates: Synthesis and uses of</p> <ol style="list-style-type: none"> 1) 2,3,6-Triamino-6- hydroxypyrimidine from Guanidine 2) p-[2'-(5-Chloro-2-methoxy benzamido) ethyl]- benzenesulphonamide from Methyl-5-chloro-2- methoxybenzene 3) 3-(p-Chlorophenyl)-3-hydroxypiperidine from 3- Chloroacetophenone <p>Nano particles in Medicinal Chemistry Introduction; Carbon nano particles (structures) and Carbon nano tubes: Functionalization for Pharmaceutical applications, Targeted drug delivery, In vaccine (Foot and mouth disease), Use in Bio-physical treatment, Gold nano particles in treatment of Cancer; Parkinsonism; Alzheimer. Silver nano particles: Antimicrobial activity.</p>	
II	<p>Classification of Dyes based on Chemical Constitution and Synthesis of Selected Dyes</p>	<p>(Synthesis of the dyes marked with * is expected)</p> <ol style="list-style-type: none"> i) Nitro Dye: Naphthol Yellow S ii) Nitroso Dye: Gambine Y iii) Azo dyes: Monoazo dyes: Orange IV *(from sulphanilic acid) & Eriochrome Black T* (from β- naphthol), Bisazo dyes: Congo Red* (from nitrobenzene), Trisazo Dye: Direct Deep Black EW* (from benzidine). iv) Diphenylmethane dye: Auramine O* (from N,N- dimethyl aniline). v) Triphenylmethane dye: Diamine series: Malachite Green* (from benzaldehyde), Triamine series: Acid Magenta, Phenol series: Rosolic acid. vi) Heterocyclic Dyes: Thiazine dyes: Methylene Blue, Azine dyes: Safranin T*, Xanthene Dyes: Eosin* (from phthalic anhydride), Oxazine Dyes: Capri Blue, Acridine Dyes: Acriflavine. vii) QuinoneDyes: Naphthaquinone: Naphthazarine Anthraquinone Dyes: Indanthrene Blue* viii) Indigoid Dyes: Indigo* ix) Phthalocyanine Dyes: Monastral Fast Blue B 	15
	<p>Health and Environmental Hazards of Synthetic Dyes and their Remediation Processes</p>	<p>Impact of the textile and leather dye Industry on the environment with special emphasis on water pollution.</p> <p>Health Hazards: Toxicity of dyes w.r.t food colours.</p> <p>Effluent Treatment Strategies: Brief introduction to effluent treatment plants (ETP) Primary Remediation processes: (Physical Processes) Sedimentation, Aeration, Sorption (activated charcoal, fly ash etc.) Secondary</p>	

		<p>Remediation processes: Biological Remediation– Biosorption, bioremediation and biodegradation Chemical Remediation: Oxidation Processes (chlorination), Coagulation-flocculation – Precipitation</p> <p>Non-textile uses of dyes: Biomedical uses of dyes</p> <p>i. Dyes used in formulations (Tablets, capsules, syrupsetc), Indigo carmine, Sunset yellow, Tartrazine</p> <p>ii. Biological staining agents Methylene blue, Crystal violet and Safranin T.</p> <p>Dyes used in food and cosmetics: Properties of dyes used in food and cosmetics Introduction to FDA and FSSAI. Duties and Responsibilities of FDA and FSSAI</p> <p>Paper and leather dyes : Structure and Requirements of dyes.</p> <p>Miscellaneous dyes: Security Inks & their types, Coloured Smokes and Camouflage colours.</p>	
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References:

1. Text book of organic medicinal & pharmaceutical chemistry. Wilson & Gisovolds, 11th Edition by John H Block, John M Beale Jr.
2. Burger's Medicinal Chemistry, Drug Discovery & Development. Abraham & Rotella. Wiley
3. Medicinal chemistry. Ashutosh Kar, New Age International Pvt. Ltd Publisher. 4th edition.
4. The Art of Drug synthesis. Johnson and Li. Wiley, 2007.
5. The organic chemistry of drug design & drug action. 2nd ed. By Richard B Silvermann, Academic Press.
6. The Organic Chemistry of Drug Synthesis. Lednicer and Mitscher, Wiley.
7. Text book of drug design and discovery. Povl-Krog-Sgaard-Larsen, Tommy Liljefors and ULF Madsen, 3rd Edition Taylor & Francis.
8. Bio-applications of nanoparticles. Edited by Warren C.W. Chan, Springer Publication.
9. Nano forms of carbon and its applications. Edited by Maheshwar Sharon and Madhuri Sharon. Monad Nanotech Pvt. Ltd.
10. Essentials of Medical Pharmacology. K D Tripathi, Jaypee Brothers Medical publishers Pvt. Ltd. Practical organic chemistry, Vogel.
11. Chemistry of Synthetic Dyes, Vol I– IV, Venkatraman K., Academic Press 1972.
12. Chemistry of Dyes and Principles of Dyeing, Shenai V.A., Sevak Publications, 1973
13. Fundamental Concepts of Environmental Chemistry, Sodhi. G. S., Alpha Science International, 2009.
14. Planning Commission, Niti Aayog, FSSAI and FDA websites.

Evaluation Pattern: Practical (Total marks: 50 marks)

A) Continuous Internal Evaluation (CIE) (40%): 20 Marks

Sr. No.	Particulars	Marks
01	Unit Test (MCQ / Descriptive – Based on Theory and/or Problems - Online/Offline – 1 unit test of 10 marks	10
02	Assignment / seminar / worksheets	05
03	Active participation in routine class instructional deliveries and Overall conduct as a responsible learner.	05

A) Semester End Evaluation (SEE) (Paper Pattern) (60%): 30 Marks

Guidelines for paper pattern for Semester End Evaluation:

1. 30 Marks per paper Semester End Theory Examination
2. Duration - These examinations shall be of one hour duration
3. Theory question paper pattern:
 - a) There shall be two questions, each of 10 marks on each unit and one question of 10 marks on both the unit.
 - b) All questions shall be compulsory with internal choice within the questions.

Question Number	Unit	Marks
01	I	10
02	II	10
03	I & II	10

CIE	SEE	Total Marks
20	30	50

Name of the Course	B.Sc.
Course Code	25_USCHE607
Nomenclature	Drugs and Dyes Practical
Class	T.Y. B.Sc.
Semester	VI
No of Credits	02
Nature	Practical
Type	Major Elective
Highlight revision specific to employability/ entrepreneurship/ skill development (if any) 100 words	

Course Outcomes: On completing the course, the learner will be able to –

- CO 1 Understand of free acid content in oils.
- CO 2 To develop practical skills in colorimetric analysis.
- CO 3 Knowledge of the unique reactivity of primary amines in diazotisation reactions.
- CO 4 Understand the principles of electrophilic aromatic substitution and the effects of substituents on the reactivity and orientation of further substitution in an aromatic ring.
- CO 5 Understand the chemical synthesis of a fluorescent dye through a condensation reaction.
- CO 6 Independently separate mixture of dyes by thin layer chromatography.
- CO 7 Emphasizes the importance of quality control, standardization, and pharmacopoeial methods in drug manufacturing and testing.

Curriculum:

UNIT	LEARNING POINTS	HOURS
Group A Estimations	1. Estimation of free acid in vegetable Oil. 2. Estimation of methyl orange by colorimetry. 3. Estimation of primary Amino group by diazotisation. 4. Estimation of Tincture iodine from commercial sample.	60 hours
Group B Preparations	5. m-dinitrobenzene from nitrobenzene. 6. m-nitroaniline from m-dinitrobenzene. 7. Fluorescein from phthalic anhydride. 8. Preparation of vat dye form Indigo. 9. TLC of a mixture of dyes (safranine- T, Indigo carmine, methylene blue). 10. Preparation of monogram of any one drug from the syllabus by I.P. Method.	

References:

4. Practical Organic Chemistry – A. I. Vogel
5. Practical Organic Chemistry – H. Middleton.
6. Practical Organic Chemistry – O. P. Aggarwal

Evaluation Pattern: Practical (Total marks: 50 marks)**B) Continuous Internal Evaluation (CIE) (40%): 20 Marks**

Sr. No.	Particulars	Marks
01	Performance during practical session, Skill, Accuracy, precision of measurement, Record of observation, calculations, graph, result and conclusion. Timely submission of journal	15
02	Overall performance (attendance, punctuality, interaction during Practical session throughout semester	05

C) Semester End Evaluation (SEE) (60%): 30 Marks

Sr. No.	Group	Title	Method	Marks
1.	A	Estimation/ Preparation	Experiment performance as per the practical slip	25
		Viva Voce and journal		05

CIE / Internal	SEE	Total Marks
20	30	50

Name of the Course	B.Sc.
Course Code	25_USCHE608
Nomenclature	Industrial Chemistry
Class	T.Y. B.Sc.
Semester	VI
No of Credits	02
Nature	Theory
Type	Major Elective
Highlight revision specific to employability/ entrepreneurship/ skill development (if any) 100 words	The revised syllabus mainly focus on providing learners with practical skills, industry insights, and entrepreneurial knowledge that enable them to thrive in the chemical industry. The syllabus should combine foundational chemistry with an understanding of industry-specific processes, regulations, and business acumen.

Course Outcomes: On completing the course, the learner will be able to –

- CO 1 Explain steps involved in metallurgy, define and classify alloys, explain relationship between composition; properties and uses of alloys, explain composition of cement, explain reactions taking place in manufacturing and setting and hardening of cement
- CO 2 Classify alcohols, explain fermentation process, define importance of power alcohol; explain reactions and role of reagents in polymers, analyze advanced polymers; role of ingredients in detergents, analyze relation between properties and uses of detergents

Curriculum:

UNIT	TITLE	LEARNING POINTS	HOURS
I	Selected Topics - II	1.1 Metallurgy <ul style="list-style-type: none"> ✦ General steps of metallurgy – concentration of ore, calcination, roasting, reduction and refining ✦ Occurrence, physico-chemical principles, extraction of copper from pyrite sand, refining by electrolysis ✦ Occurrence and extraction of lanthanides 	6
		1.2 Alloys <ul style="list-style-type: none"> ✦ Definition, purposes of alloying ✦ Ferrous alloys – Plain-carbon steels, Heat and Shock resisting steels, Stainless steels. Effect of the alloying element- Ni, Cr, Co, Mn, Mo, W and V ✦ Aluminium alloys – Composition, properties and uses of i) Duralumin, ii) Magnalium ✦ Copper alloys – Composition, properties and uses of i) Brass – Dutch Metal and German Silver and ii) Bronze – Gun metal and Nickel bronze ✦ Alloys of Pb – Composition, properties and Uses of i) Wood’s metal ii) Tinman’s solder. 	5
		1.3 Cements <ul style="list-style-type: none"> ✦ Composition of portland cement ✦ Manufacturing of cement ✦ Setting and hardening of cement 	4
II	Selected Topics - III	2.1 Fermentation Industry <ul style="list-style-type: none"> ✦ Introduction, Importance, Basic requirement of fermentation process ✦ Factors favouring fermentation, Fermentation operations. ✦ Manufacture of Industrial alcohol (Ethyl alcohol) from a) Molasses b) Food grains, c) Fruits. 	5

		<ul style="list-style-type: none"> ✦ Grades of alcohol: Silence spirit, Rectified spirit, Absolute alcohol, Proof spirit, Denatured spirit, Duty and Duty - free alcohol ✦ Importance of Power alcohol as fuel. 	
		<p>2.2 Industrial Polymers</p> <ul style="list-style-type: none"> ✦ Recapitulation of polymers ✦ Chain polymerisation, free radical polymerisation, Ziegler Natta polymerisation ✦ Step polymerisation, polycondensation, polyaddition and ring opening polymerization ✦ Advanced polymers 	6
		<p>2.3 Detergents:</p> <ul style="list-style-type: none"> ✦ Classification, composition of detergents with role of ingredients ✦ Qualitative and quantitative analysis of ingredients of detergent ✦ Properties of detergents: Alkalinity, Anionic matter, Oxygen release capacity etc and selection criteria 	4

References:

1. Industrial Chemistry - B. K. Sharma, Goyal Publishing House, Mirut
2. Shreeve's Chemical Process Industries 5th Edition, G. T. Oustin, Mc Graw Hill
3. Riegel's Handbook of Industrial Chemistry, 9th Edition, Jems A. Kent
4. Industrial Chemistry - R. K. Das, 2nd Edition, 1976.
5. Engineering Chemistry, Jain & Jain, Dhanpat Rai Publications
6. A textbook of Engineering Chemistry, S. S. Dara, S. Chand and Company

Evaluation Pattern: 50 marks

A) Continuous Internal Evaluation (CIE) (40%): 20 Marks

Sr. No.	Particulars	Marks
01	Unit Test (MCQ / Descriptive – Based on Theory and/or Problems - Online/Offline – 1 unit test of 10 marks	10
02	Assignment / seminar / worksheets	05
03	Active participation in routine class instructional deliveries and Overall conduct as a responsible learner.	05

B) Semester End Evaluation (SEE) (Paper

Pattern) (60%): 30 Marks Guidelines for

paper pattern for Semester End Evaluation:

1. 30 Marks per paper Semester End Theory Examination
2. Duration - These examinations shall be of one hour duration
3. Theory question paper pattern:
 - a) There shall be two questions, each of 10 marks on each unit and one question of 10 marks on both the units.
 - b) All questions shall be compulsory with internal choice within the questions.

Question Number	Unit	Marks
01	I	10
02	II	10

03	I & II	10
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CIE	SEE	Total Marks
20	30	50

Name of the Course	B.Sc.
Course Code	25_USCHE609
Nomenclature	Industrial Chemistry Practical
Class	T.Y. B.Sc.
Semester	VI
No of Credits	02
Nature	Practical
Type	Major Elective
Highlight revision specific to employability/ entrepreneurship/ skill development (if any) 100 words	-----

Course Outcomes: On completing the course, the learner will be able to –

- CO 1 Analyze ores for metal contents and to determine quality
- CO 2 Analyze composition of alloys and explain relationship between composition and properties
- CO 3 Determine different properties of detergent and determine quality of detergent
- CO 4 Prepare different polymers
- CO 5 Interact with experts from industries

Curriculum:

UNIT	LEARNING POINTS	HOURS
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Group A Estimations	<ol style="list-style-type: none"> 1. Estimation of Fe from haemetite 2. Estimation of Mn from pyrolusite 3. Estimation of Zn from brass 4. Estimation of Cu from bronze 5. To determine CMC of SDS by conductometry 6. To analyse given sample of detergent for its oxygen releasing capacity, active detergent matter and alkalinity 	60 hours
Group B Synthesis	<ol style="list-style-type: none"> 1. Synthesis of urea formaldehyde resin 2. Synthesis of phenol formaldehyde resin 3. Preparation of epoxy resin 	
	Mandatory Industrial Visit	

References:

1. Practical Organic Chemistry – A. I. Vogel
2. Practical Organic Chemistry – H. Middleton.
3. Practical Organic Chemistry – O. P. Aggarwal

Evaluation Pattern: Practical (Total marks: 50 marks)

A) Continuous Internal Evaluation (CIE) (40%): 20 Marks

Sr. No.	Particulars	Marks
01	Performance during practical session, Skill, Accuracy, precision of measurement, Record of observation, calculations, graph, result and conclusion. Timely submission of journal	15
02	Overall performance (attendance, punctuality, interaction during Practical session throughout semester)	05

B) Semester End Evaluation (SEE) (60%): 30 Marks

Sr. No.	Group	Title	Method	Marks
1.	A	Non-instrumental / Instrumental	Experiment performance as per the practical slip	25
		Viva Voce and journal		05

CIE / Internal	SEE	Total Marks
20	30	50

Name of the Course	B.Sc.
Course Code	25_USCHV610
Nomenclature	Analytical Chemistry
Class	T.Y. B.Sc.
Semester	VI
No of Credits	02
Nature	Theory
Type	VSC
Highlight revision specific to employability/ entrepreneurship/ skill development (if any) 100 words	The revised mainly focus on providing Lerner with both deep technical expertise in chemical analysis and the practical skills needed to excel in a variety of industries. This revision should ensure that learners are not only proficient in laboratory techniques but also possess a strong understanding of industry applications, regulatory standards, and the business aspects of analytical chemistry.

Course Outcomes: On completing the course, the learner will be able to –

- CO1 Differentiate between potentiometry and voltammetry, understand the principles of polarography and its quantitative and qualitative applications. Apply various analytical methods to food and cosmetic products.
- CO2 Explain the principles, instrumentation, and applications of various techniques including Ion Exchange Chromatography, Gas Chromatography, and High-Performance Liquid Chromatography (HPLC). Understand ion exchange equilibria and separation factors.

Curriculum:

UNIT	TITLE	LEARNING POINTS	HOURS
I	Electro – analytical methods and Chemical Analysis of Food and Cosmetics	<p>1.1 Polarography</p> <p>1.1.1 Difference between potentiometry and voltammetry, Polarizable and non-polarizable electrodes.</p> <p>1.1.2 Basic principle of polarography H-shaped polarographic cell, DME (construction, working, advantages and limitations)</p> <p>1.1.3 DC polarogram: Terms involved - Residual current, Diffusion current, Limiting current, Half-Wave Potential Role and selection of supporting electrolyte, Interference of oxygen and its removal, polarographic Maxima and Maxima Suppressors Qualitative aspects of Polarography: Half wave potential Factors affecting $E_{1/2}$.</p> <p>Quantitative aspects of polarography: Ilkovic equations: various terms involved in it (No derivation)</p> <p>1.1.4 Quantification</p> <p>1.1.5 Applications advantages and limitations. (Numerical and word problems are expected)</p> <p>1.2 Electro – analytical methods and Chemical Analysis of Food and Cosmetics Introduction to food chemistry</p> <p>1.2.1 Food processing and preservation: Introduction, need, chemical methods, action of chemicals (sulphur dioxide, boric acid, sodium benzoate, acetic acid, sodium chloride, and sugar) and pH control Physical methods Pasteurization and</p>	15

		<p>Irradiation)</p> <p>1.2.2 Determination of boric acid by titrimetry, and sodium benzoate by HPLC.</p> <p>1.2.3 Study and analysis of food products and detection of adulterants</p> <p>MILK: Composition and nutrients, types of milk (fat free, organic and lactose milk) Analysis of milk for lactose by Lane Eynon's method</p> <p>Honey: Composition, Analysis of reducing sugar in Honey by Coles Ferricyanide method,</p> <p>Tea: Composition, Types, analysis of tannin by Lowenthal's method.</p> <p>1.3 Cosmetics</p> <p>1.3.1 Introduction and Sensory Properties</p> <p>1.3.2 study of cosmetic products-</p> <p>Face powder: Composition, estimation of calcium and magnesium by complexometric titration</p> <p>Lipstick: Constituents, Ash analysis for water soluble salts: borates, carbonates, and zinc oxide.</p>	
II	Methods of Separations	<p>2.1 Ion Exchange Chromatography</p> <p>2.1.1 Introduction, Principle</p> <p>2.1.2 Types of Ion Exchangers, Ideal properties of resin</p> <p>2.1.3 Ion Exchange equilibria and mechanism, selectivity coefficient and separation factor, factors affecting separation of ions</p> <p>2.1.4 Ion exchange capacity and its determination for cation and anion exchangers.</p> <p>2.1.5 Application of ion exchange chromatography.</p> <p>2.2 Gas Chromatography (GC)</p> <p>2.2.1 Introduction, Principle, Theory and terms involved</p> <p>2.2.2 Instrumentation: Block diagram and components, types of columns, stationary phases in GSC and GLC, Detectors: TCD, FID, ECD.</p> <p>2.2.3 Qualitative, Quantitative analysis and applications.</p> <p>(Numerical and word problems are expected)</p> <p>2.3 High Performance Liquid Chromatography (HPLC)</p> <p>2.3.1 Introduction, principle, instrumentation with their significance, solvent reservoir - Degassing system, pumping system (reciprocating pumps, Screw driven -Syringe type pumps, pneumatic pumps, advantages and disadvantages of each pumps). Precolumn, sample injection system, HPLC</p>	15

		Columns, Detectors (UV visible, Refractive Index). 2.3.2 Qualitative and Quantitative applications of HPLC	
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References:

1. An Advance Dairy chemistry, V 3, P. F. Fox, P. L. H. McSweeney Springer Unit/s (3.1,3.2)
2. Analysis of food and Beverages, George Charalanbous, Academic press 1978 Unit/s (3.1,3.2)
Analytical Chemistry of Open Learning (ACOL), James W. Dodd and Kenneth H. Tonge Unit/s(4.1,4.2)
3. Analytical chemistry David Harvey The ,McGraw Hill Companies, Inc. Unit/s (4.1,4.2)
4. Analytical Chemistry, Gary.D Christan, 5th edition Unit/s (2.1,2.2)
5. Analytical chemistry, R. K. Dave. Unit/s (2.1,2.2)
6. Chemical methods of separation, J A Dean, Van Nostrand Reinhold,1969 Unit/s (2.1,2.2)
7. Formulation and Function of cosmetics, Sa Jellineck Unit/s (3.1,3.2)
8. Fundamentals of Analytical Chemistry, D .A. Skoog and D. M. West and F. J. Holler Holt.,Saunders 6th Edition (1992) Unit/s (2.1,2.2)
9. Government of India publications of food drug cosmetic act and rules. Unit/s (3.1,3.2)
10. instrumental methods Of Analysis, by Willard Merritt Dean, 7thEdition, CBS Publisher anddistribution Pvt Ltd Unit/s (1.1,1.2,1.3) (4.1,4.2,4.3)
11. Introduction to Polarography and Allied Techniques, By Kamala Zutshi, New Age International, 2006. Unit/s (1.1,1.2,1.3)
12. Modern cosmetics, E. Thomessen Wiley Inter science Unit/s (3.1, 3.2) 19. Principles of Instrumental Analysis , 5th Edition, By Skoog, Holler, Nieman Unit/s (4.1,4.2,4.3)
13. Principles of Polarography by Jaroslav Heyrovský , Jaroslav Kůta, 1st Edition, Academic Press, eBook ISBN: 978148326478 Unit/s (1.1,1.2,1.3)
14. Solvent extraction and ion exchange, J Marcus and A. S. Kertes Wiley INC 1969 Unit/s(2.1,2.2,)

Evaluation Pattern: 50 marks

A) Continuous Internal Evaluation (CIE) (40%): 20 Marks

Sr. No.	Particulars	Marks
01	Unit Test (MCQ / Descriptive – Based on Theory and/or Problems - Online/Offline – 1 unit test of 10 marks	10

02	Assignment / seminar / worksheets	05
03	Active participation in routine class instructional deliveries and Overall conduct as a responsible learner.	05

B) Semester End Evaluation (SEE) (Paper Pattern) (60%): 30 Marks Guidelines for paper pattern for Semester End Evaluation:

1. 30 Marks per paper Semester End Theory Examination
2. Duration - These examinations shall be of one hour duration
3. Theory question paper pattern:
 - a) There shall be two questions, each of 10 marks on each unit and one question of 10 marks on both the unit.
 - b) All questions shall be compulsory with internal choice within the questions.

Question Number	Unit	Marks
01	I	10
02	II	10
03	I & II	10

CIE	SEE	Total Marks
20	30	50

Name of the Course	B.Sc.
Course Code	25_USCHV611
Nomenclature	Analytical Chemistry Practical
Class	T.Y. B.Sc.
Semester	VI
No of Credits	02
Nature	Practical
Type (applicable to NEP only)	VSC

Highlight revision specific to employability/ entrepreneurship/ skill development (if any) 100 words	-----
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Course Outcomes: On completing the course, the learner will be able to –

- CO 1 Estimate reducing sugar in honey by Willstatter method
- CO 2 Estimate of Total reducing sugars before and after inversion in honey using: (a) Cole's Ferricyanide
- CO 3 Estimate of lactose in milk
- CO 4 Apply Ion exchange chromatographic method for separation of Mg^{+2} and Zn^{+2} ions
- CO 5 Determine capacity of ion exchange resin
- CO 6 Estimate amount of Chromium in water sample spectrophotometrically/
- CO 7 Determine % of Acetic acid in Vinegar sample by potentiometric method
- CO 8 Estimate amount of phosphoric acid in cola sample pH metrically.

Curriculum:

UNIT	TITLE	LEARNING POINTS	HOURS
Group A Non- Instrumental	Redox Titration	<ul style="list-style-type: none"> • Estimation of reducing sugar in honey by Willstatter method. • Estimation of total reducing sugars before and after inversion in honey using: Cole's 	60

		Ferricyanide <ul style="list-style-type: none"> • Estimation of lactose in milk 	
	Ion Exchange Chromatography	<ul style="list-style-type: none"> • Estimation of Mg^{+2} and Zn^{+2} by anion exchange resin • Estimation of ion exchange capacity of cation exchange resin 	
Group B Instrumental	Spectrophotometry	<ul style="list-style-type: none"> • Estimation of Chromium in water sample spectrophotometrically by using Diphenyl carbazide. • Estimation of Chromium in water sample spectrophotometrically by using Diphenyl carbazide. • Estimation of Titanium by H_2O_2 • Estimation of copper (II) photometrically using EDTA 	
	Potentiometry	<ul style="list-style-type: none"> • Estimation of acetic acid in Vinegar sample by using quinhydrone electrode potentiometrically. 	
	pH metry	<ul style="list-style-type: none"> • Determination of phosphoric acid in cola sample pH metrically. 	
	Conductometry	<ul style="list-style-type: none"> • To estimate % by weight of a mixture of weak acid and strong acid in the mixture against strong base conductometrically. 	

References:

1. Vogel's Textbook of Quantitative Chemical Analysis, 5th Edn., G. H. Jeffery, J Bassett, J Memdham and R C Denney, ELBS with Longmann (1989).
2. Vogel's Textbook of Quantitative Chemical analysis, Sixth edition, J.Mendham et.al
3. The chemical analysis of food and food products III edition Morris Jacob
4. The chemical analysis of food by David Pearson and Henry Edward

Evaluation Pattern: Practical (Total marks: 50 marks)

E) Continuous Internal Evaluation (CIE) (40%): 20 Marks

Sr. No.	Particulars	Marks
01	Performance during practical session, Skill, Accuracy, precision of measurement, Record of observation, calculations, graph, result and conclusion. Timely submission of journal	15
02	Overall performance (attendance, punctuality, interaction during Practical session throughout semester	05

F) Semester End Evaluation (SEE) (60%): 30 Marks

Sr. No.	Group	Title	Method	Marks
1.	A	Non-instrumental / Instrumental	Experiment performance as per the practical slip	25
		Viva Voce and journal		05

CIE / Internal	SEE	Total Marks
20	30	50

Name of the Course	On Job Training
Course Code	25_USCHJ612 / 23_PSCH209
Class	UG/PG
Semester	VI/II
No of Credits	4
Nature	Practical
Type	On Job Training
Relevance with Employability/ Entrepreneurship/ Skill development	On the job training provides learner with the opportunity to acquire hands on experience and practical skills required for specific job roles. It bridges the gap between theoretical knowledge and the practical requirements of the job. Learner can gain valuable insights into the industry practice, company culture, this experience makes them confident and competent candidate when applying for the position increasing the employability prospects. OJT is instrumental in skill development as it focuses on practical job specific competencies like technical skills, soft skills. Overall OJT enhances employability, foster entrepreneurship by providing valuable exposure in various field.

Guidelines and Evaluation pattern for On Job Training (100 Marks)

Introduction:

Inclusion of On Job Training in the course curriculum of the PG and UG programme is one of the ambitious aspects in the programme structure. The main objective of inclusion of On Job Training is to inculcate ability to interpret aspect of the study in his/ her own words.

Course Objectives:

By the end of the course, students should be able to:

1. Gain exposure to real-world insights and apply theoretical knowledge to practical situations
2. Enhance skills regarding problem-solving, decision-making, and communication skills.
3. Understand organizational dynamics and work culture.
4. Build industry connections and networking opportunities.

Course Outcomes:

1. Apply theoretical knowledge and concepts acquired during the academic program to real-world work scenarios.
2. Develop practical skills and competencies necessary for successful professional

- engagement.
3. Demonstrate effective problem-solving, decision-making, and critical thinking abilities in a work environment.
 4. Adapt to and navigate organizational dynamics and work culture in the chosen industry.
 5. Prepare a comprehensive report documenting the training/project experience, findings, and recommendations.

Guidelines for On Job Training:

The course aims to provide students with practical exposure and hands-on experience in a professional work environment related to their field of study. Students will be required to undertake a designated project or tasks in an organization or industry relevant to their field of study. On job training may of following types:

- i) Industry-based (corporate, manufacturing, R&D, etc.)
- ii) Research internships (national labs, universities other than parent institute)
- iii) Online internships with sufficient documentation and mentor verification
- iv) Hands on training courses with industry collaboration.

For alternative on job training modes like Research internships, Online internships or Hands on training courses with industry collaboration student should follow the standard guidelines as follows

General Guidelines for alternative on job training modes

1. The alternative training must match the minimum hours or weeks defined for traditional OJT
2. The proposed training must align with the student's academic program and career goals.

Guidelines for Research Internships

1. Research Internships must be conducted under a recognized professor or scientist from an accredited institute (other than parent institute) or national research organization.
2. The student shall submit: i) Internship offer letter ii) Final research report iii) Mentor's feedback and evaluation
3. Evaluation of research internship to be done by internal (college) assessor and external (mentor) assessors.

Guidelines for Online Internships

1. Only platforms or programs with proper documentation, project deliverables, and mentor interaction will be accepted.
2. Required submissions:
 - Proof of enrolment and completion certificate
 - Screenshots or copies of live project work
 - Mentor verification form with comments on engagement and deliverables
3. Students must also give a viva/presentation evaluated internally

Guidelines for Hands-on Training Courses with Industry Collaboration

1. The training partner must be MoU partner, or an industry recognized by the institution.
2. Students must be involved in real-time application or simulation-based training.
3. Required documents:
 - Letter from the industry/training provider
 - Training schedule and modules covered
 - Evaluation or skill certificate from the trainer/industry expert
 - A short report with photographs

Course Duration:

Minimum **120 hours** of On Job Training with an Organization /Private firm / Hands-on Training Courses.

- The OJT should relate to the major subject area of the program.
- Students should undertake on-job training, preferably in summer or winter vacation period.
- Project Report should be comprehensive.
- Completion Certificate from the host organization is Mandatory.

Report Structure:

The students will be required to submit a comprehensive report at the end of the On-the-Job Training. A project report must be brief in content and must include the following aspects:

a) Title Page:

Mentioning the title of the report, name of the student, program, institution, and the period of training.

b) Certificate of Completion:

A certificate issued by the organization or supervisor confirming the successful completion of the training.

c) Declaration:

A statement by the student declaring that the report is their original work and acknowledging any assistance or references used.

d) Acknowledgments:

Recognizing individuals or organizations that provided support, guidance, or resources during the training.

e) Table of Contents:

Providing a clear outline of the report's sections and page numbers.

f) Executive Summary:

A bird's eye view of your entire presentation has to be precisely offered under this category.

g) Introduction of the Company:

A concise representation of company/ organization defining its scope, products/ services and its SWOT analysis.

h) Role of student in the Organization during the On Job Training:

The key aspects handled, the department under which you were deployed and brief Summary report duly acknowledged by the reporting head.

i) Challenges:

The challenges confronted while churning out theoretical knowledge into practical world.

j) Conclusion:

A brief overview of your experience and suggestions to bridge the gap between theory and practice.

Broad guidelines for project report:

The project report of On Job Training shall be prepared as per the broad guidelines given below:

- Font type: Times New Roman
- Font size: 12-For content, 14-for Title
- Line Space: 1.5-for content and 1-for in table work
- Paper Size: A4
- Margin: in Left-1.5, Up-Down-Right-1
- The final report must be submitted as a bound hard copy.
- Number of Copies of report: 02 (Department copy and candidate copy)

Format

1st page (Main Page)

Title of the Report

Submitted

To

**R. P. Gogate College of Arts & Science and
R.V. Jogalekar College of Commerce (Autonomous), Ratnagiri**

Under

University of Mumbai

For partial completion of the degree

of

Bachelor / Master of Science

Under the

Faculty of Science

for Academic Year [----]

by

Name of Student

Under the Guidance

of

Name of the Guiding Teacher

**R. P. Gogate College of Arts & Science and
R.V. Jogalekar College of Commerce (Autonomous), Ratnagiri**

Month and Year

On separate page

Index

Chapter No	Title of the Chapter	Page No.
01		
02		
03		
04		
05		

[Company/Institution Logo]

CERTIFICATE OF COMPLETION

This is to certify that [Student's Full Name] [Student's Roll Number], has successfully completed the Academic On-the-Job Training Programme at [Company/Institution Name]

This training covered a period of 120 hours, during which [he/she] actively participated and demonstrated excellent dedication and commitment to learning.

The following work was performed by [him/her]:

- [Brief description of the work performed during the training period]

This training has provided [him/her] with valuable insights and practical experience in [relevant field/industry]. [He/She] has exhibited commendable skills, enthusiasm, and a keen interest in learning.

Certifying Authority:

[Name and Designation]

[Company/Institution Name]

[Contact Information]

[Date]

[Seal/Signature]

On separate page

Declaration by learner

I the undersigned Miss/Mr. [**Name of the learner**] hereby, declare I have completed internship at [**company name**] from [**date**] to [**date**] under the guidance of [**Name of the guiding teacher**]

I, hereby further declare that all information of this document has been obtained and presented in accordance with academic rules and ethical conduct.

Name and Signature of the learner

Certified by

Name and signature of the Guiding Teacher

Verified by

Name and Signature of the Head of the Department

On separate page

Acknowledgment

(Model structure of the acknowledgement)

To list who all have helped me is difficult because they are so numerous and the depth is so enormous.

I would like to acknowledge the following as being idealistic channels and fresh dimensions in the completion of this project.

I thank the **R. P. Gogate college of Arts & Science and R.V. Jogalekar College of Commerce (Autonomous), Ratnagiri** for giving me opportunity to do this project.

I would like to thank the Principal, Prof. Dr M.R. Sakhalkar Sir, for providing the necessary facilities required for completion of this project.

I take this opportunity to thank Vice Principal ----- and HOD ----- for moral support and guidance.

I would also like to express my sincere gratitude towards my project guide _____ whose guidance and care made the project successful.

Lastly, I would like to thank each and every person who directly or indirectly helped me in the completion of the project especially my Parents and Peers who supported me throughout my project.

Date: 17/04/2025

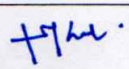


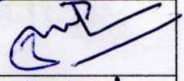
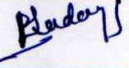
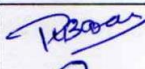
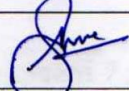
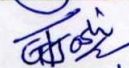

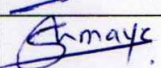

Place: Ratnagiri

Signature

Dr. Mrs. A. M. Kulkarni
Chairperson & HOD, Chemistry

Ratnagiri Education Society's
R. P. Gogate College of Arts and Science and R. V. Jogalekar College of Commerce
(Autonomous), Ratnagiri

Meeting of BoS in Chemistry

Date	17 th April 2025		
Time	11.30 AM		
Venue	Department of Chemistry		
Mode	Hybrid		
Attendance			
Sr. No.	Name and type of the Member	Present mode Online / Offline	Signature
1	Name: Dr. Mrs. Aparna M. Kulkarni Head of the Department (Chairman)	offline	
2	Name: Dr. Ghanashyam B. Sathe (VC nominee)	leave	
3	Name: Prof. Savita Ladage Dean. HBCSE, TIFR Mumbai	Online	
4	Name: Dr. Ganpat K. Naik HOD Chemistry, Parvatibai Chougule College Madgaon, Goa	Online	
5	Name: Mr. Anil Kumar Satpathy Head of QA QC Finolex Industries Pvt Ltd, Ranpar	Online	
6	Name: Dr. Vikas Kulkarni, GM, Lupin Pharmaceuticals, Mumbai Alumnus	Online	
7	Name: Mr. Maruti B. Kamble Department faculty member (1)	offline	
8	Name: Dr. Swaminath L Bhattar Department faculty member (2)	offline	
9	Name: Dr. Umesh B. Sankpal Department faculty member (3)	offline	
10	Name: Dr. Meghana E. Mhadye Department faculty member (4)	offline	
11	Name: Mrs. Pratikha Barsakar Department faculty member (5)	offline	
12	Name: Mr. Ankit A Surve Department faculty member (6)	offline	
13	Name: Trupti Gajanan Joshi Department faculty member (7)	offline	
14	Name: Miss Rina B. Shinde Department faculty member (8)	offline	
15	Name: Mr. Shirin S Limaye Department Faculty member (9)	offline	
16	Name: Mr. Ganesh M. Rathod Department faculty member (10)	offline	
17	Name: Sakshi Sanjay Chalake Department faculty member (11)	offline	