ST. XAVIER'S COLLEGE
(Autonomous), Ahmedabad

Reaccredited 'A+' (CGPA:3.27 out of 4) by NAAC (4th Cycle) | Affiliated to Gujarat University

Syllabus for

Bachelor of Science(B.Sc.) – Chemistry

(With modifications upto 15th September, 2022)

Programme Specific Outcome

A student completing this program will be able to

PSO1: Knowledge: Apply the principles of analytical, organic, inorganic and physical chemistry to solve basic chemical problems locally and globally

PSO2: Laboratory skills: Employ classical and modern laboratory techniques in the performance and documentation of experiments, suitable for a chemical industry or a chemistry graduate program.

PSO3: Environmental concern: Practice environmentally benign chemistry

PSO4: Employability/future prospects: Develop problem-solving skills and aptitude that are highly valuable to employers and entrepreneurship skills for self- employment

PSO5: Scientific communication: Have effective written and oral scientific communication skills, especially the ability to transmit complex technical information in a clear and concise manner

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St. Xavier's College (Autonomous)

Ahmedabad-09

B.Sc.Chemistry

Semester: 1
Course Name: General Chemistry (Theory) **Course Code: CH-1501**
No. of Credits: 04 **Learning Hours: 60 Hours**

Course Outcomes:

CO1: Interpret the fundamentals of organic reaction mechanisms and describe the chemical properties as well as synthetic methods for hydrocarbons

CO2: Apply the principles of some selected quantitative analysis methods to derive information regarding organic compounds

CO3: Recognize and apply the fundamentals of quantum mechanics and chemical bonding to describe atomic structure as well as molecular structure

CO4: Interpret the role of entropy in various thermodynamic process and also apply the principles of chemical kinetics to derive the rate equations for various types of reactions

Unit-1 Organic Chemistry-I **[15L]**

[Prerequisites or topics for Self Study: (i) Nomenclature of aliphatic compounds, (ii) Source Importance and applications of alkane, alkene, and alkynes. (iii) Classification of hydrocarbons (iv) physical properties of alkane, alkene and alkynes.]

(A) Alkane: **[4 Marks]**

Methods of formation:-Wrutz reaction, Corey–House Synthesis (*Gilmanreagent*) Hydrolysis of R-Mg-X, Decarboxylation of carboxylic acids and Kolbe electrolysis.

Mechanism of free radical halogenation of alkanes: orientation, reactivity and selectivity (with Energy considerations), Nitration of alkane (only reaction).

(B) Alkene: **[6 Marks]**

Methods of Preparation:- Dehydration of alcohols (with mechanism), regioselectivity in alcohol dehydration, dehalogenation, dehydrogenation, dehydrohalogenation of alkyl halides, The Saytzeff rule, Hofmann elimination (Only introduction, without mechanism).

Mechanisms involved in hydrogenation, electrophilic and free radical additions, Markownikoff's rule, peroxide effect, hydroboration-oxidation and oxymercuration-reduction. Epoxidation, ozonolysis, hydration, hydroxylation and oxidation with $KMnO_4$ and OsO_4. Polymerization of alkenes, substitution at the allylic and vinylic positions of alkenes.

(C) Alkynes: **[4 Marks]**

Methods of Preparation: Dehydrohalogenation, dehalogenation, Acidity of Alkynes (Na, Ag, Cu), Mechanism of electrophilic and nucleophilic addition reactions, hydroboration-oxidation, metal-ammonia and metal reductions (cis and trans), and polymerization.

Unit-2 Organic Chemistry-II **[15L]**

[Prerequisites or topics for Self Study:- (I) Importance and application of qualitative and quantitative analysis (ii) Brief study of various methods of qualitative and quantitative analysis, (iii) Understanding reactions and reagents (iv) Understanding different types of bonds]

(A) Quantitative Analysis and Determination of Molecular Formula: [7 Marks]

Determination of Nitrogen by Kjeldahl's method and Kjeldahl's method modified with boric acid. Molecular weight of organic acid by Ag-salt method and organic base by Chloroplatinate method, Numerical based on empirical and molecular formula.

(B) Fundamentals of Organic Reactions [7 Marks]

Curved arrow notation, drawing electron movements with arrows, half-headed and double-headed arrows, type of reagent (electrophile, nucleophile, free radical), Reactive intermediates - carbocations, carbanions, free radicals, carbenes, nitrenes and arynes (only one example).

Types of reaction, Addition (electrophilic, nucleophilic, free radical addition, Substitution reaction: S_N^1 and S_N^2 nucleophilic substitutions with mechanism. Elementary treatment of (free radical substitution reaction (*cf.* Alkane), Electrophilic substitution reaction (*cf.* Nitration), Elimination reaction: E1 and E2 reactions, Rearrangement reactions, Inter and intramolecular rearrangement. 1,2-rearrangement, Pericyclic reaction, (only sigmatropic rearrangement), olefin metathesis (one example of each)

Unit-3 Inorganic Chemistry [15L]

[Prerequisites or topics for Self Study: (i) Aufbau and Pauli's exclusion principle (ii) Hund's multiplicity rule, (iii) electronic configure of elements up to atomic number 30 (iv) effective nuclear charge and shielding [Self-study (B) I :- Properties of Ionic structures, radius ratio effect and Co-ordination numbers.] [Self Study (B) II:- Partial ionic character of covalent bond, bond moment, dipole moment, electro negativity difference, concept of resonance, resonance energy and resonance structures.]

(A) Atomic Structure and ware Mechanics: **[7 Marks]**

Idea of de–Broglie's matter wave (dual nature) and Heisen Berg's uncertainty principle Schrodinger wave equation, Normalized and Orthogonal wave, quantum numbers and their significance, radial and angular wave functions, shapes ofs, p and d orbitals and characteristics. Variation of orbital energies with atomic number and energy level diagram.

(B) Chemical Bonding [7 Marks]

(I) Ionic bonding:

(1) Lattice energy :- Definition, Born–Lande equation (derivation not required), factor's affecting lattice energy, Solvation energy and solubility of ionic solid, covalent nature of ionic compound, Polarizing power and Polarisability of ions, Fajan's rule.

(II) Covalent boning:

(1) Valance bond theory and its Limitations (2) Various types of hybridization and shapes of simple inorganic molecules and ions (such as NH_3, H_3O^+, SF_4, SF_6, PCl_5, ClF_3, I_3^-, NH_4^+, BF_4^-, XeF_4, XeF_6) by Valence Shell Electron pair Repulsion (VSEPR) Theory.

Unit-4 Physical Chemistry [15L]

[Prerequisites or topics for Self Study: Basic terms related to thermodynamics done in previous standard and first law, its derivation. Basic terms like rate of reaction with units, molecularity and order of reaction, derivation of first order rate constant and its half life.]

(A) Thermodynamics [7 Marks]

Limitations of first law and need for the second law, Entropy- its physical significance, entropy of gas and calculation of entropy for different processes. Entropy change during phase change, entropy of mixing of ideal gases, entropy change in reversible and irreversible process.

(B) Chemical kinetics [7 Marks]

Derivation of second order rate reaction constant for (a=b) and (a≠b). Derivation of third order equation (a=b=c), Determination of half life time for the 2^{nd} and 3^{rd} order reaction.

Kinetics of opposing and consecutive reaction.

Reference books: CH 1501: General Chemistry (Theory)

(1) "Elements of Quantum Mechanics" by Michael D. Fayer, Oxford University Press, Indian Edition.
(2) "Concise Inorganic Chemistry" by J. D. Lee, 5/E, Oxford University Press, Indian Edition.
(3) "Basic Inorganic Chemistry" by F. A. Cotton and G. Wilkinson, Wiley publication.
(4) "Inorganic Chemistry" by Shriver & Atkins, 4/E, Oxford University Press, Indian Edition.
(5) "Introductory Quantum Chemistry" by A. K. Chandra, 4/E, Tata McGraw Hill Publishing Company Limited, New Delhi.
(6) "Organic Chemistry" by G. Marc Loudon, 4/E, 2010, Oxford University Press, Indian Edition,
(7) "Organic Chemistry" by Robert Thornot Morrison, Robert Neilson Boyd, 6/E, 1992, Prentice Hall of India Pvt Ltd, New Delhi.
(8) "Text book of Organic Chemistry" by P. L. Soni and H. M. Chawla, 26/E, 1995, Sultan Chand & Sons Publication, New Delhi.
(9) "Text book of Organic Chemistry" by P. S. Kalsi, 1999, MacMillan of India Pvt. Ltd.
(10) "Organic Chemistry" by Bhupinder Mehta, Manju Mehta, Prentice Hall of India Pvt. Ltd,New Delhi.
(11) "Elements of Physical Chemistry" by Peter Atkins & Julio De Paula, 5/E, Oxford University Press, Indian Edition.
(12) "Physical Chemistry" by P. W. Atkins, 7/E, 2002, Oxford University Press, Indian Edition.
(13) "Physical Chemistry" by W. J. Moore, 1996, 6/E,MacGraw Hill Publication.
(14) "Principle of Physical Chemistry" by Puri, Sharma &Pathania, 41/E, Vishal Publishers.
(15) "Essentials of Physical Chemistry" by Bahl&Tuli. 22/E, S.Chand publication New Delhi
(16) "Advanced Physical Chemistry" by Gurdeep Raj, 19/E, GoelPublishing House Meerut.

St. Xavier's College (Autonomous)
Ahmedabad-09
B.Sc. Chemistry

Semester: 1
Course Name: Chemistry (Practicals) **Course Code: CH-1502L**
No. of Credits: 03 **Learning Hours: 2x2Hours**

Course Outcomes:
CO1: Perform semi-micro qualitative analysis of inorganic salts to identify the cation and anion

CO2: Use the principles of titrimetric analysis to determine the concentration of unknown acid or base

(A) Volumetric Analysis (Acid and Base)

(1) Preparation and Standardization of NaOH and HCl

(2) Succinic Acid ---------NaOH

(3) Oxalic Acid ---------- NaOH

(Hydrated and/or Anhydrous)

(4) Na_2CO_3(Anhydrous)------HCl

(B) Inorganic Qualitative Analysis (Two Radicals) (Minimum Eight Salts)

Water Soluble and Insoluble Inorganic salts of following cations and anions:

Cations : K^+, NH_4^+, Mg^{2+}, Ba^{2+}, Ca^{2+}, Sr^{2+}, Fe^{2+}, Fe^{3+}, Al^{3+}, Cr^{3+}, Zn^{2}+, Mn^{2+}, Co^{3+}, Pb^{2+}, Cu^{2+}.

Anions : S^{2-}, SO_4^{2-}, CO_3^{2-}, PO_4^{3-}, CrO_4^{2-}, Cl^- , Br^-, I^-, NO_3^-, O^{2-}

Reference books: CH 1502L: Chemistry (Practicals)

(1) "Vogel's Textbook of Quantitative Chemical analysis" Revised by G. H. Jeffery, J. Bassett, J.Mendham & R. C. Denney, 5/E , ELBS (English Language Book Society) Longman.
(2) "Analytical Chemistry" by DhrubaCharan Dash, PHI Learning Private Ltd, 2011 New Delhi. .
(3) "Analytical Chemistry" by Gary D. Christian , 4/E, John Wiley & Sons.
(4) "Advanced Practical Inorganic Chemistry" by Gurdeep Raj, 9/E, GoelPublishing House, Meerut.
(5) "Vogel's Textbook of Macro and Semimicro Qualitative Inorganic Analysis", 5/E, Orient Longman Ltd.

St. Xavier's College (Autonomous)
Ahmedabad-09
B.Sc. Chemistry

Semester: 1
Course Name: Conceptual Industrial Chemistry (Theory) **Course Code: IC-1401**
No. of Credits: 02 **Learning Hours: 30 Hours**

Course Outcomes:
CO-1: Identify the hydrocarbons through their chemical & physical properties and their application in Industry.

CO-2: Interpret the basic calculations of compounds, chemical reaction and their application.

CO-3: Synthesize petroleum products and their processing through different techniques.

CO-4: Define the types of renewable resources and to operate the technique for distillation and crystallization

Unit-1: Aromatic Hydrocarbons

[Prerequisites or topics for Self Study: classification of aliphatic compounds and their properties]

(1) Classification, Chemical and physical properties, preparation of Aromatic hydrocarbons.
(2) Application in industry – Pharmaceutical industries, drugs, dyes, Polymer industries.

Unit-2: Material Balance calculations

[Prerequisites or topics for Self Study: basic studies of states and matter and get information from the periodic table]

(1) Basic chemical calculations: Atomic weight, molecular weight, equivalent Weight, mole and Composition of liquid mixtures and gaseous mixtures.
(2) Introduction to Material balance with and without chemical reactions: Limiting reactant, Conversion yield, Recycling or bypass operation.

Unit-3: Petroleum Products

[Prerequisites or topics for Self Study: study of Unsaturated Aliphatic compounds name]

(1) Petroleum products: Introduction and formation of petroleum products
(2) Processing of petroleum products: Natural gas, fractionation of crude oil, Cracking, Reforming, Hydroforming and Isomerization.

Unit-4: Unit Operations and Renewable Resources

[Prerequisites or topics for Self Study: Get information about separation and filtration]

(1) Renewable sources: Definition, Types of renewable resources, Availability and use. Cellulose and starch: properties and modifications
(2) Distillation: Introduction, Batch and Continuous distillation, separation of Azeotropes, plate column and packed columns.
(3) Crystallization: Introduction, Solubility, nucleation, crystal growth, Equipments-Tank crystallizer, agitated crystallizer, draft tube crystallizer, evaporator crystallizer etc.

Reference books: IC 1401: Conceptual Industrial Chemistry (Theory)

1. "Organic Chemistry – Volume I"by S.M.Mukherjee, S. P. Singh and R.P. Kapoor, Kurukshetra University, Published by New Age International Ltd.
2. "Organic Chemistry"by Morrison and Boyd, 6th Edition, Prentice – Hall of India Pvt. td.
3. "Organic Chemistry of Natural Products" by Gurdeep Chatwal, Vol. 1.
4. "Chemical Engineering" by J. M. Coulson and J. F. Richardson, 4th Edition
5. "Introduction to Chemical Engineering" by Walter L. Badger and Julius T. Bancherd,
6. McGraw – Hill Publications.
7. "Industrial Chemistry" by B. K. Sharma, GOEG Publishing House, Meerut.
8. "Chemical Calculations" by G. D. Tulsi and P. L. Soni.

St. Xavier's College (Autonomous)
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B.Sc. Chemistry

Semester: 1
Course Name: Industrial Chemistry (Practicals) **Course Code: IC-1402L**
No. of Credits: 02 **Learning Hours: 2 Hours**

Course Outcomes:
CO-1: Use the principle of titrimetric analysis to determine the concentration of unknown acid or base.

CO-2: Use of unit operation for purification and preparation method.

Course content

(1) Determination of Normality of NaOH using standard solution of HCl

(2) Determination of Normality of HCl using standard solution of NaOH

(3) Purification of compounds by recrystallization.

(4) Calibration of thermometer.

(5) To determine the amount of TDS in water sample.

(6) Preparation of Methyl Salicylate.

(7) Preparation of petroleum jelly.

(8) Purification by distillation.

Reference Books: IC 1402: Industrial Chemistry (Practicals)

(1) **"**Quantitative Chemical Analysis" by Daniel C. Harris, 7th Ed.

(2) "General Chemistry: A Lab Manual" by Slowinski Wolsey.

St. Xavier's College (Autonomous)
Ahmedabad-09
B.Sc.Chemistry

Semester: 1
Course Name: Separation methods in chemistry **Course Code: EG-1301**
No. of Credits: 02 **Learning Hours: 2 Hours**

Course Outcomes:

CO: Apply the principles of solvent extraction, distillation and chromatography for physical separation of chemicals

Unit-1 Physical Methods of separation (Distillation) **[8L]**

[Prerequisites or topics for Self Study: Basic terms related to physical separation of chemicals and distillation]

Distillation and types of distillations, (1) Simple Distillation (2) Fractional Distillation (3) Steam Distillation

Unit-2 Introduction to Solvent Extraction **[7L]**

[Prerequisites or topics for Self Study: Basic terms related to extraction, types of extraction.]

Principle of solvent extraction, Partition Ratio, Distributer Coefficient, Illustrations of Solvent Extraction.

Unit-3 Introduction to chromatography **[7L]**

[Prerequisites or topics for Self Study: Basic terms related to Chromatographic Techniques*]*

Classification of Chromatographic Techniques, (based on mobile phase and type of equilibria)
Basic Principles of Elution Chromatographic terms like eluent, elueate, partition ratio, retention time etc.

Unit-4 Specific Chromatographic techniques **[8L]**

[Prerequisites or topics for Self Study: Basic terms related to TLC, Ion exchange chromatography techniques*]*

(1) Paper Chromatography: Nature of Stationary Phase, Development of Chromatograph.
(2) TLC: Nature of separation, technique of TLC, Process of development of plate, quantitative determination.
(3) Introduction to ion Exchange Chromatography: Principle, Classification of Ion exchange resins, Properties of ion exchange resins, Factors affecting ion exchange separations, Applications of Ion exchange resins.

Reference books: EG 1301: Separation methods in chemistry (Theory)

(1) Separation Science by Khopker
(2) Separation methods by H Kaur
(3) Instrumental methods of chemical analysis by Chatwal and Anand.

St. Xavier's College (Autonomous)
Ahmedabad-09
B.Sc.Chemistry

Semester: 2
Course Name: General Chemistry (Theory) **Course Code: CH-2501**
No. of Credits: 04 **Learning Hours: 60 Hours**

Course Outcomes:
CO1: Use the fundamentals of stereochemical and conformational analysis to identify the configuration and conformation of the given organic compounds

CO2: Recognize and apply the principles of Werner's theory and VB theory to understand bonding in co-ordination complexes formed by transition metals

CO3: Interpret the basic laws and conditions governing ionic equilibria, hydrolysis of various types of salts, catalysis including mechanism and derivation for enzyme catalysed reactions

CO4: Apply the basics of titrimetric analysis to find solutions to simple analytical problems

Unit-1 Organic Chemistry **[15L]**
[Prerequisites or topics for Self Study:-Understanding stereochemistry and its importance,(ii) Introduction of isomers, (iii) Types of isomerism (iv) Isomers of aliphatic hydrocarbons]

Stereochemistry of organic compounds **[Total 14 Marks]**

(1) Optical isomerism - elements of symmetry, molecular chirality, enantiomers, stereogeniccentre, optical activity, properties of enantiomers, chiral and achiral molecules with two stereogeniccentres, diastereomers, threo and erythrodiastereomers, meso compounds, resolution of enantiomers, inversion, retention and racemization.
Relative and absolute configuration, sequence rules, D & L and R & S systems of nomenclature.
(2) Geometric isomerism — determination of configuration of geometric isomers. E & Z system of nomenclature, geometric isomerism in oximes and alicyclic compounds.
(3) Conformational isomerism — Difference between configuration and conformation. conformational analysis of ethane and n-butane; conformations of cyclohexane, axial and equatorial bonds, conformation of mono substituted cyclohexane derivatives (only one example). Newman projection and Sawhorse formulae, Fischer and flying wedge formulae.

Unit-2 Inorganic Chemistry **[15L]**

[Prerequisites or topics for Self Study (A):- Electronic configuration of 3d, 4d, and 5d transition metal elements][Self-study(B) :-Important application of co-ordination compound. [Sedgwick Effective Atomic Number (EAN) Rule.]

(A) Transition Metals **[7 Marks]**
Characteristic properties of 3d elements, Ionic radii, oxidation states, complexation tendency, Magnetic behavior and electronic spectral properties, Spectrophotometric estimation of metal ions.

(B) Co-ordination compounds **[7 Marks]**
(1) Werner's theory, nomenclature, chelates

(2) Valence Bond theory of co-ordination compounds, stereochemistry of numbers 4, 5 and 6.
(3) Various types of isomerism in co-ordination complexes.

Unit-3 Physical Chemistry [15L]

[Prerequisites or topics for Self Study:- Electrolytes, introduction to electrolytic conducatance, definitions and units of basic terms: electrical conducatance, specific conductance, molar conductance, cell constants and degree of dissociation.

(A) Ionic equilibrium [08 Marks]

Definition ionic equilibrium, Ostwald's dilution law and its limitations, ionic product of water (K_w), pH scale, hydrolysis reaction and relations between K_w , K_a, K_b, and K_h for all types of salts, Buffer solution (Handerson - Hasselbalch equation), buffer capacity. Indicator theories- Oswald's and modern quinonoid theory.

(B) Catalysis [06 Marks]

Characteristics of catalysis, Types of catalysis, homogeneous and heterogeneous catalysis, enzyme catalyzed reaction and derivation mechanism.

Unit-4 Analytical Chemistry [15L]

[*Prerequisites or topics for Self Study:- Fundamental terms and definitions of analytical chemistry]*

General Introduction of analytical chemistry [14 Marks]

Introduction, Types of titrations. Requirements for titrimetric analysis. Concentration systems: molarity, formality, normality, wt % ppm, milliequalence and millimoles-problems. Primary and secondary standards, criteria for primary standards. preparation of standard solutions, standardization of solutions. Limitation of volumetric analysis, endpoint and equivalence point.

Reference books: CH 2501: General Chemistry (Theory)

(1) "Elements of Quantum Mechanics" by Michael D. Fayer, Oxford University Press, Indian Edition,
(2) "Concise Inorganic Chemistry" by J. D. Lee, 5/E, Oxford University Press, Indian Edition.
(3) "Basic Inorganic Chemistry" by F. A. Cotton and G. Wilkinson, Wiley publication.
(4) "Inorganic Chemistry" by Shriver & Atkins, 4/E, Oxford University Press, Indian Edition.
(5) "Introductory Quantum Chemistry" by A. K. Chandra , 4/E , Tata MacGraw Hill Publishing Company Limited New Delhi.
(6) "Organic Chemistry" by G. Marc Loudon, 4/E, 2010, Oxford University Press, Indian Edition.
(7) "Organic Chemistry" by Robert Thornot Morrison, Robert Neilson Boyd, 6/E, 1992, Prentice Hall of India Pvt Ltd, New Delhi.
(8) "Text book of Organic Chemistry" by P. L. Soni and H. M. Chawla, 26/E, 1995, Sultan Chand & Sons Publication, New Delhi.
(9) "Text book of Organic Chemistry" by P. S. Kalsi, 1999, MacMillan of India Pvt. Ltd.
(10) "Organic Chemistry" by Bhupinder Mehta, Manju Mehta, Prentice Hall of India Pvt.Ltd, New Delhi.
(11) "Elements of Physical Chemistry" by Peter Atkins & Julio De Paula, 5/E, Oxford University Press, Indian Edition.
(12) "Physical Chemistry" by P. W. Atkins, 7/E, 2002, Oxford University Press, Indian Edition.
(13) "Physical Chemistry" by W. J. Moore, MacGraw Hill Publication, 1996, 6/E.
(14) "Principle of Physical Chemistry" by Puri, Sharma &Pathania, 41/E, Vishal Publishers.
(15) "Essentials of Physical Chemistry" by Bahl &Tuli. 22/E, S. Chand publication New Delhi.
(16) "Advanced Physical Chemistry" by Gurdeep Raj, 19/E, Goel Publishing House, Meerut.

Semester: 2
Course Name: Chemistry (Practicals) **Course Code: CH-2502L**
No. of Credits: 03 **Learning Hours: 2x2Hours**

Course Outcomes:
CO1: Apply the principles of organic separation and functional group reactivity to identify qualitatively the given organic compound

CO2: Use the principles of titrimetric analysis to determine the concentration of unknown metal solution and redox reagents

(A) Volumetric Analysis:-

Redox Titrations:-

(1) $KMnO_4$…… $FeSO_4.7H_2O$

(2) $K_2Cr_2O_7$……$FeSO_4(NH_4)_2SO_4.6H_2O$

Complexometric Titration by EDTA:-

(1) Estimation of Ca^{+2} / Mg^{+2}…….. EDTA

Iodimetry Titration $Na_2S_2O_3$----------I_2

(B) Organic Spotting :- (06 Solids and 04 Liquids).

List organic compounds having different mono functional groups:

Solids : Acids : (i) Benzoic acid (ii) Oxalic acid (iii) Succinic acid (iv)

Phenols : (i) β-Napthol (ii) α-Napthol (iii) Resorcinol (iv) Phenol

Neutral : (i) Urea (ii) Thiourea (iii) Benzamide (iv) Napthalene

Liquids : (i) Aniline (ii) Nitrobenzene (iii) Benzaldehyde (iv) Ethanol

(v) Ethylacetate (vi) Chloroform (vii) Chlorobenzene (viii) Acetone

Reference books: CH 2502L Chemistry (Practicals)

(1) "Vogel's Textbook of Quantitative Chemical analysis" Revised by G. H. Jeffery, J. Bassett,J. Mendham & R. C. Denney, 5/E, ELBS (English Language Book Society) Longman.
(2) "Analytical Chemistry" by DhrubaCharan Dash, PHI Learning Private Ltd, 2011,New Delhi,
(3) "Analytical Chemistry" by Gary D. Christian , 4/E, John Wiley & Sons.
(4) "Comprehensive Practical Organic Chemistry – Qualitative Analysis" by V. K. Ahluwalia, SunitaDhingra, First Indian Reprint 2010, University Press (India) Private Limited, Hyderabad,
(5) "Organic Analytical Chemistry theory and Practice" by Mohan Jag, Narosa

St. Xavier's College (Autonomous)
Ahmedabad-09
B.Sc. Chemistry

Semester: 2
Course Name: Selected topics in Industrial Chemistry (Theory) **Course Code: IC-2401**
No. of Credits: 02 **Learning Hours: 30 Hours**

Course Outcomes:
CO-1: To relate the trivial names of chemical compound with modern era and use of equipment in Industries.

CO-2: Apply the techniques of unit operation in different processes

CO-3: Employ the principles to control the pollution of industries &importance of inorganic compounds in industries.

CO-4: Describe the types of system and their co-relation with energy.

Unit-1: Basics concept of industrial material

[Prerequisites or topics for Self Study: Get information about basic chemicals and techniques*]*

(1) Nomenclature of Basic Chemical Compounds

(2) Heat Exchangers

(3) Basics of chromatography.

Unit-2: Unit operation -1

[Prerequisites or topics for Self Study: Get basic information about types of unit operation]

(1) Extraction
(2) Fuels
(3) Vacuum pumps

Unit-3: Application of industrial chemistry

[Prerequisites or topics for Self Study: Study about the inorganic component from their properties]

(1) Pollution
(2) Inorganic materials of industrial importance: Alumina, Silica, charcoal, diamond, Graphite, Lamp black etc.

Unit-4: Energy balance

[Prerequisites or topics for Self Study: Basic study of system and types of systems, energy and their relation]

Introduction: Types of system, general energy balance procedure, bond Energy, Heat of Formation, Heat of Reaction, Examples of heat of formation and heat of reaction calculations, Specific heat, Relation between C_p and $C_{v.}$

Reference books: IC 2401 : Selected Topics in Industrial Chemistry:(Theory)

(1) ‘‘Chemical Engineering’’ by J. M. Coulson and J. F. Richardson, 4th Edition
(2) “Introduction to Chemical Engineering’’ by Walter L. Badger and Julius T. Bancherd, McGraw – Hill Publications.
(3) “Industrial Chemistry’’ by B. K. Sharma, GOEG Publishing House, Meerut.
(4) “Chemical Calculations’’ by G. D. Tulsi and P. L. Soni.
(5) “A text book of Plant Utilities” by D.B.Dison.

St. Xavier's College (Autonomous)
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B.Sc. Chemistry

Semester: 2
Course Name: Industrial Chemistry (practical) **Course Code: IC-2402L**
No. of Credits: 02 **Learning Hours: 2 Hours**

Course Outcomes:
CO-1: Calculate the total acidity of industrial water sample and assay of $ZnSO_4$ & H_3BO_3

(1) Determination of mineral and Total Acidity of water Samples.

(2) To verify the Beer – Lambert Law by Colorimeter.

(3) To identify amino acid present in the given sample mixture using TLC.

(4) TLC of paracetamol drug.

(5) To carry out assay value of given sample of H_3BO_3 (Boric acid).

(6) To carry out assay value of given sample of $ZnSO_4.7H_2O$.

(7) To carry out assay value of given sample of H3BO3 (Boric acid).

(8) To carry out assay value of given sample of ZnSO4.7H2O

Reference books: IC 2402: Industrial Chemistry (Practical)

(1) "Quantitative Chemical Analysis" by Daniel C. Harris, 7th Ed.
(2) "General Chemistry: A Lab Manual" by Slowinski Wolsey.

St. Xavier's College (Autonomous)
Ahmedabad-09
B.Sc. Chemistry

Semester: 3
Course Name: Organic Chemistry (Theory) **Course Code: CH-3501**
No. of Credits: 04 **Learning Hours: 60 Hours**
Course Outcomes:
CO1: Apply the fundamentals of organic chemistry to describe the structure, synthesis and chemical properties of carbohydrates, amino acids, some selected heterocycles and beta dicarbonyl compounds

CO2: Remember and recognize the reagents and reaction mechanisms employed to synthesize derivatives of benzene, naphthalene and other polynuclear hydrocarbons

CO3: Apply the concepts of resonance, inductive effects etc to evaluate the acid-base properties of organic molecules

Unit 1
[Prerequisites or topics for Self Study (A):- Basic terms related to Carbohydrate chemistry] [Self-study (B) :-Basic terms related to Amino acid chemistry]

[A] Carbohydrates **(8L)[8 Marks]**

Introduction, classification of carbohydrates, osazone formation, epimerization, step up and step down reactions of monosaccharides, simple structures of glucose and fructose, Fischer's proof of configuration of D-glucose. Haworth Presentation of Glucose, Mutarotation.

[B] Amino acid **(7L)[6 Marks]**

Introduction of amino acid, Classification and properties of amino acids, Zwitter ion, Isoelectric point, Strecker's and Gabreil pthalimide synthesis of amino acids. Reactions of amino acids, Ninhydrin test.

Unit 2
[Prerequisites or topics for Self Study (A):- Fundamentals and definitions related to Electrophilic aromatic Substitution][Self-study (B):- Fundamentals and definitions related to Polynuclear hydrocarbon.]

[A] Electrophilic aromatic Substitution **(8L)[8 Marks]**

Introduction, effect of substituent groups, determination of orientation and relative reactivity, classification of substituent groups, electrophilic substitution (ES) reactions. (Nitration, Sulfonation, Halogenation, Friedel Craft alkylation and acylation), Orientation in mono and disubstituted benzene.

[B] Polynuclear hydrocarbon **(7L)[6 Marks]**

Nomenclature, structure and synthesis of Naphthalene and its derivatives. Reactions (oxidation, reduction and electrophilic substitution reaction (ESR)) of naphthalene. Preparation and reactions of anthracene and phenanthrene.

Unit 3

[Prerequisites or topics for Self Study (A):- Basic terms related to Heterocyclic Compounds] [Self-study (B):- Fundamentals and definitions related toβ -dicarbonyl compounds.]

[A] Heterocyclic Compounds (8L)[8 Marks]

Introduction, Three and four membered ring with one hetero atom: Preparation of azirine (Neber rearrangement), oxirane (oxidation of alkenes), azitidine (cyclization of γ haloalkylamines), Five membered ring with one hetero atom: Structure and preparation of Pyrrole (Knorr synthesis, Paal Knorr synthesis, Hantzsch synthesis), Furan (synthesis from carbohydrates, Paal-Knorr synthesis) and Thiophene (Paal-Knorr synthesis, Hinsberg method); Nitration, sulfonation, halogenations and Friedel Crafts reaction for pyrrole, furan and thiophene, Six membered ring with one heteroatom: Structure and preparation of pyridine (Hantzsch synthesis, cyclization of acetylene with hydrogen cyanide) and piperidine (from 1,5 diamine hydrochloride salt); Nitration, sulfonation, halogenations and Chichibabin reaction for pyridine, Five and six membered rings with two heteroatoms: Preparation of Pyrazoles(From1,2 dicarbonyl compound with hydrazine) and Pyrimidines (From 1,3 dicarbonyl compound with amidines)

[B] β-dicarbonyl compounds (7L)[6 Marks]

Introduction, synthesis of Ethyl acetoacetate (EAA) and Diethylmalonate. Acidic and ketonic hysrolysis of β-dicarbonyl compounds. Synthetic applications of β-dicarbonyl compounds. (i) Crotonic acid from EAA (ii) Valeric Acid from diethyl malonate

Unit 4 Chemical Reactivity and Molecular Structure: (Acid- Base Properties) (15L)[14 Marks]

[Prerequisites or topics for Self Study: Basic terms related to chemical reactivity and molecular structure and acid- base concepts.]

Acid-Bases, scale of acidity-basicity, Resonance effect, drawing of structures and the condition for resonance, Effect of change of hybridization on acidity and basicity, Inductive and electronic effects, steric effect and hydrogen bonding, Lewis acid and bases, Keto – enol tautomerism . Difference between resonance and tautomerism.

Reference books: CH3501: Organic Chemistry (Theory)

(1) "Organic Chemistry" by Robert Thornot Morrison and Robert Neilson Boyd,Prentice Hall of India Pvt Ltd, New Delhi, Sixth Edition, 1992.
(2) "Organic Chemistry", by Bhupinder Mehta, Manju MehtaPrentice Hall of India Pvt Ltd, New Delhi, 2005.
(3) "Organic Chemistry", by James B Hedrickson Donald J. Cram and George S. Hammond, Mc-Graw-Hill Kogakusha,Ltd., Third Edition.
(4) "Advance Organic Chemistry", by Arun Bahl, B. S. Bahl, S. Chand & Company Ltd., New Delhi, First Edition, 2003.
(5) "Organic Chemistry", by I. L. Finar, Pearson Education Pet Ltd, New Delhi, First Edition, 2002.
(6) "Organic Chemistry", by G. Marc Loudon, Oxford University Press, Forth Indian edition, 2010.
(7) "Text book of Organic Chemistry" by P.S.Kalsi, , MacMillan of India Pvt. Ltd., 1999.
(8) "Text book of Organic Chemistry"by P.L. Soni and H.M. Chawala, Sultan Chand & Sons Publication, New Delhi, 26th Edition, 1995.
(9) "Heterocyclic chemistry" by Raj K. Bansal, New Age International (P) Ltd Publishers, Fourth Edition, 2008.
(10) "Heterocyclic Chemistry in Drug Discovery", Edited by Jie Jack Li (Editor), Wiley Publishers, New Jersey 2013.

St. Xavier's College (Autonomous)
Ahmedabad-09
B.Sc. Chemistry

Semester: 3
Course Name: Organic Chemistry (Theory) **Course Code: CH-3504**
No. of Credits: 04 **Learning Hours: 60 Hours**

Course Outcomes:
CO1: Apply the fundamentals of organic chemistry to describe the structure, synthesis and chemical properties of some selected heterocycles and beta dicarbonyl compounds

CO2: Remember and recognize the reagents and reaction mechanisms employed to synthesize derivatives of benzene, naphthalene and other polynuclear hydrocarbons

CO3: Apply the concepts of resonance, inductive effects etc to evaluate the acid-base properties of organic molecules

CO4: Use the 12 principles of green chemistry to design green synthetic processes and methodologies

Unit 1 Selected Topics in Green Chemistry

[A] Fundamentals of green chemistry (7L)[07 marks]

Introduction, basic principles of green chemistry. Designing a green synthesis: Green starting materials, green reagents, green solvents and reaction conditions, green catalysts.

[B] Green reagents, catalysts, solvents and Comparative study of green processes (7L)[07Marks]

Green reagent: dimethyl carbonate, Green catalysts: Acid catalysts, phase transfer catalysts-Tetra-n-butyl, Green solvents:supercritical carbon dioxide, solid supported synthesis, Comparison of traditional processes versus green processes in the syntheses of Ibuprofen, adipic acid.

Unit 2

[Prerequisites or topics for Self Study (A):- Fundamentals and definitions related to Electrophilic aromatic Substitution][Self-study (B):- Fundamentals and definitions related to Polynuclear hydrocarbon.]

[A] Electrophilic aromatic Substitution (8L)[8 Marks]

Introduction, effect of substituent groups, determination of orientation and relative reactivity, classification of substituent groups, electrophilic substitution (ES) reactions. (Nitration, Sulfonation, Halogenation, Friedel Craft alkylation and acylation), Orientation in mono and disubstituted benzene.

[B] Polynuclear hydrocarbon (7L)[6 Marks]

Nomenclature, structure and synthesis of Naphthalene and its derivatives. Reactions (oxidation, reduction and electrophilic substitution reaction (ESR)) of naphthalene. Preparation and reactions of anthracene and phenanthrene.

Unit 3

[Prerequisites or topics for Self Study (A):- Basic terms related to Heterocyclic Compounds] [Self-study (B) :-Fundamentals and definitions related to β -dicarbonyl compounds.]

[A] Heterocyclic Compounds (8L) [8 Marks]

Introduction, Three and four membered ring with one hetero atom: Preparation of azirine (Neber rearrangement), oxirane (oxidation of alkenes), azitidine (cyclization of γ haloalkylamines), Five membered ring with one hetero atom: Structure and preparation of Pyrrole (Knorr synthesis, Paal Knorr synthesis, Hantzsch synthesis), Furan (synthesis from carbohydrates, Paal-Knorr synthesis) and Thiophene (Paal-Knorr synthesis, Hinsberg method); Nitration, sulfonation, halogenations and Friedel Crafts reaction for pyrrole, furan and thiophene, Six membered ring with one heteroatom: Structure and preparation of pyridine (Hantzsch synthesis, cyclization of acetylene with hydrogen cyanide) and piperidine (from 1,5 diamine hydrochloride salt); Nitration, sulfonation, halogenations and Chichibabin reaction for pyridine, Five and six membered rings with two heteroatoms: Preparation of Pyrazoles (From1,2 dicarbonyl compound with hydrazine) and Pyrimidines (From 1,3 dicarbonyl compound with amidines)

[B] β-dicarbonyl compounds (7L)[6 Marks]

Introduction, synthesis of Ethyl acetoacetate (EAA) and Diethylmalonate. Acidic and ketonic hysrolysis of β-dicarbonyl compounds. Synthetic applications of β-dicarbonyl compounds. (i) Crotonic acid from EAA (ii) Valeric Acid from diethyl malonate

Unit 4 Chemical Reactivity and Molecular Structure: (Acid- Base Properties)

(15L)[14 Marks]

[Prerequisites or topics for Self Study: Basic terms related to chemical reactivity and molecular structure and acid- base concepts.]

Acid-Bases, scale of acidity-basicity, Resonance effect, drawing of structures and the condition for resonance, Effect of change of hybridization on acidity and basicity, Inductive and electronic effects, steric effect and hydrogen bonding, Lewis acid and bases, Keto – enol tautomerism . Difference between resonance and tautomerism.

Reference books: CH3501: Organic Chemistry (Theory)

(1) "Organic Chemistry" by Robert Thornot Morrison and Robert Neilson Boyd,Prentice Hall of India Pvt Ltd, New Delhi, Sixth Edition, 1992.

(2) "Organic Chemistry", by Bhupinder Mehta, Manju MehtaPrentice Hall of India Pvt Ltd, New Delhi, 2005.

(3) "Organic Chemistry", by James B Hedrickson Donald J. Cram and George S. Hammond, Mc-Graw-Hill Kogakusha,Ltd., Third Edition.

(4) "Advance Organic Chemistry", by Arun Bahl, B. S. Bahl, S. Chand & Company Ltd., New Delhi, First Edition, 2003.

(5) "Organic Chemistry", by I. L. Finar, Pearson Education Pet Ltd, New Delhi, First Edition, 2002.

(6) "Organic Chemistry", by G. Marc Loudon, Oxford University Press, Forth Indian edition, 2010.

(7) "Text book of Organic Chemistry" by P.S.Kalsi, , MacMillan of India Pvt. Ltd., 1999.

(8) "Text book of Organic Chemistry"by P.L. Soni and H.M. Chawala, Sultan Chand & Sons Publication, New Delhi, 26th Edition, 1995.

(9) "Green Chemistry: An Introductory Text", by Mike Lancaster, RSC Publishing, Cambridge, UK, 2nd Edition, 2010

(10) "New trends in green chemistry" by V.K. Ahluwalia, M. Kidwai, Anamay Publishers, NewDelhi, (2004)

(11) "Green Chemistry: Environmentally Benign Reactions", Editor:V. K. Ahluwalia, University of Delhi, India Publication 2007.

(12) "Green Chemistry: Greener Alternatives to Synthetic Organic Transformations" by V.K. Ahluwalia, Narosa Publishing House,2011

(13) “Green Chemistry: Environmentally Benign Reactions” by V. K. Ahluwalia, Ane Books India, 2011
(14) “Heterocyclic chemistry” by Raj K. Bansal, New Age International (P) Ltd Publishers, Fourth Edition, 2008.
(15)“Heterocyclic Chemistry in Drug Discovery”, Edited by Jie Jack Li (Editor), Wiley Publishers, New Jersey 2013.

St. Xavier's College (Autonomous)
Ahmedabad-09
B.Sc. Chemistry

Semester: 3
Course Name: Physical Chemistry (Theory) **Course Code: CH-3502**
No. of Credits: 04 **Learning Hours: 60 Hours**

Course Outcomes:
CO1: Calculate the work function and free energy of chemical systems to determine the spontaneity of the reaction and also modify the kinetic rate equation to include temperature

CO2: Remember and recognize the definition of colloids and different types of colloidal systems as well as adsorption and different adsorption isotherms

CO3: Remember and recognize the basics of polymer chemistry as well as nuclear chemistry

CO4: Employ the fundamentals of electrochemistry to determine the outcome of simple acid-base titrations conductometrically

CO5: Comprehend the terms used in phase rule; derive the phase rule and use it to understand the behaviour of one component system as well as systems with simple congruent melting point with illustrations

Unit 1
[Prerequisites or topics for Self Study (A):Fundamentals and definitions related to Thermodynamics] [Self-study(B) :-Basic terms related to Chemical Kinetics.]

(A) Thermodynamics **(8L)[8 marks]**

Work and free energy functions; Helmoltz function and variation of free energy change with temperature and pressure; Gibbs Helmoltz equation, derivation. Numericals based on theory. Nernst theorem and consequences.

(B) Chemical Kinetics **(7L)[6 marks]**

Theories of reaction rates: Collision theory of bimolecular gaseous reactions and Activated Complex theory of bimolecular reactions; Effects of temperature on reaction rates; Derivation of Arrhenius equation.

Unit 2

[Prerequisites or topics for Self Study (A):- Basic terms related to Electrochemistry [Self-study (B):- Fundamentals and definitions related to Phase Rule]

(A) Electrochemistry **(8L)[8 marks]**

Transport number; Determination of transport numbers by moving boundary method; Conductometric titrations: Principle and advantages; Titration of Strong acid against strong base (HCl vs NaOH); Titration of Weak acid against strong base (CH_3COOH vs NaOH); Titration of Strong acid against weak base (HCl vs NH_4OH); Titration of very weak acid against strong base (H_3BO_3 vs NaOH); Titration of mixture of acids against strong base (HCl + CH_3COOH vs NaOH); Activity and activity coefficient; Ionic strength.

(B) Phase Rule **(7L)[[6 marks]**

Theoretical derivation of phase rule; One component system : water system and sulphur system; Condensed phase rule; Silver – lead (Ag-Pb) system; Zn-Cd system, Freezing mixture (salt-H_2O) system, Congruent melting point.

Unit 3

[Prerequisites or topics for Self Study (A):- Various fundamental aspects of Adsorption][Self-study (B):-Basic terms related to Colloids]

(A) Adsorption **(8L)[8 marks]**

Definition of terms, Types of adsorption (physical, chemical and their difference), Types of adsorption isotherms (5 types), Derivation of Freundlich adsorption isotherm, Derivation of Langmuir adsorption isotherm, Applications of adsorption. Factors affecting adsorption of gases on solids.

(B) Colloids **(7L)[6 marks]**

Colloidal Systems; Preparation of Colloidal Solutions; General Properties of Colloidal Systems; Properties of hydrophobic Colloidal Systems. Purification of colloidal solution.

Unit 4

*[Prerequisites or topics for Self Study (A):- Fundamentals and definitions related to***)** *Polymer Chemistry][Self-study(B) :-Various fundamental aspects of Nuclear Chemistry.]*

(A) Polymer Chemistry **(8L)[8 marks]**

Definition: Monomer, Polymer, Polymerization, Classification of Polymers; Chain polymerization: Free radical and Ionic polymerization [cationic and anionic], Co-ordination polymerization, Step polymerization: Polycondensation and Polyaddition and Ring Opening Polymerization.

(B) Nuclear Chemistry **(7L)[[6 marks]**

Particle acceleration –linear accelerator, Cyclotron, Geiger-Muller counter, proportional counter, scintillation counter.

Reference books: CH 3502: Physical Chemistry (Theory)

(1) "Principles of physical chemistry",by B.R. Puri, L.R. Sharma, Madan S. Pathania, Vishal publishing-Jalandhar, 44th Edition, 2010-2011.

(2) "Thermodynamics for chemistry"by S. Glasstone, Affiliated East-West Press Pvt. Ltd, New Delhi.

(3) "An introduction to electrochemistry", by S. Glasstone, Affiliated East-West press Pvt. Ltd, New Delhi.

(4) "Essential of physical chemistry",B.S.Bahl, G.D.Tuli and Arun Bahl, S.Chand-New Delhi, Reprint, 2006.

(5) "Polymer chemistry", by V.R. Gowarikar, New Age International(P) Ltd, Fifteen Reprint, Sep.,1999.

St. Xavier's College (Autonomous)
Ahmedabad-09
B.Sc. Chemistry

Semester: 3
Course Name: Inorganic & Physical Chemistry (Practicals **Course Code: CH-3503L**
No. of Credits: 2.5 **Learning Hours: 2X3 Hours**

Course Outcomes:
CO1: Perform semi-micro qualitative analysis of a mixture of inorganic salts (four ions) and identify the cations and anions

CO2: Apply the principles of conductometry, refractometry, chemical kinetics and viscometry to perform chemical analysis

Course Content

[A] Inorganic Mixture

Semi micro method of analysis of inorganic mixture containing four radicals (excluding phosphate, arsenite, arsenate and borate)

Minimum eight mixtures should be performed.

Mixture may be water soluble, or partly water soluble, or insoluble in water

[B] Physical Experiment

1. To determine the relative strength between HCl and H_2SO_4 by studying hydrolysis of methyl acetate.
2. To determine the temperature coefficient and energy of activation of hydrolysis of methyl acetate catalyzed by acid.
3. To study the adsorption of an organic acid by Animal Charcoal. (Acetic acid /Oxalic acid).
4. To determine of freezing point curve of the mixture of Naphthalene and Biphenyl OR o-nitro phenol and p-toluidine
5. Conductometric titration.
   (i) Strong acid Strong Base (HCl, NaOH)
   (ii) Weak acid Strong base (CH_3COOH, NaOH)
   (iii) Mixture of acids Strong base (HCl + CH_3COOH, NaOH)
6. To determine specific refraction and molar refraction of liquid A, B and its Mixture
7. To determine absolute viscosities of liquid A, B and its Mixture

Reference books: CH 3503L: Inorganic & Physical Chemistry (Practicals)

(1) "Textbook of Quantitative chemical Analysis", by Vogel's Pearson Education Ltd. Sixth

Edition, 2008.

(2) "Qualitative Inorganic Analysis", by Vogel's Pearson Education Ltd. Seventh Edition, 2009.

(3) "Advanced Inorganic Chemistry", by Gurdeep Raj, Goel Publishing House, Meerut, Volume –I, 24th Revised Edition,1998.

(4) "Advance Physical Practical Chemistry", by J .B.Yadav , Goel Publishing House, Meerut

(5) "Experiments in Physical Chemistry",by P.H.Parsania, Neminath Printers Rajkot First Edition 2004.

(6) "Practical Physical Chemistry", by A.M.. James and F.E.Prichard Longman Group Limited London Third Edition Reprinted 1979.

St. Xavier's College (Autonomous)
Ahmedabad-09
B.Sc. Chemistry

Semester: 3
Course Name: Industrial Process Chemistry (Theory) **Course Code: IC-3401**
No. of Credits: 2 **Learning Hours: 30 Hours**
Course Outcomes:
CO-1: Distinguish between unit operation and unit process and preparation of nitro and sulfo aromatic compounds.

CO-2: Design the commercial products through halogenations & hydrogenation.

CO-3: Classify the dyes on the basic of structure and method of application.

CO-4: Synthesize different dyes and their application in commercial ways.

Unit 1 Unit process I **(8L)[14 Marks]**
[Prerequisites or topics for Self Study:- Basic chemistry of types of unit process and term related to it.]
Nitration: Introduction, kinetics and mechanism, preparation of aromatic nitro compounds.
Sulfonation: Introduction, kinetics and mechanism, preparation of aromatic nitro compounds.

Unit 2 Unit process II **(7L)[14 Marks]**
[Prerequisites or topics for Self Study:- Basic chemistry and terms related to halogen compound for unit process and various catalyst.]
Halogenation: Introduction, Kinetics and mechanism of halogenation, commercial manufactures like chloromethane, chloral and Monochloro acetic acid.
Hydrogenation: Introduction, Catalyst for hydrogenation, Hydrogenation of vegetable oils, Manufacture of Methanol by hydrogenation

Unit 3 Introduction of dyes **(8L)[14 Marks]**
[Prerequisites or topics for Self Study:- Basic chemistry and terms related to dyes and pigments and their characteristics]
Introduction about dyes and pigments, Classification of dyes on the basis of structure and method of application, chemistry mode of application to fibers and classification: Azodyes, Acid dyes, Basic dyes and Mordent dyes.

Unit 4 Synthetic dyes **(7L)[14 Marks]**
[Prerequisites or topics for Self Study:- Basic chemistry and terms related to dyes and pigments.]
Synthesis of different dyes like Eriochrome Black T, Congo red, Methyl Orange, Mordent Yellow, and Anthraquinone dyes, Alizarin dyes, Reactive dye and disperse dyes in commercial ways.

Reference books: IC 3401: Industrial Process Chemistry (Theory)

(1) "Study Material in Vocational Subject of Industrial Chemistry", Compiled/edited by J.K.Bhambhani, KishinchandChellaram College, Mumbai.
(2) "Handbook of Dyes and Pigments", K.M. Smith(Volume I,II and III) 2nd Edition.
(3) "Instrumental Analysis", by William Kemp, 3rd Edition.
(4) "Fundamentals of Analytical chemistry", by Skoog, West, Holier and Crouch, 8th Edition.
(5) "Analytical Chemistry", by Gary D. Christian6th Edition

(6) “Organic Chemistry”,by I. L. Finar, Pearson Education Pvt. Ltd, Delhi, India.
(7) “Organic Chemistry – Volume I” by S.M.Mukherjee, S. P. Singh and R.P. Kapoor Kurukshetra University, Published by New Age International Ltd.
(8) “Organic Chemistry”, by Morrison and Boyd, 6th Edition, Prentice – Hall of India Pvt. Ltd
(9) “Organic Chemistry of Natural Products”, Vol. 1,byGurdeepChatwal, Himalaya Publishing House, India.
(10) “Chemical Engineering”,by J. M. Coulson and J. F. Richardson,4th Edition.
(11) “Introduction to Chemical Engineering”by “Walter L. Badger and Julius T. Bancherd McGraw – Hill Publications.
(12) “Industrial Chemistry”, by B. K. Sharma ,GOEL Publishing House, Meerut.

St. Xavier's College (Autonomous)
Ahmedabad-09
B.Sc. Chemistry

Semester: 3
Course Name: Industrial Chemistry (Practical) **Course Code: IC-3402L**
No. of Credits: 2 **Learning Hours: 3 Hours**

Course Outcomes:

CO-1: Evaluate the C.O.D & D.O value from industrial water sample.

CO-2: Preparation of different types of dyes used in industry.

Course Content

1. Determination of C.O.D. and D.O. value in the Industrial water samples.
2. To prepare 5- nitro salicylic acid from salicylic acid in maximum yields.
3. Preparation of anthraquinone from anthrecene
4. Preparation of p-nitro acetanilide from acetanilide.
5. Preparation of methyl orange.
6. Preparation of Mordent yellow.
7. Preparation of disperse dye.
8. Preparation of diazoaminobenzene from aniline.

Reference books: IC 3402L: Industrial Chemistry (Practicals)

(1) "Elementary Practical Organic Chemistry",Part I, II and III by Arthur I. Vogel.

(2) "Practical organic Chemistry",by F. G. Mann and B. C. Saunders, 4th Edition.

(3) "Instrumental Analysis", by William Kemp,3rd Edition.

St. Xavier's College (Autonomous)
Ahmedabad-09
B.Sc. Chemistry

Semester: 3
Course Name: Green Chemistry **Course Code: EG-3301**
No. of Credits: 2 **Learning Hours: 2 Hours**

Course Outcomes:
CO: Interpret and apply the 12 principles of green chemistry to design green synthetic processes using green reagents, solvents and catalysts

Unit 1 Fundamentals of green chemistry (8L)[14 marks]
[Prerequisites or topics for Self Study :- Basic terms related to Green chemistry chemistry]
Introduction, basic principles of green chemistry. Designing a green synthesis: Green starting materials, green reagents, green solvents and reaction conditions, green catalysts.

Unit 2 Reagents and catalysts in green synthesis (7L)[14 marks]
[Prerequisites or topics for Self Study: -Basic terms related to Reagents and catalysts]
(a) Green reagents: dimethyl carbonate, polymer supported reagents.
(b) Green catalysts: Acid catalysts, oxidation catalysts, basic catalysts, phase transfer catalysts-Tetra-n-butyl

Unit 3 Green solvents and selected techniques in green Chemistry (8L)[14 marks]
[Prerequisites or topics for Self Study:- Basic terms related to solvents and green solvents
(a) Water, ionic liquids, deep eutectic solvents, supercritical carbon dioxide.
(b) Solid state reactions: solid phase synthesis, solid supported synthesis.
(c) Microwave assisted synthesis: reactions in water, reactions in organic solvents, solvent free reactions.
(d) Ultrasound assisted reactions.

Unit 4 Comparative study of selected green processes (7L)[14 marks]
[Prerequisites or topics for Self Study: -Basic terms related to green processes chemistry]
Comparison of traditional processes versus green processes in the syntheses of
Ibuprofen, adipic acid, 4-aminodiphenylamine, p-bromotoluene and benzimidazole.

Reference books: EG 3301: Green chemistry (Theory)

(1) "Green Chemistry: An Introductory Text", by Mike Lancaster,RSC Publishing, Cambridge, UK,2nd Edition,2010
(2) "New trends in green chemistry" by V. K. Ahluwalia, M. Kidwai, Anamay Publishers,
(4) NewDelhi, (2004)
(3) *"Green Chemistry: Environmentally Benign Reactions"*, Editor:V. K. Ahluwalia,
(5) University of Delhi, India Publication 2007.
(4) "Green Chemistry: Greener Alternatives to Synthetic Organic Transformations" by V.K.
(6) Ahluwalia, Narosa Publishing House,2011
(5) "Green Chemistry: Environmentally Benign Reactions" by V. K. Ahluwalia, Ane Books India, 2011

St. Xavier's College (Autonomous)
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B.Sc. Chemistry

Semester: 4
Course Name: Inorganic Chemistry (Theory) **Course Code: CH-4501**
No. of Credits: 4 **Learning Hours: 60 Hours**

Course Outcomes:
CO1: Apply the postulates of quantum mechanics to solve the Schrodinger wave equation for simple chemical systems

CO2: Use the bonding theories like CFT and MOT to understand the chemical properties and structure of simple molecules, co-ordination compounds and organometallic compounds

CO3: Employ the basics of organometallic chemistry to infer the stability and catalytical reactions of organometallic complexes

Unit 1 Wave Mechanics **(15L)[14 marks]**
[Prerequisites or topics for Self Study: Various fundamental aspects and definitions related Wave–Mechanics]

Basic postulates of quantum mechanics (Postulates 1,2,3 and 4); Setting up of operators: commutator; Particle in a box (One dimensional); Zero potential energy; Characteristics of the wave functions; Electron in a ring.

Unit 2 Coordination Compounds **(15L)[14 marks]**
[Prerequisites or topics for Self Study (A):- Basic terms related to Crystal Field Theory] [Self-study (B):- Fundamentals and definitions related to Coordination Chemistry]

[A] Crystal Field Theory **(8L) [8 marks]**

Crystal Field Theory, Orientation of d-orbitals and Crystal Field Splitting of Energy levels; Crystal Field Splitting in Octahedral complexes; Crystal Field Stabilization Energy (CFSE); Crystal Field Splitting in Tetrahedral Complexes; Crystal Field Splitting in Tetragonal and square Planar Complexes; Magnetic Properties of Metal Complexes and Crystal Field Theory; Factors influences the magnitude of Crystal Field Splitting; Color of Transition Metal Complexes; Crystal Field Effects on Ionic Radii; Crystal Field Effects on Lattice Energies; Jahn- Teller Effect.

[B] Coordination Chemistry **(7L) [6 marks]**

Coordination Chemistry: Lability, inertness, Stability, Instability, reaction, kinetics and mechanism, Trans effect and Influence

Unit 3 Chemical Bonding **(15L)[14 marks]**

[Prerequisites or topics for Self Study (A):- Fundamentals and definitions related to Chemical Bonding]

Introduction of AO's, MO's, Molecular orbital Theory; LCAO Molecular Orbital Theory;

Energy Level Diagram for Molecular Orbitals; Mixing of Orbitals; Filling up of Molecular Orbitals; MO diagram of Heteronuclear Diatomic molecules (HF, HCl); Molecular orbitals of Polyatomic Species (BeH_2, CO_2,NH_3)(Excluding Walsh diagram); M.O. Theory of [Co $(NH_3)_6]^{3+}$ and $[CoF_6]^{3-}$; Molecular orbital or Band Theory for metals.

Unit 4

[Prerequisites or topics for Self Study (A):- Basic terms related to Organometallic Chemistry] [Self-study (B):- Various fundamental aspects and applications of Catalysis]

[A] Organometallic Chemistry (8L)[8 marks]

Introduction, Bonding: Stable electron configurations, electron count preference, Electron counting and oxidation states.

Ligands: Carbon monoxide, Phosphines, hydrieds and dihydride complexes, n'-Alkyl, alkenyl, alkynyl, and Aryl ligands.

Types of organometallic reactions.

[B] Catalysis (7L)[6 marks]

General principle, The language of catalysis, hydrogenation of alkene. Heterogeneous catalysis: surfaces four interactions with adsorbates.

Reference books: CH 4501: Inorganic Chemistry (Theory)

(1) "Advanced Inorganic Chemistry", by Gurdeep Raj, Goel Publishing House, Meerut, Volume – I, 24th Revised Edition,1998.

(2) "Modern Inorganic Chemistry', by R.D. Madan, S. Chand & Co. Ltd., New Delhi, 2nd Edition, 2006.

(3) "Concise Inorganic Chemistry", by J.D. Lee, Wiley India Publication, 5th Edition, 1996, Reprint 2011.

(4) "Selected Topics in Inorganic Chemistry", by W.V. Malik, G.D. Tuli, R.D. Madan, S.Chand & Co. Ltd., New Delhi, 7th Edition, 2007.

(5) "Introductory Quantum Chemistry", by A.K. Chandra, Tata- McGraw Hill Pub. Co. Ltd., New Delhi, 4th Edition.

(6) "Principles of Inorganic Chemistry", by Puri, Sharma, Kalia, Milestone Publishers & Distributors, New Delhi, 3rd Edition, 2006.

(7) "Quantum chemistry", by R.K.Prasad, New Age International (P) Ltd., Publishers, 4th Edition, 2010.

(8) "Shriver & Atkins' Inorganic Chemistry", Peter Atkins, Tina Overton, Jonathan Rourke, Mark Weller, Fraser Armstrong, Oxford University Press, 2011.

(9) "Inorganic Chemistry", by Catherine E Housecroft and Alan G Sharpoe, 2nd edn.

St. Xavier's College (Autonomous)
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B.Sc. Chemistry

Semester: 4
Course Name: Analytical Chemistry (Theory) **Course Code: CH-4502**
No. of Credits: 4 **Learning Hours: 60 Hours**

Course Outcomes:
CO1: Employ the fundamentals of quantitative analysis to interpret the theory and locate the end point for various acid-base systems, determine the theoretical construction of the graph and understand its actual nature.

CO2: Apply the basics of classical analysis methods to comprehend the various aspects of gravimetric analysis

CO3: To employ the method of solvent extraction and remember its use in single and batch process, extraction of metals and also determine the separation efficiency

CO4: Remember the theory and uses of 8-Hydroxy Quinoline, Cupferron, DMG and N-benzoyl-N-phenylhydroxylamine as precipitants

Unit 1 Acid Base and Precipitation Titrations **(15L)[14 marks]**
[Prerequisites or topics for Self Study(A):Fundamentals and definitions related to qualitative and quantitative analysis e.g. Theory of acid-base titration][Self-study(B):- Basic terms related to Precipitation Titration]

[A] Theory of acid-base titration: **(8L)[[8 marks]**

Theory of acid-base titration, Ways of locating the end point of an acid-base titration, Titration of strong acid with strong base, Titration of weak acid with strong base, Titration of weak base with strong acid, Titration of weak base with weak acid, Factors determining the exact form of a pH curve.

[B] Precipitation Titration **(7L) [6 marks]**

Titration curves, Feasibility, Indicators, Mohr, Volhard and Fajans' Methods, Factors affecting solubility

Unit 2 Redox Titrations **(15L)[14 marks]**
[Prerequisites or topics for Self Study(A): [Self-study(B) :- Fundamental aspects of Redox titration]

[A] Redox titration **(7L)[7 marks]**

Theory of redox titration, study of redox titration by electrochemical potential method, Ways of locating the end point for redox titration

[B] Redox titration (7L)[7Marks]

Titration involving Iodine: iodimetry and iodometry, Titration with reducing agents and oxidising agents, metallic reductors.

Unit 3 Gravimetric analysis and Organic reagents **(15L)[14 marks]**
[Prerequisites or topics for Self Study (A):- Fundamentals and definitions related to gravimetric analysis] Self Study (B):- Fundamental aspects of Organic reagents used in quantitative Analysis]

[A] Gravimetric Analysis (8L) [8 Marks]

Introduction, Precipitation, Digestion, Filtration, Washing of the precipitate, Drying and/or incineration of the precipitate, Weighing, Gravimetric factors, Specific and selective precipitation, Organic precipitants, Masking or sequestering agent, Problems involved in precipitation gravimetry.

[B] Organic reagents used in quantitative Analysis (7L)[6Marks]

Separation of methods with 8-Hydroxy Quinoline, Cupferron , DMG and *N*-benzoyl-*N*-phenylhydroxylamine.

Unit 4 Solvent Extraction and Complexometric Titration (15L)[14 marks]

[Prerequisites or topics for Self Study (A):Fundamentals and definitions related to Solvent Extraction Separation][Self-study (B):- Fundamentals and definitions related to Complexometric titrations]

[A] Solvent Extraction Separation (8L) [8 Marks]

Principles of solvent extraction, choice of solvent, distribution coefficient, distribution ratio, percentage, (%) extraction. The extraction process, solvent extraction of metals, selective extraction and separationefficiency.

[B] Complexometric Titration (7L) [6 Marks]

Theory of complexometric titration involving EDTA, Study of EDTA complex formation taking disodium salt of EDTA and effect of pH, Ways of locating the end point, Estimation of calcium and magnesium by complexometric titration by EDTA.

Reference books: CH 4502: Analytical Chemistry (Theory)

(1) "Analytical Chemistry", by Dhruba Charan Dash, PHI Learning Pvt. Ltd., New Delhi, 2011.

(2) "Quantitative Analysis", by R.A.Day, A.L.Underwood, Prentice-Hall of India Pvt.Ltd., New Delhi, 2004. (Sixth edition)

(3) "Analytical Chemistry", by Gary D. Christian, John Wiely & Sons, INC, New York, 1994. (Fifth edition)

(4) "Analytical Chemistry An Introduction", by Douglas A. Skoog, Donald M. West, F.James Holler, Saunders College Publishing, Harcourt Brace College Publishers, Philadelphia, 1994. 6th edn.

(5) "A Textbook of Analytical Chemistry",by Y.Anjaneyulu, K.Chandrasekhar, Valli Manickam, Pharma Book Syndicate, Hyderabad, India, 2006.

(6) "Instrumental Methods of analysis" by H.H . Willard, L.L. Mirrit, J.A. Dean, CBS Publications

(7) **"**Solvent extraction in Analytical Chemistry"by G.H. Morrison, F. Frieiser, John Wiley & Sons, NY.

(8) "Quantitative Chemical Analysis" by Daniel C. Harris, W H Freeman, New York.

(9) "Ion exchange and solvent extraction of metal compounds' by Y. Macros, A.S.Kertes, Wiley, Interscience.

St. Xavier's College (Autonomous)
Ahmedabad-09
B.Sc. Chemistry

Semester: 4
Course Name: Organic and Analytical Chemistry (Practicals) **Course Code: CH-4503L**
No. of Credits: 2.5 **Learning Hours: 2X3 Hours**

Course Outcomes:
CO1: Apply the principles of organic separation and functional group reactivity to identify qualitatively the given multi-functional organic compound

CO2: Use the basic principles of classical analytical techniques to determine an inorganic or organic analyte gravimetrically or volumetrically

[A] Organic Spotting and Estimation

Organic spotting minimum eight compounds (5 solids and 3 liquids)

Acids: Salicylic acid, Cinnamic acid, Anthranilic acid, Sulfanilic acid

Phenols: m-Nitrophenol, p-Nitrophenol, α- Naphthol ,β-Naphthol

Bases: m and p – Nitroanilines, p-Toludine

Neutral : Solids:- Acetanilide, Glucose
Liquids:- Methanol Acetophenone, Carbon tetrachloride (CCl_4), Methylacetate

Estimations: (1) Glucose
(2) Acetamide
(3) Phenol/Aniline

[B] Volumetric and Gravimetric Analysis Volumetric

Analysis :

(a) Nitrite by back titration.
(b) Determination of the available cholrine in Hypochorates
(b) Estimation of Ni by using EDTA , $MgCl_2$ (Back Titration)

Gravimetric Analysis :

(a) Fe as Fe_2O_3
(b) Ba as $BaSO_4$
(c) Al as Al_2O_3

Reference books: CH 4503L: Organic and Analytical Chemistry (Practicals)
(1) "Elementary Practical Organic Chemistry Part-II, Qualitative Organic Analysis", by I Vogel,

CBS Publishers & Distributers, New Delhi, Second Edition, 2004.

(2) "Elementary Practical Organic Chemistry Part III Quantitative Organic Analysis", by I Vogel, CBS Publishers & Distributers, New Delhi, Second Edition, 2004.

(3) "Comprehensive Practical Organic Chemistry – Qualitative Analysis", by V.K. Ahluwalia, Sunita Dhingra, University Press (India) Private Limited, Hyderabad, First Indian Edition, 2010.

(4) "Organic Analytical Chemistry theory and Practice", by Mohan Jag, Narosa Publication, New Delhi, 2003.

(5) "Advanced Practical Organic Chemistry",by J Leonard, B Lygo, G Procter, Stanley Thornes (Publishers) Ltd., First Indian Edition, 2004.

(6) "Analytical Chemistry : Practice", by John H. Kennedy, Saunders College Publishing, New York, Second Edition, 1990.

(7) "Quantitative Analysis", by R.A.Day, A.L.Underwood, Prentice-Hall of India Pvt.Ltd., New Delhi, Sixth Edition, 2004.

(8) "Analytical Chemistry", byGary D. Christian, John Wiely & Sons, INC, New York, Fifth Edition, 1994.

St. Xavier's College (Autonomous)
Ahmedabad-09
B.Sc. Chemistry

Semester: 4
Course Name: Applied Industrial Chemistry (Theory) **Course Code: IC-4401**
No. of Credits: 2 **Learning Hours: 3 Hours**

Course Outcomes:
CO-1: To prepare commercial products through alkylation, amminolysis and hydrolysis.
CO-2: Interpret large range of engineering material of increasing importance in industrial application as polymer.
CO-3: To analyze and formulate the chemicals and natural materials used in cosmetics.
CO-4: To develop a creative and marketing skill through fundamentals of entrepreneurship.

Unit1 Unit Process III **(8L)[14 Marks]**
[Prerequisites or topics for Self Study: - Basic chemistry and terms related to alkyl group or aralkylradical for unit process and about aminating agents]

(a) Alkylation: Introduction, Types of alkylation, alkylating agents, Thermodynamics andMechanism of Alkylation, Manufacture of Alkyl benzenes and Phenyl ethyl alcohol.
(b) Ammination by Ammonolysis
(c) Hydrolysis

Unit 2 Polymer Science **(7L)[14 Marks]**
[Prerequisites or topics for Self Study: - Basic chemistry and terms related to polymers and types of polymers]

Introduction and Classification of Polymers, Nomenclature of Polymers, Mechanism of Free radical and ionic Polymerization, Polymer degradation, Properties and application of Synthetic polymers.

Unit 3 Cosmetic Chemistry **(8L)[14 Marks]**
[Prerequisites or topics for Self Study: - Basics of basic raw material for the production of hair and oralcareproductsand some for perfumery material]

Introduction, Raw Materials for Cosmetic chemistry, Perfumery Products, Dental products, Regulation of Cosmetic Products, Quality and Environ mental Issues by Cosmetics.

Unit 4 Entrepreneurship **(7L)[14 Marks]**
[Prerequisites or topics for Self Study:-Fundamentals of Entrepreneurship]

Creative skills, knowledge, strength or power, Investment, risk factor, economically and Financiallysound, Marketing Skill.

Reference books: IC 4401: Industrial Process Chemistry (Theory)

(1) "Polymer Science", by V.R. Gowarikar, N.V. Viswanathan, and Jaydevshreedhar,New Age International Limited Publisher.

(2) “Comprehensive Industrial Chemistry” by Dr. Prakash G. More ,PragatiPrakashan, India.
(3) “Polymer Chemistry”by Malcolm P. Stevens, 3rd Edition.
(4) “A Text Book of Polymers”volume II , by M.S. Bhatnagar, S.Chand & Company Ltd, New Delhi.
(5) “Chemistry and Technology of the Cosmetics and Toiletries Industries”, by D.F. Williams,Springer International Edition.
(6) “Entrepreneurship”by Robert D. Hisrion and Michael P. Peters, 5th Edition.
(7) “Organic Chemistry”,by I. L. Finar,Pearson Education Pvt. Ltd, Delhi, India.
(8) “Study Material in Vocational Subject of Industrial Chemistry”, complied/edited by J.K.Bhambhani,Kishinchand Chellaram College, Mumbai.
(9) “Organic Chemistry of Natural Products”,Vol. 1, by GurdeepChatwal, Himalaya Publishing House, India.
(10) “Introduction to Chemical Engineering” byWalter L. Badger and Julius T. Bancherd, McGraw - Hill Publications.
(11) “Industrial Chemistry”by B. K. Sharma,GOEL Publishing House, Meerut.

St. Xavier's College (Autonomous)
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B.Sc. Chemistry

Semester: 4
Course Name: Industrial Chemistry (Practical) **Course Code: IC-4402L**
No. of Credits: 2 **Learning Hours: 3 Hours**

Course Outcomes:
CO-1: Preparation of chemical compounds through unit process

1. To prepare P-amino diazo-benzene in maximum yields.
2. Preparation of p-amino benzoic acid from p-nitro benzoic acid.
3. Preparation of m-nitro aniline from m-dinitrobenzene.
4. Preparation of p-nitro benzoic acid from p-nitro toluene
5. Preparation of phenylazo-β-napthol from aniline
6. To analyze the % of Mg in given sample of Talcum Powder.
7. Preparation of race- acetophenone from resorcinol

Reference books: IC 4402L: Industrial Chemistry (Practicals)

(1) "Elementary Practical Organic Chemistry", Part I, II and III byArthur I. Vogel.

(2) "Practical organic Chemistry",by F. G. Mann and B. C. Saunders, 4th Edition.

(3) "Product process Design andPrinciples" by J.D.Seader, Warren D.Seider and Daniel R. Lewin.

(4) "Quantitative Chemical Analysis" , by Daniel C. Harris,7th Ed.

Semester: 4
Course Name: Soil Composition and Analysis (Theory) **Course Code: EG-4301**
No. of Credits: 2 **Learning Hours: 2 Hours**

Course Outcomes:
CO: Use the principles of qualitative and quantitative chemical analysis to determine the pH, moisture, primary nutrients, micronutrients and trace nutrients in a soil sample

Unit 1 Introduction to Soil Chemistry **(8L)[14 Marks]**

[Prerequisites or topics for Self Study: - Basic terms related to Soil Chemistry]

Importance of soil, soil formation, composition of soil, the soil profile, types of soil, micro and macro plant nutrients.

Unit 2 Analysis of Primary Soil Nutrients **(7L)[14 Marks]**

[Prerequisites or topics for Self Study: - Basic terms related to Analysis of Primary Soil Nutrients]

Soil fertility and productivity, techniques for the analysis of soil, soil reaction, determination of total nitrogen in soil, determination of phosphorus in soil, determination of potassium in soil by flame photometry.

Unit 3 Analysis of Secondary Soil Nutrients **(8L)[14 Marks]**

[Prerequisites or topics for Self Study: - Basic terms related to Analysis of Secondary Soil Nutrients]

Determination of total sulphur in soil, determination of calcium in soil determination of magnesium in soil, determination of lime and liming material in soil. Mechanical analysis of soil.

Unit 4 Analysis of Micro Soil Nutrients **(7L)[14 Marks]**

[Prerequisites or topics for Self Study: - Basic terms related to Analysis of Micro Soil Nutrients]

Determination of total manganese in soil, determination of Fe (II) and Fe (III) in soil, determination of silica in soil, determination of soluble salts in soil, determination of sodium in soil by flame photometry.

Reference books: EG 4301: Soil Composition and Analysis (Theory)

(1) "Environmental Chemistry" by H. Kaur, Pragati Prakashan, 2nd Edition.

(2) “Soils in our Environment” by Raymond W. Miller, Duane T. Gardiner, Prentice Hall, 8th Edition.
(3) “Principles of Soil Chemistry”, by Kim H. Tan, 4th Edi.CRC Press, Taylor and Francis Group, United States of America
(4) “Text book of Soil Science”, by T D Biswas, S K Mukherjee, Tata McGraw-Hill Publishing Company Ltd., New Delhi, Second edition, 2006.

St. Xavier's College (Autonomous)
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B.Sc. Chemistry

Semester: 5
Course Name: Organic chemistry (Theory) **Course Code: CH-5501**
No. of Credits: 4 **Learning Hours: 60 Hours**
Course Outcomes:

CO1: Apply the knowledge of stereochemistry to determine the configuration of molecules without a chiral carbon and to determine the stereochemical outcome of chemical reactions

CO2: Remember and decipher the mechanistic details of nucleophilic substitution reactions on aliphatic and aromatic molecules

CO3: Remember and apply inorganic reagents, important name reactions and molecular rearrangements for organic synthetic applications

CO4: Apply the fundamentals of organic chemistry to describe the structure, synthesis and chemical properties of disaccharides and biochemically important heterocycles

Unit 1 Stereo Chemistry-I **(15L)[14 marks]**

[Prerequisites or topics for Self Study :- Basic terms related to Stereo Chemistry, Understanding Stereoselectivity and Stereospecificity]

(A) Stereo Chemistry (I) **[07 Marks]**

Optical activity in the absence of chiral carbon (Biphenyls, Allenes and Spirans)

(B) Stereoselectivity and Stereospecificity **[07 Marks]**

Stereoselective and stereospecific reactions.Mechanism "Addition of halogens to alkenes". Stereochemistry of E2 reaction (syn and anti elimination).

Unit 2 Inorganic reagents, organic rearrangements and name reactions **(15L)[14 marks]**

[Prerequisites or topics for Self Study: - Basic terms related to Inorganic reagents for organic synthesis, Understanding Molecular rearrangements and Name Reactions and their importance, definitions of carbocations, carbenes and nitrenes]

(A) Inorganic reagents for organic synthesis **[07 Marks]**

Use of specific reagents and their synthetic applications with mechanism.

(i) Aluminium Isopropoxide (ii) Lithium Aluminium Hydride (iii) Adams's catalyst (PtO_2) (iv) Selenium Dioxide (v) Osmium Tetroxide (vi) Lead Tetraacetate

(B) Molecular rearrangements and Name Reactions **[07 Marks]**

Rearrangements occurring through carbocations, carbenes and nitrenes Principle, Mechanism and Synthetic applications of the reactions:

1. Wolf rearrangement (ii) Fries migration (iii) Hoffmann reaction

Oppenauer oxidation reaction (v) Diels-Alder reaction (vi) Birch Reduction

Unit 3 Nucleophilic Substitution reactions (15L)[14 marks]

[Prerequisites or topics for Self Study:-Fundamental terms and definitions related to Nucleophilic Substitution reactions]

(A) Nucleophilic Substitution at a Saturated Carbon Atom [08 Marks]

Mechanism and scope of reaction-available mechanism, Kinetic Characteristics, Scope of reaction, Stereochemistry of S_N1 and S_N2 reactions, Relative reactivity in substitution, Solvent effect, variation at carbon site, Relative leaving group activity, S_Ni (substitution nucleophilic internal) Mechanism and Neighboring group participation. Elimination Reactions, E1, E2 and E1cB mechanism, Orientation E1and E2 reactions, Elimination Vs Substitution.

(B) Nucleophilic Aromatic Substitution [06 Marks]

Nucleophilic aromatic substitution, Bimolecular displacement and its mechanism, Reactivity, Orientation, Electron withdrawal by resonance, Evidence for the two steps-mechanism, Elimination-addition mechanism-Benzyne.

Unit 4 Carbohydrate and Purine, Pyrimidines (15L)[14 marks]

[Prerequisites or topics for Self Study: - Basic terms related to Carbohydrates, Fundamental terms and definitions related to Purine, Pyrimidines]

(A) Carbohydrates [06 Marks]

Disaccharides, structure of (+) maltose, (+) cellobiose, (+) lactose and (+) sucrose.

(B) Purine and Pyrimidines [08 Marks]

(i) Purines – Synthesis of Purines, Adenine and Guanine.

(ii) Pyrimidines – Synthesis of Pyrimidine, Uracil, Thymine and Cytosine.

Reference books: CH 5501: Organic chemistry (Theory)

(1) Organic Chemistry**:** I. L. Finar, Vol-II, 5th Edition, Pearson Education Ltd.

(2) Organic Chemistry**:** Morrison & Boyd, 6th Edition, Prentice Hall of India Pvt. Ltd.

(3) Stereochemistry of carbon compounds**:** E. L. Eliel, Wiley Eastern Ltd.

(4) Stereochemistry and mechanism through solved problems**:** P. S. Kalsi, New Age International.

(5) Stereochemistry of Organic Compounds: Principles and Applications**:** D. Nasipuri; New Academic Science; 4th Revised Edition.

(6) Organic Chemistry**:** Hendrickson, Cram, Hammond, McGraw-Hill.

(7) Organic Chemistry**:** 6th Edition, John Mcmurry, Brooks Cole, International Edition.

(8) Organic Chemistry**:** T.W. Graham Solomons and Craig B. Fryhle Wiley, 8th Edition.

(9) Organic Chemistry**:** Francis A. Carey, McGraw-Hill, 7^{th} Edition.

(10) Organic Chemistry**:** Leroy G.Wade, Prentice Hall, 6^{th} Edition.

(11) Organic Chemistry**:** Jonathan Clayden, Nick Greeves, Stuart Warren and Peter Wothers. Oxford University Press, USA.

St. Xavier's College (Autonomous)
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B.Sc. Chemistry

Semester: 5
Course Name: Inorganic chemistry (Theory) **Course Code: CH-5502**
No. of Credits: 4 **Learning Hours: 60 Hours**
Course Outcomes:

CO1: Remember the basics of symmetry elements and operations as well as use them to determine the point group of molecules

CO2: Use the fundamentals of MOT and construct the MO diagram for all types of complexes as well as remember the mechanistic details of reactions of transition metal complexes

CO3: Remember the principle, instrumentation and application of Mossbauer spectroscopy

CO4: Remember the preparation, structure and properties of inorganic polymers containing boron and silicon

Unit 1 Molecular symmetry **(15L)[14 marks]**

[Prerequisites or topics for Self Study: - Basic terms related to symmetry and its importance]

Molecular symmetry,
Introduction, symmetry operations and symmetry elements: Cn, σ, Sn, i and E.

Point groups for the molecules (excluding S_{2n} and I_h)

Multiplication tables of C_{2v}, C_{2h} and C_{3v} point groups.

Application of symmetry
- Polar molecule
- Chiral molecule

Unit 2 Metal – Ligand Bonding **(15L)[14 marks]**

[Prerequisites or topics for Self Study: - Basic terms related to crystal field theory*, Fundamental terms and definitions of π- bonding and Molecular orbital theory]*

Metal-Ligand bonding

Limitations of Crystal field theory

Molecular Orbital theory

-Octahedral

1. Only sigma interaction $[Co(NH_3)_6]^{3+}$

2. Sigma & Pi-donation $[FeF_6]^{3-}$

3. Sigma & Pi-donation, Pi- acceptance

$[Fe(CN)_6]^{4-}$

-Tetrahedral

1. Sigma & Pi-donation $[Ni(Cl)_4]^{2-}$

-Square planar

Sigma & Pi-donation, Pi- acceptance

$[PtCl_4]^{2-}$

Unit 3 Reaction mechanism of transition metal complexes. (15L)[14 marks]

[Prerequisites or topics for Self Study: - Basic terms related to Reaction mechanism of transition metal complexes, Fundamental terms and definitions of VBT and CFT.]

Energy profile of a reaction

Kinetic application of VBT and CFT.

Kinetics of octahedral substitution

Acid hydrolysis

Factor affecting acid hydrolysis

Base hydrolysis, conjugate base mechanism

Substitution reaction in square planner complexes

Redox reaction:- electron transfer reaction: outer sphere and inner-sphere type reaction.

Unit 4 Inorganic polymers and Mossbauer Spectroscopy (15L)[14 marks]

[Prerequisites or topics for Self Study: -Basic terms related to Inorganic polymers, Fundamental terms and definitions related to Mossbauer Spectroscopy]

(A) Inorganic polymers [07 Marks]

Classification of inorganic polymers.

Polymers containing boron and silicon**:** methods of preparation, physical and chemical properties,

Structures and their uses.

Types of Inorganic polymers

Comparison with organic polymers

Synthesis, structural aspects and application of silicones, , Borazine, Silicates and phosphazines.

(B) Mossbauer Spectroscopy [07 Marks]

Principle and Instrumentation.

Experimental technique

Application for iron and stanus (Tin) complexes

Reference books: CH 5502: Inorganic chemistry (Theory)

(1) Concise Inorganic Chemistry**:** J.D. Lee; Wiley India, 5th Edition (1996).

(2) Shriver and Atkins' Inorganic Chemistry**:** Atkins, Overton, Rourke, Weller, Armstrong; Oxford University Press, 5th Edition (2011).

(3) Advanced Inorganic Chemistry**:**.F.A. Cotton and Wilkinson G.; John Wiley, 5th Edition (1988).

(4) Introductory Quantum Chemistry**:** A.K. Chandra; Tata- McGraw Hill, 4th Edition (1994).

(5) Quantum chemistry**:** R.K. Prasad; New Age International, 4th Edition (2010).
(6) Electron and chemical bonding**:** H. B. Grey, W.A.Benjamin. INC, New York.
(7) Inorganic chemistry**:**. James E. Huheey, 4thEdition,Wesley Publishing Company.
(8) Mechanism of Inorganic reaction**:**Basalo and Pearson, 2nd Edition, Wiley Eastern Pvt Ltd.
(9) Introduction to Advanced Inorganic chemistry, Durrant and Durrant, John Wiley.
(10) Advanced Inorganic chemistry**:** (Vol. 1) SatyaPrakash, Tuli, Basu and Madan; S. Chand
(11) Advanced Inorganic chemistry**:** Gurdeep Raj; Goel Publishing House, 23rd Edition (1998).
(12) Physical methods for chemists, 2nd edition by R S Drago.

Semester: 5
Course Name: Physical chemistry (Theory) **Course Code: CH-5503**
No. of Credits: 4 **Learning Hours: 60 Hours**

Course Outcomes:

CO1: Derive the Clausius-Clapeyron equation and apply it for various systems as well as derive equations to study the effect of temperature on equilibrium constant Van't-Hoff isochore

CO2: Remember the fundamentals of electrochemistry and apply them to comprehend the working of electrodes as well as fuels cells

CO3: Predict the reaction rates of heterogenous reactions, retarded reactions and also determine the primary and secondary salt effect on reaction rates

CO4: Remember the techniques and types of polymerization as well as determine the molecular mass based on various methods

CO4: Recognize the methods for the used for the detection of isotopes by different types of mass spectrograph. The student will also be able to remember the applications of isotopes and different tracer techniques

CO5: Remember and recognize the fundamental principles of rotational and vibrational spectra

Unit 1 Thermodynamics **(15L)[14 marks]**

[Prerequisites or topics for Self Study: - Basic Fundamental terms and definitions relayed to Thermodynamics]

Thermodynamics

Thermodynamics, Clausius - Clapeyron equation, Trouton's Rule, Craft's equation, van't Hoff's isotherm and isochore equations.

Unit 2 Electrochemistry and Fuel Cell **(15L)[14 marks]**

[Prerequisites or topics for Self Study: - Basic terms related to Electrochemistry, Fundamental terms and definitions of Fuel Cell]

(A) Electrochemistry **[8 Marks]**

Electrochemical cell and Electrolytic cell, Reversible and irreversible electrodes and cell, Poggendorff's compensation method and Weston cell, Reference electrodes (i) Saturated Calomel Electrode (ii) Standard Hydrogen Electrode (iii) Quinhydrone Electrode.

(B) Fuel Cell **[6 Marks]**

Fuel Cell – their electrochemistry, H_2 - O_2 fuel cells, methanol fuel cells, Hydrogen fuel cell, Electrodes and electrolytes used in fuel cells

Unit 3 Chemical Kinetics and Polymer Chemistry **(15L)[14 marks]**

*[Prerequisites or topics for Self Study: - Basic terms related to **Chemical Kinetics**, Fundamental terms and definitions related to polymer chemistry]*

(A) Chemical Kinetics [07 Marks]

Prediction of reaction rate, Primary and secondary salt effect, Heterogeneous reactions, Retarded reaction.

(B) Polymer Chemistry [07 Marks]

Techniques of polymerization, Co-polymers, Bio-polymers, Polymer additives, Thermodynamics of polymer solution, Molecular weight determination of polymers: Number average molecular weight, Weight average molecular weight, Viscosity and Osmotic pressure method.

Unit 4 Nuclear Chemistry and Molecular spectra (15L)[14 marks]

[Prerequisites or topics for Self Study: - Basic terms related to Nuclear Chemistry, Fundamental terms and definitions related to Molecular spectra]

(A) Nuclear Chemistry [07 Marks]

Detection of isotopes, Bainbridge's velocity focusing mass spectrograph, and Nier's double focusing mass spectroscopy, Dempster's mass spectrograph, Applications of isotopes and trace technique examples

(B) Molecular spectra [07 Marks]

Pure rotational spectra,-energy level diagram, application to determine bond distance. Pure vibrational spectra–equation for frequency of spectral lines, determination of force constant, amplitude of vibration, Morse potential and vibrational transitions, dissociation energy of a diatomic molecule. Vibrational-Rotational spectra, Equation for frequency of vibrational-rotational spectral line.

Reference books: CH 5503: Physical chemistry (Theory)

(1) Physical Chemistry**:** G. M. Barrow, 5th Edition, McGraw-Hill education, India.

(2) Advanced Physical Chemistry**:**Gurdeep Raj, 35th Edition (2009), Goel / Krshina Publishing House.

(3) Principles of Physical Chemistry**:**Puri, Sharma and Pathania, 42nd Edition, Vishal Publishing Company.

(4) Polymer Science**:**Gowariker, Viswanathan and Sreedhar, 1st Edition (2012 reprint) New Age International.

(5) Essentials of Nuclear Chemistry**:**Arnikar, 4th Edition (2012 reprint), New Age International.

(6) Physical Chemistry**:** Atkins, 9th Edition. Oxford University Press.

(7) Advanced Physical chemistry**:**Gurtu and Gurtu, 11thEdition ,PragatiPrakashan.

(8) Physical chemistry**:** Levine, 6th Edition, McGraw-Hill education, India.

St. Xavier's College (Autonomous)
Ahmedabad-09
B.Sc. Chemistry

Semester: 5
Course Name: Analytical Spectroscopic Techniques **Course Code: CH-5504**
No. of Credits: 4 **Learning Hours: 60 Hours**
Course Outcomes:
CO1: Remember the theoretical principles and instrumentation of UV, visible, IR, Raman and NMR spectroscopy and apply these to solve structural problems in chemistry

CO2: Remember the theoretical principles and instrumentation of atomic absorption spectroscopy and Flame emission spectroscopy with the interferences in the technique

Unit 1 Ultraviolet Spectroscopy **(15L)[14 marks]**
[Prerequisites or topics for Self Study: - Fundamental terms and definitions related to ultraviolet spectroscopy]

(A) Ultraviolet Spectroscopy **[08 Marks]**

Origin of UV Spectra, Principle, Electronic transition (σ-σ*, n-σ*, π-π* and n-π*), relative positions of λ max considering conjugative effect, steric effect, solvent effect, red shift

(bathochromic shift), blue shift (hypsochromic shift), hyperchromic effect, hypochromic effect (typical examples). Aromatic and Polynuclear aromatic hydrocarbons.

(B) Ultraviolet Spectroscopy (Problems) **[06 Marks]**

Problems of Dienes and enones using Woodward-Fieser rules.Problems of aromatic ketones, aldehydes and esters using empirical rules.

Unit 2 Infrared Spectroscopy and Raman Spectra **(15L)[14 marks]**
[Prerequisites or topics for Self Study: - Fundamental terms and definitions related to Infrared Raman Spectroscopy]

(A) Infrared Spectroscopy **[08 Marks]**

Introduction, principle of IR spectroscopy, instrumentation, sampling technique, selection rules, types of bonds, absorption of common functional groups. Factors affecting frequencies, applications. Application of Hooke's law, characteristic stretching frequencies of O-H, N-H, C-H, C-D, C=C, C=N, C=O functions; factors affecting stretching frequencies (H-bonding, mass effect, electronic factors, bond multiplicity, ring size).

(B) Raman Spectra **[06 Marks]**

Basic principal, Instrumentation, Application of Raman spectra, Comparison of IR and Raman spectra.

Unit 3 Nuclear Magnetic Resonance Spectroscopy (15L)[14 marks]

[Prerequisites or topics for Self Study: - Fundamental terms and definitions related to Nuclear Magnetic Resonance Spectroscopy*]*

(A) Nuclear Magnetic Resonance [07 Marks]

Principal, Magnetic and non magnetic nuclei, absorption of radio frequency. Equivalent and non equivalent protons, chemical shifts, anisotropic effect, relative strength of signals, spin-spin coupling, long range coupling, coupling constant, Deuterium labelling, applications to simple structural problems.

(B) Problems based on Spectral data [07 Marks]

Structural problems based on UV, IR and NMR

Unit 4 Visible and Atomic Spectroscopy (15L)[14 marks]

[Prerequisites or topics for Self Study: - Basic terms related to Visible Spectroscopy, Fundamental terms and definitions related to Atomic Spectroscopy]

(A) Visible Spectroscopy [06 Marks]

Introduction, Beer Lambert's law, instrumentation (light source, optical system, wavelength selector, light sensitive device), Accuracy and error of Spectrophotometry.

(B) Atomic Spectroscopy [08 Marks]

Introduction, Principle, Flame Emission Spectroscopy (FES) and Atomic adsorption Spectroscopy (AAS), Principal, comparison and applications, Burners (Total consumption burner and Premix burners), Inductively coupled plasma Emission Spectroscopy (ICPES)

Reference books: CH 5504: Analytical chemistry (Theory)

(1) Introduction to Spectroscopy**:** Donald L. Pavia, Gary M. Lampman, George S. Kriz Cengage Learning; 4th Edition.

(2) Spectrometric Identification of Organic Compounds**:** Robert M. Silverstein, Francis X. Webster, David Kiemle Wiley; 7th Edition.

(3) Infrared spectra of Complex molecules**:** J. Bellamy, John Wiley & Sons, Inc., 3rd Edition.

(4) Spectroscopic Method in Organic Chemistry**:** Dudley Williams, Ian Fleming McGraw-Hill Education; 6th Edition.

(5) Applications of spectroscopic techniques in Organic Chemistry**:** P.S. Kalsi, New Age International; 6th Edition.

(6) Elementary Organic Spectroscopy; Principles And Chemical Applications**:** Y. R. Sharma, S. Chand & Co Pvt Ltd.

(7) Fundamentals of Molecular Spectroscopy**:** C. M. Banwell and E. McCash, Tata McGraw Hill, 4th Edition.

(8) Modern Raman Spectroscopy**:** A Practical Approach; Ewen Smith, Geoffrey Dent., Wiley; 1st Edition.

Semester: 5
Course Name: Nanomaterials and Nanotechnology **Course Code: CH-5401**
No. of Credits: 2 **Learning Hours: 30 Hours**
Course Outcomes:
CO1: Remember and recognize the fundamentals of nanotechnology and nanomaterials

CO2: Remember and recognize the characterization techniques for nanomaterials

CO3: Recognize the applications of nanotechnology in various fields

Unit 1 Introduction and preparation of Nanomaterials (8L)[14 marks]
[Prerequisites or topics for Self Study: - Basic terms related to, , Fundamental terms and definitions of]

Introduction to Nanomaterials, Optical, magnetic and chemical properties of Nanomaterials, Preparation of Nanoparticles: Chemical Approaches: Chemical reduction; Sonochemical synthesis; Sol-Gel Synthesis; Self-assembly. Physical Approaches: Aerosol spray; Gas condensation; Laser vaporization and vapour deposition; Sputtering.

Unit 2 Nanostructured materials (7L)[14 marks]
[Prerequisites or topics for Self Study: - Fundamental terms and definitions related to Nanostructured materials]

Quantum dots, wells & wires; Carbon Nanotubes (CNTs): Single walled carbon nanotubes (SWNTs), Multiwalled carbon nanotubes (MWNTs), Graphenes, Fullerenes, Metal/Oxide nanoparticles (NPs), Nanorods, Nanotubes and Nanofibres, Semiconductor quantum dots, Polymer NPs.

Unit 3 Characterization techniques for Nanomaterials (8L)[14 marks]
[Prerequisites or topics for Self Study: - Basic terms related to Characterization techniques for Nanomaterials]

Characterization techniques for Nanomaterials-I [07 marks]

Particle size Analyser (Laser scattering), Optical Microscopy: Scanning Electron Microscopy (SEM), Transmission Electron Microscopy (TEM), Scanning Tunnel Microscopy (STM).

Characterization techniques for Nanomaterials-II [07 marks]

X-ray Diffraction (XRD), Auger Emission Spectroscopy, Electron Spectroscopy for Chemical analysis (ESCA)

Unit 4 Application of Nanomaterials: (7L)[14 marks]
[Prerequisites or topics for Self Study: - Basic terms related to Application of Nanomaterials and understanding the applications of Nanomaterials*]*

Applications Solar energy conversion and catalysis, Polymers with a special architecture, Liquid crystalline systems, Applications in displays and other devices, Advanced organic materials for data storage, Photonics, Chemical and biosensors, Nanomedicine and Nanobiotechnology.

Reference books: CH 5401: Nanomaterials and Nanotechnology (Theory)

(1) Introduction to Nanotechnology**:** Charles P. Poole, Jr. and Frank J. Owens; Wiley Student Edition, 2008

(2) Nanostructures and Nanomaterials: Synthesis, Properties and Applications**:** G. Cao, ICP, London, 2004.

(3) Nanobiotechnology, Concepts, Applications and perspectives**:** C. M. Niemeyer and C. A. Mirkin, WILEY-VCH, Verlag GmbH & Co, 2004.

(4) Nanotechnology - Molecularly Designed Materials**:** G. M. Chow and K. E. Gonslaves; (American chemical society)

(5) Optical Properties of semiconductor nanocrystals**:** S. P. Gaponenko, Cambridge University Press, 1980.

(6) Nanostructures &Nanomaterials: Synthesis, Properties & Applications**:** G. Cao, Imperial College Press, 2004.

(7) Nano - The essentials**:** T. Pradeep, Tata McGraw Hill, New Delhi, 2007.

(8) Nano materials**:** J. Dutta& H. Hofman.

(9) "NANOTECHLOGY-basic science and emerging technologies**:** Mick Wilson, KamaliKannagaraet.al., University of new south wales press ltd,2008.

(10) Nanotechnology**:** Mark Ratner and Daniel Ratner, Pearson Education.

(11) Nanomaterials**:** A.K. Bandyopadhyay; New Age International Publishers.

St. Xavier's College (Autonomous)
Ahmedabad-09
B.Sc. Chemistry

Semester: 5
Course Name: Inorganic, Physical, Organic & Analytical Chemistry Practicals-I **Course Code: CH-5505L**
No. of Credits: 5 **Learning Hours: 4x3 Hours**

Course Outcomes:

CO1: Perform semi-micro qualitative analysis of a mixture of inorganic salts (6 ions) and identify the cations and anions

CO2: Apply the principles of conductometry, chemical kinetics, pH metry, Potentiometry and colorimetry to perform chemical analysis

CO3: Perform single step organic synthesis using green methods

CO4: Perform the quantitative analysis of simple organic molecules and drugs by volumetric and chromatographic methods

Practical [I] (Inorganic and Physical Practicals)

[A] Inorganic Qualitative Analysis:

Inorganic Qualitative Analysis of mixture containing six radicals only.
(Minimum 08 mixtures to be done)

[B] Physical Chemistry (Kinetics, Solubility & Instruments)

(I) Kinetics and solubility:

Investigate the order of reaction in experiments no. 1, 2 and 3 by graphical method. Exp 1: Reaction between $K_2S_2O_8$ and KI ($a \neq b$)
Exp 2: Reaction between $KBrO_3$ and KI ($a = b$) Exp 3: Reaction between H_2O_2 and HI ($a \neq b$)

(II) Instruments:

Exp 1: Determine dissociation constant of monobasic acid (CH_3COOH) using pH meter. Exp 2: Determine the amount of bases in given mix ($NaOH+NH_4OH$) Conductometrically using standard solution of HCl
Exp3: Determine the amount of ferrous in the given solution of Ferrous Ammonium Sulphatepotentiometerically using standard $KMnO_4$ solution.
Exp 4: Determine the concentration of Cu^{2+} and Fe^{3+} in the given solution by Colourimetry.

Reference books: CH 5505 L: Chemistry (Practicals)

(1) Vogel's "Textbook of Quantitative Chemical Analysis"**:** Pearson Education Ltd. 6th Edition, 2008.
(2) Vogel's "Qualitative Inorganic Analysis"**:** Pearson Education Ltd. 7th Edition, 2009.

(3) Gurdeep Raj, "Advanced Practical Inorganic Chemistry"**:** Krishna Prakashan, Meerut, 21st Edition, 2009.
(4) J. B. Yadav, "Advanced Practical Physical Chemistry"**:** Krishna Prakashan, Meerut, 29th Edition, 2010.
(5) P. H. Parsania, "Experiments in Physical Chemistry"**:**Neminath Printers Rajkot 1st Edition 2004.
(6) A. M. James and F. E. Prichard, "Practical Physical Chemistry"**:** Longman Group Limited London 3rd Edition Reprinted 1979.

Practical [II] (Organic and Analytical Practicals)

[A] Organic Preparation:

(i) Nitration of Acetanilide
(ii) Acetanilide from Aniline (Green Preparation)
(iii) Benzilic Acid from Benzil (Green Preparation)
(iv) 1,5-Diphenyl-penta-1,4-diene-3-one from Benzaldehyde and Acetone(Green Preparation)
(v) Diels-Alder reaction between furan and maleic acid (Green Preparation)

[B] Analytical:

(I) Organic Estimation:

(1) Unknown Acid (e.g., Oxalic, Succinic, Citric, Tartaric, Benzoic, Phthalic and Cinnamic acid)
(2) Ketone (Acetone)
(3) Ester

(II) Chromatography [TLC]:
Analysis of the following drugs by Thin Layer Chromatography.

(i) Aspirin (ii) Paracetamol (iii) Ibuprofen

Reference books: CH 5505 L: Chemistry (Practicals)

(1) A. I. Vogel, "Elementary Practical Organic Chemistry Part-II, Qualitative Organic Analysis"**:** CBS Publishers & Distributers, New Delhi, 2nd Edition, 2004.
(2) A. I. Vogel, "Elementary Practical Organic Chemistry Part III Quantitative Organic Analysis"**:** CBS Publishers & Distributers, New Delhi, 2nd Edition, 2004.
(3) Hand book of Organic qualitative analysis by H. T. Clarke.
(4) Practical Organic Chemistry**:** F. G. Mann and B. C. Saunders. Low – priced Text Book. ELBS, Longman.
(5) V.K. Ahluwalia, SunitaDhingra, "Comprehensive Practical Organic Chemistry – Qualitative Analysis"**:** University Press (India) Private Limited, Hyderabad, 1st Indian Edition, 2010.
(6) "Advanced Practical Organic Chemistry"**:** Stanley Thornes Publishers Ltd., J Leonard, B Lygo, G Procter, 1st Indian Edition, 2004.
(7) "Quantitative Analysis"**:**R. A. Day, A. L. Underwood, Prentice-Hall of India Pvt. Ltd.,New Delhi, 6th Edition, 2004.

St. Xavier's College (Autonomous)
Ahmedabad-09
B.Sc. Chemistry

Semester: 5
Course Name: Pharmaceutical chemistry (Theory) **Course Code: IC-5401**
No. of Credits: 2 **Learning Hours: 30 Hours**

Course Outcomes:
CO-1: To recognize the basic terms related to pharmacopeia and monograph of drugs.

CO-2: Classify pharmaceutical drug as sedatives, antimicrobial, cardiovascular and vitamins.

CO-3: To formulate pharmaceutical drug and plan their routes of administration.

CO-4: Design a drug choosing its target through functional group modification

Unit 1 Pharmacopeia and monograph of drugs [14 marks]

[Prerequisites or topics for Self Study: - Basic terms related to pharmacopeia and monograph of drugs]

- **Pharmaceuticals:** Historical background and development of pharmaceutical industry in India in brief.
- **Pharmacopeias:** Development of Indian pharmacopeia and Introduction of I.P., U.S.P., and B.P
- **Monograph of drugs:** Paracetamol, Trimethoprim, Bisacodyl, Mebendazole, Sulphamethoxazole.
- **Various types of Excipients :** Coating agent, coloring agent

Unit 2 Classification of pharmaceutical drugs: [14 marks]
Raw materials, Process of manufacture, effluent handling of the following
Bulk drugs

[Prerequisites or topics for Self Study: - Basic terms related to classification of pharmaceutical drugs]
- Hypnotic and sedatives drug: General; Early hypnotics; Barbiturate derivatives; Non barbiturate compounds
- Antimicrobial drug: Mercurochrome, Isoniazid (INH), PAS
- Cardiovascular drug : Introduction, cardiovascular agent-Methyl dopa
- Vitamins: Introduction and biological activity of Vit-A, Vit- $B_{6,}$ Vit-C

Unit 3 Pharmaceutical Dosage Forms [14 marks]

[Prerequisites or topics for Self Study:-Fundamental terms and definitions pharmaceutical dosage forms]
- Pharmaceutical Formulation

- Routes of administration: Introduction, Types & Usage.
- Pharmaceutical packaging: Introduction, Packaging material, ancillary materials, Packaging machinery, Packaging evaluation.

Unit 4 Drug discovery and Design [14 marks]

[Prerequisites or topics for Self Study: - Basic terms related to Drug discovery and Design]

- Drug discovery: Choosing diseases, choosing drug target
- Drug design: Identification of the active part, Functional group Modification

Reference books: IC 5401: Pharmaceutical chemistry (Theory)

(1) A text book of pharmaceutical chemistry by H.Kaur.
(2) Pharmaceutical Dosage form & Drug delivery system by Howard c. Ansel, Nicholas G. Popovich.
(3) Medicinal chemistry by V.K.Ahluwalia
(4) Medicinal Chemistry, 2nd edition, by Ashutosh Kar.
(5) Medicinal Chemistry by Gurdeep Chatwal.

Semester: 5

Course Name: Industrial Chemistry (Practicals) **Course Code: IC-5402L**

No. of Credits: 2 **Learning Hours: 3 Hours**

Course Outcomes:

CO-1: Estimation & identification of drugs through different techniques

Laboratory Session

1. To estimate purity of Sulphamethoxazole in tablet as powder by Mohr's method.
2. To identify related substance present in Bisacodyl tablet by TLC.
3. To identify related substance present in sulfa drug tablet by TLC.
4. Preparation of paracetamol drug from p-amino phenol.
5. To determine the sulphated Ash of paracetamol tablet.
6. To carry out assay value of given sample of NH_4Cl used as mouth wash by volhard Method.
7. To determine the % of vitamin- C in given sample.
8. To carry out assay value of given sample of MnO_4 used as Germicide and Antiseptic

References Book: Industrial Chemistry (Practicals)

(1) Practical Pharmaceutical Chemistry by A.H. Beckett, J. B. Stenlake Vol-2.

St. Xavier's College (Autonomous)
Ahmedabad-09
B.Sc. Chemistry

Semester: 6
Course Name: Organic Chemistry (Theory) **Course Code: CH-6501**
No. of Credits: 4 **Learning Hours: 60 Hours**
Course Outcomes:
CO1: Predict the stereochemical outcome of a reaction with a pro-chiral centre or suggest methods to control the stereochemistry of the product formed

CO2: Determine the configuration of chiral molecules containing nitrogen, sulphur and phosphorous

CO3: Use the basics of organic reaction mechanisms to understand the classification, structure, preparation and chemical properties of some alkaloids, isoprenoids, dyes, explosives, pesticides, drugs and vitamins

Unit 1 Stereo Chemistry (II) **(15L)[14 marks]**
[Prerequisites or topics for Self Study: - Fundamental terms and definitions related to Concept of prostereo isomerism and chiral synthesis and terns related to Stereo chemistry of compounds other than Carbon]

(A) Stereo Chemistry (II) **[08 Marks]**

Concept of prostereo isomerism and chiral synthesis (Asymmetric Induction), Cram's rule, Prelog's generalization, Prelog's rule and assignment of configuration.

(B) Stereochemistry of compounds other than Carbon **[06 Marks]**

Stereo chemistry of the compounds containing Nitrogen. Phosphorus and Sulphur

Unit 2 Alkaloids and Isoprenoids (Terpenoids) **(15L)[14 marks]**

[Prerequisites or topics for Self Study: -Fundamental terms and definitions of Alkaloids and Isoprenoids (Terpenoids)*]*
(A) Alkaloids **[07 Marks]**

Classification, General method of determining structure, analytical and synthetic methods, structure of Coniine, Nicotine, Atropine and Papaverine.

(B) Isoprenoids (Terpenoids) **[07 Marks]**

Classification, General method of determining structure, Isoprene rule, Chemistry of Citral, α-Terpineol, Camphor and their synthesis, study of reactions of β-carotene (No Synthesis).

Unit 3 Basics aspects of Dyes, Explosives and Pesticides. **(15L)[14 marks]**

[Prerequisites or topics for Self Study: - Fundamental terms and definitions related to Dyes, Explosives, and Pesticides]

(A) Synthetic Dyes **[06 Marks]**

Classification of Dyes- Anionic and Cationic dyes, Mordant and Vat dyes, Reactive and Dispersed dyes, Synthesis of Alizarin, Malachite green, Indigo, Congo red, Eosin.

(B) Explosives **[04 Marks]**

Preparation of RDX, PETN, Nitroglycerine, Tetryl.

(C) Pesticides **[04 Marks]**

Preparation of Aldrine, Malathion, Parathion, Methoxychlor.

Unit 4 Fundamentals of Drugs and Vitamins **(15L)[14 marks]**

[Prerequisites or topics for Self Study: - Basic terms related to Drugs and Vitamins]

(A) Synthetic Drugs **[08 Marks]**

General Classification, Chemotherapy, Antipyretics, Analgesics, Hypnotics, Sedatives, Anaesthetics, Antimalerials, Antiseptics, Cardiovascular drugs. (Minimum two illustrations of each, only names without structures).Methods of preparation and uses of Antipyrine, Phenacetin, n-Hexyl resorcinol, Alprazolam, Zaleplon, Benzocaine, Lidocaine, Chloroquine, Atenolol, Sulphadiazine, Trimethoprim and Tolbutamide.

(B) Vitamins **[06 Marks]**

Structure and Biochemistry of Vitamin-A (A_1) (Retinol), Vitamin-B_6 (Pyridoxine).

Reference books: CH 6501: Organic chemistry (Theory)

(1) Organic Chemistry**:** I. L. Finar, Vol-II, 5^{th} Edition, Pearson Education Ltd.

(2) Organic Chemistry**:** Morrison & Boyd, 6^{th} Edition, Prentice Hall of India Pvt. Ltd.

(3) Stereochemistry of carbon compounds**:** E. L. Eliel, Wiley Eastern Ltd.

(4) Stereochemistry and mechanism through solved problems**:** P. S. Kalsi, New Age International.

(5) Stereochemistry of Organic Compounds: Principles and Applications**:** D. Nasipuri; New Academic Science; 4^{th} Revised Edition.

(6) Organic Chemistry**:** Hendrickson, Cram, Hammond, McGraw-Hill.

(7) Organic Chemistry**:** 6^{th} Edition, John Mcmurry, Brooks Cole, International Edition.

(8) Organic Chemistry**:** T.W. Graham Solomons and Craig B. Fryhle Wiley, 8^{th} Edition.

(9) Organic Chemistry**:** Francis A. Carey, McGraw-Hill, 7^{th} Edition.

(10) Organic Chemistry**:** Leroy G.Wade, Prentice Hall, 6^{th} Edition.

(11) Organic Chemistry**:** Jonathan Clayden, Nick Greeves, Stuart Warren and Peter Wothers. Oxford University Press, USA.

St. Xavier's College (Autonomous)
Ahmedabad-09
B.Sc. Chemistry

Semester: 6
Course Name: Inorganic Chemistry (Theory) **Course Code: CH-6502**
No. of Credits: 4 **Learning Hours: 60 Hours**

Course Outcomes:
CO1: Determine and remember the terms related to energy levels of the d-orbitals in transition metals as well as the theories and rules that govern the transition of electrons in electronic spectra of transition metals

CO2: Recognize more aspects of operators in quantum chemistry as well as use the Schrodinger wave equation to determine the energy of complex systems such as the rigid rotator and the hydrogen atom

CO3: Remember the approximations methods such as variation method and apply it to determine the structure of simple linear conjugated systems and for hybridisations

CO4: Remember the structure and bonding as well as reaction mechanisms of organometallic compounds

Unit 1 Term (state) symbol and Electronic spectra of metal complexes (15L)[14 marks]
[Prerequisites or topics for Self Study: - Basic terms related to Term (state) symbol , Fundamental terms and definitions related to Electronic spectra of metal complexes]

(A) Term (state) symbol [07 Marks]

Term symbol , determination of term symbol of ground state

Russel – Saunders coupling

Calculation number of microstates

Pigeon hole diagram

P^2 and D^2 configuration

Hund's rule

Hole formation

(B) Electronic spectra of metal complexes

Selection rule:-Laporte orbital and spin selection rule,

Rrelaxation in selection rules,

Vibronic of coupling

Jahn Teller distortion.

Orgel energy level diagram of d^5 and combined diagram of $d^1 – d^9$,$d^2 – d^8$, $d^3 – d^7$, $d^4 – d^6$ and their spectra.

Unit 2 Quantum chemistry (15L)[14 marks]

[Prerequisites or topics for Self Study: - Fundamental terms and definitions related to Quantum chemistry]

Hermitian operator, Theorems concerning Hermitian operator.

Particle in a three dimensional box

The rigid Rotator and rotation spectra

The Schrodinger equation in spherical polar coordinates for hydrogen atom.

Separation of variables

Solution of Φ equations.

Unit 3 Quantum chemistry for bonding (15L)[14 marks]

[Prerequisites or topics for Self Study: - Basic terms related to, , Fundamental terms and definitions related to Quantum chemistry for bonding]

The Huckl Moleculer orbital [HMO] Theory

Variation principle

Solution of secular equation

HMO treatment to ethylene molecule, allylic cation, allylic free radical and allylic anion

Hybridization:-

Hybridization wave functions of sp, sp^2 and sp^3.

Unit 4 Metal π – complexes and Reaction of organometalic compounds. (15L)[14 marks]

[Prerequisites or topics for Self Study: - Basic terms related to Metal π – complexes and Reaction of organometalic]

(A) Metal π – complexes

Metal carbonyl structure and bonding of polynuclear metal carbonyls,

$Fe_2(CO)_9$, $Fe_3(CO)_{12}$, $Co_2(CO)_8$

$Mn_2(CO)_{10}$, $Ir_4(CO)_{12}$, $Co_4(CO)_{12}$

Vibrational spectra of metal carbonyl for bonding and structural illustration.

Structure and bonding of metal nitrosyl, metal carbonyl hydrides.

[B] Reaction of Organometalic compounds [07 marks]

Ligand substitution

Oxidative addition and Reductive elimination.

σ (Sigma) bond metathesis

1, 2-Insertion and β- hydride elimination

α, γ and δ- hydride elimination and cyclometallation.

Reference books: CH 6502: Inorganic chemistry (Theory)

(1) Concise Inorganic Chemistry**:** J.D. Lee; Wiley India, 5th Edition (1996).

(2) 'Shriver and Atkins' Inorganic Chemistry**:** Atkins, Overton, Rourke, Weller, Armstrong; Oxford University Press, 5th Edition (2011).

(3) Advanced Inorganic Chemistry**:**. F.A. Cotton and Wilkinson G.; John Wiley, 5th Edition (1988).

(4) Introductory Quantum Chemistry**:** A.K. Chandra; Tata- McGraw Hill, 4th Edition (1994).

(5) Quantum chemistry**:** R.K. Prasad; New Age International, 4th Edition (2010).

(6) Electron and chemical bonding**:** H. B. Grey, W.A.Benjamin. INC, New York.

(7) Inorganic chemistry**:**. James E. Huheey, 4thEdition,Wesley Publishing Company.

(8) Mechanism of Inorganic reaction**:**Basalo and Pearson, 2nd Edition, Wiley Eastern Pvt Ltd.

(9) Introduction to Advanced Inorganic chemistry, Durrant and Durrant, John Wiley.

(10) Advanced Inorganic chemistry**:** (Vol. 1) SatyaPrakash, Tuli, Basu and Madan; S. Chand

(11) Advanced Inorganic chemistry**:**Gurdeep Raj; Goel Publishing House, 23rd Edition (1998).

(12) Physical methods for chemists, 2nd edition by R S Drago.

St. Xavier's College (Autonomous)
Ahmedabad-09
B.Sc. Chemistry

Semester: 6
Course Name: Physical Chemistry (Theory) **Course Code: CH-6503**
No. of Credits: 4 **Learning Hours: 60 Hours**

Course Outcomes:
CO1: Remember the colligative properties, partial molal properties, the third law of thermodynamics as well as its applications

CO2: Remember and recognize the working of a concentration cell; apply electromotive force for desalination and reverse osmosis as well as prevention of corrosion

CO3: Use the basics of phase rule to describe binary systems and solve numericals based on them

CO4: To remember the basics of photochemistry, the laws and various phenomena associated as well as solve numericals based on them

Unit 1 Thermodynamics **(15L)[14 marks]**

[Prerequisites or topics for Self Study: - Basic terms related to Thermodynamics]

Colligative properties: Boiling point elevation and freezing point depression. Molal elevation constant (K_b) and Molal depression constant (K_f), Calculation of absolute value of entropy using third law of thermodynamics, Law of mass action using chemical potential, Partial molar quantity.

Unit 2 Electrochemistry **(15L)[14 marks]**

[Prerequisites or topics for Self Study:-Fundamental terms and definitions related to Electrochemistry]

Concentration cell: Cell with and without-transference, Electrode concentration cell, Gas electrode concentration cell, Applications of EMF to determine K_{sp}, Valancy of ion, K_a, (hydrolysis constant) Activity and activity coefficient determination, Define liquid junction potential and how it can be avoided, Equation for liquid junction potential, Decomposition potential, Overvoltage, Tafel equation

Unit 3 Phase Rule and Osmosis **(15L)[14 marks]**

[Prerequisites or topics for Self Study: - Basic terms related to Phase Rule, Fundamental terms and definitions related to electrochemistry]

(A) Phase Rule **[07 Marks]**

Completely miscible liquid pair -ideal solution, real solutions- positive and negative deviation from Raoult's law, distillation of binary miscible solutions (zeotropes and azeotropes), fractional distillation,

Partially miscible liquid pairs- Phenol water system, Triethylamine water system and nicotine water system

Completely immiscible liquid pair- steam distillation

(B)Applications of electrochemistry [07 Marks]

Desalination and reverse osmosis, Numerical based on electrochemical synthesis and corrosion.

Unit 4 Photochemistry and Metallic Corrosion (15L)[14 marks]

[Prerequisites or topics for Self Study: - Basic terms related to **Photochemistry**, *Fundamental terms and definitions related to Metallic Corrosion]*

(A) Photochemistry [07 Marks]

Laws of Photochemistry :Grotthuss-Draper Law, Einstein Law, Quantum yield ,Reasons for high and low quantum yield, Fluorescence and Phosphorescence, Chemiluminescence, Photosensitized reactions.

(B) Metallic Corrosion [07 Marks]

Types of corrosion, Electrochemical series, Corrosion in acidic and neutral medium, Differential aeration principle, Atmospheric corrosion, Prevention of corrosion by various factor.

Reference books: CH 6503: Physical chemistry (Theory)

(1) Physical Chemistry**:** G. M. Barrow, 5th Edition, McGraw-Hill education, India.

(2) Advanced Physical Chemistry**:** Gurdeep Raj, 35th Edition (2009), Goel / Krshina Publishing House.

(3) Principles of Physical Chemistry**:**Puri, Sharma and Pathania, 42nd Edition, Vishal Publishing Company.

(4) Polymer Science**:** Gowariker, Viswanathan and Sreedhar, 1st Edition (2012 reprint) New Age International.

(5) Essentials of Nuclear Chemistry**:** Arnikar, 4th Edition (2012 reprint), New Age International.

(6) Physical Chemistry**:** Atkins, 9th Edition. Oxford University Press.

(7) Advanced Physical chemistry**:** Gurtu and Gurtu, 11thEdition ,Pragati Prakashan.

(8) Physical chemistry**:** Levine, 6th Edition, McGraw-Hill education, India.

St. Xavier's College (Autonomous)
Ahmedabad-09
B.Sc. Chemistry

Semester: 6
Course Name: Analytical Chemistry (Theory) **Course Code: CH-6504**
No. of Credits: 4 **Learning Hours: 60 Hours**

Course Outcomes:
CO1: To interpret data scientifically and employ various statistical tests for the same.

CO2 : Recognize the methods of separation like Solid Phase Extraction, solvent extraction by flow injection analysis, chromatography and specialized techniques as well as remember the instrumentation of sophisticated chromatographic techniques like HPLC, HPTLC etc

CO3: Remember and employ the principles of polarography and potentiometry for quantitative analysis

CO4: Employ the fundamentals of titrimetric analysis for titrations involving polyprotic acids and base, mixtures of acids/bases, reducing agents, oxidising agents and complexes; solve based on these principles

Unit 1 Errors and treatment and use of organic reagents in quantitative Analysis
(15L)[14 marks]

[Prerequisites or topics for Self Study: - Basic terms related to Errors and treatment of Analytical data and Fundamental terms and definitions related to Solvent Extraction Separation]

(A) Errors and treatment of Analytical data **[08 Marks]**

Significant figures, Accuracy and precision, Types of errors and minimization of errors. Ways of expressing accuracy and precision. Rejection of a result, Test of significance (Q-Test, Student t-Test and F-Test) correlation coefficient. Literature of Analytical Chemistry.

(B) Solvent Extraction Separation: **[06 Marks]**
The separation efficiency of metal chelates, Analytical separations, Multiple batch extractions, Counter current extractions ,Solid Phase extractions and Solvent extraction by Flow injection analysis.

Unit 2 Chromatographic methods and Solvent Extraction Separation (15L)[14 marks]

[Prerequisites or topics for Self Study: - Basic terms related to Chromatography , Fundamental terms and definitions related to Ion exchange chromatography, Gas Chromatography, HPLC]

(A) Chromatographic methods **[08 Marks]**

General principle, classification of chromatographic separation.Ion exchange chromatography (Ion Exchange equlibria, Types of Ion Exchange capacity, Application of Ion Exchange resins).Gas Chromatography, Instrumentation and evolution of data.High Performance Liquid Chromatography (HPLC) Principle and Instrumentation.

(B) Special Chromatographic techniques. [06 Marks]

Ion exchange chromatography (Ion Exchange equlibria, Types of Ion Exchangers and ion-exchange capacity, Application of Ion exchange chromatography). Gas Chromatography Principle and Instrumentation . High Performance Liquid Chromatography (HPLC) Principle and Instrumentation.

Unit 3 Electro analytical Techniques (15L)[14 marks]

[Prerequisites or topics for Self Study: - Basic terms related to Polarography, Fundamental terms and definitions related to Potentiometry]

(A) Polarography [07 Marks]

Introduction, Principle, electrode, Types of currents, Determination of half wave potential, Ilkovic equation, methods of determining concentration (Standard addition method and Calibration method)

(B) Potentiometry [07 Marks]

The scope of potentiometric titrations, Precipitation and neutralization titrations, Graphical method including Gran's plot for selecting end point, Differential titration, Dead stop titration, Ion selective Electrode, various types of Ion selective Electrodes and use of Calcium ion selective electrode.

Unit 4 Acid Base Titrations and Complexometric titration (15L)[14 marks]

[Prerequisites or topics for Self Study: - Basic terms related to Acid Base Titrations, Fundamental terms and definitions related to Complexometric titrations]

(A) **Acid Base Titrations [07 Marks]**

Titration of polyprotic acid and mixture of acids, titration of salts, Differential Alkali titration.

(B) **Complexometric titration [07Marks]**

EDTA titration techniques-Direct, Back, Displacement and Indirect Tititration, Masking, Demasking agent, ligand effect and Hydrolysis of EDTA complex, Auxiliary complexing agent-EDTA titration with an auxiliary complexing agent.

Reference books: CH 6504: Analytical chemistry (Theory)

(1) Analytical Chemistry**:** Gary D. Christian, 6th Edition; Wiley & Sons

(2) Fundamentals of Analytical Chemistry**:** D. A. Skoog, D. M. West and F. J. Holler, 9th Edition, Cengage Learning.

(3) Instrumental Methods of analysis**:** (CBS) H.H . Willard, L.L. Mirrit, J.A. Dean

(4) Solvent extraction in Analytical Chemistry**:** G.H. Morrison, F. Frieiser, John Wiley & Sons, NY.

(5) Instrumental Methods of Inorganic Analysis**:** A.I. Vogel, ELBS

(6) Chemical Instrumentation**:** A Systematic approach- H.A. Strobel

(7) The principals of ion-selective electrodes and membrane transport**:** W.E.Morf

(8) Principles of Instrumental Analysis**:** Douglas A. Skoog., F. James Holler, Stanley R. Crouch, Cengage Learning; 6th Edition.

(9) Quantitative Chemical Analysis**:** Daniel C. Harris, W H Freeman, New York.

(10) Ion exchange and solvent extraction of metal compounds**:** Y. Macros, A.S.Kertes, Wiley, Interscience.

St. Xavier's College (Autonomous)
Ahmedabad-09
B.Sc. Chemistry

Semester: 6
Course Name: Everyday Chemistry (Theory) **Course Code: CH-6401**
No. of Credits: 2 **Learning Hours: 30 Hours**

Course Outcomes:
CO1: Remember and recognize the classification of fertilizers as well as the preparation and properties of various fertilizers

CO2: Remember and identify the additives in food and their functions

CO3: Remember and recognize the classes of adhesives, their preparation and bonding mechanisms

CO4: Remember the chemical and physical properties of oils, fats and waxes; their extraction methods and applications

Unit 1 Fertilizers **(15L)[14 marks]**

[Prerequisites or topics for Self Study: - Basic terms related to Fertilizers]

Classification of Fertilizers, Nitrogen (Ammonia, ammonium nitrate and urea); phosphorous (phosphoric acid, DAP, rock phosphate); and potassium based (potassium nitrate and potash) fertilizers, composting, bio-fertilizer.

Unit 2 Food chemistry **(15L)[14 marks]**

[Prerequisites or topics for Self Study: - Fundamental terms and definitions related to Food chemistry]

Food additives: Enhancers, sugar substitutes, sweeteners, food colors, antioxidants, acids and bases used in food.

Food chelating agents, emulsifiers, thickening agents, gel builders, stabilizers, common food toxicants, flavors, Biomaterial: Uses of bacteria, yeasts and molds in food industry

Unit 3 Adhesives **(15L)[14 marks]**

[Prerequisites or topics for Self Study: - Basic terms related to adhesives]

Types of Bonding, Classification of adhesive, Preparation of adhesive, Starch adhesive, Protein adhesive. Synthetic resin adhesive, Rubber based adhesive, Use of Adhesive.

Unit 4 Oils, Fats, Waxes **(15L)[14 marks]**

[Prerequisites or topics for Self Study: - Fundamental terms and definitions related to Oils, Fats, Waxes]

Vegetable and animal oils and fats, extraction of vegetable oils, refining of edible oils, hydrogenation of oils, waxes and their applications.

Analysis of Oils, Fats and Wax, Ester value, acid value, Iodine Value and Saponification value.

Reference books: CH 6401: Everyday Chemistry (Theory)

(1) Industrial Chemistry by B.K.Sharma

(2) Hand book of industrial chemistry Vol I & II K. H. Davis & F.S. Berner Edited by S.C. Bhatia, CBS publishers .

(3) Polymer science, Bill meyer, F. W. Jr. John Wiely& sons

(4) Chemical engineering vol.1 &2 by Coulson and Richardson's.(6^{th} Edition)

(5) The chemistry of oils & fats,F.D.Gunstone,Blackwell Pub.

(6) Baileys Industrial oils & fats products,Vol 1-5,John Wiley & Sons

St. Xavier's College (Autonomous)
Ahmedabad-09
B.Sc. Chemistry

Semester: 6
Course Name: Inorganic, Physical, Organic & Analytical Chemistry Practicals **Course Code: CH-6505L**
No. of Credits: 5 **Learning Hours: 4X3 Hours**

Course Outcomes:
CO1: Use the principles of quantitative analysis and determine the amount of metal ions in mixtures and alloys gravimetrically as well as volumetrically

CO2: Apply the principles of conductometry, chemical kinetics, pHmetry, Potentiometry and colorimetry to perform chemical analysis

CO3: Separate a mixture of organic compounds based on their nature and identify them qualitatively

Practical [I] (Inorganic and Physical Practicals)

[A] Inorganic Quantitative Analysis:

(I)Gravimetric determination of the radicals:

(After removal of interfering radicals in mixed solution)

(a) $BaCl_2$, $FeCl_3$ and HCl (Determination of Ba as $BaSO_4$)
(b) $CuCl_2$, $MnCl_2$ and HCl (Determination of Mn as $Mn_2P_2O_7$)
(c) $CuSO_4$, $FeSO_4(NH_4)_2\ SO_4$ and H_2SO_4 (Determination of Fe as Fe_2O_3)
(d) $CuSO_4$, $Al_2\ (SO_4)_3$ and H_2SO_4 (Determination of Al as Al_2O_3)

(II) Analysis of Alloy:

(a) Brass (Cu → Volumetrically, Zn → Gravimetrically)
(b) German Silver (Cu → Volumetrically, Ni → Gravimetrically)

[B] Physical: (Kinetics and Instruments)

(I) Kinetics:

Investigate the order of reaction in the following experiments by graphical method, Exp 1: Reaction between $K_2S_2O_8$ and KI (a =b)
Exp 2: Reaction between $KBrO_3$ and KI (a≠ b) Exp 3: Reaction between H_2O_2 and HI (a = b)

(II) Instruments:

Exp 1: Titration of unknown strength of HCl with standard NaOH solution using pH meter.
Exp2 : To determine the concentration of CrO_4^{2-} and Ni^{2+} in solution by colourimetry.
Exp 3 : Titration of a mixture of HCl and CH_3COOH potentiometrically.

Exp 4 : Determination of normality and amount of given halide by conductometric titration.

Reference books: CH 6505 L: Chemistry (Practicals)

(1) Vogel's "Textbook of Quantitative Chemical Analysis"**:** Pearson Education Ltd. 6th Edition, 2008.
(2) Vogel's "Qualitative Inorganic Analysis"**:** Pearson Education Ltd. 7th Edition, 2009.
(3) Gurdeep Raj, "Advanced Practical Inorganic Chemistry"**:** Krishna Prakashan, Meerut, 21st Edition, 2009.
(4) J. B. Yadav, "Advanced Practical Physical Chemistry"**:** Krishna Prakashan, Meerut, 29th Edition, 2010.
(5) P. H. Parsania, "Experiments in Physical Chemistry"**:**Neminath Printers Rajkot 1st Edition 2004.
(6) A. M. James and F. E. Prichard, "Practical Physical Chemistry"**:** Longman Group Limited London 3rd Edition Reprinted 1979.

Practical [II] (Organic and Analytical Practicals)

[A] Organic:

Organic separation and Identification:

Separation of Binary Mixtures and Identification (Minimum 8 Mixtures)

(i) Solid + Solid (4 Mixtures)
(ii) Solid + Liquid (2 Mixtures)
(iii) Liquid + Liquid (2 Mixtures)

One Mixture from each of the following should be given Acid-Base, Acid-Phenol, Acid-Neutral, Phenol-Base, Phenol-Neutral, Base-Neutral, and Neutral-Neutral. Water soluble compounds are included.

Identification of separated organic compound must be done by physical and chemical tests, sodium fusion test, M.P / B.P., derivatives and crystallization.

[B] Analytical:

Volumetric Analysis:

(1) Estimation of Fe^{3+} by EDTA (Back Titration)
(2) Estimation of Bi^{3+} by EDTA
(3) Estimation of Chloride by silver nitrate (Mohr's Method)
(4) Estimation of Zn^{2+} and Cd^{2+} in a mixture by EDTA
(5) Estimation of Ca^{2+} and Mg^{2+} in a mixture by EDTA
(6) Determination of percentage purity of H_2O_2 solution by Iodometry method.

Reference books: CH 6505 L: Chemistry (Practicals)

(1) A. I. Vogel, "Elementary Practical Organic Chemistry Part-II, Qualitative Organic Analysis"**:** CBS Publishers & Distributers, New Delhi, 2nd Edition, 2004.
(2) A. I. Vogel, "Elementary Practical Organic Chemistry Part III Quantitative Organic Analysis"**:** CBS Publishers & Distributers, New Delhi, 2nd Edition, 2004.
(3) Hand book of Organic qualitative analysis by H. T. Clarke.

(4) Practical Organic Chemistry**:** F. G. Mann and B. C. Saunders. Low – priced Text Book. ELBS, Longman.

(5) V.K. Ahluwalia, SunitaDhingra, "Comprehensive Practical Organic Chemistry – Qualitative Analysis"**:** University Press (India) Private Limited, Hyderabad, 1st Indian Edition, 2010.

(6) "Advanced Practical Organic Chemistry"**:** Stanley Thornes Publishers Ltd., J Leonard, B Lygo, G Procter, 1st Indian Edition, 2004.

(6) "Quantitative Analysis"**:**R. A. Day, A. L. Underwood, Prentice-Hall of India Pvt. Ltd., New Delhi, 6th Edition, 2

St. Xavier's College (Autonomous)
Ahmedabad-09
B.Sc. Chemistry

Semester: 6
Course Name: Medicinal Chemistry (Theory) **Course Code: IC-6401**
No. of Credits: 2 **Learning Hours: 30 Hours**

Course Outcomes:
CO-1: Identify the fundamentals terms and definition related to pharmacodynamics and pharmacokinetics.

CO-2: Interpret pharmaceutical agent as Anesthetic, analgesic and sulfa drug.

CO-3: To describe basic concept of prodrug.

CO-4: Interpret fundamentals of combinatorial chemistry and their analysis.

Unit 1 Pharmacodynamic and Pharmacokinetics [14 Marks]

[Prerequisites or topics for Self Study:-Fundamental terms and definitions related to Pharmacodynamic and pharmacokinetics]

- Introduction
- Drug target : Protein & Enzymes as drug target
- Drug metabolism

Unit 2. Pharmacodynamic Agents [14 Marks]

[Prerequisites or topics for Self Study:-Fundamental terms and definitions related to Pharmacodynamic Agents]

- General Anesthetic: General ;Theories of anesthesia; Physical Theories; Neurophysiologic theory, Biochemical theories; Ideal anesthetic; Volatile anesthetics; Halogenated derivatives; Gaseous anesthetics; Intravenous anesthesia.

- Analgesic Drug : General, Synthetic analgesic derivatives, derivative based on Pepperdine
- Sulfonamide drug :General, Nomenclature, S.A.R., Classification of sulfonamide

- **Unit 3. Pro drug and drug delivery system [14 Marks]**

[Prerequisites or topics for Self Study:-Fundamental terms and definitions related to pro drug and drug delivery system]

- Basic concepts of prodrug
- Types of prodrug

Unit 4. Combinatorial chemistry [14 Marks]

[Prerequisites or topics for Self Study:-Fundamental terms and definitions related to combinatorial chemistry]

- Introduction
- Solution phase combinatorial chemistry
- Detection and Analysis

Reference books: IC 6401: Medicinal chemistry (Theory)

(1) An Introduction to Medicinal Chemistry by Graham L. Patrick, 2nd, Edition

(2) The organic chemistry of drug design & drug action by Richard B., Silverman, 2nd edition

(3) Text book of Organic Medicinal & Pharmaceutical Chemistry by John H. Block & John M. Beale, Jr. 11th edition.

(4) A text book of Medicinal Chemistry by P.Parimoo, CBS Publishers & Distributors.

St. Xavier's College (Autonomous)
Ahmedabad-09
B.Sc. Chemistry

Semester: 6
Course Name: Industrial Chemistry (Practical) **Course Code: IC-6402L**
No. of Credits: 2 **Learning Hours: 3 Hours**

Course Outcomes:
CO-1: Preparation and analyze the pharmaceutical drug through different technique.

CO-2: Perform the assay of pharmaceutical drug.

Laboratory Sessions

1. To Prepare Aspirin Drug from salicylic acid.
2. To determine the % of Aspirin in the given sample.
3. To estimate the amount of paracetamol on given sample by spectrophotometer.
4. To perform the Assay of ZnO by IP 95.
5. Determination of Antacid drug by titration method.
6. To carry out assay of Mebendazole drug by potentiometrically.
7. To determine the % purity of Isoniazid (INH) as antitubercolysis drug

VI. References Books: Industrial Chemistry (Practicals)

(1) Advanced practical Medicinal Chemistry by Ashutosh Kar.