Maharashtra Education Society

Abasaheb Garware College, Pune

(Autonomous)

(Affiliated to Savitribai Phule Pune University)

Three Years Degree Program in Chemistry

(Faculty of Science and Technology)

Syllabi under Autonomy

S.Y. B. Sc. (Chemistry)

Choice Based Credit System [CBCS] Syllabus

To be implemented from Academic Year 2023-2024

Structure of the course S. Y. B. Sc. Chemistry

Semester	Course Type	Course	Discipline specific Core Subjects (DSCC)	Remark	Credits	No. Of Lectures/ Practicals
III	Compulsory	USCH-231	Physical Chemistry	Theory	2	36 L
	Compulsory	USCH-232	Inorganic Chemistry	Theory	2	36 L
	Compulsory	USCHP-233	Chemistry Practical–I	Practical	2	72 L
IV	Compulsory	USCH-241	Organic Chemistry	Theory	2	36 L
	Compulsory	USCH-242	Analytical Chemistry	Theory	2	36 L
	Compulsory	USCHP-243	Chemistry Practical–II	Practical	2	72 L

***Important Notice:**

i. Each lecture (L) will be of 50 minutes.
ii. Each practical of 4 hours and 12 practical sessions per semester
iii. 12 weeks for teaching 03 weeks for evaluation of students (theory as well as practical).

Evaluation Pattern

1. Each theory and practical course carry 50 marks equivalent to 2 credits.

2. Each course will be evaluated with Continuous Assessment (CA) and

College Assessment mechanism.

3. Continuous assessment shall be of 15 marks (Internal, 30%) while End Semester Evaluation shall be of 35 marks (70%).

4. To pass each course, a student has to secure 40% mark in continuous assessment as well as End Semester assessment i.e. 6 marks in continuous assessment and 14 marks in End Semester assessment for the respective course.

5. For Continuous Assessment (internal assessment) minimum two tests per paper must beorganized, of which one must be written test of 10 marks.

6. Method of assessment for internal exams: Viva-Voce, Project, survey, field visits, tutorials, assignments, group discussion, etc. (on approval of the head of centre).

Pattern of Question Papers

Theory: Internal Examination = 15 Marks

- Time: 1 hour
- Total Marks: **15**: 10 Marks Internal examination + 5 Marks assignment
- Title of the questions:

  Q.1) Multiple Choice Questions

  Q.2) Write True or False

  Q.3) Explain the following terms

  Q.4) Answer the following
- All questions are compulsory
- Each question carries 1 mark

Theory: External Examination = 35 Marks (2 hours)

For theory courses, end-semester question papers will be set by the College and centralized assessment for theory papers done as per the rules laid down by the College. Questions will be designed to test the conceptual knowledge and understanding of the basics and advanced concepts of the subject. There will be **two sections** for each paper. Each section will be of **35 marks** and the pattern of question paper shall be:

Question 1 (10 Marks)	5 out of 7-short answer type questions of 2 marks each; precisely answerable in 2-5 sentences (such as define, short problem, draw the structure / neat labelled diagram, short reasons, characteristics, applications, etc.)
Question 2 (09 Marks)	3 out of 5 – descriptive answer type questions of 3 marks each; answerable in sufficient length with graph or diagram or flow sheet if necessary.
Question 3 (16 marks)	4 out of 6 – Critical analysis / differentiation / evaluative / summarize interpret, write notes, numerical problem type of questions of 4 marks each; answerable in 15 lines with graph or diagram if applicable.

In question paper setting weightage for each chapter will be proportional to number the theory lectures assigned to that chapter.

Practical: Internal Practical

Total Marks: **15**, 5 Marks for Test + 5 Marks for Oral + 5 Marks for Journal

Practical: External Practical Examination

Total Marks: **35**, 30 Marks for experiment + 5 Marks for Oral

Preamble:

Taking into consideration the rapid changes in science and technology and newer approaches in different areas of Chemistry and related subjects, board of studies in Chemistry with concern of teachers of Chemistry and industry has prepared the syllabus of S.Y.B.Sc. Syllabus of U.G.C. is followed as a model curriculum.

Programme objectives:

1. To understand fundamental concept of physical, organic, analytical and Inorganic chemistry.
2. To impart basic understanding of reaction mechanism through the structural compositions of organic and inorganic materials compounds.
3. To apply the practical skills and learn basics behind the experimental operations in analytical chemistry with accuracy and precision.
4. To prepare background for advanced and applied studies in chemical sciences.

Eligibility:

Passed F.Y.B.Sc. or equivalent course with Chemistry as one of the subjects.

SEMESTER- III

Course code and Title

USCH-231: Physical Chemistry (2 Credits, 36 L)

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1. Chemical Kinetics [12 L]

Introduction to Chemical Kinetics: Recapitulation, The rate of reaction: Definition, rate law, and rate constants, reaction order, and Molecularity, determination of rate law, Problems. Integrated rate laws: Zero order of reaction, first-order reaction, second-order reaction, and its Half-life of reaction, Problems., The Arrhenius equation: The temperature dependence of reaction rates, interpretation of the Arrhenius parameters, Collision theory of reaction rate, factor affecting rate of reaction, Problems., Reaction dynamics: Collision theory and Transition-state theory of bimolecular reactions, Comparison of the two theories (qualitative treatment only), Problems.

Learning Outcome:

After studying the Chemical Kinetics student will able to-

1) Define / Explain concept of kinetics, terms used, rate laws, Molecularity, order.
2) Explain factors affecting rate of reaction.
3) Explain / discuss / derive integrated rate laws, characteristics, expression for half-life and examples of zero order, first order, and second order reactions.
4) Determination of order of reaction by integrated rate equation method, graphical method, half-life method and differential method.
5) Explain / discuss the term energy of activation with the help of energy diagram.
6) Explanation for temperature coefficient and effect of temperature on rate constant k.
7) Derivation of Arrhenius equation and evaluation of energy of activation graphically.
8) Derivations of collision theory and transition state theory of bimolecular reaction and comparison.
9) Solve / discuss the problem based applying theory and equations.

2. Surface Chemistry [8 L]

Adsorption: introduction, surface growth, Physisorption and chemisorption and their characteristics, factors affecting the adsorption of gases on solids: Freundlich isotherms, Langmuir adsorption isotherms and BET isotherms (introduction), applications, and

problems., Heterogeneous Catalysis: Introduction, Mechanisms of heterogeneous catalysis- i) unimolecular reaction, ii) the Langmuir- Hinshelwood mechanism iii) the Eley- Rideal mechanism, catalytic activity at surface.

Learning Outcomes

1) Define / explain adsorption, classification of given processes into physical and chemical adsorption.
2) Discuss factors influencing adsorption, its characteristics, differentiates types as physisorption and Chemisorption
3) Classification of Adsorption Isotherms, to derive isotherms.
4) Explanation of adsorption results in the light of Langmuir adsorption isotherm, Freundlich's adsorption Isotherm and BET theory.
5) Apply adsorption process to real life problem.
6) Discuss L-H mechanism to understand surface catalyzed reaction
7) Discuss E-R mechanism to understand surface catalyzed reaction
8) Understanding volcano curve
9) Solve / discuss problems using theory.

3. Phase equilibrium **[8L]**

Introduction, definitions of phase, components and degrees of freedom of a system, Stability of phases, and criteria of phase equilibrium. Gibbs phase rule and its thermodynamic derivation, Phase diagrams of one-component systems- water, Carbon dioxide and sulfur systems, problems.

Learning Outcomes

1) Define the terms in phase equilibria such as- system, phase in system, components in system, degree of freedom, one / two component system, phase rule, etc.
2) Explain meaning and Types of equilibrium such as true or static, metastable and unstable equilibrium.
3) Discuss meaning of phase, component and degree of freedom.
4) Derive of phase rule.
5) Explain of one component system with respect to: Description of the curve, Phase rule relationship and typical features for i) Water system ii) Carbon dioxide system iii) Sulphur system

4. Ideal and Real Solutions [8L]

Introduction, chemical potential of liquids - ideal solutions, ideal dilute solutions-Raoult's and Henry's Law, liquid mixtures, phase diagram of binary systems: liquids-vapour pressure diagrams, temperature composition diagrams, liquid-liquid phase diagrams, solubility of partially miscible liquids-critical solution temperature, effect of impurity on partially miscible liquids, Problems.

Learning Outcomes

1) Define various terms, laws, differentiate ideal and no-ideal solutions.
2) Discuss / explain thermodynamic aspects of Ideal solutions-Gibbs free energy change, Volume change, Enthalpy change and entropy change of mixing of Ideal solution.
3) Differentiate between ideal and non-ideal solutions and can apply Raoult's law.
4) Interpretation of i) vapour pressure–composition diagram ii) temperature-composition diagram.
5) Explain distillation of liquid solutions from temperature – composition diagram.
6) Explain / discuss azeotropes, Lever rule, Henrys law and its application.
7) Discuss / explain solubility of partially miscible liquids- systems with upper critical. Solution temperature, lower critical solution temperature and having both UCST and LCST.
8) Explain / discuss concept of distribution of solute amongst pair of immiscible solvents.
9) Derive distribution law and its thermodynamic proof.
10) Apply solvent extraction to separate the components of from mixture interest.
11) Solve problem by applying theory.

References:

1. Atkins' Physical Chemistry by Peter Atkins, Julio de Paula, James Keeler -11th edition
2. Principles of Physical Chemistry by B.R. Puri, L.R. Sharma, M.S. Pathania
3. Essentials of Physical Chemistry by BahlTuli-Revised Multicolour Edition 2009, S. Chand and Company Ltd.
4. Barrow, G.M. Physical Chemistry Tata McGraw-Hill (2007).

5. Principles of Physical Chemistry, Fourth Edition by S.H. Marron and C. F. Pruton

6. Physical Chemistry by Thomas Engel, Philip Reid, Warren Hehre.

Course code and Title:

USCH-232: Inorganic Chemistry (2 Credits, 36 L)

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1. Chemistry of d-block elements [04]

Position in periodic table, electronic configuration, trends in properties *w.r.t* (a) Oxidation state (b) Complex formation ability (c) Magnetic properties (d) Colour(e) Catalytic activity *[Ref.-1]*

SelfLearning: Trends in properties wr.t. . (a) Size of atoms and Ions , b) Reactivity, c) Density, d) Melting &Boiling points.)

Learning Outcome:

1. To know position of d-block elements in the periodic table.
2. To know the general electronic configuration & electronic configuration of elements.
3. To know trends in periodic properties of these elements *w.r.t*. catalytic activity, oxidation state, complex formation ability, color, magnetic properties, a) Oxidation state (b) Complex formation ability (c) Magnetic properties (d) Colour (e) Catalytic activity

References:

1. Concise Inorganic Chemistry by J.D. Lee - 5th edition. Pages 859-863, 865-866,

2. Coordination Chemistry and its isomerism [10 L]

Comparative study of double salt and coordination compound, basic definitions: Coordinate bond, ligand, denticity, chelate, oxidation state. Calculation of oxidation state of centralmetal ion; Werner's theory, equilibrium constant (Ref-6: 138-140), chelate effect. (*Ref.-1*: 194-200, 222-224; *Ref-4*: 483-492)

Self-Learning: Oxidation state of central metal ion, IUPAC nomenclature

Isomerism: Introduction, Classification, polymerization isomerism, ionization isomerism, hydrates isomerism, Linkage isomerism, coordination isomerism, coordination position isomerism, geometric Isomerism, optical isomerism. (*Ref-1*: 232-236)

Learning Outcome:

1. After studying the Introduction to Coordination Compounds student will able to define different terms related to the coordination chemistry.
2. Explain Werner's theory of coordination compounds. Differentiate between primary and secondary valency. Correlate coordination number and structure of complex ion.
3. Explain different types of isomerism in coordination complexes

References

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

3. Valence Bond Theory (VBT) of Coordination complexes [6 L]

Introduction and assumptions of VBT, applications of VBT on the basis of hybridization to explain the structure and bonding in $[Ag(NH_3)_2]^+$, $[Ni(Cl_4)]^{2-}$, $[Ni(CN)_4]^{2-}$, $[Cr(H_2O_6)]^{3+}$, $[Fe(CN)_6]^{3-}$ (Inner orbital complex) and $[FeF_6]^{3-}$ (outer orbital complex). Use of observed magnetic moment in deciding the geometry in complexes with coordination number, limitations of VBT. (*Ref-2*: 592-597, *Ref-3*:350-351).

Learning Outcome:

After studying the VBT student will able to

1. Apply principles of VBT to explain bonding in coordination compound of different geometries.
2. Correlate no of unpaired electrons and orbitals used for bonding.
3. Identify / explain / discuss inner and outer orbital complexes.
4. Explain / discuss limitation of VBT.

4. Crystal Field Theory (CFT) [6 L]

Crystal field Theory (CFT): Introduction and Assumptions,

Application of CFT to

i) Octahedral complexes (splitting of 'd' orbitals in Oh ligand field, effect of weak and strong ligand fields, colour absorbed and spectrochemical series, Crystal field stabilization energy and factors affecting it, tetragonal distortion in Cu (II) complexes
ii) Tetrahedral complexes;
iii) spin only magnetic moment of Oh and Td complexes. (Ref-1:194-225).

Self-Learning: Shapes of d-orbitals

Learning outcomes:

After studying the CFT student will be able to,

1. Explain principle of CFT.
2. Apply crystal field theory to different type of complexes (Td, Oh, complexes)
3. Explain: i) strong field and weak field ligand approach in Oh complexes ii) Magnetic properties of coordination compounds on the basis of weak and strong ligand field ligand concept. iii) Origin of color of coordination complex.
4. Calculate field stabilization energy and magnetic moment for various complexes.
5. To identify Td and Oh complexes on the basis of magnetic properties / unpaired electrons.
6. Explain electrochemical series, tetragonal distortion / Jahn-Teller effect in Cu(II) Oh complexes only.

References:

1. Concise inorganic chemistry, J. D. Lee, 5th Ed (1996), Blackwell Science
2. Inorganic Chemistry, James E. House, Academic Press (Elsevier), 2008
3. Inorganic Chemistry by Miessler and Tarr, Third Ed. (2010), Pearson

5. Introduction to Molecular Orbital Method (MOT) [6 L]

Introduction and postulates of MO theory, LCAO approximation, s-s combination of orbitals, s-p combination of orbitals, p-p combination of orbitals, p-d combination of

orbitals, d-d combination of orbitals, nonbonding combination of orbitals, Rules for linear combination of atomic orbitals, example of molecular orbital treatment for homonuclear diatomic molecules: Explain following molecules with respect to MO energy level diagram, bond order and magnetism: H_2^+ molecule ion, H_2 molecule, He_2^+ molecule ion, He_2 molecule, Li_2 molecule, N_2 molecule, O_2 molecule, O_2^- and O_2^{2-} ion, F_2 molecule etc.

Self-Learning: Molecules with respect to MO energy level diagram, bond order and magnetism Li+, Be_2, Be^+, B_2, C_2 etc.

Learning Outcome**:** After studying the MOT student will able to

1. Define terms related to molecular orbital theory (AO, MO, sigma bond, pi bond, bond order, magneticmomentetc.).
2. Explain and apply LCAO principle for the formation of MOs from AOs.
3. Explain formation of different types of MOs from AOs.
4. Distinguish between atomic and molecular orbitals, bonding, anti-bonding and nonbonding molecular orbitals.
5. Draw and explain MO energy level diagrams for homo diatomic molecules. Explain bond order and magnetic property of molecule.
6. Explain formation and stability of molecule on the basis of bond order.
7. Apply MOT to explain bonding in diatomic molecules other than explained in syllabus

6. Overview of Properties and application of Nanomaterials [4 L]

Introduction, different types of properties of nanomaterials, Optical properties with examples, applications of nanomaterials.

Self-Learning: Introduction and history of nanoscience and nanotechnology (F.Y.B.Sc.)

Learning Outcome**:** After studying the NanomaterialProperties student will able to understand the properties of nano-material and their application in different fields.

1. The students are expected to understand the fundamentals, principles, and recent developments in the subject area.
2. It is expected to inspire and boost interest of the students towards chemistry as the main subject.
3. To familiarize the applications of Chemistry in day to day life.
4. To create foundation for research and development in Chemistry.

Course code and Title

USCHP-233: Chemistry Practical-I (2 Credit, 12 Practicals, 72 L)

Section A: Physical Chemistry Practicals

A. Chemical Kinetics: (Any Three)

1. To Study the Acid catalyzed hydrolysis of an ester (methyl Acetate) and determine the rate constant (k). (First order reaction)

2. To study the kinetics of saponification reaction between sodium hydroxide and ethyl acetate.

3. To compare the relative strength of HCl and H_2SO_4 or $HNO_3$by studying the kinetics of hydrolysis of methyl acetate.

4. Energy of activation of the reaction between $K_2S_2O_8$ and KI with unequal initial concentration.

5. To determine the order of the reaction with respect to $K_2S_2O_8$by fractional life method following the kinetics of per sulphate-iodide reaction.

B. Ideal and Real solutions (Any two)

1. To study the variation of mutual solubility temperature with % concentration for the phenol - water system

2. To study the effect of added electrolyte on the critical solution temperature of phenol-water system and to determine the concentration of the given solution of electrolyte.

3. To obtain the temperature-composition phase diagram for a two component liquid system with maximum (or minimum) boiling point and to determine the maximum (or minimum) boiling point and composition.

C. Adsorption (Compulsory)

1. To verify the Freundlich's and Langmuir adsorption isotherm for adsorption of acetic acid on activated charcoal.

References:

1) Systematic experimental Physical Chemistry, S. W. Rajbhoj, T. K. Chondekar, Anjali publication.
2) Practical Physical Chemistry, Vishwanathan and Raghwan , Viva book.

3) Practical Chemistry, O. P. Pandey, D. N. Bajpai Dr. S. Giri, S Chand Publication
4) Experiments in Chemistry, D. V. Jahagirdar, Himalaya Publication.
5) Systematic experimental Physical Chemistry, S. W. Rajbhoj, T. K. Chondekar, Anjali publication.

Learning Outcome:

1. Understanding the basics of chemical kinetics
2. Determination of relative strength and order of reaction
3. Understanding the basics of behaviour of ideal vs non-ideal solutions
4. Understanding the basics of Freundlich's and Langmuir's adsorption theory

Section B: Inorganic Chemistry Practicals

A. Inorganic Coordination Complex synthesis and Purity determination.
(Any Three)

1. Synthesis of tetra mine Copper (II) sulphate monohydrate complex.
2. Determination of purity of tetramine Copper (II) sulphate monohydrate complex
3. Synthesis of Tris (ethylenediamine) nickel (II) from Ni(II) salt, ethylediamine and sodium thiosulfate. Comment on color and magnetic properties of the complex
4. Determination of purity of Tris (ethylenediamine)nickel(II) complex.
5. Estimation of Fe(III) from given solution by converting it to Fe(II) using Zn metal and then by titrating with standard solution of $K_2Cr_2O_7$-A Green Approach

B. Inorganic Qualitative Analysis (Binary Mixture contain Borate) (*Any Two*)

C. Synthesis of Nanoparticles such as quantum dot and study of their optical Properties of synthesized quantum dot. (*Any One*)

1.

2.

References:

1. Iron Analysis by Redox Titration A General Chemistry Experiment, Journal of Chemical Education, Volume 65, Number 2, February 1988.183.

2. A Precise Method for Determining the CO2 Content of Carbonate Materials, Journal of Chemical Education, Vol. 75, No. 12, December 1998.
3. Vogel's Textbook Quantitative Chemical Analysis, 3rd and 6th Ed.
4. Advanced Practical Chemistry, Jagdamba Sing et al, PragatiPrakashan, Merrut.
5. Practical Chemistry, Panday, Bajpai, Giri, S.Chand and Co

Learning Outcome:

1. Understanding the basics of co-ordination compounds
2. Understanding the relationship between colour and it's hybridization, geometry.
3. Understanding the basics techniques of identification and separation of metal ions.
4. Understanding the size dependent properties on nano-material particles

Examination Pattern: At the time of examination student has to perform one experiment either from Physical or Inorganic section. 50% students must be assigned Physical chemistry and 50% Inorganic chemistry experiment.
Distribution of 35 marks: 30 marks for experimental performance and 5 mark for oral.

SEMESTER- IV

Course code and Title

USCH-241: Organic Chemistry (2 Credits, 36 L)

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1. Alkyl and Aryl Halides: [8 L]

Alkyl Halides (up to 5 Carbons): Introduction and IUPAC nomenclature, Types ofNucleophilic Substitution (SN1, SN2 and SNi) reactions. Preparation: from alkenes and alcohols. Reactions: hydrolysis, nitrite & nitro formation, nitrile &isonitrile formation. Williamson's ether synthesis: Elimination vs. substitution. Aryl Halides: Introduction and IUPAC nomenclature, Preparation: (Chloro, bromo and iodo-benzene case): from phenol, Sandmeyer and Gattermann reactions. Reactions (Chlorobenzene): Aromatic nucleophilic substitution (replacement by –OH group) and effect of nitro substituent. Benzyne Mechanism: KNH2/NH3 (or NaNH2/NH3). Reactivity and Relative strength of C-Halogen bond in alkyl, allyl, benzyl, vinyl and aryl halides

Learning Outcome

After studying the Alkyl and Aryl Halides student will able to-

1. Identify and draw the structures alkyl / aryl halides from their names or from structure name can be assigned.
2. Explain / discuss synthesis of alkyl / aryl halides.
3. Write / discuss the mechanism of Nucleophilic Substitution (SN1, SN2 and SNi) reactions.
4. Explain /Discuss important reactions of alkyl / aryl halides.
5. To correlate reagent and reactions. 6. Give synthesis of expected alkyl / aryl halides.

2. Alcohols, Phenols and Ethers (Up to 5 Carbons) [6 L]

Alcohols: Introduction and IUPAC nomenclature, Preparation: Preparation of 1^o, 2^o and 3^o alcohols: using Grignard reagent, ester hydrolysis, reduction of aldehydes, ketones, carboxylic acid and esters. Reactions: with sodium, HX (Lucas test), esterification, oxidation (with PCC, alc. $KMnO_4$, acidic dichromate, conc. HNO_3). Oppeneauer oxidation Diols: (Up to 6 Carbons) oxidation of diols. Pinacol-Pinacolone rearrangement.

Phenols (Phenol case): Introduction and IUPAC nomenclature, Preparation: Cumene hydroperoxide method, from diazonium salts. Reactions: Electrophilic substitution: Nitration, halogenation and sulphonation. Reimer-Tiemann Reaction, Gattermann Reaction, Houben– Hoesch Condensation, Schotten–Baumann Reaction. Ethers (aliphatic and aromatic): Cleavage of ethers with HI.

Learning Outcome:

After studying the Alcohols and Phenols student will able to-

1. Identify and draw the structures alcohols / phenols from their names or from structure name can be assigned.
2. Able to differentiate between alcohols and phenols
3. Explain / discuss synthesis of alcohols / phenols.
4. Write / discuss the mechanism of various reactions involved.
5. Explain /Discuss important reactions of alcohols / phenols.
6. To correlate reagent and reactions of alcohols / phenols
7. Give synthesis of expected alcohols / phenols.

3. Aldehydes and Ketones (aliphatic and aromatic) [6 L]

(Formaldehyde, acetaldehyde, acetone and benzaldehyde)

Introduction and IUPAC nomenclature, Preparation: from acid chlorides and from nitriles. Reactions – Reaction with HCN, ROH, $NaHSO_3$, NH_2-G derivatives. Iodoform test, Aldol Condensation, Cannizzaro's reaction, Wittig reaction, Benzoin condensation, Clemenson reduction and Wolff Kishner reduction. Meerwein-Pondorff-Verley reduction.

Learning Outcome:

After studying the aldehydes and ketones student will able to-

1. Identify and draw the structures aldehydes and ketones from their names or from structure name can be assigned.
2. Explain / discuss synthesis of aldehydes and ketones.
3. Write / discuss the mechanism reactions aldehydes and ketones.
4. Explain /Discuss important reactions of aldehydes and ketones.
5. To correlate reagent and reactions of aldehydes and ketones

6. Give synthesis of expected aldehydes and ketones.

7. Perform inter conversion of functional groups.

4. Carboxylic acids and their derivatives- Carboxylic acids (aliphatic and aromatic) [6 L]

Introduction and IUPAC nomenclature,Preparation: Acidic and Alkaline hydrolysis of esters. Reactions: Hell–Vohlard – ZelinskyReaction. Carboxylic acid derivatives (aliphatic): (up to 5 carbons) Preparation: Acid chlorides, Anhydrides, Esters and Amides from acids and their inter conversion. Reaction: Comparativestudy of nucleophilicity of acyl derivatives. Reformatsky Reaction, Perkin condensation.

Learning Outcome:

After studying the carboxylic acids and their derivatives student will able to-

1. Identify and draw the structures carboxylic acids and their derivatives from their names or from structure name can be assigned.

2. Explain / discuss synthesis of carboxylic acids and their derivatives.

3. Write / discuss the mechanism reactions carboxylic acids and their derivatives.

4. Explain /Discuss important reactions of carboxylic acids and their derivatives.

5. Correlate reagent and reactions of carboxylic acids and their derivatives

6. Give synthesis of expected carboxylic acids and their derivatives.

7. Perform inter conversion of functional groups.

5. Amines and Diazonium Salts: [4 L]

Amines (Aliphatic and Aromatic): Introduction and IUPAC nomenclature, Preparationfrom alkyl halides, Gabriel's Phthalimide synthesis, Hofmann Bromamide reaction.Reactions: Hofmann vs. Saytzeff elimination, Electrophilic substitution (Case Aniline): Nitration, Bromination, Sulphonation. Diazonium salts: Preparation from aromatic amines.

Learning Outcome:

After studying the amines and diazonium Salts student will able to-

1. Identify and draw the structures amines from their names or from structure name can be assigned.

2. Explain / discuss synthesis of carboxylic amines.
3. Write / discuss the mechanism reactions carboxylic amines.
4. Explain /Discuss important reactions of carboxylic amines.
5. To correlate reagent and reactions of carboxylic amines.
6. Give synthesis diazonium salt from amines and reactions of diazonium salt.
7. Perform inter conversion of functional groups.

6. Biomolecules and Functional Groups: [6 L]

Carbohydrates – Classification, General Properties, Basic reactions of aldoses and ketoses (Case – Glucose); Amino Acids – Classification of Amino acids (based on R group); Basic reactions of -COOH and -NH_2; Lipids – Only Classification

Learning Outcome:

After studying the Biomolecules and Functional Groups, student will able to-

1. Identify and draw the structures biomolecules from their names or from structure name can be assigned.
2. Explain /Discuss important reactions of biomolecules.
3. To correlate reagent and reactions of biomolecules.

References:

1) Morrison, R.T. & Boyd, R.N. Organic Chemistry, Prentice Hall of India, Sixth Edition, 2002, 283-308.
2) Jonathan Clayden, Nick Greeves, Stuart Warren, Peter Wothers Organic Chemistry Oxford University Press, USA, 2nd Ed.
3) Bahl, A. and Bahl, B.S. Advanced Organic Chemistry, S. Chand, 2010.
4) Graham Solomon, T.W., Fryhle, C.B. &Dnyder, S.A. Organic Chemistry, John Wiley and Sons (2014).
5) McMurry, J.E. Fundamentals of Organic Chemistry, 7th Ed. Cengage Learning India Edition, 2013.
6) Sykes, P. A Guidebook to Mechanism in Organic Chemistry, Orient Longman, New Delhi (1988).
7) Finar, I. L. Organic Chemistry (Vol. I and II), E.L.B.S.

Course code and Title:

USCH-242: Analytical Chemistry (2 Credits, 36 L)

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1. Neutralization titrations: [4 L]

Theory of indicators, neutralization curves for strong acid strong base, weak acid strong base, weak base strong acid. Preparation of approximate 0.1 M HCl and standardization against anhydrous sodium carbonate, determination of Na_2CO_3 content in washing soda.

2. Complexometric Titrations: [4 L]

Definition of complexing agent and complexometric titration, EDTA-as complexing agent (structure of EDTA and metal ion EDTA complex), Types of EDTA titration (direct and back titration), pH adjustment and amount of indicator in EDTA titration, metal ion indicators (general properties, solochrome black – T, Patton and Reeder's indicator only), standard EDTA solution, determination of Ca(II) and Mg(II), total hardness of water.

3. Redox Titrations: [2L]

Definition of oxidizing agent, reducing agent, redox titration, $K_2Cr_2O_7$ and $KMnO_4$ as oxidizing agents, 1,10- phenanthroline as indicator in reduction titration, diphenyl amine as oxidation indicator, $KMnO_4$ as self-indicator, Standard KMnO4 solution and standardization with sodium oxalate, Determination of H_2O_2

4. Precipitation titrations: [2 L]

precipitation reactions, determination of end point (formation of coloured ppt, formation of soluble coloured compound, adsorption indicator), standard AgNO3 soln., standardization of $AgNO_3$ soln. – potassium chromate indicator- Mohr's titration, determination of chloride and bromide, determination of iodide. Problems based on analysis.

5. Introduction to Gravimetric Analysis: [6 L]

Introduction to gravimetric analysis; Precipitation methods; The colloidal state; Supersaturation and precipitate formation; The purity of the precipitate: Co-

precipitation; Conditions of precipitation; Precipitation from homogeneous solution; Washing the precipitate; Ignition of the precipitate

6. pH metry and potentiometry: [4 L]

pH meter and electrodes used for pH measurement. Working of pH meter; Applications of pH metry, Reference electrodes used in potentiometry and indicator electrodes used in potentiometry

7. Conductometry [8 L]

Electrolytes and Non electrolytes, Strong and Weak electrolytes, Ohms Law, Resistance, volt, coulomb, ampere, mechanism of electrolytic conductance, specific resistance and specific conductance, difference between electronic and electrolytic conductance, Equivalent conductance, Construction and working of a conductivity cell, Wheatstone bridge circuit, Calculation of resistance of a solution using Wheatstone Bridge circuit, Cell constant of a conductivity cell, Specific conductance, Effect of concentration on specific conductance and equivalent conductance, Equivalent conductance at infinite dilution, Kohlrausch Law and its applications, Conductivity water, Conductometric Acid-Base titrations, Numerical Calculations based on different terms in conductometry.

8. Colorimetry [6 L]

Interaction of electromagnetic radiation with matter, Frequency, wave number and wavelength, Terms used in colorimetry; Radiant energy, radiant power, transmittance, absorbance, absorptivity, molar absorptivity, path length. Fundamental laws of photometry; Lamberts Law, Beers Law, Lambert- Beers Law, Deviations from Beers Law, Instrumentation and working of a colorimeter, Factors affecting colorimetric measurements, Applications of colorimetry. Numerical Calculations based on relation between frequency and wavelength, Lambert Beers Law, Applications of colorimetry; Calculation of unknown concentration of Fe (III) in unknown solution by calibration curve method using ammonium thiocyanate.

Course code and Title:

USCH-243: Practical Chemistry-II (2 Credits, 12 Practicals, 72 L)

Section A: Syllabus for Analytical Chemistry Practicals (Any Six Practicals)

1. Determination of sodium carbonate content of washing soda by titration with standard solution of HCl
2. Determination of molecular weight of organic acid by titration against standardized NaOH (monobasic/dibasic acid)
3. Determination of hardness of water from given sample by complexometric titration with E.D.T.A.
4. Estimation of H_2O_2 in the given sample by titration with $KMNO_4$ solution.
5. Preparation of Ni-DMG complex
6. Determination of equivalence point of acetic acid with NaOH by pH-metric titration and identification of best indicator for the titration
7. Determination of the cell constant of the given cell using 0.01M KCl solution and determination of dissociation constant of a given monobasic weak acid
8. Conductometric titration of strong acid against strong base
9. Preparation of standard solutions of $KMNO_4$/ $CuSO_4$, measurement of their absorbance values and verification of Beer's law.
10. Preparation of solution of Fe (III) and SCN^- ions in different molar proportion, measurement of their absorbance values and calculation of equilibrium constant of $[Fe(SCN)]^{2+}$

References:

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

Section B: Syllabus for Organic Chemistry Practicals (Any Six Practicals)

I] Organic Estimations (any two)

1. Determination of molecular weight: Determination of molecular weight of organicacid by titration against standardized NaOH - a) monobasic acid or b) dibasic acid
2. Estimation of amides: Determine the amount of acetamide in given solution byvolumetric method. (Standardization of acid must be performed)
3. Estimation of Ethyl benzoate: To determine the amount of ethyl benzoate in given solution volumetrically. (Standardization of acid must be performed).

II] Organic Qualitative Analysis (Two mixtures: solid-solid type)

1. Determination of type and separation of two components from given binary mixture of organic compounds containing mono-functional group (Ex. - carboxylic acid, phenols, amines, amide,nitro, etc.) and systematic identification of any one component qualitatively.

III]. Organic Preparations (Any two)

1. Preparation of benzoic acid from ethyl benzoate (Identification and confirmatory Test of – COOH group, M.P and purity by TLC)
2. Acetylation of primary amine (Green approach)
3. Base catalyzed Aldol condensation (Green approach)
4. Preparation of Quinone from hydroquinone (Confirm the conversion by absence of phenolic –OH group in product, M.P and purity by TLC)

References:

i) Vogel's textbook of practical organic chemistry

ii) Comprehensive Practical Organic Chemistry by V.K. Ahluwalia and Renu Aggarwal

Examination Pattern: At the time of examination student has to perform one experiment either from Organic or Analytical organic section. 50% students must be assigned Organic chemistry experiments and 50% Analytical chemistry experiments.

Distribution of 35 marks: 30 marks for experimental performance and 5 mark for oral.