SRI VENKATESWARA UNIVERSITY:TIRUPATI

B.Sc Honours in CHEMISTRY

III-SEMESTER

W.E.F.2024-25

Course Code 5: FUNDAMENTALS IN ORGANIC CHEMISTRY

Credits: 03

Course outcomes:

At the end of SEMESTER the student will be able to

1. Understand and explain the differential behaviour of organic compounds based on fundamental concepts learnt.
2. Formulate the mechanism of organic reactions by recalling and correlating the fundamental properties of the reactants involved.
3. Learn and identify many organic reaction mechanisms .
4. Correlate and describe the stereo-chemical properties of organic compounds and reactions.

Syllabus:

Unit1. Structural theory in Organic Chemistry *(9 h)*

Types of bond fission and organic reagents (Electrophilic, Nucleophilic, and free radical reagents). Reaction intermediates – Carbocations, carbanions & free radicals. Bond polarization: Factors influencing the polarization of covalent bonds, inductive effect - Application of inductive effect (a) Basicity of amines (b) Acidity of carboxylic acids Resonance or Mesomeric effect, application to (a) acidity of phenol, and (b) acidity of carboxylic acids. Hyper conjugation and its application to stability of carbonium ions, Free radicals and alkenes.

Unit II Saturated Hydrocarbons (Alkanes and Cycloalkanes) *9h*

General methods of preparation of alkanes- Wurtz and Wurtz Fittig reaction, Corey House synthesis, physical and chemical properties of alkanes, Conformational analysis of alkanes (Conformations, relative stability and energy diagrams of Ethane, Propane and butane).

General molecular formulae of cycloalkanes and relative stability, Baeyer strain theory, Cyclohexane conformations with energy diagram, Conformations of monosubstituted cyclohexane.

UNIT-III Unsaturated Hydrocarbons (Alkenes and Alkynes) *9h*

General methods of preparation, physical and chemical properties, Saytzeff and Hoffmann eliminations (with mechanism), Electrophilic Additions, (H_2, HX) mechanism (Markownikoff/ Anti markownikoff addition) with suitable examples-syn and anti-addition;addition of X_2, HX. Oxy mercuration de mercuration, ozonolysis, hydroxylation, Diels Alder reaction, 1,2- and1,4-addition reactions in conjugated dienes. Reactions of alkynes, acidity, electrophilic and nucleophilic additions, hydration to form carbonyl compounds, Alkylation of terminal alkynes, Oxidation with $KMnO_4$, OsO_4, Reduction and Polymerization reaction of acetylene.

UNIT-IV Benzene and its reactivity *(9h)*

Concept of aromaticity, Huckel's rule - application to Benzenoid (Benzene, Naphthalene) and

Non - Benzenoid compounds (cyclopropenylcation, cyclopentadienyl anion and tropylium cation) Structure of Benzene – Preparation
- polymerisation of acetylene and decarboxylation- Properties -mechanism of electrophilic aromatic substitution of Friedel-Craft's alkylation and acylation. halogenation and nitration,

UNIT-V Orientation of aromatic substitution(9h)

Orientation of aromatic substitution - ortho, para and meta directing groups. Ring activating and deactivating groupswith examples (Electronic interpretation of various groups like NO_2 and Phenolic). Orientation of (i) Amino, methoxy and methyl groups (ii) Carboxy, nitro, nitrile, carbonyl and sulphonic acid groups (iii) Halogens.

II. List of Reference Books

1. Morrison, R. N. & Boyd, R. N. Organic Chemistry, Dorling Kindersley (India) Pvt. Ltd. (PearsonEducation).

2. Finar, I. L. Organic Chemistry (Volume 1), Dorling Kindersley (India) Pvt. Ltd. (Pearson Education).

3. Guide book to Mechanism in Organic Chemistry by Peter Sykes 6^{th} edition,1985.

III –SEMESTER
Course Code 5: Organic Qualitative analysis
Credits: 01
Organic Qualitative analysis

Course outcomes:

At the end of the course, the student will be able to;

1. Use glassware, equipment and chemicals and follow experimental procedures in the laboratory

2. Determine melting and boiling points of organic compounds

3. Understand the application of concepts of different organic reactions studied in theory part of organic chemistry

Syllabus:

Analysis of an organic compound through systematic qualitative procedure for functional group identification including the determination of melting point and boiling point with suitable derivatives. Alcohols, Phenols, Aldehydes, Ketones, Carboxylic acids, Aromatic primary amines, amides and simple sugars.

Co-curricular activities and Assessment Methods

1. Continuous Evaluation: Monitoring the progress of student's learning

2. Class Tests, Worksheets and Quizzes

3. Presentations, Projects and Assignments and Group Discussions: Enhances critical thinking skills and personality

4. SEMESTER -End Examination: critical indicator of student's learning and teaching methods adopted by teachers throughout the SEMESTER .

Reference books:

1) Vogel A.I .Practical Organic Chemistry, Longman Group Ltd.
2) \ Bansal R.K. Laboratory Manual of Organic Chemistry, Wiley-Eastern.

3) Ahluwalia V. K. and Agarwal R. Comprehensive Practical Organic Chemistry, University press.

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III -SEMESTER

Course Code 6: ORGANIC CHEMISTRY

(Halogen and Oxygen containing organic compounds)

Credits: 03

Course outcomes:

At the end of the course, the student will be able to:

1. Understand the concept of $SN_1$and$SN_2$and SN_i mechanisms.
2. Describe the reactivity of alcohols and phenols.
3. Achieve the skills required to propose various mechanisms
4. Apply the concepts for synthesising various oxygen containing organic compounds
5. Interconvert the monosaccharides.

Syllabus:

Unit – I Halogen compounds (9 h)

Alkyl halides: Preparation of alkyl halides from i) alkanes, ii) alkenes and iii) alcohols. Properties - nucleophilic substitution reactions–$SN_1$and SN_2 and SN_i mechanisms with energy profile diagrams, Williamson's synthesis.

Aryl halides: Preparation i) from phenols ii) Sandmeyer's reaction, nucleophilic aromatic substitution (Benzyne mechanism);relative reactivity of alkyl, allyl, vinyl and benzyl, aryl halides towards nucleophilic substitution reactions.

Unit II Alcohols and Phenols (9 h)

Alcohols: Preparation of 1^0,2^0,3^0alcohols from Grignard's reagent, Bouveault–Blanc Reduction; Chemical properties – substitution of –OH by using PCl_5, $SOCl_2$ and with HX / $ZnCl_2$, Pinacol Pinacolone arrangement with mechanism, relative reactivity of 1°, 2°, 3°alcohols.

Phenols : Preparation from diazonium salt and Cumene. Reactions and mechanism–Reimer–Tiemann**,**Kolbe–Schmitt Reactions, Fries and Claisen rearrangements.

Unit III Carbonyl Compounds (9 h)

Preparation from-Acid chlorides,1,3-dithiane and nitriles; Structure and reactivity of carbonyl group, Nucleophilic addition reactions with HCN, $NaHSO_3$ and alcohols. addition-

elimination reactions with hydroxylamine, hydrazine, Oxidations and reductions (Clemmensen's, Wolf–Kishner's, with$LiAlH_4$ & $NaBH_4$).

Reaction & Mechanism- Aldol condensation, Cannizzaro reaction, Perkin reaction, Benzoin condensation, Claisen-Schmidt reaction, Haloform reaction

Unit-IV Carboxylic acid and Active methylene Compounds (9h)

Carboxylic Acids: Preparation from Grignard reagent and hydrolysis of nitriles, Reactions of monocarboxylic acids- Reactions involving -H, -OH and-COOHgroups, formation of salts, esters, acidchlorides, amides and anhydrides. Degradation of carboxylic acids by Huns-Diecker's reaction, decarboxylation by Schmidt reaction, Arndt-Eistert synthesis, halogenation by Hell- Volhard- Zelinsky reaction. Mechanisms of acidic and alkaline hydrolysis of esters, Reformatsky reactions, Curtius rearrangement.

Unit V : Carbohydrates (9 h)

Classification and their biological importance, Monosaccharides: Structural elucidation of glucose and fructose, epimers and anomers, mutarotation, determination of ring size of glucose and fructose, Haworth projections and conformational structures; Interconversions of aldoses and ketoses; Killiani-Fischer synthesis and Ruff degradation;

II. List of Reference Books

1) 1.Morrison, R. N. & Boyd, R. N. Organic Chemistry, Dorling Kindersley (India) Pvt. Ltd. (PearsonEducation).

2) 2.Finar, I. L. Organic Chemistry (Volume 1), Dorling Kindersley (India) Pvt. Ltd. (Pearson Education).

3) Guide book to Mechanism in Organic Chemistry by Peter Sykes 6^{th} edition,1985.

Course Code 6: Organic preparations

Credits: 01

Organic preparation

Course outcomes:

On the completion of the course, the student will b eable to do the following**:**

1. How to use glassware, equipment and chemicals and follow experimental procedures in the laboratory.
2. How to calculate limiting reagent, theoretical yield, and percent yield.
3. How to perform common laboratory techniques including reflux, distillation, recrystallization, vacuum filtration.
4. How to critically evaluate data collected to determine the identity, purity and percent yield of products and to summarize findings in writing in a clear and concise manner.

Syllabus - Organic preparations (50M)

i. Acetylation of β-naphthol, vanillin and salicylic acid by:

a) Using conventional method.

b) Using green approach

ii. Preparation of Nerolin

Co-curricular activities and Assessment Methods;

1. Continuous Evaluation: Monitoring the progress of student's learning
2. Class Tests, Worksheets and Quizzes
3. Presentations, Projects and Assignments and Group Discussions: Enhances critical thinking skills and personality
4. SEMESTER -End Examination: critical indicator of student's learning and teaching methods adopted by teachers throughout the SEMESTER .

Reference books:

1. Vogel A.I .Practical Organic Chemistry, Longman Group Ltd.
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B.Sc Chemistry

III - SEMESTER w.e.f.2024-25

Course Code 7: PHYSICAL CHEMISTRY - I

(Solutions & Electro Chemistry)

Credits: 03

Course outcomes:

At the end of the SEMESTER the student will be able to

1. Understand the ideal and non ideal behaviour of solutions.
2. Determine the molecular mass of non-volatile solutes.
3. Discuss the basic concepts of Photochemistry.
4. Apply the principles of electrical conductivity.
5. Explain the importance of emf and its applications.

Syllabus:

Unit I Solutions (9 h)

Classification - Miscible, Partially miscible and Immiscible - Raoult's Law – Azeo tropes- HCl-H_2O system and ethanol-water system. Partially miscible liquids-phenol- water system. Critical solution temperature (CST).Immiscible liquids and steam distillation. Nernst distribution law. Calculation of the partition coefficient. Applications of distribution law.

Unit II Colligative Properties (9 h)

Relative lowering of Vapour Pressure, Elevation in boing point depression in freezing point and Osmotic pressure. Determination of molecular mass of non-volatile solute by Ostwald-Walker method, Cottrell's method, Rast method and Barkeley-Hartley method.
Abnormal colligative properties.Van'tHoff factor.

Unit III Photochemistry (9h)

Difference between thermal and photo chemical processes, Laws of photo chemistry- Grothus-Draper's law and Stark-Einstein's law of photochemical equivalence, Quantum yield- Photochemical reaction mechanism- hydrogen- chlorine and hydrogen- bromine reaction. Qualitative description of fluorescence, phosphorescence, Jablonski diagram, chemi luminescence - Photosensitized reactions- energy transfer processes (simple example).

Unit IV Electrochemistry-I (9h)

Conductance, Specific conductance, equivalent conductance and molar conductance - effect of dilution. Cellconstant. Strong and weak electrolytes, Kohlrausch's law and its applications,Definition of transport number, determination of transport number by Hittorf's method. Debye-Huckel - Onsagar'sequation for strong electrolytes (derivation excluded), Application of conductivity measurements- conductometrictitrations.

Unit V Electrochemistry-II (9h)

Electrochemical Cells- Single electrode potential, Types of electrodes with examples: Metal-metal ion, Gas electrode, Inert electrode, Redox electrode, Metal-metal insoluble salt- salt

anion. Determination of EMF of a cell, Nernst equation, Applications of EMF measurements-Potentio metric titrations. Fuelcells –Basic concepts, examplesandapplications.

List of Reference books:

1) Principles of physical chemistry by Prutton and Marron

2) Solid State Chemistry and its applications by Anthony R. West

3) Text book of physical chemistry by K L Kapoor

4) Text book of physical chemistry by S Glasstone

5) Advanced physical chemistry by Bahl and Tuli

6) Advanced physical chemistry by Gurudeep Raj

7) Principles of physical chemistry by Puri, Sharma and Pathania.

III - SEMESTER

Course Code 7: PHYSICAL CHEMISTRY -I

Credits: 01

PHYSICAL CHEMISTRY

I. Course outcomes:

At the end of the course, the student will be able to:

1. Use of glassware, equipment and chemicals and follow experimental procedures in the laboratory.
2. Understand and apply the concepts of solutions practically.
3. Apply concepts of electrochemistry in experiments.

II. Syllabus:

CST, Conductometric and Potentiometric Titrimetry **50 M**

1. Determination of CST for Phenol-water system.
2. Effect of electrolyte on CST.
3. Conductometric titration - Determination of concentration of HCl solution using standard NaOH solution.
4. Conductometric titration – Determination of concentration of CH_3COOH Solution using standard NaOH solution.
5. Potentiometric titration-Determination of concentration of HCl using standard NaOH solution.

III. Co-curricular activities and Assessment Methods;

1) Continuous Evaluation: Monitoring the progress of student's learning
2) Class Tests, Worksheets and Quizzes
3) Presentations, Projects and Assignments and Group Discussions: Enhances critical thinking skills and personality

4) SEMESTER -End Examination: critical indicator of student's learning and teaching methods adopted by teachers throughout the SEMESTER .

IV. List of reference books:

1) A Text Book of Quantitative Inorganic Analysis(3^{rd}Edition) –A.I.Vogel

2) Web related references suggested by teacher.

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III -SEMESTER w.e.f.2024-25

COURSE CODE 8: INORGANIC AND PHYSICAL CHEMISTRY

Credits: 03

I. Course outcomes:

At the end of the SEMESTER the student will be able to:

1) Apply IUPAC nomenclature for Coordination compounds
2) Understand the various theories, structure and stereo chemistry of coordination compounds.
3) Explain the reaction mechanism in complexes.
4) Apply the 18 electron rule.
5) Discuss the basic concepts of thermodynamics.

II. Syllabus;

Unit I : Coordination Chemistry-I (9 h)

IUPAC nomenclature of Coordination compounds, structural and stereo isomerism in complexes with coordination numbers 4 and 6. Valence Bond Theory (VBT):Postulates-magnetic properties- Inner and outer orbital complexes. Limitations of VBT, CFT- Postulates

Splitting in Octahedral, tetrahedral, Crystal field stabilization energy(CFSE), Crystal field effects for weak and strong fields Jahn-Teller distortion

UNIT–II : Coordination Chemistry II (9 h)

1. Inorganic molecular Reaction Mechanism: (**6 h)**

Introduction to inorganic reaction mechanisms. Concept of reaction pathways, transition state, intermediate and activated complex. Labile and inert complexes, ligand substitution reactions – SN_1 and SN_2,Substitution reactions in square planar complexes, Trans-effect, theories of trans effect and its applications

2. Stability of metal complexes: (3 h)

Thermodynamic stability and kinetic stability, factors affecting the stability of metal complexes, chelate effect, determination of composition of complex by Job's method and mole ratio method.

Unit III Organo metallic compounds (9 h)

Definition and classification of organo metallic Compounds on the basis of bond type, Metalcarbonyls:18electron rule, electron count of mononuclear, poly nuclear and substituted metal carbonyls of 3d series. General methods of preparation of mono and binuclear carbonyls of 3d series. π-acceptor behaviour of CO (MO diagram of CO to be discussed), synergic effect and use of IR data to explain extent of back bonding.

Unit IV Thermodynamics- I (9 h)

Concept of heat(q), work(w), internal energy(U), State function and Path function- statement of first law; enthalpy(H), relation between heat capacities, Joule-Thomson effect- coefficient, Calculation of work for the expansion of perfect gas under isothermal and adiabatic conditions for reversible processes. Temperature dependence of enthalpy of formation- Kirchoff's equation.

Unit V Thermodynamics II (9 h)

Second law of thermodynamics Different Statements of the law, Carnot cycle and its efficiency, Carnot theorem, Concept of entropy, entropy as a state function, entropy changes in reversible and irreversible processes. Entropy changes in spontaneous and equilibrium processes.

List of Reference Books:

1) Concise coordination chemistry by Gopalan and Ramalingam
2) Coordination Chemistry by Basalo and Johnson
3) Text book of physical chemistry by S Glasstone
4) Concise Inorganic Chemistry by J.D.Lee
5) Advanced Inorganic Chemistry Vol-I by Satyaprakash, Tuli, Basu and Madan
6) A Text Book of Physical Chemistry by K.L.Kapoor Vol 2, 6th edition, 2019.

III- SEMESTER

COURSE CODE 8: QUALITATIVE INORGANIC ANALYSIS

Credits: 01

Qualitative inorganic analysis

(Minimum of Six mixtures should be analyzed)

Course outcomes:

At the end of the course, the student will be able to:

1) Understand the basic concepts of qualitative analysis of inorganic mixture.

2) Use glassware, equipment and chemicals and follow experimental procedures in the laboratory.

3) Apply the concepts of common ion effect, solubility product and concepts related to qualitative analysis.

Analysis of Mixture **50M**

Analysis of mixture salt containing two anions and two cations (From two different groups) from the following:

Anions: Carbonate, Sulphate, Chloride, Bromide, Acetate, Nitrate, Borate, Phosphate. **Cations:** Lead, Copper, Iron, Aluminium, Zinc, Nickel, Manganese, Calcium, Strontium, Barium, magnesium and Ammonium.

Minimum of Six mixtures should be analyzed.

Co-curricular activities and Assessment Methods

1) Continuous Evaluation: Monitoring the progress of student's learning
2) Class Tests, Worksheets and Quizzes
1) Presentations, Projects and Assignments and Group Discussions: Enhances critical thinking skills and personality

2) SEMESTER - End Examination: critical indicator of student's learning and teaching methods adopted by teachers throughout the SEMESTER .

List of Text books:

1. A textbook of qualitative inorganic analysis by A.I. Vogel.