SAURSHTRA UNIVERSITY
B. Sc. SEMESTER-I
C-101: CHEMISTRY THEORY

3 Credits
100 Marks

UNIT– I: INORGANIC CHEMISTRY

1. Atomic structure and periodic properties[10 Hours]

Dual nature of electron, De-Broglie's equation, Heisenberg's uncertainty principle, quantum numbers, Aufbauprinciple, Pauli's exclusion and Hund's rule for electron configuration.

Periodicity in atomic properties and its causes, explanation of general trends of periodic properties: atomic and ionic radii, ionization potential, electronegativity and electron affinity.

Chemistry of s and p block elements

Special characteristics such asmetallic character, polarizing power, hydration energy,inert pair effect, relative stability of different oxidation state, diagonal relationship of (1) lithium with magnesium (2) boron with silicon and (3) beryllium with aluminum, anomalous behavior of Li and Be, formation of complex compounds, catenation, allotropy (diamond and graphite-theirstructure, properties and its uses).

2. Chemical bonding in covalent compounds [10 Hours]

Covalent bond: Valence bond theory and its limitations. Concept of hybridization: sp($BeCl_2$), sp^2 (BF_3), sp^3 (SiH_4), sp^3d (PCl_5) and sp^3d^2 (SF_6).

Stereochemistry of inorganic molecules: Sidgwick Powell rule and VSEPR theory. Structure of molecules: $SnCl_2$, SO_4^{-2}, CO_3^{-2}.

Basic concept of MO theory.Bonding and anti-bonding molecular orbitals.Gerade and ungerade molecular orbitals.σ-molecular orbital andσ*-molecular orbital, π-molecular orbital and π*-molecular orbital.Conditions for effective combinations of atomic orbitals.Energy level diagrams of B_2, C_2, N_2, O_2, F_2, CO, NO, CO_2 (with s-p mixing and orbital interaction) with calculation of bond order and magnetic moment.Comparison of MO theory and VB theory.

UNIT-II: ORGANIC CHEMISTRY

3. Basic organic chemistry and aliphatic hydrocarbons containing σ bond

[10 Hours]

Nomenclature of organic compounds (Only acyclic - IUPAC-1993).
Electronicdisplacements: Inductive, electromeric, mesomericeffects and hyper conjugation. Applications of inductiveeffectto bondlength, dipole-moment, reactivity of alkyl halides, relative strength of acid, basicity of amines.

Homolytic and heterolytic fission, curly arrow rules
Reaction intermediates: carbocation, carbanion, free radical, carbenes and benzynes (formation by cleavage type, structure, relative stabilities, generation).Types of organic reagents: Nucleophiles and electrophiles.

Types of organic reactions: Substitution, addition, elimination and rearrangement.Nucleophilic substitution reaction mechanism (S_N1 & S_N2) for alkyl halides.

Introduction to stereochemistry: Configuration, Fischer projection formula, homomers and enantiomers. Geometrical isomerism: cis–trans, C.I.P rules with E/Z notations.

4. Aliphatic hydrocarbons(acyclic)[10 Hours]

Chemistry of alkanes:
Formation of alkanes: Wurtz reaction, Wurtz-Fittig reactions. Free radical substitutions: Halogenation-relative reactivity and selectivity.

Hydrocarbons containing carbon-carbonΠ bonds
Formation of alkeneelimination reactions, dehydration of alcohols, dehydrohalogenation of alkyl halides, dehalogenation of vicinal and germinal dihalides.
Mechanism of E1, E2, E1cb reactions, Saytzeff and Hofmann eliminations.Electrophilic addition reactions and their mechanisms (Markownikov/ Anti Markownikov rule).

Reactions of alkenes:Oxymercuration-demercuration, hydroboration oxidation, ozonolysis, reduction (catalytic), syn and anti-hydroxylation (oxidation), 1,2-and 1,4-addition reactions in conjugated dienes, Diels-Alder reaction.

Formation of alkynes: Dehydrohalogenation of vicinal and geminaldihalides, dehalogenation of tetrahalides

Reactions of alkynes: Acidity, electrophilic addition reactions like halogenation, hydrohalogenation, hydration, hydroboration, addition of carbene and catalytic hydrogenation.Nucleophilic addition with hydrogen cyanide and alcohol, hydration to form carbonyl compounds, alkylation of terminal alkynes.

UNIT III: PHYSICAL CHEMISTRY

5. Chemical kinetics [12 Hours]

Concept of chemical kinetic: rate of chemical reaction, concentration dependence of reaction rate specific reaction rate constant, order and molecularity of the reaction. Factors affecting rate of the reaction.

Definition, derivation of integrated rate equations for zero, first and second (same and different reactants) order reactions, their characteristics and half -life periods.

Determination of the order of reaction: (1) Hit and trial method or Integration method and its limitations (2)Fractional change method, (3) Oswald's isolation method (4) graphical method and(5) van't Hoff differential method. Concept of activation energy.Derivation of Arrhenius equation and determination of activationenergy by integrated equation andgraphical methods.

Theories of reaction rates: Collision theory and absolute reaction rate theory of bimolecular reactions and qualitative comparison. Numericals

6. Adsorption [4 Hours]

Introduction, types of adsorption (physical and chemical), characteristics and factors affecting adsorption. Adsorption isotherm and Freundlich equation. Langmuir theory of adsorption: assumptions, derivation, modification in equation at very low and high pressure, limitations and applications of adsorption.

7. Catalysis [4 Hours]

Introduction, types of catalysis (homogeneous and heterogeneous), characteristics of catalysis, autocatalysis, negative catalysis (Inhibitor), promoters, and catalytic poisoning.Activation energy and catalysis. Theories of catalysis:(1) Intermediate

compound formation and (2) adsorption theory, active centers.Enzyme catalysis and its characteristics.

Reference books: Inorganic Chemistry

1. UGC Inorganic Chemistry - H. C. Khera(PragatiPrakashan).
2. Inorganic Chemistry - J. N. Gurtu& H. C. Khera
3. Concise of Inorganic Chemistry - J. D. Lee.
4. Basic Inorganic Chemistry - Gurdeep& Chatwal.
5. Advanced Inorganic Chemistry - Raymond Chang
6. Advanced Inorganic Chemistry- Cotton and Wilkinson.
7. Co-ordination Chemistry – Banerjee.
8. Atomic Structure and Chemical Bonding by Manas Chanda.
9. Coordination Chemistry- Gurdeep Chatwal and M. S. Yadav.
10. Inorganic Chemistry - P. L. Soni.
11. Principles of Inorganic Chemistry- B. R. Puri, L. R. Sharma & K. C. Kalia.

Reference books: Organic Chemistry

1. Organic Reaction Mechanism, including Reaction Intermediates, ,V. K. Ahluwalia, Ane's Chemistry active series.
2. Organic Chemistry, Vol-1, by Sultanat, Ane's Student Edition, Ane Book Pvt Ltd
3. Undergraduate Organic Chemistry, vol-1, Jagdambasingh, L.D.S.Yadav, PragatiPrakashan, 8th edition-2013.
4. Organic Chemistry by F.A. Carey, Mc Graw-Hill Inc.
5. Organic Chemistry by I. L. Finar.
6. Organic Reaction Mechanism by Ahluvaliya.
7. Organic Chemistry by Morrison and Boyd.
8. Organic Chemistry by Francis A. Carey.
9. Organic Chemistry by Clayden.
10. Stereochemistry of Organic–Principles and Application by D. Nasipuri 3rd addition
11. Stereochemistry Conformation and Mechanism by P. S. Kalsi

Reference books: Physical Chemistry

1. Essentials of Physical Chemistry, B. S. Bahl, G. D. Tuli and ArunBahl, S. Chand & Co. New Delhi.
2. Elements of Physical Chemistry, B. R. Puri, L. R. Sharma and Madan Pathania, Vishal Publishing Co. Jalandhar.
3. Principles of Physical Chemistry, Samuel H. Maron and Carl F. Prutton, Oxford & IBH Publishing Co. Pvt. Ltd. New Delhi.

4. Physical Chemistry, B. K. Sharma, Goel Publication House. Meerut.
5. Chemical Kinetics, G. R. Chatwal and Harish Mishra, Goel Publication House. Meerut.
6. An Introduction of Physical Chemistry, D. K. Chakrabarty, Narosa Pub. House, New Dellhi.

SAURSHTRA UNIVERSITY
B. Sc. SEMESTER-I
C-102: CHEMISTRY PRACTICALS

3 Credits
50 Marks

1. Organic qualitative analysis [20 marks]
(Minimum 12 compounds)

Compounds containing one functional group such as phenolic, carboxylic acid, ester, amide, nitro, amine, aldehyde, ketone, alcohol, halogen, anilide, carbohydrate and hydrocarbon.

List of compounds: Benzoic acid, cinnamic acid, phenol, α-naphthol, β-naphthol, acetone, ethyl methyl ketone, methyl acetate, ethyl acetate, naphthalene, anthracene, aniline, nitrobenzene, benzamide, urea, thiourea, chloroform, acetanilide, carbon tetra chloride, chloro benzene, bromo benzene.

2. Volumetric analysis [15 Marks]

Part-1 Acid-base titrations

1 To prepare a solution by dissolving 'x' g $NaHCO_3$ /Na_2CO_3 in 100 ml solution and determine its concentration in terms of normality and molarity using 0.1 N HCl solution.
2 To determine the normality, molarity and g/lit of NaOH and HCl using 0.1 N Na_2CO_3 solution.
3 To determine the normality, molarity and g/lit of each component in a given mixture of $NaHCO_3$ and Na_2CO_3 using 0.1N HCl solution.

Part-2 Redox titrations

4 To determine the normality, molarity and g/lit of each component in a mixture of $H_2C_2O_4.2H_2O$ and H_2SO_4 using 0.1 N $KMnO_4$ and 0.1N NaOH solution.
5 To determine the normality, molarity and g/lit of each component in a mixture of $H_2C_2O_4.2H_2O$ and $K_2C_2O_4.H_2O$ using 0.1N NaOH and 0.1 N $KMnO_4$ solution
6 To determine the normality, molarity and g/lit of $KMnO_4$ and $FeSO_4.7H_2O$ solution using 0.1 N $H_2C_2O_4.2H_2O$ solution.

7 To determine the normality, molarity and g/lit of $FeSO_4$ $(NH_4)_2SO_4.6H_2O$ and $K_2Cr_2O_7$ solutions using 0.1 N $KMnO_4$ solution.

SAURSHTRA UNIVERSITY
B. Sc. SEMESTER-II
C-201: CHEMISTRY THEORY

3 Credits
100 Marks

UNIT–I:INORGANIC CHEMISTRY

1. Basics of ionic compounds [7Hours]

Introduction, characteristics of ionic solids, Born Haber cycle and its applications, Max Born equation, limiting radius ratio.Relation between radius ratio, co-ordination number and crystal structure. Derivation of $r+/r^-$ ratio in triangular,planar, square planar, body centered and tetrahedral crystal lattices. Defects in ionic crystals (stoichiometric and non-stoichiometric), study of N & P types of semi-conductors.

2. Chemistry of elements of 3d series [6 Hours]

Introduction, definition, electronic configuration, reversal of energies of 3d and 4s orbitals, physical properties such as atomic properties (atomic radii, Ionic radii, and ionization potential), metallic conductivity, melting point & boiling point, density, reducing properties, tendency of formation of alloys, catalytic properties, magnetic and spectral properties. Calculation of spin only magnetic momentum of inner orbital and outer orbital complexes $[NiCl_4]^{-2}$, $[Ni(CN)_4]^{-2}$, $[FeF_6]^{-4}$, $[Fe(CN)_6]^{-4}$.

3. Basics of co-ordination chemistry [7Hours]

Warner theory, types of ligands (simple ligands, π-acid ligands, according to number of donating electrons, chelating ligands) with definition and examples.Co-ordination number and geometry related to co-ordination number. Isomerism and its classification(structural and stereo isomerisms). In structural isomerism: (1) ionization(2) hydration (3) co-ordination (4) co-ordination positions (5) polymerization and (6) linkage isomerism. Geometric/cis-trans isomerism in ML_4 and ML_6 types of complexes.

UNIT II: ORGANIC CHEMISTRY

4. Cycloalkanes [10 Hours]

Introduction and classification of ring system (monocyclic and polycyclic, size, number of carbon atoms common between the two rings).

IUPAC nomenclature of cycloalkanes (including simple spiro compounds, fused ring and bridged ring systems-bicyclic only).

Method of preparation of small ring cycloalkanes: Intra-molecular Wurtz's reaction, Simmons-Smith, Diels-Alder reaction

Chemical properties of cycloalkanes: Substitution reactions, addition reactions, Baeyer's strain theory and its limitations (puckering).

Conformations andconformational analysis: Conformation of ethane, propane and butane.

5. Aromatic hydrocarbons [10 hours]

Aromaticity:Criteria for aromatic, non-aromatic and antiaromatic types, applications of Huckel's rule to simple annulene, cyclic carbocation/anion.

Electrophilic aromatic substitution reactions of benzene with mechanism.Theory of effect of substituents on reactivity and orientation (with resonating structures for activating and deactivating groups).

Electrophilic aromatic substitution reactions of the followings with mechanisms:Halogenation, nitration, sulphonation, Friedel Crafts alkylation, Friedel Crafts acylation.

UNIT III: PHYSICAL CHEMISTRY

6. Ionic equilibria [12 Hours]

Types of electrolytes.Degree of ionization and factors affecting degree of ionization.Ionization constant and Ionic product of water.Ionization constants of weak acids and bases.Common ion effect and calculation of concentrations of OH^- ions (NH_4Cl+NH_4OH) and H^+ ions (H_2S+HCl).Solubility and solubility products of sparingly soluble salts- applications of solubility product.

Hydrolysis of salts: Definition of hydrolysis of salts.Salts of strong acids and bases. Relation among K_h, K_a, or K_b and K_w. Degree of hydrolysis and pH of the solution of salts of weak acids and strong bases, salts of weak bases and strong acids and salts of weak bases and weak acids.

Buffer solutions: Definition and types of buffer solutions, Buffer action, derivation of Henderson-Hasselbalch equation. Numericals.

7. Solid state [8 Hours]

Nature of solids, unit cells, crystal systems, Bravais lattices and identification of planes. Laws of crystallography: (1) Law of symmetry, (2)Law of constancy of interfacial angles and (3) law of rational indices.Miller and Weiss indices.Derivation of Bragg's law.X–Ray.Diffraction methods: Rotating crystal method and powder method. Structures of NaCl,CsCland KCl. Numericals.

Reference books: Inorganic Chemistry

1. UGC Inorganic Chemistry - H. C. Khera(PragatiPrakashan).
2. Inorganic Chemistry - J. N. Gurtu& H. C. Khera
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2. Elements of Physical Chemistry, B. R. Puri, L. R. Sharma and Madan Pathania, Vishal Publishing Co. Jalandhar.
3. Principles of Physical Chemistry, Samuel H. Maron and Carl F. Prutton, Oxford & IBH Publishing Co. Pvt. Ltd. New Delhi.
4. Physical Chemistry, B. K. Sharma, Goel Publication House. Meerut.
5. Chemical Kinetics, G. R. Chatwal and Harish Mishra, Goel Publication House. Meerut.
6. An Introduction of Physical Chemistry, D. K. Chakrabarty, Narosa Pub. House, New Dellhi.

SAURSHTRA UNIVERSITY
B. Sc. SEMESTER-II
C-202: CHEMISTRY PRACTICALS

3 Credits
50 Marks

1. **Qualitative analysis of inorganic salts**: **[20 Marks]**
(Minimum 12 salts-containing two radicals)

Inorganic salts containing anion(chloride, bromide iodide, nitrate, nitrite, sulphate, sulphite, sulphide, carbonate, phosphate (soluble & insoluble), oxide, chromate, and dichromate).

2. Inorganic volumetric analysis **[15 Marks]**
(Standard solution should be given)

1 Quantitative estimation of Cu^{2+} in a given $CuCl_2.2H_2O$ solution using 0.01M EDTA solution.
2 Quantitative estimation of Ni^{2+} in a given $NiSO_4.7H_2O$ solution using 0.01M EDTA solution.
3 Quantitative estimation of Zn^{2+} in a given $ZnCl_2$ solution using 0.01M EDTA solution.
4 Determination of total hardness of water by EDTA.
5 Determination of acetic acid in a commercial vinegar using 0.1M NaOH solution.
6 Determination of alkali in antacid using 0.1M HCl solution.
7 Quantitative estimation of Fe^{2+} by dichromate method (Internal indicator method).

PAPER STYLE

INSTRUCTIONS

1. **B. Sc. Chemistry Syllabus for Semester I & II consists of three units:**
   UNIT – I: Inorganic Chemistry
   UNIT – II: Organic Chemistry
   UNIT –III: Physical Chemistry
2. **All units carry equal weightage.**
3. **All units should be given equal weightage in the question paper.**
4. **70 Marks for Semester & 30 marks for Internal Examinations.**
5. **Time duration:** $2\frac{1}{2}$ **Hours**
6. **Question 1 carries 20 Marks**
7. **Questions 2 & 3 carry 25 Marks each**

Question1: Shorts questions (From UNIT I-III) [20 Marks]
(One word, one line,explain, definition, trueor false,fill up the blanks, MCQ, etc.)

Question 2: From Units I-III [25 marks]

a. **Answer Any 3 out of 4 (2 questions from Unit I and onequestion from Unit II & III). [2x3=6Marks]**
b. **Answer Any 3 out of 4 (2 questions from Unit II and onequestion from Unit I & III). [3x3=9 Marks]**
c. **Answer Any 2 out of 3 (1 question from Unit-I to III). [5x2 =10 Marks]**

Question 3: From Units I-III [25 marks]

a. **Answer Any 3 out of 4 (2 questions from Unit III and onequestion from Unit I & II). [2x3=6 Marks]**
b. **Answer Any 3 out of 4 (2 questions from Unit II and onequestion from Unit I & III). [3x3=9 Marks]**
c. **Answer Any 2 out of 3 (1 question from Unit-I to III). [5x2 =10 Marks]**

Saurashtra University

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Grade 'A' ~~CGPA 3.06~~

BSc Semester III & IV
Chemistry Syllabus

w.e.f from June 2017

26/12/16

With effect from June 2017

BSc Chemistry Semester III & IV
[2017-18]

Unit wise Distribution

Unit-I	Inorganic		[12-hours]
Unit-II	Inorganic		[08-hours]
Unit-II	Organic		[04-hours]
Unit-III	Organic		[12-hours]
Unit-IV	Organic		[04-hours]
Unit-IV	Physical		[08-hours]
Unit-V	Physical		[12-hours]
		Total	**: 60 hours**

BSc Semester III Chemistry Syllabus

Unit-I

1. Wave mechanics and MO theory **[12 hours]**

Introduction of wave Mechanics, Postulates of wave Mechanics, Interpretation of ψ, ψ^2, $\psi\psi^*$, Derivation of Schrodinger's equation in three dimensions (Cartesian Coordination), Eigen function & Eigen value, Orthogonal & Normalized wave function and problems on it, Concept of Molecular Orbital Theory, Characteristic of Molecular Orbital, Wave function of H2+ & H2, Potential energy and Schrodinger's equation for H2+ & H2, Derivation of normalized wave function of H2+ based on M.O.T., Hybridization ; Derivation co efficient of wave function of Sp, Sp2 & Sp3 Hybridization.

Unit-II

2. Chemistry of Lanthanide Elements **[8 hours]**

Introduction, Position in the periodic table, Occurrence & Important ores, Isolation of Lanthanide Elements from ore, Individual Isolation by (I) Ion Exchange Method (II) Solvent Extraction Method, Electronics Configuration with necessary Explanation, Oxidation State & their Stability, Magnetic properties, Color, Isotopes, spectral properties, Lanthanide Contraction, Misch Metal, Uses of Lanthanides & their Compounds.

3 Aryl halides: **[4-hours]**

Preparation (by direct halogenation, from diazonium salts), nucleophilic aromatic substitution, SNAr, Benzyne mechanism

Other reactions of Aryl halides: Wurtz-Fitting, Fitting reaction, Ulmann reaction

Relative reactivity of alkyl, allyl/benzyl, vinyl and aryl halides towards nucleophilic substitution reactions.

Unit-III

4. Alcohols, Phenols, Ethers and Epoxides: **[6-hours]**

Alcohols: Preparation: Preparation of 1^0, 2^0 and 3^0 alcohols: using Grignard reagent; by reduction of aldehydes, ketones, carboxylic acid and esters.

Reactions: With sodium, HX (Lucas test), esterification and oxidation (with alkaline KMnO4, acidic dichromate, conc. HNO3)

Diols: oxidation of diols by periodic acid and lead tetraacetate

Phenols :(Phenol case)

Acidity and factors affecting it;

Reactions: Electrophilic substitution (Nitration, halogenation and sulphonation),

Ethers: Preparation of Ethers by Williamson Synthesis

Reactions: Substitution Reaction [Reaction with Cl_2 in dark & Reaction of Cl_2 in light], Reactions involving C-O bond cleavage [hydrolysis, reaction with H_2SO_4, cold HI & hot HI]

Epoxides: Reactions of epoxides with alcohols, ammonia derivatives and $LiAlH_4$.

5. **Nitrogen Containing Functional Groups:** **[6-hours]**

Amines

Classification of amines (Aliphatic and Aromatic)

Basicity of amines, effect of substituent on basicity of amines

Preparation of amines (by reduction of nitro compounds, reaction of organic halides with ammonia, Hoffmann degradation of amides)

Reactions of primary alkyl & arylamines: [Reaction with acid chlorides, aryl sulphonyl chlorides, alkylhalides, HNO_2]

Chemical reactions of Aniline: Electrophilic substitution (nitration, bromination, sulphonation), Diazotization of Aniline and reactions of Diazonium salt

Hinsberg Reaction to distinguish between Primary, Secondary and Tertiary amines

Preparation and important reactions of **nitro compounds, nitriles and isonitriles**

Unit-IV

6. **Name Reactions and Rearrangements** **[4-hours]**

Name Reaction: Reimer-Tiemann reaction, Kolbe's Schmidt reaction, Carbylamine reaction

Rearrangement: Pinacol-Pinacolone Rearrangement, Fries Rearrangement, Claisen Rearrangement,

7. **Phase Equilibrium:** **(8 hours)**

Introduction, Criteria of phase equilibrium, Explanation of terms: Phases, Components and Degrees of freedom of a system , Gibbs Phase Rule, Limitations of Phase Rule, Phase Diagram, Phase diagrams of one-component systems (water and sulphur)

Two component systems: Condensed Phase Rule, Eutectics system (Lead-Silver) and Park method of desilverization, Congruent melting point system (Mg – Zn) and Incongruent melting point system (Na - K).

Unit - V

8. **Solutions:** **(8 hours)**

Introduction, Factors affecting solubility, Types of solutions, Types of liquid – liquid solutions

Miscible Liquid Pair: Ideal solutions and Raoult's law, Deviations from Raoult's law (Non-ideal solutions), Vapour pressure - composition curves of ideal and non-ideal solutions, Temperature - composition curves of ideal and non-ideal solutions. Distillation of ideal and non-ideal solutions, Lever rule, Fractional column and Bubble cap tower, Azeotropes.

Immiscible Liquid Pair: Introduction, Principle of steam distillation and its applications.

Numericals,

Solution of Gas in Liquid: Factors affecting solubility of a gas., Effect of pressure (Henry's Law), Numericals.

9. **Nernst Distribution Law:** **(4 hours)**

Introduction, Nernst Distribution Law, Its limitations, Modified Nernst Distribution Law [Solute associate in the solvent, Solute dissociate in the solvent, Solute enters into chemical reaction with solvent], Applications, Solvent extraction Numericals

Reference book:

1. UGC Inorganic Chemistry - H. C. Khera (Pragati Prakashan)
2. Principles of Inorganic chemistry – Puri, Sharma & Kalia
3. Concise Inorganic Chemistry - J. D. Lee
4. Advanced Inorganic Chemistry- Cotton and Wilkinson
5. Basic Inorganic Chemistry - Gurdeep & Chatwal
6. Organic Chemistry (Volume I, II & III) by S.M. Mukherji, S.P. Singh and R.P. Kapoor
7. A Text Book of Organic Chemistry (II Edition) by Raj K. Bansal
8. Name Reactions in Organic Synthesis by Dr. A.R.Parikh et. al
9. Reactions and Rearrangements by Gurdeep Chatwal
10. Essentials of Physical Chemistry, B. S. Bahl, G. D. Tli and Arun Bahl, S. Chand & Co., New Delhi
11. Elements of Physical Chemistry, Late B.R. Puri, L. R. Sharma and Madan Pathania, Vishal Publishing Co. Jalandhar
12. Principles of Physical Chemistry, Samule H. Maron and Carl F. Prutton, Oxford & IBH Publishing Co. Pvt. Ltd. New Delhi
13. Physical Chemistry, B. K. Sharma, Goel Publication House, Meerut.

BSc Semester IV Chemistry Syllabus

Unit-I

1. **Organometallic compounds** **[6 hours]**

Introduction, Classification based on nature of M-C Bond and heptacity.

Preparation, Properties and uses of Organo Lithium compounds and organo magnesium compounds

Preparation, bonding & structure of : Zeise Salts, Tri Methyl aluminium (dimer), Ferrocene

2. **Bioinorganic chemistry** **[6 hours]**

Metalloporphyrins, structure and roll of Hemoglobin in biological system, myoglobin, structure of chlorophyll and its importance, toxicity of arsenic, mercury, lead and cadmium, reason for toxicity.

Unit-II

3. **Noble gases** **[8 hours]**

Introduction, Occurrence, Compounds of inert gas;

Preparation, structure (VBT) and properties of XeF_2, XeF_4, XeF_6, $XeOF_4$, XeO_2F_2, $XeOF_2$, KrF_2, oxide of xenon – XeO_3, XeO_4, use of Noble gases.

4. **Active methylene compounds:** **[4-hours]**

Definition, Keto-enol Tautomerism in Ethyl acetoacetate,

Preparation of Ethyl acetoacetate [Claisen Condensation with reaction mechanism]

Chemical Reactions of Ethyl acetoacetate: [Reduction, hydrolysis (with dil. H_2SO_4, with ethanolic KOH), with sodium ethoxide, reaction with alkylhalide, Reaction with $NaHSO_3$ and HCN, reaction with Aldehydes]

Synthesis from Ethyl acetoacetate

- Monocarboxylic acid: Butyric acid and Valeric acid
- Ketone : 2-Pentanone and 3- Methyl 2-pentanone
- α, β – unsaturated acid : Crotonic acid
- Dicarboxylic acid: Adipic acid
- Diketone: Acetyl acetone and Acetonyl acetone,
- Keto acid: Levulenic acid

Unit-III

5. **Carbonyl Compounds (Aldehydes & ketones):** **[6-hours]**

Structure, reactivity and Preparation of aldehydes and ketones: from acid chlorides and from nitriles.

Reactions: Nucleophilic additions (with HCN, ROH, $NaHSO_3$), Nucleophilic addition-elimination reactions (with ammonia derivatives with mechanism), oxidations and reductions (Clemmensen, Wolff-Kishner, $LiAlH_4$, $NaBH_4$.)

6. **Carboxylic Acids and their Derivatives:** **[6-hours]**

Carboxylic acids:

Acidity of Carboxylic acids, Effect of substituents on Acidity of carboxylic acids

Preparation of monocarboxylic acids (by hydrolysis of acid derivatives)
Reactions of monocarboxylic acids: Salt formation, Decarboxylation, Halogenation – Hell Volhard Zelinsky Reaction

Carboxylic acid derivatives

Preparation of Acid chlorides, Anhydrides, Esters and Amides from carboxylic acids and their inter-conversion
Mechanism of Esterification
Hydrolysis of Esters ($B_{AC}2$ Mechanism)

Unit-IV

7. **Name Reaction and Rearrangements-II:** **[4-hours]**

Name Reaction: Aldol condensation, Perkin Reaction, Wittig reaction
Rearrangement: Beckmann Rearrangement, Benzil-Benzilic acid Rearrangement, and Hofmann bromamide degradation.

8. **Physical Properties and Molecular Structure:** **(8-hours.)**

Introduction

Types of Physical Properties: Additive and Constitutive Properties
Molar Volume: Kopp's Law, Atomic Volume
Surface Tension: Explanation of Surface Tension, Name of Methods to Determine Surface Tension, The Drop Weight Method
Parachor: Macleod Equation and $P_1/P_2 = V_1/V_2$, Atomic Parachor, To Determine Structure of (i) Quinine (ii) Benzene (iii) Isocyanides group(iv) Nitro group
Viscosity: Explanation (Briefly), Unit and Factors Affecting the Viscosity, Measurement of Viscosity (Derivation of $\eta_1 / \eta_2 = d_1t_1 / d_2t_2$), Ostwald's Viscometer
Refractive Index and Refractivity: Introduction, Specific and Molecular Refractivity, Abbe Refractometer, Molecular Refractivity and Chemical Constitution
Optical Activity: Polarization of Light, Optical Activity,Factors Affecting Angle of Rotation, Specific Rotation, Polarimeter
Dipole Moment: Polar and Non-polar molecule,Electric Polarization (Polarizability of Molecules), The Mosotti Clausious Equation, Kinds of Molar Polarization [Electron & Nuclear Polarization, Orientation Polarization (Permanent Dipole Moment)]; Application of Dipole Moment: Identification of Polar and Non-polar molecules, Molecular Structure :(i) Mono atomic molecules, (ii) Diatomic molecules (iii) Triatomic molecules (CO_2, H_2O, SO_2) (iv) Tetratomic molecules (NH_3, BCl_3) (v) Aromatic Compounds (Benzene) (vi) Resonance Structure (N_2O) (vii) Cis-Trans Isomer (viii) Orientations in Organic Molecules (o, m and p substitution),
Numericals

Unit - V

9. **Thermodynamics:** **(12 hours)**

Introduction, Limitations and Advantages of Thermodynamics, Types of Systems

State Variables, properties of System: Extensive and Extensive Properties, Types of Processes, State and Path Functions, Exact and Inexact Differential Concept of Heat, Work and Internal Energy, First Law of Thermodynamics: Statements, Mathematical derivation. Heat absorbed at constant volume, Perpetual Machine of First Kind, Enthalpy, Heat Capacity: Its types and derivation of relation ($Cp - Cv = R$). Isothermal Reversible and Irreversible Work of Ideal Gas, Proof: $Wr > Wirr$. Relations between P – V, V – T and T – P for Adibatic Process, Adiabatic Reversible and Irreversible work of Ideal Gas, Joule Thomson Effect, Joule Thomson Coefficient, Joule Thomson of Ideal Gas, Zeroth Law (Only Statement and Explanation), Variation of Enthalpy with Temperature (Kirchhoff Equation), Flame and Explosion Temperature, Numericals

Reference book:

1. Quantum chemistry by A. K. Chandra
2. Basic Concept of Quantum Chemistry by R. K. Das.
3. Molecular Physical Chemistry by McQuarrie
4. UGC Inorganic Chemistry - H. C. Khera (Pragati Prakashan)
5. Principles of Inorganic chemistry – Puri, Sharma & Kalia.
6. Concise Inorganic Chemistry - J. D. Lee
7. Advanced Inorganic Chemistry- Cotton and Wilkinson
8. Basic Inorganic Chemistry - Gurdeep & Chatwal
9. Organic Chemistry (Volume I, II & III) by S.M. Mukherji, S.P. Singh and R.P. Kapoor
10. A Text Book of Organic Chemistry (II Edition) by Raj K. Bansal
11. Name Reactions in Organic Synthesis by Dr. A.R.Parikh et. al
12. Reactions and Rearrangements by Gurdeep Chatwal
13. Essentials of Physical Chemistry, B. S. Bahl, G. D. Tli and Arun Bahl, S. Chand & Co.. New Delhi.
14. Elements of Physical Chemistry, Late B.R. Puri, L. R. Sharma and Madan Pathania, Vishal Publishing Co. Jalandhar.
15. Principles of Physical Chemistry, Samule H. Maron and Carl F. Prutton, Oxford & IBH Publishing Co. Pvt. Ltd. New Delhi.
16. Physical Chemistry, B. K. Sharma, Goel Publication House. Meerut.
17. Elements of Physical Chemistry, Samuel Glasstone and David Lewis, Macmillan & Co.

PAPER STYLE

INSTRUCTIONS TO PAPER SETTERS

1. B. Sc. Chemistry Syllabus for Semester III & IV consists of **FIVE** units
2. All the units carry equal weightage (14 Marks each)
3. There must be one question from each unit.
4. Each subtopic must be given due weightage in question paper
5. 70 Marks for Semester Examination & 30 marks for Internal Examinations.
6. Time duration: 2 ½ Hours

Question 1: Answer the following (UNIT-I)

a. Four objective questions each of one Mark : 1x4 = 4
b. Answer any one out two each of two Marks : 1x2 = 2
c. Answer any one out two each of three Marks : 1x3 = 3
d. Answer any one out two each of five Marks : 1x5 = 5

Total Marks: 14

Question 2: Answer the following (UNIT-II)

a. Four objective questions each of one Mark : 1x4 = 4
b. Answer any one out two each of two Marks : 1x2 = 2
c. Answer any one out two each of three Marks : 1x3 = 3
d. Answer any one out two each of five Marks : 1x5 = 5

Total Marks: 14

Question 3: Answer the following (UNIT-III)

a. Four objective questions each of one Mark : 1x4 = 4
b. Answer any one out two each of two Marks : 1x2 = 2
c. Answer any one out two each of three Marks : 1x3 = 3
d. Answer any one out two each of five Marks : 1x5 = 5

Total Marks: 14

Question 4: Answer the following (UNIT-IV)

a. Four objective questions each of one Mark : 1x4 = 4
b. Answer any one out two each of two Marks : 1x2 = 2
c. Answer any one out two each of three Marks : 1x3 = 3
d. Answer any one out two each of five Marks : 1x5 = 5

Total Marks: 14

Question 5: Answer the following (UNIT-V)

a. Four objective questions each of one Mark : 1x4 = 4
b. Answer any one out two each of two Marks : 1x2 = 2
c. Answer any one out two each of three Marks : 1x3 = 3
d. Answer any one out two each of five Marks : 1x5 = 5

Total Marks: 14

PRACTICALS

Chemistry Practicals Semester III

1. **Organic Qualitative Analysis [minimum 10]**

[Minimum six bifunctional Organic Compounds should be given]

Identification of an organic compound through the functional group analysis and determination of melting point or boiling point

(Bifunctional organic compounds)

2. **Organic Volumetric Estimation:**

[Standard solution to be given]

1. To determine the amount of $-CONH_2$ in the given Acetamide solution
2. To determine the amount of Phenol / m-cresol in the given solution
3. To determine the amount of Aniline / p-toludine in the given solution
4. To determine the amount of Ester in the given solution
5. To determine the amount of Glucose in the given solution
6. To determine the amount of –COOH in the given carboxylic acid

Chemistry Practicals Semester IV

1. **Inorganic Qualitative Analysis:**

[Minimum ten inorganic mixtures should be given]

Qualitative Analysis of an inorganic mixture containing four radicals, excluding PO_4^{-3}, CrO_4^{-2}, $Cr_2O_7^{-2}$, AsO_3^{-3}, AsO_4^{-3}, BO_3^{-3} and S^{-2}

2. **Physicochemical Exercise**

1. To determine the specific reaction rate of the hydrolysis of methyl acetate / Ethyl acetate catalyzed by H^+ ion at room temperature.
2. To study the rate of reaction between $K_2S_2O_8$ and KI.
3. To study the rate of reaction between $KBrO_3$ and KI.
4. To determine the temperature coefficient and Energy of activation for the hydrolysis of ester at two different temperatures.
5. To determine the temperature coefficient and Energy of activation for the reaction between $K_2S_2O_8$ and KI at two different temperatures
6. To determine the rate of adsorption of the given organic acid using animal charcoal.
7. Distribution Law: To study the partition co-efficient of benzoic acid between water and benzene / kerosene and hence study the molecular condition of benzoic acid in the solution.
8. To study the partition co-efficient of acetic acid between water and chloroform and hence study the molecular condition of acetic acid in the solution.

26/12/16

SAURASHTRA UNIVERSITY
B.Sc. SEMESTER – V
CHEMISTRY [C-501] SYLLABUS
INORGANIC CHEMISTRY AND INDUSTRIAL CHEMISTRY
EFFECTIVE FROM JUNE-2018

UNIT-1

Wave mechanics: [12 hours]

- Outline of basic concepts of wave mechanics.
- Operator's algebra (Addition, Subtraction, multiplication), commutative property, linear operation, commutation operation, the operator $\nabla$and ∇^2, momentum operator, Hamiltonian operator.
- Particle in one dimensional box; normalised wave equation and energy related to particle moving in one dimensional box, energy equation and its interpretation with energy levels, linear polyenes as one dimensional box model, examples based on one dimensional box model.
- Particle in three dimensional box; Derivation of normalised wave equation, energy related with it, energy levels and degeneracy example.
- Wave equation for hydrogen atom: To derive the relation between Cartesian and polar coordinates, Schrodinger equation in polar coordinates, separation of variables to derive R(r), $\theta(\theta)$ and $\phi(\phi)$ equations.
- Energy of 1s orbital, normalisation condition and problems on it (in polar coordinates for three dimension)

UNIT-2

Crystal field Theory: 1 [12 hours]

- Introduction
- Concept of crystal field theory
- Splitting of d-orbitals in octahedral and tetrahedral crystal filed with CFSE concept.
- Factor affecting splitting energy.
- Weak field and strong field ligands.
- High spin and low spin complexes with paring energy
- Magnetic behaviour of transition metal complexes
- Orbital angular momentum contribution to magnetic momentum of complexes
- Example based on CFSE, pairing energy and magnetic momentum

UNIT-3

1. **Transition metal complexes of π-acid ligands: [7 hours]**

- Metal carbonyls: Definition, preparation, physical and chemical properties, nature of M-CO linear bond based on MO theory with spectral support, classification of metal carbonyls, type of CO group and detection of CO group, using IR spectra

- Structure of $Ni(CO)_4$, $Fe(CO)_5$, $Fe_2(CO)_9$, $Co_2(CO)_8$, $Fe_3(CO)_{12}$ and $Mn_2(CO)_{10}$
- Metal nitrosyl: Structure and bonding in complexes of NO^+, NO^- and NO.

2. Cement: [5 hours]

- Introduction and type of cement.
- Raw materials and manufacturing process (1) Dry process (2) Wet process.
- Setting of cement (1) Hydrolysis (2) Hydration.
- Properties of cement.
- Testing of cement and ISI specification of cement.
- Mortar, concrete, RCC
- Curing and decay of cement.
- Uses of cement.

UNIT-4

Fertilizers: [12 hours]

- Introduction to fertilizers, role of plant nutrients.
- Classification and properties of fertilizers.
- Nitrogenous fertilizers.
- Manufacturing process of (1) Ammonium nitrate (by prilling method), (2) Ammonium sulphate (sindri process), (3) Urea (from Ammonium carbonate), (4) Calcium cyanamide(by electro carbonate) and action of fertilizers(of all above).
- Phosphate fertilizer: (1) Normal super phosphate and its manufacturing process, (2) Triple super phosphate and its manufacturing process, (3) Manufacture of mono ammonium and diammonium phosphate.
- Potassium fertilizer: NPK fertilizers and nomenclature.

UNIT-5

Glass: [12-hours]

- Introduction
- Physical and chemical properties of glass
- Raw materials for glass manufacture
- Chemical reactions involved in glass manufacture
- Manufacture process: Formation of batch material, Melting, Shaping, Annealing, and Finishing.
- Special type of glass: Fused silica glass, High silica glass, optical glass, borosilicate glass, lead glass, glass wool, Pyrex glass, photochromic glass, insulating glass, rare earth glass, vitreosil glass, photosensitive glass.

SAURASHTRA UNIVERSITY
B.Sc. SEMESTER – V
CHEMISTRY [C-502] SYLLABUS
ORGANIC CHEMISTRY AND SPECTROSCOPY
EFFECTIVE FROM JUNE-2018

UNIT-I:

1. **Name reactions, Rearrangements and Reagent: [6 hours]**

Reactions

(a) Arndt Eistert reaction
(b) BischlerNapierski reaction
(c) Wolf-Kishner reaction

Rearrangements

(a) Beckmann rearrangement
(b) Curtius rearrangement
(c) Bayer-villiger oxidation

Reagent

(a) Lithium Aluminium hydride $LiAlH_4$
(b) Triphenyl phosphine
(c) Sodamide

2. **Alkaloids [6 hours]**

Introduction, Occurrence, classification, Isolation, General method of proving structure of alkaloids, Constitution, Properties and synthesis of

(a) Coniine
(b) Nicotine
(c) Papaverine

UNIT-II:

1. **Carbohydrates [9hours]**

Introduction, classification and nomenclature, general reaction of monosaccharides (with reference to Glucose and Fructose)

Inter-conversions:

(a) Conversion of Aldose to the corresponding ketose
(b) Conversion of Aldose to the next higher Ketose (wolform method)
(c) Conversion of Aldose to the Ketose having two more carbon atoms (Swoden method)
(d) Conversion of Ketose to the corresponding Aldose

Step-up reaction (Ascending in Aldose series)

(a) Kiliani reaction
(b) Swodennitromethane reaction

Step-down reaction (Descending in Aldose series – Aldohexose to Aldopentose) by Ruff's method

Configuration of monosaccharides

Ring structure of Aldoses

Determination of ring size of Glucose by

(a) Methylation method
(b) Periodic oxidation method

Mutarotation of D (+) glucose

2. **Synthesis Drugs, Dyes and Sweetening Agents [3 hours]**

Synthesis and applications of

Drug: Ibuprofen, Atenlol and Adrenaline

Dyes: Orange II, Crysodine G, Auramine O

Sweetening agent: Saccharin, p-anisylurea and dulcin

UNIT-III:

1. **Synthesis of Heterocyclic Compounds containing Two Heteroatoms [6 hours]**

Synthesis of

1. Pyrazole
2. Imidazole
3. Isoxazole
4. Thiazole
5. Pyrimidine
6. Pyridiazine
7. Oxazine
8. Thiazine
9. Dioxane

2. **Ultraviolet and Visible Spectra [6 hours]**

Instrumentation; types of transition in organic molecules; auxochrome; chromophore; explanation of bathochromic shift and hypsochromic shift; hyperchromic and hypochromic effects; calculation of λ_{max} of (i) dienes and conjugated dienes; (ii) enones and dienones(iii) aromatic carbonyl system; factor affecting of UV spectral bands; application of UV.

UNIT-IV:

1. **Molecular Symmetry [12 hours]**

Introduction; symmetry element and symmetry operations with illustrations; definition of properties of group; subgroup and classes; products of symmetry operation; symmetry point group [C_1, C_s, C_i, C_n, C_{nv}, D_n, D_{nh}, D_{nd}, C_v, $D_{\alpha h}$, Td, Oh]; multiplication tables for C_{2v}, C_{3v} and C_{2h} point groups.

UNIT-V:

1. **Infrared Spectroscopy [12 hours]**

Introduction; Range of IR , theory of IR; Modes of fundamental vibration; IR active, force constant; Vibration coupling; Fermi resonance; Finger print region; Instrumentation; Application of IR; determination of structure of organic molecules From IR; Interpretation of IR for given molecules and problems.

SAURASHTRA UNIVERSITY
B.Sc. SEMESTER – V
CHEMISTRY [C-503] SYLLABUS
PHYSICAL CHEMISTRY AND ANALYTICAL CHEMISTRY
EFFECTIVE FROM JUNE-2018

UNIT-I:

1. Second law of thermodynamics [12 hours]

- Limitations of first law of thermodynamics
- Spontaneous process
- Carnot cycle & theorem
- Statements of second law of thermodynamics
- Perpetual motion of second kind (briefly)
- Concept of entropy, Definition of entropy
- ΔS in reversible & irreversible (spontaneous) process
- ΔS in ideal gases
- ΔS of mixture of ideal gas
- ΔS in physical transformations
- Entropy and second law of thermodynamics
- Physical significance of entropy

UNIT-2

1. Electrochemistry-1 [8 hours]

- Introduction
- Types of cell
- Half-cell, standard half-cell, standard cell
- Standard electrode potential
- Conventional sign and representation of cell
- emf series
- Types of electrode such as active, Innert and gas electrode
- Types of reversible electrodes
- Galvanic cell
- Hydrogen electrode, calomel electrode, glass electrode
- Reversible cell and Irreversible cell
- Nernst equation for the calculation of single electrode potential
- Examples based on theory

2. Phase rule [4 hours]

- Three component system
- Method of graphical presentation
- Types of partially miscible three liquid systems:
    1. One partially miscible pair: Effect of adding third component,Nature of tie line, Plait point, Binodae curve, Characteristics ofdiagram, A is added to binary system, A is constant and B and Cvaried.
    2. Formation of two pairs of partially miscible liquid

3. Formation of three pairs of partially miscible liquid

- Application of ternary liquid diagram

UNIT-3

1. Free energy and chemical equilibrium [8 hours]

- Work function: its physical significance and variation with V and T
- ΔG for ideal gases, Gibbs Helmholtz equation and its applications
- Free Energy: its significance & variation with P and T
- Criteria for chemical equilibrium
- Vant Hoff reaction isotherm
- Law of active mass
- ClausiusClapeyron equation

2. Colourimetry [4 hours]

- Introduction
- Grotthuss Draper law, lambert's law, Beer's law, lambert's-beer's law and Derivation, application & deviation of lambert's law
- Spectrophotometric titration with graph and proper explanation
- Deficit of absorbance by product and titrant
- Deficit of absorbance by product and reagent
- Deficit of absorbance by reagent and titrant
- Deficit of absorbance by product only

UNIT-4

1. Conductometry [9 hours]

- Electric transport , Specific conductance in metals and in electrolyte solution, equivalent conductance
- Importance of conductivity electrodes and platinization of electrodes etc.
- Variation of specific conductance with dilution as well as area of cross section of dip type electrode and distance between two plates of electrodes etc.
- Kohlrausch law and its importance, cell constant and its importance.
- Conductometric Titration:
  (1)Strong acid - strong base
  (2)Strong acid - Weak base
  (3)Weak acid – Strong base
  (4)Mixture of strong acid + Weak acid - strong base
- Precipitation Titration :
  (1) $AgNO_3$ – NaCl (2) $BaCl_2$ – K_2SO_4 (3) $Ba(OH)_2$ – $MgSO_4$
- Replacement Titration:
  (1) Salt of weak acid – strong acid
  (2) Salt of weak base – strong base
- Degree or hydrolysis and Hydrolysis constant
- Determination of solubility and solubility product of sparingly soluble salt, for the measurement of conductivity
- Importance of conductivity water and temperature for the measurement of conductivity

2. **Introduction of complexometry titration [3 hours]**
   - Method of preparation of standard EDTA solution
   - Velcher's law explanation of Pm- $\rightarrow$ EDTA Vol., Graph with stability constant value.
   - Types of EDTA titration (i) Direct, (ii) Back titration, (iii) Substitution titration(iv) Alklimetry titration mixture with the help of masking and demasking agent.
   - Principle of metal ion indicator, use of EBT, calcon, muroxide with structure and characteristics.

UNIT-5

1. **Volumetric analysis with example of calculation based on pH, normality, molarity, Ksp etc. [12 hours]**
   - Ostwald's law- Regarding indicator – necessary derivation and formulaof indicator used in Neutralization, redox, precipitation titration.
   - Primary and secondary standard explanation

   Explanation of neutralization titration with graph
   - Strong acid - Strong base titration
   - Weak acid - Strong base titration
   - Strong acid – Weak base titration
   - Poly protic acid - Strong base titration

   Redox Titration
   - Principle of external and internal indicator in redox titration.e.g. Diphenyl amine, starch & $K_3[Fe(CN)_6]$
   - Redox Titration with graph and calculation
   - Iodometry and Iodimetry titration
   - Preparation of standard sodium thiosulphate solution

   Precipitation Titration
   - Argentometric Titration (I) Mohr's method (II) Fazan'smethod (III) Volhard's method with use of proper indicator, graph and its practical application
   - Examples of calculation based on pH, Normality,Molarity,Ksp etc...

Saurashtra University
B.Sc. SEMESTER – V
CHEMISTRY PRACTICALS [C-504] SYLLABUS
[Practical Exam. would be conducted for 1 ½ days]
[Total Marks: 105 marks]
EFFECTIVE FROM JUNE-2018

1. **Organic Separation (Mixture of two compounds) [30+5 marks]**
   [Minimum 12 mixtures should be done]
   Separation & Analysis of an organic mixture containing
   (a) Two solid components using water, $NaHCO_3$, NaOH and HCl for separation
   (b) Liquid + liquid component - separation by physical method.
   (c) Liquid + solid component - separation by physical method.
2. **Inorganic Volumetric Analysis [30 marks]**
   [Minimum 8 exercises should be done]
   For volumetric exercise all the standard solutions are to be prepared by the students.
   i. Iodometry and Iodimetry
   (a) Estimation of Cu^{+2} and $CuSO_4.5H_2O$ in the given $CuSO_4.5H_2O$ using 0.05N $Na_2S_2O_3.5H_2O$ solution.
   (b) Estimation of As^{+3} and As_2O_3 in the given As_2O_3 using 0.05N $Na_2S_2O_3.5H_2O$ solution.
   ii. Complexometric titration:
   1. Estimation of the amount of Ni^{+2} in the given $NiSO_4.7H_2O$ solution using 0.02 N EDTA solutions.
   2. Estimation of the amount of Mg^{+2} and Pb^{+2} in the given solution containing a mixture of Mg^{+2} and Pb^{+2} using 0.02 N EDTA solution
   3. Estimation of the amount of Ca^{+2} and Zn^{+2} in the given solution containing a mixture of Ca^{+2} and Zn^{+2} using 0.02 N EDTA solution
   4. Estimation of the amount of Fe^{+3} and Cr^{+3} in the given solution containing a mixture of Fe^{+3} and Cr^{+3} using 0.02 N/ 0.01 M $Pb(NO_3)_2$ and 0.02 N/ 0.01 M EDTA solution.
   iii. Redox titration
   1. Determination of the amount of NO_2^{-1} in the given $NaNO_2$ or KNO_2 solution by reduction method using 0.1 N $KMnO_4$ solutions.
   iv. Water Analysis
   1. To determine the amount of chloride in the given sample of water using 0.02 N $AgNO_3$
   v. To determine the purity of $NaHCO_3$ in the given sample
3. **Physicochemical Exercise [30 marks]**
   [Minimum 10 exercises should be done]
   1. Conductometry
   i. To determine normality and gms/lit of xNHCl and also determine specific conductance by conductometry.

ii. To determine normality and gms/lit of the mixture of HCl+CH_3COOH by conductometry.
iii. To determine the normality of weak acid by conductometry
iv. To determine the concentration of Ni+2 using 0.1M EDTA solution.
v. To determine the normality of x$NAgNO_3$ using 0.5N NaCl by Conductometry.

2. Thermodynamics:

i. Calculate entropy of vaporization (ΔS_v) of a given liquid by plotting a graph of log (1/time) vs (1/temperature)

3. Refractometer

i. To determine specific refractivity and molecular refractivity of given pure liquid A, B, C, D.
ii. To determine specific refractivity and molecular refractivity of glycerine (10%, 5%, 2.5%) and unknown glycerine solution.

4. Viscosity

i. To determine relative and absolute viscosity of pure liquid A, B, C, D by Ostwald's viscometer.
ii. Preparation three different 10%, 5%, 2.5% aqueous solution of glycerine, find viscosity of these three solutions as well as unknown concentration solution with the help Ostwald's viscometer.

5. Colourimetry

i. Find out the amount of Ni^{+2} in the given solution by colourimetry method.
ii. Find out the amount of Fe^{+3} in the given solution by colourimetry method.

6. Polarimeter

i. To determine specific rotation of three different concentration (10%, 5%, 2.5%) of dextrose solution. From graph find out the unknown.
ii. Study the inversion rate of sugar in presence of 1N HCl and determine the rate of reaction.

7. Viva. [5+5=10 marks]

SAURASHTRA UNIVERSITY
B.Sc. SEMESTER-VI
CHEMISTRY [C-601] SYLLABUS
INORGANIC CHEMISTRY & INDUSTRIAL CHEMISTRY
EFFECTIVE FROM JUNE-2018

UNIT-1

Multi electron system [12 Hours]

- Introduction
- Concept of spectral terms and term symbols
- s-s coupling, l-l coupling, l-s coupling, j-j coupling and L-S couplingwith vector diagram.
- Derivation of spectral term symbol for P^1, P^2, P^3, &d^1 to d^9
- Micro states: Definition, calculation and derivation of microstates forp^1,p^2,d^1&d^2 by pigeon hole diagram
- Hund's rule for the determination of ground state spectral term
- All type of examples including calculation of S.Ms,l ML,J,MJ and microstates

UNIT-2

Crystal Field Theory-II [12 Hours]

- Jahn-Teller effect: Statement and explanation
- Tetragonal distortion with example
- Splitting of d-orbital in square planar complexes with examples
- Hole formalism
- Splitting of D and F ground terms using hole formalism
- Orgel Diagram of D and F states
- Selection rules for d-d transition
- Types of electronic transition in metal complexes
- Absorption spectrum of Ti^{+3},Cu^{+2}& Ni^{+2}

UNIT-3

1. Magneto Chemistry [6 Hours]

- Introduction (Magnetic field, Magnetic pole, Intensity ofmagnetization)
- Magnetic induction
- Permeability, intensity of magnetism, magnetic susceptibility, molar magnetic susceptibility
- Magnetic behaviour: Diamagnetism, Paramagnetism, Ferromagnetismand Antiferro magnetism
- Effect of temperature on magnetic behaviour of substances
- Derivation of equation for total angular magnetic momentum anddiamagnetic momentum
- Determination of magnetic susceptibility by Gouy method

2. Oil and Fats [6 Hours]

- Introduction
- Distinction between oils and fats and their classification
- Properties of Oils and Fats

- Manufacturing of cotton seed oil by (i) Expression method and (ii)Solvent extraction method
- Refining of crude vegetable oil; Hydrogenation of oils, Optimum conditions for the process, Dry process, Wet process
- Analysis of oils and fats; Saponification value, Acid value, Iodine value, Reichert-Meissl-Wollny (RM) value.

UNIT-4

Environmental Pollution [12 Hours]

- Environment :Definition and introduction
- Segments of environment:Atmosphere, Hydrosphere, Lithosphere,Biosphere
- Air Pollution: Introduction,Greenhouse effect, Major sources of air pollution, Photochemical smog and acid rain, CFC and ozone depletion, Sources and effects of NO_X and SO_X, Control of Air pollution
- Water pollution: Introduction and Classification of water pollution(Physical pollution, Chemical pollution, Biological pollution, Physiological pollution); Sources of water pollution(Sewage and domestic waste, Industrial effluents, Agricultural discharges, Fertilizers, Toxic metals, Siltation, Thermal pollutions, Radioactive materials); Water Pollution Control, Dissolved Oxygen (DO) determination, Chemical Oxygen Demand (COD) determination, Biological Oxygen Demand (BOD) determination

UNIT-5

Soaps and Detergents [12 Hours]

- Introduction to soap, Types of soap (Toilet soap, Transparent soap, Shaving soap, Neem soap, Liquid soap)
- Manufacturing of soap (Batch process, Continuous process)
- Recovery of glycerine from spent lye.
- Introduction to detergents
- Principal group of synthetic detergents
- Biodegradability of surfactants
- Classification of surface active agents
- Anionic detergents (Manufacture of anionic detergents (i) Oxo Process (ii) Alfol Process (iii) Welsh Process)
- Cationic detergents (Manufacture process)
- Non Ionic detergents (Manufacture by batch process)
- Amphoteric detergents
- Manufacture of shampoo

List of Reference Books

Inorganic Chemistry

1) Quantum Chemistry-R.K. Prasad, New Age International Publishers.
2) Inorganic Chemistry-James E. Huheey (3rd Edition) HarperInternational SI Edition.
3) Coordination chemistry -GurdeepChatwal and M.S. Yadav, Himalaya publishing House.
4) Principles of Inorganic Chemistry -B.R.Puri, L.R. Sharma &K.C.Kalia; Vallabh Publications, Delhi
5) Modern aspects of Inorganic Chemitry- H.J. Emeleus and A.G.Sharpe; Routledge&Kegan Paul Ltd., 39 Store street, London WCIE7DD
6) Advance Inorganic Chemistry (3rd Edition)- F.A. Cotton and G.Wilkinson; Wiley Eastern Pvt. Ltd.

Industrial Chemistry

1) Industrial Chemistry -B.K. Sharma
2) Outlines of Chemical Technology - Charles Dryden
3) Regiel's Handbook of Industrial Chemistry - James A. Kent
4) Engineering Chemistry- Jain & Jain
5) Environmental Chemistry -A.K. De
6) Environmental Chemistry -Sharma &Kaur
7) Environmental Solution of Analysis- S.M. Khopkar
8) Environment Pollution Control Engineering -Rao C.S.

SAURASHTRA UNIVERSITY
B.Sc. SEMESTER – VI
CHEMISTRY [C-602] SYLLABUS
ORGANIC CHEMISTRY AND SPECTROSCOPY
EFFECTIVE FROM JUNE-2018

UNIT-I

1. **Terpenoids:** **[7 Hours]**

   Introduction, Occurrence, Isolation, General characteristics of Terpenoids, Isoprene Rule, Constitution and Synthesis of:

   a. Citral
   b. α-Terpineol

2. **Synthetic Explosive, Perfumes and Insecticides** **[5 Hours]**

   Synthesis and uses of: Explosives:

   a. RDX (Research Department Explosive)
   b. TNT (Trinitrotoluene)
   c. PETN (Pentaerythritoltetranitrate)

   Perfumes:

   a. Musk Xylene
   b. Musk Ketone
   c. Musk Ambrette

   Insecticides:

   a. Baygon
   b. Carbendazim
   c. Parathion

UNIT-Il

1. **Amino acids, Peptides and Proteins** **[12 Hours]**

   Introduction, Classification of amino acids name and formula

   Synthesis of amino acids by:

   a. Amination of α-halogen acids
   b. Gabriel pthalimide synthesis
   c. Erlenmeyer azlactone synthesis
   d. Hydantoin method

   Physical properties of amino acids, Chemical properties of amino acids, Isoelectric point

   Introduction to Polypeptides, Synthesis of Polypeptides by:

   a. Bergmann Method
   b. Sneehan's Method (use of Phthaloyl group)
   c. Fischer's Method (use of p-toluenesulphonylchloride)

   Introduction and classification of proteins,

   Constitution of Thyroxine, Synthesis of Thyroxine

UNIT-III

1. **Polynuclear Aromatic Hydrocarbons** **[5 Hours]**

   Introduction, Classification of Polynuclear hydrocarbon, Synthesis and chemical properties:

   a. Biphenyl
   b. Diphenyl methane
   c. Naphthalene
   d. Anthracene

2. **Conformational Isomerism** **[3 Hours]**
   Conformation of cyclic system: Cyclohexane
   Conformational analysis of cyclohexane: Boat form and Chair form
   Conformation of mono-substituted and di-substituted cyclohexane
3. **Mass spectrometry** **[4 Hours]**
   Introduction, Basic principle; instrumentation; General fragmentation modes, important features for the mass spectra of alkanes (No problems)

UNIT-IV

1 **Nuclear Magnetic Resonance Spectroscopy** **[12 Hours]**
Introduction; Principle; nuclear quantum number; equivalent and non-equivalent protons with illustrations; enantiometric and diasteriometric protons; shielding and deshielding of protons; chemical shift; paramagnetic anisotropic effect; relative intensity of signals; spin- spin coupling and coupling constant; Deuterium labeling; applications of NMR; problems based on determination of structure of organic molecules from NMR spectral data

UNIT-V

1. **Problems based on UV, IR, NMR spectroscopy** **[12 Hours]**
   [Molecular Formula should be given]

Reference Books

1. Synthetic Organic Natural Products (Volume I & II) by O.P Agrawal.
2. Organic Chemistry of Natural Products by GurudeepChatwal
3. A Text Book of Organic Chemistry by Raj K. Bansal
4. Organic Chemistry by Clayden
5. Medicinal Chemistry by Ashutoshkar
6. Pharmaceutical Chemistry by Axel Kleemann&Jugen Engel
7. Organic Name reactions by GautamBrahmachari
8. Organic Reaction Mechanisms by V.K. Ahluwalia
9. Reactions and Rearrangements by GurdeepChatwal
10. Name Reactions in Organic Synthesis by Dr. A.R.Parikhet. al
11. Chemical application of group theory by F Albert Cotton
12. Symmetry in chemistry by H.N. Jhaffe
13. Spectrometric identification of organic compounds by Silverstien, Bassler and Morril
14. Elementary organic spectroscopy by Y.R Sharma
15. Spectroscopy of organic compounds by John R Dyer
16. Spectroscopy of organic compounds by PS Kalsi
17. Molecular Spectroscopy by B.K.Sharma
18. Organic Spectroscopy by B.K.Sharma

SAURASHTRA UNIVERSITY
B.Sc. SEMESTER – VI
CHEMISTRY [C-603] SYLLABUS
Physical Chemistry and Analytical Chemistry
EFFECTIVE FROM JUNE-2018

UNIT-I

1. Activity of Electrolytes [8 Hours]

- Ionic Activity: Introduction
- Derivation of $a_2 = a_+^{\vartheta +} a_+^{\vartheta -}$ and $a_2 = a_+ a_-$ for 1-1 electrolyte.
- Mean activity and its relation with a_+ and a_-
- Relationship between a_2 and $a_\pm$ i.e. $a_2 = at$
- Mean ionic activity coefficient f_t and f_+ ,ionic strength : Definition, explanation, equation Debye Huckel limiting law (without derivation)
- Derivation of $-\log f_\pm = Az_+z_-\mu^{½}$
- Interpretation of equation
- Graph of $-\log f_\pm \rightarrow \mu 1/2$ and its explanation/discussion
- Empirical correction of Debye Huckel limiting law of (i) Size of ion and (ii) Orientation of solvent molecules, Methods to determine Activity coefficient
- Solubility method
- Emf method
  - chemical cell with transference
  - concentration cell without transference
- Examples based on theory

2. Third Law of Thermodynamics [4 Hours]

- Nernst heat theorem
- Third law of thermodynamics
- Determination of absolute entropies of solids, liquids and gases
- Applications of third law of thermodynamics (ΔS^0, ΔG^0 and equilibrium constant of chemical reaction)
- Tests of third law of thermodynamics, Residual entropy.

UNIT II

1. Electrochemistry-2 [12 Hours]

- Concentration cells: Definition, (1) Electrode concentration cells (2)Electrolyte concentration cells
- Concentration cells without transference
- Concentration cells with transference
- Liquid junction potential, Elimination of liquid junction potential.
- Applications of emf measurements:
  Determination of
  1) Solubility of sparingly soluble salts
  2) Valency of metal ion
  3) Dissociation constant of weak acid
  4) Transport number of ion

5) Ionic product of water
6) Degree of hydrolysis
7) pH by different electrodes

- Example

UNIT III

1. Partial Molar Properties [4 Hours]

- Definition
- Concept of chemical potential, Gibbs-Duhem equation
- Variation of chemical potential with temperature and pressure
- Determination of partial molar properties by method of intercept
- Applications of chemical potential (Henry's law, Rault's law and Nernst's distribution law)

2. Error and statistics [8 Hours]

- Introduction, Explanation of errors & mistake
- Classification of errors, Determinate and indeterminate errors, Operational and personal error, Instrumental errors and reagent errors, additive and proportional error.
- Accuracy and precision, minimization of error
- Calibration of Instruments , blank measurement , independent method parallel method, Standard addition method
- Explanation of Significant figure and its laws with completeInterpretation
- Mean and standard deviation , variance and coefficient of variance
- Absolute error and relative error, mean value, deviation and relativeMean deviation. Gausian curve and its explanation
- Importance of Q – test and T -test (Student T-test)
- Example on errors, significant figures, Q test & T-tests.

UNIT IV

1. Chromatography [12 Hours]

- Introduction,
- Classification of chromatography - types of chromatography
- Detail study of
  (a) Adsorption (Column) chromatography
  (b) Partition chromatography – paper and TLC.
  (c) Gas chromatography- GLC & GSC.
  (d) Ion exchange chromatography.
- Application such as main physical characteristic of chromatography: Solubility, adsorption value, volatility, Rf value, Rx value, nature of adsorption etc.
  a. Column chromatography: Principle, Method of separation of green leafpigment, mixture of inorganic salts, vitamins,colors of flowers etc. separation of α,β,γ carotene from carrot.
  b. Partition chromatography:

- **Paper chromatography:**Principle of paper chromatography, Experimental methods like :Ascending and Descending method containing one dimensional and two dimensional method; circular method and its Rf value , Rx value; circular method, separation of amino acids and metal ions(Fe^{+} , Co^{+2}, $Ni^{+2)}$ mixture using spray reagent ninhydrine and aniline phthalate
- **TLC:**Principle, Method of preparation of chromatoplate, Experimental techniques, superiority of TCL over other chromatographic Techniques, Application of TLC.

c. Gas chromatography; Principle of GLC and GSC,

- GLC:Instrumentation, Evaluation selection and characteristic of carrier gas, Effect of temperature& pressure of gas, application
- GSC:Methods and its application.

d. Ion Exchange chromatography: Principle, Type of resins, Properties of ion exchange resins, Basic requirement of useful resins, Method of separation with illustration curve, Application of ion exchange resins

UNIT V

1. Basic principle of qualitative analysis [3 Hours]

Separation of the following in presence of each other

(i)	Cl^{-1} , Br^{-1} , I^{-1}	(ii)	NO_2^{-1} ,NO_3^{-1} , Br^{-1}
(iii)	S^{-2} , SO_3^{-2} , SO_4^{-2}	(iv)	PO_4^{-3} , AsO_3^{-3} , AsO_4^{-3}
(v)	CO_3^{-2} , SO_3^{-2} , S^{-2}	(vi)	Cu^{+2} , Cd^{+2}

2. Potentiometry and pH metry: [9 Hours]

- Introduction and interpretation of pH metry and potentiometry.
- Importance of indicator and reference electrode in the measurement of EMF and pH
- E.M.F. method:
  - (i) Study of acid-base Titration
  - (ii) Redox Titration
  - (iii) Argentometric titration include mixture of Cl^{-}, Br^{-}, I^{-} with graph and proper explanation.
- pH metry :

  Definition,Interpretation of various methods of determining pH value like pH paper method, potentiometric method using only hydrogen electrode as indicator electrode and calomel electrode as reference electrode to determine pH value
- Weak acid-strong base titration with curve and determination of dissociation constant (Ka) of weak acid.

Reference Books for Physical Chemistry

1. Elements of Physical Chemistry by Samuel Glasstone and D lewis
2. Principles of Physical Chemistry by SH Maron and CF Prutton
3. Thermodynamics for Chemists by Samuel Glasstone
4. Elements of Physical Chemistry by BR Puri, LR Sharma, MS Pathania
5. Advanced Physical Chemistry by JN Gurtu
6. Physical Chemistry by N Kundu and SK Jain
7. Physical Chemistry by KL Kapoor
8. Physical Chemistry by BK Sharma
9. Thermodynamics by Gurudeeep Raj
10. Introduction to electrochemistry by S. Gladstone

Reference Books **for Analytical Chemistry**

1. Fundamental of analytical chemistry by Skoog& West
2. Instrumental Method & Chemical Analysis by B.K. Sharma Analytical
3. Water Analysis and Water pollution by V.P. Kudesia
4. Instrumental Method & Chemical Analysis by ChatwalAnand
5. Thin layer chromatography by Egal Stall
6. Book for Water Analysis by R. K. Trivedi, V. P. Kudesia
7. Analytical Chemistry by Dick
8. Inorganic Qualitative analysis by Vogel and Gehani Parekh
9. Electrometric Methods of analysis by Browning
10. Principle of instrumental analysis by Skoog

SAURASHTRA UNIVERSITY
B.Sc. SEMESTER-VI
CHEMITRY PRACTICAL [C-604] SYLLABUS
[PRACTICAL EXAMINATION WOULD BE CONDUCTED FOR 1 ½ DAYS]
[TOTAL MARKS: 105 MARKS]
EFFECTIVE FROM- JUNE-2018

1. **Inorganic Qualitative Analysis (six radicals)** **[30 marks]**
   [Minimum 12 inorganic mixtures should be analyzed]
   To analyze the given inorganic mixture containing six radicals

2. **Organic Synthesis** **[35 marks]**
   (Percentage of yield, crystallization, melting point)
   [Minimum 8 syntheses should be done]
   - **i. Acetylation / Benzoylation**
     1. Acetylation of salicylic acid
     2. Acelytation of aniline
     3. Acelytation of phenol
     4. Benzoylation of aniline
     5. Benzoylation of phenol
   - **ii. Aliphatic Electrophilic substitution**
     1. Preparation of iodoform from ethanol
     2. Preparation of iodoform from acetone
   - **iii. Aromatic Electrophilic Substitution**
     Nitration:
     1. Preparation of m-dinitrobenzene,
     2. Preparation of nitro acetanilide.

     Halogenation:
     1. Preparation of p-bromo acetanilide,
     2. Preparation 2:4:6 -tribromo phenol
   - **iv. Diazotization / Coupling**
     1. Preparation of methyl orange
     2. Preparation of methyl red
   - **v. Oxidation**
     Preparation of benzoic acid from benzaldehyde

3. **Physicochemical Exercise** **[30 marks]**
   [Minimum 10 exercises should be done]
   - **i. pH metry**
     1. To determine normality and gms/lit. of xNHCl by pH metry
     2. To determine normality and dissociation constant of weak acid ($xNCH_3COOH$) by pH metry.
     3. To determine normality and dissociation constant of dibasic acid (xN oxalic acid/malonic acid/maleic acid) using 0.1N NaOH solution.

ii. Potentiomentry

1. To determine normality and dissociation constant of benzoic acid used 0.1N NaOH.
2. To determine normality of given acid xNHCl using NaOH solution.
3. To determine concentration of xN FAS using $K_2Cr_2O_7$.
4. To determine normality of each halide in the mixture using 0.1N $AgNO_3$ solution.

iii. Surface tension:

1. Find the surface tension of the liquids A, B and C by using drop weight method. Find the value of parachor of liquid and CH_2 group.

iv. Chromatography

1. To determine Rf value of individual and mixture of amino acid by ascending paper chromatography.
2. To determine Rf value of individual and mixture of amino acid by circular paper chromatography.
3. To determine Rf value of individual and mixture of amino acid by thin layer chromatography (TLC).
4. To determine Rf value of individual and mixture of metal ions by ascending paper chromatography.
5. To determine Rf value of individual and mixture of metal ions by circular paper chromatography.

4. Viva (5+5) [10 Marks]

SAURASHTRA UNIVERSITY
B.Sc. SEMESTER-V and VI
PAPER STYLE – THEORY
EFFECTIVE FROM- JUNE-2018

Instructions to paper setters

1. B. Sc. Chemistry Syllabus for Semester V & VI consists of **FIVE** units each
2. All the units carry equal weightage (14 Marks each)
3. There must be one question from each unit.
4. Each subtopic must be given due weightage in question paper
5. 70 Marks for Semester Examination & 30 marks for Internal Examinations.
6. Time duration: 2 ½Hours

Question 1: Answer the following (UNIT-I)

a. Four objective questions each of one Mark :1x4 = 4
b. Answer any one out two each of two Marks :1x2 = 2
c. Answer any one out two each of three Marks :1x3 = 3
d. Answer any one out two each of five Marks :1x5 = 5

Total Marks: 14

Question 2: Answer the following (UNIT-II)

a. Four objective questions each of one Mark :1x4 = 4
b. Answer any one out two each of two Marks :1x2 = 2
c. Answer any one out two each of three Marks :1x3 = 3
d. Answer any one out two each of five Marks :1x5 = 5

Total Marks: 14

Question 3: Answer the following (UNIT-III)

a. Four objective questions each of one Mark :1x4 = 4
b. Answer any one out two each of two Marks :1x2 = 2
c. Answer any one out two each of three Marks :1x3 = 3
d. Answer any one out two each of five Marks :1x5 = 5

Total Marks: 14

Question 4: Answer the following (UNIT-IV)

a. Four objective questions each of one Mark :1x4 = 4
b. Answer any one out two each of two Marks :1x2 = 2
c. Answer any one out two each of three Marks :1x3 = 3
d. Answer any one out two each of five Marks :1x5 = 5

Total Marks: 14

Question 5: Answer the following (UNIT-V)

a. Four objective questions each of one Mark :1x4 = 4
b. Answer any one out two each of two Marks :1x2 = 2
c. Answer **a**ny one out two each of three Marks :1x3 = 3
d. Answer any one out two each of five Marks :1x5 = 5

Total Marks: 14