**Deccan Education Society's**

# Fergusson College (Autonomous), Pune - 411004

## Syllabus under Autonomy

## for

## S. Y. B. Sc. Chemistry

## From Academic Year 2017-18

| Particulars | Name of Paper | Paper Code | Title of Paper | Type of Paper | No. of Credits |
|---|---|---|---|---|---|
| S. Y. B. Sc. Semester III | Theory Paper - 1 | CHE2301 | Chemical Kinetics and QuantitativeAnalysis of Organic Compounds | CORE-1 | 3 |
| | Theory Paper - 2 | CHE2302 | Reaction Mechanism and Principlesof Metallurgy | CORE- 2 | 3 |
| | Practical Paper - 1 | CHE2303 | Inorganic and Analytical Chemistry Practicals | PCORE-1 | 2 |
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| S. Y. B. Sc. Semester IV | Theory Paper - 3 | CHE2401 | Thermodynamics and Volumetric Analysis | CORE-3 | 3 |
| | Theory Paper - 4 | CHE2402 | Introduction of Bio-molecules and Coordination Chemistry | CORE-4 | 3 |
| | Practical Paper - 2 | CHE2403 | Physical and Organic Chemistry Practicals | PCORE-2 | 2 |

# S.Y. B.Sc. (Chemistry) Semester III

## Chemistry Paper - 1 (CHE2301): Chemical Kinetics and Quantitative Analysis of Organic Compounds

**[Credits-3]**

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**Objectives:**

1. Concept of kinetics, terms used, rate laws, types of order, difference between order and molecularity
2. To know the meaning of terms catalyst, catalysis, positive catalysis and negative catalysis.
3. Concept of distribution of solute amongst pair of immiscible solvents
4. Chemical analysis and its applications
5. Meaning of error and terms related to expression & estimation of errors.
6. Basic principles in qualitative analysis
7. Classification of compounds with different functional groups
8. Solving Numerical Problems

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| **Unit-I** | **Chemical Kinetics**<br>Introduction to Chemical kinetics, molecularity and order of reaction, reaction rates, rate laws, rate constant and its significance, Integrated rate law expression and its characteristics – zero order, first order, second order equal and unequal initial concentrations, differential rate laws for half-integral order reactions, pseudo molecular reactions, factors affecting rate of reaction, determination of order of reaction, collision theory of reaction rates (Arrhenius equation and non Arrhenius behaviour), transition state theory, numerical. | **14** |
| **Unit-II** | **Catalysis**<br>Types of catalysis, homogenous and heterogeneous catalysis, characteristics of catalytic reactions, promoters and catalytic poisoning, autocatalysis, negative catalysis, activation energy and catalysis, Theories of catalysis (Intermediate compound formation theory and adsorption theory), Acid-base catalysis, enzyme catalysis MichaelisMenten mechanism, Km, $r_{max}$ and its characteristics, numericals. | **6** |
| **Unit-III** | **Distribution Law**<br>Nernst distribution law, Statement and thermodynamic proof for Nernst distribution law, Limitation of distribution law, association and dissociation of solute in solvent (modification in distribution law), application of distribution law, Numericals. | **4** |
| **Unit-IV** | **Introduction to Analytical Chemistry** Introduction, chemical analysis, applications of chemical analysis, sampling, types of analysis, common techniques, instrumental methods, other techniques, factors affecting on choice of method. | **3** |

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| **Unit-V** | **Errors in Quantitative Analysis**<br>Introduction, Error, accuracy, precision, methods of expressing accuracy and precision, classification of errors, significant figures and computations, distribution of random errors, mean and standard deviations, reliability of results, numericals. | **5** |
| **Unit-VI** | **Inorganic Qualitative Analysis**<br>Basic principle, common ion effect, solubility, solubility product, preparation of original solution, classification of basic radicals in groups, separation of basic radicals, removal of interfering anions (phosphate and borate), detection of acidic radicals. | **8** |
| **Unit-VII** | **A. Qualitative Analysis**:<br>Types of organic compounds, characteristic tests and classifications, reactions of different functional groups, analysis of binary mixtures.<br><br>**B. Quantitative Analysis**:<br>Analysis–estimation of C, H, (O) by combustion tube, detection of nitrogen, sulfur, halogen and phosphorous by Lassigen's test, estimation of nitrogen by Dumas's Kjeldahl's method, estimation of halogen, sulphur and phosphorus by Carius Method, determination of empirical and molecular formula, numerical problems. | **3**<br><br>**5** |

**Text Books:**

1. Principles of Physical Chemistry. By Maron and Pruton 4th Ed. Oxford and IBH publication
2. Essentials of Physical Chemistry. By Bahl and Tuli, Reprint edition 2014.
3. Fundamentals of Analytical Chemistry by Skoog, West, Holler and Crouch
4. A textbook of macro & semi micro qualitative analysis by A.J. Vogel, fifth edition
5. Quantitative Organic Analysis, fourth edition, A.J. Vogel, ELBS

**References:**

1. Castellan, G. W. Physical Chemistry 4th Ed. Narosa, 2004.
2. Engel, T. & Reid, P. Physical Chemistry 3rd Ed. Pearson, 2013.
3. Atkins, P.W. & Paula, J. Physical Chemistry, 10th Ed., Oxford University Press, 2014
4. Analytical Chemistry by G.D. Christian, sixth edition.
5. Vogel's textbook of Quantitative Analysis, sixth edition J. Mendham, R.C. Denney, J.D. Barnes, and MJK Thomas

# S.Y. B.Sc. (Chemistry) Semester III

**Chemistry Paper - 2 (CHE2302): Reaction Mechanism and Principles of Metallurgy**

**[Credits-3]**

**Objectives:**

1. To learn types of reaction mechanisms, name reactions and rearrangements.
2. To learn different configurations and stability of cycloalkanes
3. Basic principles of Metallurgy, ores and minerals
4. To know the different theories of acids and bases.
5. Recapitulation of periodic table, skeleton of long form of periodic table
6. Compounds of s-block and p-block elements

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| **Unit-I** | **Reaction Mechanism:**<br>Introduction, types of reagents, electrophile, nucleophile and free radical. Types of organic reactions: Addition, Elimination (□-elimination and Hofmann elimination), substitution (aliphatic electrophilic and nucleophilic, aromatic electrophilic) and rearrangement. Mechanism: (i) Markovnikov and anti-Markovnikov addition reaction (ii) Saytzeff and Hoffmann elimination (iii) SN1 , SN2and SNi reactions | **6** |
| **Unit-II** | **Name Reactions and Rearrangements:**<br>Mechanisms of: Reimer–Tiemann, Kolbe's–Schmidt Reactions, haloform reaction, Aldol, Knoevenagel condensation, Claisen-Schmidt, Perkin, Cannizzaro and Wittig reaction, Benzoin condensation, Dieckmann and Reformatsky reactions. Pinacol-Pinacolone, Beckmann and Benzil-Benzilic acid, and Baeyer Villiger oxidation, Claisen condensation, Hofmann bromamide degradation and Curtius, Fries rearrangements. | **10** |
| **Unit-III** | **Stereoisomerism :**<br>Recapitulation of Stereochemistry in general, Baeyer's strain theory, Conformation and stability of cyclohexane, mono and disubstituted cyclohexane with $CH_3$ groups. Locking of conformation.$E_2$-Elimination reactions in substituted cyclohexane (cis and trans 1-bromo-2-methyl cyclohexane).<br>. | **8** |
| **Unit-IV** | **Acids, Bases and Solvents:**<br>Definition of acids and bases, Arrhenius theory, Brönsted-Lowry concept of acid-base reactions, solvated proton, relative strength of acids, levelling solvents, Lewis acid-base concept, Classification of Lewis acids, Lux-Flood theory, strength of acids and bases, trends of hydracids and oxyacids, Properties of solvents,Hard and Soft Acids and Bases (HSAB) Application of HSAB principle. | **8** |

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| **Unit-VI** | **Chemistry of *s* and *p* Block Elements:**<br>Position of elements in periodic table, electronic configuration, trends in properties like atomic size, ionization potential, electro-negativity, relative stability of different oxidation states, anomalous behavior of first member of each group, Inert pair effect. Crown ethers and cryptans, separation of s-block elements using crown ethers. Compounds of s-block elements: oxides, hydroxides, peroxides, super oxides. Study of the following compounds with emphasis on structure and bonding - Borate, Boron nitrides, Diborane, Halides of aluminum, Allotropes of carbon, Silanes, Oxyacids of phosphorous and sulphur, Inter -halogen compounds | **10** |
| **Unit-VII** | **General Principles of Metallurgy:**<br>Occurrence of metals, ores and minerals, types of ores, operations involved in metallurgy, crushing, concentration, various methods of concentration such as hand picking,gravity separation, magnetic separation. Froth flotation, Calcinations, Roasting etc.Reduction, various methods of reduction such as smelting, Aluminothermic process and electrolytic reduction, Refining of metals, Electrolytic process, van Arkel-de and Mond's process, Zone refining. | **6** |

**Text Books:**


1. Organic Chemistry by Stanley Pine McGraw-Hill Book Company.5th edition
2. Organic Chemistry by Morrison Boyd &Bhattacharjee Pearson Education, 7th Ed.
3. Concise Inorganic Chemistry by J.D. Lee, 5thedition.
4. Inorganic Chemistry J. House, Academic Press 2nd Edition.


**References:**


1. Organic Chemistry by Paula Bruice Pearson Higher Education 7th edition.
2. Organic Chemistry by Clayden, Greeves, Oxford press.
3. Stereochemistry of carbon compounds - E. L. Eliel
4. StereochemistryConformation and Mechanism, Kalsi, P. S. New Age International.
5. Reactions, rearrangements and reagents – S N Sanyal.
6. Inorganic Chemistry, D.F. Shiver & P.W. Atkins- C. H. Longford ELBS - 2ndedition.
7. Basic Inorganic Chemistry, F.A. Cotton and G. Wilkinson, Wiley Eastern Ltd 1992.
8. Concept and Model of Inorganic Chemistry by Douglas – Mc Daniels - 3rdedition.
9. Chemistry by Raymond Chang - 5thedition.
10. Inorganic Chemistry by A. G. Sharpe - 3rd edition.
11. Fundamental Chemistry by A. K. Dee.(3rdEd.)
12. Advanced Inorganic Chemistry, Satyaprakash, Tuli, Basu.
13. Text book of Inorganic Chemistry, P.L. Soni.

# S.Y. B.Sc. (Chemistry) Semester III

## Chemistry Paper - 3 (CHE2303): Inorganic and Analytical Chemistry Practicals

**[Credits-2]**

**List of Practical: Any ten experiments from the list of experiments**

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| **Inorganic Qualitative Analysis (Any Four)** | |
| 1. | Two simple mixtures (without phosphate or borate) |
| 2. | Three Mixtures containing $PO_4^{3-}$ (With $PO_4^{3-}$ removal) |
| 3. | Three Mixtures containing $BO_3^{3-}$ (With $BO_3^{3-}$ removal) |
| **Preparation of Coordination Complexes and Yield (Any One)** | |
| 4. | Preparation of $[Cu(NH_3)_4]SO_4.H_2O$ |
| 5. | Preparation of $[Ni(NH_3)_6]Cl_2$ |
| **B. Analytical Chemistry Practicals (Any Five)** | |
| 6. | Determination of Ca in presence of Mg using EDTA. |
| 7. | a) Preparation of standard 0.05N oxalic acid solution and standardization of approx 0.05N $KMnO_4$ solution.<br>b) Determination of the strength of given $H_2O_2$ solution with standard 0.05N $KMnO_4$solution. |
| 8. | a) To determine the amount of Aspirin from a given tablet.<br>b) To finds the absolute error & relative error with reference to the mean of analysis.<br>c) To find the standard deviation & relative standard deviation with reference to the mean of analysis. |
| 9. | Estimation of Nickel/Aluminum from the given salt solution by using Eriochrome Black-T indicator (Back titration method). |
| 10. | To determine the amount of copper from the given solution iodometrically. |
| 11. | a) To choose the best indicator in the titration between standard 0.05N oxalic acid solution & approx. 0.05N NaOH.<br>b) To standardize the approx. 0.05N NaOH solution against standard 0.05N oxalic acid solution using best indicator.<br>c) To determine the amount of acetic acid in commercial vinegar by titrating with approx. 0.05N NaOH solution using selected best indicator. |
| 12. | To find out the amount of Acetone in the given solution iodometrically. |
| 13. | Report of one day industrial study tour [either in semester III or IV]. |
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**References:**

1. Analytical Chemistry by G. D. Christian 6th Edition.
2. Vogel's Textbook of Quantitative Chemical Analysis 6th Edition by R. C. D. Denney, J. D. Barnes, M. J. K. Thomas.
3. Quantitative Organic Analysis, Fourth Edition, A. J. Vogel, ELBS

# S.Y. B.Sc. (Chemistry) Semester IV

**Chemistry Paper - 1 (CHE2401): Thermodynamics and Volumetric Analysis**

**[Credits-3]**

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**Objectives:**

1. Thermodynamic terms and basic concept: system boundary, surroundings, thermodynamic systems, thermodynamic process, nature of heat and work, internal energy, first law of thermodynamics(mathematical expression), molar heat capacities, relation between $C_p$ and $C_v$, Joule Thomson effect and numericals
2. Free energy concepts, types and its variation
3. Ideal and non-ideal solutions and laws governing these solutions
4. Solving Numericals
5. Meaning of equivalent weight, molecular weight, normality, molality, primary & secondary standards, different way to express concentrations of the solution.
6. Types instrumental and non-instrumental analysis
7. Role of indicators.

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| **Unit-I** | **Chemical Thermodynamics**<br>Thermodynamic Terms: System, Boundary, Surroundings, Homogenous and heterogeneous systems, Types of thermodynamic systems, Intensive and extensive properties, States of systems (equilibrium and non-equilibrium states), Thermodynamic process, Reversible and irreversible process, Nature of heat and work, Internal energy, First law of thermodynamics, Carnot cycle, enthalpy of system, molar heat capacities, Adiabatic expansion of an ideal gas, work done in Adiabatic reversible expansion<br>Second law of thermodynamics: spontaneous process, entropy, standard entropy of formation | **8** |
| **Unit-II** | **Free Energy and Equilibrium**<br>Introduction, Helmholtz free energy, variation of Helmholtz free energy with volume and temperature, Helmholtz free change energy for chemical reaction, Gibb's free energy, Variation of Gibb's free energy with pressure and temperature, Gibb's free energy change for chemical reaction, Free energy change for physical transitions, Free energy change for an ideal gas; standard free energy change, Gibb's-Helmholtz equation, Properties and significance of Gibb's free change, Van't Hoff reaction isotherm, thermodynamic equilibrium constants, Relation between Kp and Kc for gaseous reactions, variation of equilibrium constant with temperature, Criteria for chemical equilibrium, Physical equilibrium, Clapeyron equation, Clausius–Clapeyron equation, Application of Clausius– Clapeyron equation, numericals. | **8** |

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| **Unit-III** | **Solutions**<br>Ways of expressing concentration, Solutions of gases in gases, Henry law, Solution of liquids in liquid , Types of solutions, Ideal solutions, Raoult's law, ideal and non ideal solutions, Henry's law, Application of Henry's law with example $CS_2$ in acetone, problems based on Raoult's law and Henry's law, vapor pressure–composition diagram of ideal and non ideal solution, temperature composition diagram of miscible binary solutions, distillation from temperature–composition diagram, Azeotropes, Theory of fractional distillation, steam distillation, solutions of solids in liquid. | **8** |
| **Unit -IV** | **Introduction to Volumetric Analysis**<br>Introduction, methods of expressing concentrations, primary and secondary standard solutions, Apparatus used and their calibration: burettes, micro burettes, volumetric pipettes, graduated pipettes, volumetric flask, methods of calibration, Instrumental & non-instrumental analysis, principles & types. | **5** |
| **Unit -V** | **Non Instrumental Volumetric Analysis**<br>**i. Introduction**<br>Introduction of volumetric (titrimetric) analysis, titrant, titrand, direct titration, indirect titration-back and blank titration<br><br>**ii. Acid–Base Titrations**<br>Acid base indicators, Ostwald's Theory of acid base indicators, mixed and universal indicators Strong acid–Strong base, Weak acid–strong base, Weak acid-Weak base titration, Displacement titrations, polybasic acid titrations. (Discuss titration with respect to neutralization and equivalence point determination, titration curves and limitations)<br><br>**iii. Redox Titrations**<br>Principle of redox titration, detection of equivalence point using suitable indicators, Titration of oxalic acid vs $KMnO_4$, Application- Estimation of Fe(II) & $H_2O$<br><br>**iv. Complexometric Titrations**<br>Principle, Mg-EDTA titration, Role of Metal ion indicators in EDTA titration, choice of indicators, Applications, Estimation of Al (III) & Nickel.<br><br>**v. Iodometric Titration: Iodometry (Direct and Indirect Titration)**<br>Principle, detection of end point, difference between iodometry and iodimetry, Standardization of sodium thiosulphate solution using potassium dichromate and iodine method, Applications, estimation of Cu , estimation of Acetone. | **19** |

**Text Books:**

1. Principles of Physical Chemistry. By Maron and Pruton 4th Ed. Oxford and IBH publication
2. Essentials of Physical Chemistry. By Bahl and Tuli, Reprint edition 2014.
3. Chemical thermodynamics by R. P. Rastogiamd R.P. Misera
4. Fundamentals of Analytical Chemistry by Skoog, West, Holler and Crouch
5. A textbook of macro & semi micro qualitative analysis by A.J. Vogel, fifth edition
6. Quantitative Organic Analysis, fourth edition, A.J. Vogel, ELBS

**References:**

1. Elements of Chemical thermodynamics, L.K Nash 2nd Ed.
2. Chemical Thermodynamics by M. Roy.
3. Castellan, G. W. Physical Chemistry 4th Ed. Narosa, 2004.
4. Engel, T. & Reid, P. Physical Chemistry 3rd Ed. Pearson, 2013.
5. Atkins, P.W. & Paula, J. Physical Chemistry, 10th Ed., Oxford University Press, 2014
6. Analytical Chemistry by G.D. Christian, 6th Edition.
7. Vogel's Textbook of Quantitative Analysis, 6th Edition J. Mendham, R. C. Denney, J. D. Barnes, and MJK Thomas

# S.Y. B.Sc. (Chemistry) Semester IV

## Chemistry Paper - 2 (CHE2402): Introduction of Bio-molecules and Coordination Chemistry

**[Credits-3]**

**Objectives:**

1. To learn the uses, merits and demerits of different reagents
2. To learn concept of aromaticity.
3. To learn the reactions and synthetic route for preparation of heterocyclic compounds
4. To Understand the reactions and importance of biochemistry of carbohydrates and amino acids.
5. To understand the Werner's formulation of complexes and identify the ionisable ions.
6. Be able to give the IUPAC name the co-ordination compound.
7. Be able to define, explain and draw various types of isomerism in complexes.
8. To know position of d-block elements and noble gas elements in periodic table.
9. Bonding and structures of important compounds
10. To know the impact of toxic chemicals

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| **Unit-I** | **Reagents in Organic Synthesis**<br>Reducing agents: Catalytic hydrogenation homogenous and heterogeneous, Birch reduction, Bouvaelt-Blanc Reduction, $NaBH_4$, $LiAlH_4$, Sn/HCl, $NH_2NH_2$/OH, baker's yeast.<br>Oxidizing agents: $KMnO_4$, $K_2Cr_2O_7$, Jones reagent, PDC, PCC, Per acids, $OsO_4$, Prevost oxidation, $MnO_2$ and $SeO_2$. | **8** |
| **Unit-II** | **Chemistry of Heterocyclic Compounds with One Hetero Atom**<br>Classification and nomenclature, Structure, aromaticity in 5-numbered and 6-membered rings containing one heteroatom; Synthesis, reactions and mechanism of substitution reactions of: Furan, Pyrrole (Paal-Knorr synthesis, Knorr pyrrole synthesis and Hantzsch synthesis), Thiophene, Pyridine (Hantzsch synthesis), Nitration, Sulphonation, Acylation and Catalytical reduction, Fischer indole synthesis, Synthesis of quinoline (Skraup synthesis) and isoquinoline (Pictet-Spengler reaction and Bischler-Napieralski reaction) | **8** |
| **Unit-III** | **Introduction of Bio-Molecules**<br>Carbohydrates: Definition, classification, reaction of monosaccharide (glucose)- oxidation, reduction, osazone and ester formation, isomerization, Killiani-Fischer synthesis and Ruff degradation, D/L configuration of (+) Glucose, Fischer-Haworth and chair formulae, Brief account of disaccharides: Sucrose, cellobiose, maltose and lactose, Polysaccharides: Starch, cellulose and glycogen.<br>Amino acids: Fischer projection, relative configuration, classification, structures and reactions of amino acids, Properties and chemical reactions with amino and carboxylic group, Peptide linkage. | **8** |
| **Unit-IV** | **Coordination Chemistry**<br>Werner's theory, valence bond theory (inner and outer orbital complexes), electroneutrality principle, back bonding, Sidgwick's theory, | **8** |

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| | EAN Rule, IUPAC Nomenclature of coordination compounds, Isomerism, Types of Isomers (Structural isomerism-ionization, hydrate, linkage, ligand, coordination position and polymerization and Stereoisomerism). | |
| **Unit-V** | **Chemistry of d-Block Elements:** Position of d-block in periodic table, electronic configuration, trends in properties of these elements w.r.t. (a) size of atoms & ions (b) catalytic activity (c) variable oxidation states (d) complex formation ability (e) colour (f) magnetic properties (g) non-stoichiometry | **6** |
| **Unit-VI** | **Noble Gases:** Occurrence and uses, rationalization of inertness of noble gases, Clathrates, structure and properties of $XeF_2$, $XeF_4$ and $XeF_6$ Molecular shapes of noble gas compounds, oxide and oxoflurides (VSEPR Theory) | **4** |
| **Unit-VII** | **Chemical Toxicology** Metal ions present in biological systems, classification of elements according to their action in biological system. Excess and deficiency of some trace metals. Biochemical effect of toxic chemicals, Toxicity of metal ions (Hg, Pb, Cd and As), reasons for toxicity, Biological methylation | **6** |

**Text Books:**


1. Organic Chemistry by Stanley Pine McGraw-Hill Book Company5th edition.
2. Organic Chemistry by Morrison Boyd &Bhattacharjee Pearson Education 7th Ed.
3. Concise Inorganic Chemistry by J. D. Lee - 5thedition.
4. Coordination Chemistry2009D. Banerjea
5. Inorganic Chemistry, P.L. Soni.


**References:**


1. Organic Chemistry by Paula Bruice Pearson Higher Education 7th edition.
2. Organic Chemistry by Clayden, Greeves, Oxford press.
3. Reactions, rearrangements and reagents – S N Sanyal.
4. Heterocyclic Chemistry by Joule and Keith Mills, Wiley-Blackwell 4th edition
5. Biochemistry by Satyanaryana Elsevier 4th edition
6. Organic Chemistry-7th Ed. Morrison, Boyd &Bhattacharjee Pearson Education, 2011
7. Outline of Biochemistry 5th Ed., Conn, StumpfBruening& Roy Doi John Wiley 1987
8. Stereochemistry of carbon compounds - E. L. Eliel
9. Heterocyclic Chemistry 5th Ed. John A. Joule and Keith Mills, Wiley-Blackwell 2010
10. Reactions, rearrangements and reagents – S N Sanyal
11. Inorganic Chemistry, D. F. Shiver & P.W. Atkins- C H. Longford ELBS - 2ndedition.
12. Basic Inorganic Chemistry, F. A. Cotton and G. Wilkinson, Wiley Eastern Ltd 1992.
13. Concept and Model of Inorganic Chemistry by Douglas, Mc Daniels, 3rdedition.
14. Chemistry by Raymond Chang, 5thedition.
15. Inorganic Chemistry by A. G. Sharpe, 3rd edition.
16. Fundamental Chemistry by A. K. Dee (3rdEd.)
17. Advanced Inorganic Chemistry, Satyaprakash, Tuli, Basu.

# S. Y. B. Sc. (Chemistry) Semester IV

## Chemistry Paper - 3 (CHE2403): Physical and Organic Chemistry Practicals

**[Credits-2]**

**List of Practicals: Any eight experiments from the list and Hobby project/Poster/ Any other activity (**equivalent to 2 experiments)

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| **A. Physical Chemistry Practicals (Any Five)** | |
| 1. | To determine critical solution temperature of phenol water system. |
| 2. | To determine molecular weight of given organic liquid by steam distillation. |
| 3. | Determination of solubility of benzoic acid at different temperature and to determine ΔH of dissociation process. |
| 4. | To determine the partition coefficient of iodine between water and carbon tetrachloride. |
| 5. | To compare the relative strength of HCl and $H_2SO_4$ by studying the kinetics of hydrolysis of an ester. |
| 6. | To determine the first order velocity constant of decomposition of hydrogen peroxide by volume determination of oxygen. |
| 7. | To determine the rate constant of base catalyzed ester hydrolysis |
| 8. | To study the neutralization of acid (HCl) by base (NaOH) and $CH_3COOH$ by NaOH. |
| 9. | Computational Chemistry: To optimize structure and spectra of molecules using standard software's. |
| 10. | Report of one day industrial study tour [either in semester III or IV]. |
| **B. Organic Chemistry Practicals (Any Five)** | |
| 11. | Qualitative analysis of unknown binary organic compounds. (Including elemental test) Solid mixtures only (Minimum Three Mixtures). |
| 12. | Preparation of phthalimide form phthalic anhydride |
| 13. | Benzolyation of one of the following amines (aniline, *o*-, *m*-, *p*-toluidines and *o*-, *m*-, *p*-anisidine) and one of the following phenols (β-naphthol, resorcinol, p-cresol) |

**References:**


1. Practical Physical Chemistry by Findlay's
2. A textbook of practical physical chemistry and calculations by J. Rose
3. Practical Chemistry (Revised Edition) by O. P. Pandey , S. Chand publications.
4. Advanced Physical Chemistry by Gurtu-Gurtu Fifth Edition 2011.
5. Practical Chemistry by V. K. Ahluwalia, S. Dhingra, A.Gulati 2008.
6. Molecular Modelling by Andrew Leach
7. A. I. Vogel's Textbook of Practical Organic Quantitative 5th Ed., John Wiley, 1989.