UNIVERSITY OF MYSORE

DEPARTMENT OF STUDIES IN CHEMISTRY

Post-graduate Degree Programme in Chemistry

1. **B. Sc. (Honors) Degree in Chemistry – I and II Semesters**
2. **M. Sc. Degree in Chemistry – III and IV Semesters**

Choice Based Credit Based Semester System – 2010 - 2011

SCHEME OF STUDY AND EXAMINATION

B. Sc. (HONORS) DEGREE IN CHEMISTRY

FIRST SEMESTER

THEORY

Core Papers	Paper Title	Contact Hours/week & Credits	Total Marks / Paper	Assessment Weightage		Semester End Exam. Duration (hrs) & Assessment Weightage
				I test	II test	
CHA HCT:1.1	Fundamentals of Chemical Analysis	2 h & 2	40	25 %	25 %	2 h and 50 %
CHI HCT:1.2	Concepts and Models of Inorganic Chemistry	2 h & 2	40	25 %	25 %	2 h and 50 %
CHO HCT:1.3	Stereochemistry and Organic Reaction Mechanisms – I	2 h & 2	40	25 %	25 %	2 h and 50 %
CHP HCT:1.4	Chemical Thermodynamics and Chemical Kinetics	2 h & 2	40	25 %	25 %	2 h and 50 %

PRACTICALS

Core Papers	Paper Title	Contact Hours/week & Credits	Total Marks / Paper	Assessment Weightage		Semester End Exam. Duration (hrs) & Assessment Weightage
				I test	II test	
CHA HCP:1.5	Analytical Practicals - I	4 h & 2	40	25 %	25 %	4 h and 50 %
CHI HCP:1.6	Inorganic Practicals - I	4 h & 2	40	25 %	25 %	4 h and 50 %
CHO SCP_1:1.7	Organic Practicals – IA	4 h & 2	40	25 %	25 %	4 h and 50 %
OR	**OR**					
CHO SCP_2:1.7	Organic Practicals – IB					
CHP SCP_1:1.8	Physiacl Practicals – IA	4 h & 2	40	25 %	25 %	4 h and 50 %
OR	**OR**					
CHP SCP_2:1.8	Physical Practicals - IB					

ELECTIVE – I (FOR CHEMISTRY STUDENTS ONLY)

THEORY

Core Papers	Paper Title	Contact Hours/week & Credits	Total Marks / Paper	Assessment Weightage		Semester End Exam. Duration (hrs) & Assessment Weightage
				I test	II test	
CHA ELT:1.1	Applied Analysis – I	2 h & 2	40	25 %	25 %	2 h and 50 %
CHI ELT:1.2	Industrial Inorganic Chemistry	2 h & 2	40	25 %	25 %	2 h and 50 %
CHO ELT:1.3	Organic Reaction Mechanisms – II	2 h & 2	40	25 %	25 %	2 h and 50 %
CHP ELT:1.4	Polymers, Semiconductors and Biophysical Chemistry	2 h & 2	40	25 %	25 %	2 h and 50 %

OPEN ELECTIVE /CROSS BORDER PAPER – I (FOR NON-CHEMISTRY STUDENTS ONLY)

THEORY

Core Papers	Paper Title	Contact Hours/week & Credits	Total Marks / Paper	Assessment Weightage		Semester End Exam. Duration (hrs) & Assessment Weightage
				I test	II test	
CHAO CBT:1.1	Analytical & Organic Chemistry – I	2 h & 2	40	25 %	25 %	2 h and 50 %
CHIP CBT:1.2	Inorganic & Physical Chemistry - I	2 h & 2	40	25 %	25 %	2 h and 50 %

NOTE:

1. CHA HCT / CHI HCT / CHO HCT / CHP HCT / CHA HCP and CHI HCP are hard core and compulsory papers.
2. CHO SCP_1 and CHO SCP_2 are soft core papers and the students of chemistry have to select one of the two papers.
3. CHP SCP_1 and CHP SCP_2 are soft core papers and the students of chemistry have to select one of the two papers.
4. Chemistry students have to compulsorily opt one of the four Elective – I group papers.
5. Students of both chemistry and non-chemistry, when register for additional credits, can opt more than one elective paper in Elective – I group papers. However, a minimum of 15 students have to register for additional credits for operationalization of such a paper.
6. Open elective / Cross border – I papers are for other than chemistry students. Students have to opt one of the two open-elective papers. However, for operationalization of such a paper, a minimum of ten students are required to opt such a paper.
7. For 2 and 3, a minimum of ten students should opt the paper.
8. Semester end exam in both theory and practical papers will be conducted for 20 marks per credit.

SECOND SEMESTER

THEORY

Core Papers	Paper Title	Contact Hours/week & Credits	Total Marks / Paper	Assessment Weightage		Seminar	Semester End Exam Duration (hrs) & Assessment Weightage
				I test	II test		
CHA HCT:2.1	Titrimetric Analysis & Separation Techniques	3 h & 3	60	22.5 %	22.5 %	5 %	3 h and 50 %
CHI HCT:2.2	Advanced Inorganic Chemistry	3 h & 3	60	22.5 %	22.5 %	5 %	3 h and 50 %
CHO HCT:2.3	Synthetic Organic Chemistry	3 h & 3	60	22.5 %	22.5 %	5 %	3 h and 50 %
CHP HCT:2.4	Quantum-, Electro-, Nuclear- and Photochemistry	3 h & 3	60	22.5 %	22.5 %	5 %	3 h and 50 %

PRACTICALS

Core Papers	Paper Title	Contact Hours/week & Credits	Total Marks/ Paper	Assessment Weightage		Semester End Exam. duration (hrs) & Assessment Weightage
				I test	II test	
CHA SCP_1:2.5	Analytical Practicals – IIA	4 h & 2	40	25 %	25 %	4 h and 50 %
OR	**OR**					
CHA SCP_2:2.5	Analytical Practicals – IIB					
CHI SCP_1:2.6	Inorganic Practicals – IIA	4 h & 2	40	25 %	25 %	4 h and 50 %
OR	**OR**					
CHI SCP_2:2.6	Inorganic Practicals - IIB					
CHO HCP:2.7	Organic Practicals –II	4 h & 2	40	25 %	25 %	4 h and 50 %
CHP HCP:2.8	Physical Practicals –II	4 h & 2	40	25 %	25 %	4 h and 50 %

NOTE

1. CHA HCT / CHI HCT / CHO HCT / CHP HCT / CHO HCP and CHP HCP are hard core and compulsory papers for all students.
2. CHA SCP_1 and CHA SCP_2 are soft core papers and the students of chemistry have to select one of the two papers.
3. CHI SCP_1 and CHI SCP_2 are soft core papers and the students of chemistry have to select one of the two papers.
4. For 2 and 3, a minimum of ten students should opt a paper for its operationalization.
5. Semester end exam in both theory and practical papers will be conducted for 20 marks per credit.

M. Sc. DEGREE IN CHEMISTRY

THIRD SEMESTER

THEORY

Core Papers	Paper Title	Contact Hours/week & Credits	Total Marks / Paper	Assessment Weightage		Seminar	Semester End Exam duration(hrs) & Assessment Weightage
				I test	II test		
CHA HCT:3.1	Instrumental Methods of Analysis - I	2 h & 2	40	22.5 %	22.5 %	5 %	2 h and 50 %
CHI HCT:3.2	Organometallic Chemistry & Catalysis	2 h & 2	40	22.5 %	22.5 %	5 %	2 h and 50 %
CHO HCT:3.3	IR, Mass and NMR Spectroscopy	2 h & 2	40	22.5 %	22.5 %	5 %	2 h and 50 %
CHP HCT:3.4	Advanced Chemical Kinetics, Microwave and vibration spectroscopy	2 h & 2	40	22.5 %	22.5 %	5 %	2 h and 50 %

PRACTICALS

Core Papers	Paper Title	Contact Hours/week & Credits	Total Marks/ Paper	Assessment Weightage		Semester End Exam duration (hrs) & Assessment Weightage
				I test	II test	
CHA HCP:3.5	Analytical Practicals - III	4 h & 2	40	25 %	25 %	4 h and 50 %
CHI HCP:3.6	Inorganic Practicals - III	4 h & 2	40	25 %	25 %	4 h and 50 %
CHO SCP_1:3.7	Organic Practicals – IIIA	4 h & 2	40	25 %	25 %	4 h and 50 %
OR	**OR**					
CHO SCP_2:3.7	Organic Practicals – IIIB					
CHP SCP_1:3.8	Physical Practicals – IIIA	4 h & 2	40	25 %	25 %	4 h and 50 %
OR	**OR**					
CHP SCP_2:3.8	Physical Practicals - IIIB					

ELECTIVE – II (FOR CHEMISTRY STUDENTS ONLY)

THEORY

Core Papers	Paper Title	Contact Hours/week & Credits	Total Marks/ Paper	Assessment Weightage		Semester End Exam. duration (hrs) & Assessment Weightage
				I test	II test	
CHA ELT:3.1	Applied Analysis – II	2 h & 2	40	25 %	25 %	2 hrs and 50 %
CHI ELT:3.2	Structural Methods in Inorganic Chemistry	2 h & 2	40	25 %	25 %	2 hrs and 50 %
CHO ELT:3.3	Bio-organic Chemistry	2 h & 2	40	25 %	25 %	2 hrs and 50 %
CHP ELT:3.4	Pharmaco Kinetics	2 h & 2	40	25 %	25 %	2 hrs and 50 %

OPEN ELECTIVE /CROSS BORDER PAPER –II (FOR NON-CHEMISTRY STUDENTS ONLY)

THEORY

Core Papers	Paper Title	Contact Hours/week & Credits	Total Marks/ Paper	Assessment Weightage		Semester End Exam. Duration(hrs) & Assessment Weightage
				I test	II test	
CHAO CBT:2.1	Analytical & Organic Chemistry – II	2 h & 2	40	25 %	25 %	2 h and 50 %
CHIP CBT:2.2	Inorganic & Physical Chemistry - II	2 h & 2	40	25 %	25 %	2 h and 50 %

NOTE:

1. CHA HCT / CHI HCT / CHO HCT / CHP HCT / CHA HCP and CHI HCP are all hard core and compulsory papers for chemistry students.
2. CHO SCP_1 and CHO SCP_2 are soft core papers and the students of chemistry have to select one of the two papers.
3. CHP SCP_1 and CHP SCP_2 are soft core papers and the students of chemistry have to select one of the two papers.
4. For 2 and 3, a minimum of ten students should opt the paper for its operationalization.
5. Students of chemistry should compulsorily select one of the four Elective –II papers.
6. One seminar each in II and III semesters will be evaluated for 20 marks and one-fourth of the marks obtained will be added to each of the hard core theory papers in chemistry.

7. Students of both chemistry and non-chemistry registering for additional credits can opt more than one elective paper in Elective – II group papers. However, a minimum of 15 students have to register for additional credits for operationalization of such a paper.
8. Open elective / Cross border – II papers are for other than chemistry students only. Students have to opt one of the two open-elective papers. However, for operationalization of such a paper, a minimum of ten students are required to opt such a paper.
9. Semester end exam in both theory and practical papers will be conducted for 20 marks per credit.

FOURTH SEMESTER

THEORY

Core Papers	Subject	Contact Hours/week & Credits	Total Marks / Paper	Assessment Weightage		Semester End Exam. Duration (hrs) & Assessment Weightage
				I test	II test	
CHA HCT:4.1	Instrumental Methods of Analysis –II	3 h & 3	60	25 %	25 %	3 h and 50 %
CHI HCT:4.2	Bio-inorganic Chemistry	3 h & 3	60	25 %	25 %	3 h and 50 %
CHO HCT:4.3	Photochemistry, heterocyclic Chemistry & Molecular Rearrangement	3 h & 3	60	25 %	25 %	3 h and 50 %
CHP HCT:4.4	Applied electro-solid state- and Quantum Chemistry	3 h & 3	60	25 %	25 %	3 h and 50 %

PRACTICALS

Core Papers	Subject	Contact Hours/week & Credits	Total Marks / Paper	Assessment Weightage		Semester End Exam. Duration (hrs) & Assessment Weightage
				I test	II test	
CHA SCP_1:4.5	Analytical Practicals – IVA	4 h & 2	40	25 %	25 %	4 h and 50 %
OR	**OR**					
CHA SCP_2:4.5	Analytical Practicals – IVB					
CHI SCP_1:4.6	Inorganic Practicals – IVA	4 h & 2	40	25 %	25 %	4 h and 50 %
OR	**OR**					
CHI SCP_2:4.6	Inorganic Practicals - IVA					
CHO HCP:4.7	Organic Practicals –IV	4 h & 2	40	25 %	25 %	4 h and 50 %
CHP HCP:4.8	Physical Practicals –IV	4 h & 2	40	25 %	25 %	4 h and 50 %
CH HCD: 4.9	Dissertation/ Project Work	4 h & 2	40	25 %	25 %	Project Report- 40 % Viva-voce - 10%

NOTE:

1. CHA HCT / CHI HCT / CHO HCT / CHP HCT / CHO HCP, CHP HCP and CH HCD are hard core and compulsory papers for all students.
2. CHA SCP_1 and CHA SCP_2 are soft core papers and the students of chemistry have to select one of the two papers.
3. CHI SCP_1 and CHI SCP_2 are soft core papers and the students of chemistry have to select one of the two papers.
4. For 2 and 3, a minimum of ten students should opt a paper for its operationalization.
5. The admission, add on facilities, distribution, continuous assessment, earning of credits, awards of grades and special programs if any are as per the University regulations.
6. Semester end exam in both theory and practical papers will be conducted for 20 marks per credit.

B.Sc (HONORS) DEGREE IN CHEMISTRY

FIRST SEMESTER

THEORY

CHA HCT: 1.1. FUNDAMENTALS OF CHEMICAL ANALYSIS

UNIT-I

Analytical chemistry-meaning and analytical prospective, scope and function: Analytical problems and their solutions, trends in analytical methods and procedures.

Language of analytical chemistry - analysis, determination and measurement. Techniques, methods, procedures and protocols. Classifying analytical techniques. Selecting an analytical method-accuracy, precision, sensitivity, selectivity, robustness and ruggedness. Scale of operation, equipment, time and cost. Making the final choice.

Errors and treatment of analytical data: Limitations of analytical methods-Error-determinate and indeterminate errors, minimization of errors. Accuracy and precision. Distribution of random errors, the normal error curve. Statistical treatment of finite samples-measures of central tendency and variability-mean, median, range, standard deviation and variance. Student's t-test. Confidence interval of mean. Testing for significance-comparison of two means and two standard deviations. Comparison of an experimental mean and a true mean. Criteria for the rejection of an observation-Q-test. Propagation of errors-determinate errors and indeterminate errors.

Standardization and calibration: Comparison with standards-direct comparison and titrations. External standard calibration-the least squares method, regression equation, regression coefficient. Internal standard methods and standard-addition methods. Figures of merit of analytical methods-sensitivity and detection limit, linear dynamic range.

[16 HOURS]

UNIT-II

Obtaining and preparing samples for analysis: Importance of sampling, designing a sample plan-random, judgement, systematic-judgement, stratified and convenience sampling. Type of sample to collect-grab and composite samples. Insitu sampling. Size of sample and number of samples. Implementing the sampling plan-solutions, gases and solids. Bringing solid samples into solution-digestion and decomposing.

Titrimetric analysis: An overview of titrimetry. Principles of titrimetric analysis. Titration curves. Titrations based on acid-base reactions-titration curves for strong acid - strong base, weak acid – strong base and weak base – strong acid titrations. Selecting and evaluating the end point. Finding the end point with visual indicators, end point by monitoring pH and temperature. Quantitative applications – selecting and standardizing a titrant, inorganic analysis-alkalinity, acidity and free CO_2 in water and waste waters, nitrogen, sulphur, ammonium salts, nitrates and nitrites, carbonates and bicarbonates. Organic analysis-functional groups like carboxylic acid,

sulphonic acid, amine, ester, hydroxyl and carbonyl. Air pollutants like SO_2. Quantitative calculations. Characterization applications-equivalent weights and equilibrium constants.

Acid-base titrations in non-aqueous media: Role of solvent in acid-base titrations, solvent systems, differentiating ability of a solvent, some selected solvents, titrants and standards, titration curves, effect of water, determining the equivalence point, typical applications-determination of carboxylic acids, phenols and amines.

[16 HOURS]

REFERENCES

1. Fundamental of Analytical Chemistry, D.A. Skoog, D.M. West, Holler and Crouch 8th edition, 2005, Saunders College Publishing, New York.
2. Analytical Chemistry, G.D. Christian, 5th ed., 2001 John Wiley & Sons, Inc, India.
3. Quantitative Analysis, R.A. Day and A.L. Underwood, 6th edition,1993 prentice Hall, Inc. New Delhi.
4. Vogel's Textbook of Quantitative Chemical Analysis, J. Mendham, R.C. Denney, J.D. Barnes and M.J.K. Thomas, 6th edition, Third Indian Reprint.2003 Pearson Education Pvt. Ltd., New Delhi.
5. Analytical Chemistry Principles, John H. Kennedy, 2nd edition, Saunders College Publishing, California, 1990.
6. Principles and Practicals of Analytical Chemistry, F. W. Fifield and Kealey, 3rd edition, 2000, Blackwell Sci., Ltd. Malden, USA.
7. Modern Analytical Chemistry, David Harvey, McGraw Hill, New Delhi, 2000.

CHI HCT: 1.2. CONCEPTS AND MODELS OF INORGANIC CHEMISTRY

UNIT I

Structures and energetics of ionic crystals: Introduction, MX (NaCl, CsCl, ZnS) and MX_2 (fluorite, rutile, βcrystobalite and cadmium iodide) types. The perovskite and spinel structures. Thermodynamics of ionic crystal formation. Lattice energy, Born-Haber cycle, Born-Lande equation. Applications of lattice energetics. Ionic radii, factors, affecting the ionic radii, radius ratio rules.

Structures and energetics of inorganic molecules: Introduction, Energetics of hybridization. VSEPR model for explaining structure of AB, AB_2E, AB_3E, AB_2E_2, ABE_3, AB_2E_3, AB_4E_2, AB_5E and AB_6, molecules. M.O. treatment of homonuclear and heteronuclear diatomic modecules. M.O. treatement involving delocalized πbonding (CO_3^{2-} , NO_3^- , NO_2^-, CO_2 and N_3^-), M.O. correlation diagrams (Walsh) for triatomic molecules.

[16 HOURS]

UNIT-II

Electron deficient compounds: Diborane and its reactions, higher boranes, ploy hedral boranes (preparations, properties, structure and bonding). Wade's rules, carboranes and metallocarboranes.

Lanthanides: Review of important properties (spectral, magnetic etc). Abundance and extraction, General principles- conventional, solvent extraction and ion exchange methods. Separation from monazite. Chemistry of principal oxidation states (II, III and IV) Uses: lanthanides as shift reagents, high temperature super conductors.

Actinides: Occurrence and preparation of elements, Isolation of the elements: thorium and uranium, enrichment of uranium for nuclear fuel, uranium hydrides, oxides and chlorides. Chemical reactivity and trend. Chemistry of trans-uranium elements.

[16 HOURS]

REFERENCES:

1. Basic Inorganic Chemistry – 3rd edn. F.A. Cotton, G. Wilkinson and P.L. Gaus, John Wiley and Sons (2002).
2. Inorganic Chemistry, 3rd edn. James E. Huheey, Harper and Row Publishers (1983).
3. Inorganic Chemistry, 3rd edn. G.L. Miessler and D.A. Tarr, Pearson Education (2004).
4. Inorganic Chemistry, 2nd edn. D.F. Shriver, P.W. Atkins and C.H. Langford, Oxford University Press (1994).
5. Inorganic Chemistry, 2nd edn. C.E. Housecroft and A.G. Sharpe, Pearson Education Ltd. (2005).
6. Introduction to Modern Inorganic Chemistry, K.M. Mackay and R.A. Mackay, Blackie Publication (1989).
7. Concepts and Models of Inorganic Chemistry 3rd edn. B.E. Douglas, D.H. McDaniel and Alexander, Wiley (2001).

CHO HCT: 1.3. STEREOCHEMISTRY AND REACTION MECHANISMS-I

UNIT-I

Stereoisomerism: Projection formulae [Fly wedge, Fischer, Newman and Saw hourse], enantiomers, diasteroisomers, racemic mixture and their resolution, configurational notations of simple moleculesx, DL and RS configurational notations.

Stereoselectivity: Sterioselective reactions, diasteroselective reactions, stereospecific reactions, regioselective & regiospecific reactions.

Opotical Isomerism: Conditions for optical isomerism, optical isomerism due to chiral centres and molecular dissymmetry, allenes and biphenyls, criteria for optical purity.

Geometrical isomerism: Due to C=C, C=N and N=N bonds, E,Z conventions, determination of fonfiguration by physical and chemical methods.

Conformational Isomerism: Elementary account of conformational equillibria of ethane, butane and cyclohexane.

Conformational analysis: Conformation of cyclic compounds such as cyclopentane, cyclohexane, cyclohexanone derivatives and decalins. Conformational analysis of 1,2-; 1,3-, 1,4-disubstituted cyclohexane derivatives and D-Glucose, Effect of conformation on the course of rate of reactions.

[16 HOURS]

UNIT-II

Structure and reactivity: Acids and Bases, Structural effect on acidity and basicity, hydrogen bonding Resonance, inductive and hyperconjugation effects.

Reaction Intermediates: Formation, structure, stability, detection and reactions of carbocations (classical and non-classical), carbanions, free radicals, carbenes, nitrenes, nitrile oxides, nitrile imines, nitrile ylides and arynes.

Substitution reactions: Mechanism of nucleophilic substitution reactions-Kinetics, Mechanism and stereochemical factor affecting the rate of S_N^1, S_N^2, S_{RN}^1, S_N^1, S_N^2, S_N^{II} reactions, Neighbouring group participation.

Aromatic nucleophilic substitution: SN1, SN2 and benzyne mechanism, Bucherer reaction.

Aromatic electrophilic substitution: Mechanism of nitration, halogenation, sulphonation, Friedel-Crafts alkylation and acylation, Mannich reaction, chloromethylation, Vilsmeier-Haack reaction.

[16 HOURS]

REFERENCES

1. E. L. Eliel and S. H. Wilen, Stereochemistry of Organic Compounds, Jhon Willey and Sons, New York. 1994.
2. H. Pine, Hendrickson, Cram and Hammond, Organic Chemistry, Mac Grow Hill, New York, 1987.
3. Organic Chemistry-Morrison & Boyd
4. Finar, Organic Chemistry, ELBS Longmann, Vol. I & II 1984.
5. Basic Principles of Organic Chemistry-Robert & Casereo
6. N. S. Issacs, Reactive intermediates in Organic Chemistry, Jhon Willey and Sons, New York. 1974.
7. R. K. Bansal, Organic Reaction Mechanism, Wiley Eastern Limited, New Delhi, 1993.
8. J. Marcdh, Advanced Organic chemistry, Willey Interscience, 194.
9. E. S. Gould, Mechanism and structure in Organic Chemistry, Halt, Rinhart & Winston, New York, 964.
10. A Guide book to mechanism in Organic Chemistry-Petersyke
11. F. A. Carey and Sundberg, Advanced Organic Chemistry-Part A & B, 3rd edition, Plenum Press, New York, 1990.
12. P. S. Kalsi, Stereo Chemistry of Organic compounds and solved problems.

CHP HCT: 1.4 CHEMICAL THERMODYNAMICS AND CHEMICAL KINETICS

UNIT I

Concepts of entropy and free energy: Entropy as a measure of unavailable energy. Entropy change during spontaneous process. Helmholtz and Gibbs free energies. Thermodynamic criteria

of equilibrium and spontaneity. Variation of free energy with temperature and pressure. Third law of thermodynamics-calculation of absolute entropies.

Partial molar properties: Partial molar volumes and their determination by intercept method and from density measurements. Chemical potential and its significance. Variation of chemical potential with temperature and pressure. Formulation of the Gibbs Duhem equation. Derivation of Duhem-Margules equation.

Fugacity: Determination of fugacity of gases. Variation of fugacity with temperature and pressure.Activity and activity coefficients. Variation of activity with temperature and pressure. Determination of activity coefficients by vapour pressure, depression in freezing point, solubility measurements and by electrical methods.

Thermodynamics of dilute solutions: Raoult's law, Henry's law. Ideal and non-ideal solutions.

[16 HOURS]

UNIT II

Kinetics of complex reactions: Parallel, consecutive and reversible reactions. Determination of order of reaction. Arrhenius equation, energy of activation and its experimental determination. Simple collision theory-mechanism of bimolecular reaction. Lindemann's theory, Hinshelwood's theory for unimolecular reaction (No derivation). Activated complex theory of reaction rate, classical thermodynamic treatment,
partition function, statistical thermodynamic treatment. Kinetics of reactions in solution-Salt effects, effect of dielectric constant (single sphere and double sphere model), effect of pressure, volume and entropy change on reaction rates. Cage effect with an example. Kinetics of heterogeneous reactions - Langmuir's theory, unimolecular and bimolecular surface reactions.

Fast Reactions: Study of kinetics by flow techniques, equation for contact time, stopped flow and continuous flow methods. Relaxation method, equation for relaxation time, temperature jump and pressure jump methods, flash photolysis, pulse radiolysis and shock tube method. Potential energy surface, theoretical calculation of energy of activation.

[16 HOURS]

REFERENCES

1. Thermodynamics for Chemists by S. Glasstone, Affiliated East-west press, New Delhi, (1965).
2. Chemical Thermodynamics by I.M. Klotz, W.A. Benzamin Inc. New York, Amsterdam (1964).
3. Basic Physical Chemistry by W.J. Moore, Prentice Hall of India Pvt. Ltd., New Delhi (1986).
4. Text book of Physical Chemistry by Samuel Glasstone, MacMillan Indian Ltd., 2nd edition (1974).
5. Theoretical Chemistry by S. Glasstone.
6. Elementary statistical thermodynamics by N.D. Smith Plenum Press, NY (1982).
7. Elements of Physical Chemistry –Lewis and Glasstone.
8. Physical Chemistry by P.W. Atkins, ELBS, 4th Edition, Oxford University Press (1990)
9. Chemical Kinetics by K.J. Laidler.
10. Chemical Kinetics –Frost and Pearson.

11. Kinetics and Mechanism of Chemical Transformation by J. Rajaram and J.C. Kuriacose.
12. Chemical Kinetics –L.K. Jain.
13. Chemical Kinetics –Benson.
14. Kinetics in Analytical Chemistry – H. B. Mark and G. A. rechnitz, Interscience Publishers, John Willey and Sons, New York.

PRACTICALS

CHA HCP: 1.5. ANALYTICAL PRACTICALS-I

1. Determination of total acidity of vinegar and wines by acid-base titration.
2. Determination of purity of a commercial boric acid sample, and of Na_2CO_3 content of washing soda.
3. Titration of chromate-dichromate mixtures by acid-base titration.
4. Determination of replaceable hydrogen and relative molecular mass of a weak organic acid by titration with NaOH.
5. Determination of ephedrine and aspirin in their tablet preparations by residual acid-base titrimetry.
6. Analysis of urine for sugar using Benedict's reagent and blood for bicarbonate by acid-base titration.
7. Titrimetric analysis of a soil sample for calcium carbonate and organic carbon.
8. Determination of aniline by non-aqueous acid-base titration.
9. Non-aqueous titrimetric assay of chlorpromazine tablets, injections and elixir/syrup.
10. Periodate determination of ethylene glycol and glycerol (Malprade reaction).
11. Determination of carbonate and bicarbonate in a mixture by pH-metric titration and comparison with visual acid-base titration.
12. Analysis of water/waste water for acidity by visual and pH metric-titrations.
13. Analysis of water/waste water for alkalinity by visual and pH metric-titrations.
14. Determination of carbonate and hydroxide-analysis of a commercial washing soda by visual and pH-titrimetry.
15. Determination of ammonia in house-hold cleaners by visual and conductometric titration.
16. Acid rain analysis by standard-addition titration.
17. Determination of protein in bread by Kjeldahl method.
18. Potentiometric determination of the equivalent weight and Ka for a pure unknown weak acid.
19. Spectrophotometric determination of creatinine in urine.
20. Flame emission spectrometric determination of sodium and potassium in river/lake water.

[64 HOURS]

REFERENCES

1. Fundamental of Analytical Chemistry, D.A. Skoog, D.M. West, Holler and Crouch 8th edition, 2005, Saunders College Publishing, New York.
2. Analytical Chemistry, G.D. Christian, 5th ed., 2001 John Wiley & Sons, Inc, India.
3. Quantitative Analysis, R.A. Day and A.L. Underwood, 6th edition, 1993 Prentice Hall, Inc. New Delhi.

4. Vogel's Textbook of Quantitative Chemical Analysis, J. Mendham, R.C. Denney, J.D. Barnes and M.J.K. Thomas, 6th edition, Third Indian Reprint.2003 Pearson Education Pvt. Ltd., New Delhi.
7. Analytical Chemistry Principles, John H. Kennedy, 2nd edition, Saunders College Publishing, California, 1990.
8. Practical Clinical biochemistry methods and interpretations, R.Chawla, J.P. Bothers Medical Publishers (P) ltd., 1995.
9. Laboratory manual in biochemistry, J. Jayaraman, New Age International Publishers, New Delhi, 1981.
10. Practical clinical Biochemistry-Harold Varley and Arnold.Hein mann, 4th edn.

CHI HCP: 1.6 INORGANIC PRACTICALS-I

1. Determination of iron in haematite using cerium(IV) solution (0.02M) as the titrant, and gravimetric estimation of insoluble residue.
2. Estimation of calcium and magnesium carbonates in dolomite using EDTA titration, and gravimetric analysis of insoluble residue.
3. Determination of manganese dioxide in pyrolusite using permanganate titration.
4. Qunatitative analysis of copper-nickel in alloy/mixture:
    i. Copper volumetrically using KIO_3.
    ii. Nickel gravimetrically using DMG
5. Determination of lead and tin in a mixture: analysis of solder using EDTA titration.
6. Complexometric determination of calcium and lead in a mixture.
7. Quantitative analysis of chloride and iodide in a mixture:
    i. Iodide volumetrically using KIO_3
    ii. Total halide gravimetrically.
8. Determination of chlorate in commercial samples by iodometric method.
9. Determination of borax by neutralization titration.
10. Gravimetric analysis of molybdenum with 8- hydroxyqunoline.
11. Spectrophotometric determinations of :
    a. Titanium using hydrogen peroxide.
    b. Vanadium using eriochrome cyanine R in micellar medium.
    c. Chromium using diphenyl carbazide in industrial effluents.
    d. Iron using thiocyanate/1,10-phenanthroline method in commercial samples.
    e. Nickel using dimethylglyoxime in steel solution.
12. Circular paper chromatographic separation of (Demonstration):
    a. Iron and nickel
    b. Copper and nickel

[64 HOURS]

REFERENCES

1. A Text Book of Quantitative Inorganic Analysis – A.I. Vogel, 3rd edition.

2. Vogel's Text Book of Quantitative Chemical Analysis – 5th edn, J. Basset, R.C. Denney, G.H. Jeffery and J. Mendhom.
3. Spectrophotometric determination of elements – Z. Marczenko.
4. Quantitative Chemical Analysis – Daniel C. Harris, 7th edition, (2006)

CHO SCP_1:1.7. ORGANIC PRACTICALS - IA

1. Preparation of parabromoaniline from acetanilide.
2. Preparation of n-butyl bromide from n-butanol.
3. Preparation of p-nitroiodobenzene from paranitroaniline.
4. Preparation of aniline from nitrobenzene.
5. Preparation of ß-D-Glucose penta acetate.
6. Preparation of phenoxy acetic acid.
7. Preparation of cyclohexanol to cyclohexanone.
8. Preparation of chalcone.
9. Preparation of S-Benzylthiuronium chloride.
10. Condensation of anthracene and maleic anhydride (Diels-Alder reaction).
11. Preparation of m-nitrobewnzoic acid from methyl benzoate.

[64 HOURS]

CHO SCP_2:1.7 ORGANIC PRACTICALS - IB

1. Preparation of p-nitro aniline from acetanilide.
2. preparation of Glucosazone.
3. Preparation of cis and trans cinnamic acid.
4. Preparation of paraamino azobenzene.
5. Preparation of Benzoic acid (cannizaro's reaction).
6. Preparation of anthroquinone.
7. Preparation of 4-methyl-7-hydroxy coumarin (pechmann reaction)
8. Preparation of paratoluidine from paranitrotoluene.
9. Preparation of cinnamic acid.
10. Preparation of benzophenone

[64 HOURS]

REFERENCES

1. A Text book of practical organic Chemistry – A. I. Vogel Vol.I
2. Practical Organic Chemistry-Mann & Saunders.
3. Manual of Organic Chemistry –Dey and Seetharaman.
4. An introduction to practical organic Chemistry-Robert, Wingrove etc.
5. Semimicro qualitative organic Analysis by Cheronis, Entrikin and Hodnet.
6. J. N. Guthru & R. Kapoor, Advance experimental Chemistry, S. Chand Company, New Delhi-1991.
7. R. K. Bansal, Laboratory Manual of Organic Chemistry, New PGE International (P) LTd. London, 3rd edition. 1996.

8. N. K. Visno, Practical Organic Chemistry, New PGE International (P) Ltd. London, 3rd edition, 1996.

CHP SCP_1:1.8 PHYSICAL PRACTICALS - IA

1. Study of kinetics of hydrolysis of an ester using HCl/H_2SO_4 at two different temperatures, determination of rate constants and energy of activation.
2. Study of kinetics of reaction between $K_2S_2O_8$ and KI, first order, determination of rate constants at two different temperatures and E_a.
3. Conductometric titration of a mixture of HCl and CH_3COOH against NaOH.
4. Conductometric titration of a mixture of HCl, CH_3COOH and $CuSO_4$ against NaOH.
5. Potentiometric titration of KI vs $KMnO_4$ solution.
6. Determination of dissociation constant of a weak acid by potentiometric method.
7. Potentiometric titration of $AgNO_3$ vs KCl.
8. To obtain the absorption spectra of coloured complexes, verification of Beer's law and estimation of metal ions in solution using a spectrophotometer.
9. Spectrophotometric titration of $FeSO_4$ against $KMnO_4$.
10. Determination of heat of solution of benzoic acid by variable temperature method (graphical method).
11. Thermometric titration of hydrochloric acid with a NaOH.
12. Determination of molecular weight of a compound using Bekmann's cryoscopic method using benzene or/and water as solvent.
13. Potentiometric titrations of (a) Fe(II) vs V(V).
14. Kinetics of photodegradation of indigocarmine (IC) using TiO_2 as photocatalyst and study the effect of [TiO_2] and [IC] on the rate of photo degradation.
15. Conductometry –To determine the degree of hydrolysis and hydrolysis constant of aniline hydrochloride.
16. Conductometric titration of potassium iodide with mercuric perchlorate.
17. Determination of the molecular weight of a polymer material by viscosity measurements (cellulose acetate/methyl acrylate).

[64 HOURS]

CHP SCP_2:1.8 PHYSICAL PRACTICALS -IB

1. Study of kinetics of hydrolysis of an ester using HCl/H_2SO_4 at two different concentrations, determination of rate constants and compare the rate constants.
2. Study of kinetics of reaction between $K_2S_2O_8$ and KI, second order, determination of rate constant and E_a.
3. Conductometric titration of a mixture of HCl and $ClCH_2COOH$ against NaOH.
4. Conductometric titration of a mixture of HCl, HCOOH and $CuSO_4$ against NaOH.
5. Potentiometric titration of KCl vs $KMnO_4$ solution.
6. Determination of dissociation constant of acetic acid by potentiometric method.
7. Potentiometric titration of $AgNO_3$ vs. KBr.
8. Verification of Beer's law and calculation of molar extinction coefficient for $CuSO_4$ system.

9. Spectrophotometric titration of $FeSO_4$ against $K_2Cr_2O_7$.
10. Determination of heat of solution of salicylic acid by variable temperature method (Graphical method).
11. Thermometric titration of sulphuric acid with a NaOH.
12. Potentiometric titrations of (a) Fe(II) vs. Ce(IV).
13. Kinetics of photodegradation of indigocarmine (IC) using ZnO as photocatalyst and study the effect of [ZnO] and [IC] on the rate of photo degradation.
14. Conductometry –To determine the degree of hydrolysis and hydrolysis constant of aniline hydrochloride.
15. Conductometric titration of potassium iodide with mercuric perchlorate.
16. Determination of the molecular weight of a polymer material by viscosity measurements (polyvinyl alcohol/polystyrene).

[64 HOURS]

REFERENCES

1. Practical Physical Chemistry – A.J. Findlay.
2. Experimental Physical Chemistry –F. Daniels et al.
3. Selected Experiments in Physical Chemistry – Latham.
4. Experiments in Physical Chemistry – James and Prichard.
5. Experiments in Physical Chemistry – Shoemaker.
6. Advanced Physico-Chemical Experiments –J. Rose.
7. Practical Physical Chemistry –S.R. Palit.
8. Experiments in Physical Chemistry – Yadav, Geol Publishing House.
9. Experiments in Physical Chemistry – Palmer.
10. Experiments in Chemistry –D.V. Jahagirdar, Himalaya Publishing House, Bombay, (1994).
11. Experimental Physical Chemistry –Das. R.C. and Behera B, Tata Mc Graw Hill.

ELECTIVE-I (FOR CHEMISTRY STUDENTS ONLY)

CHA ELT: 1.1. APPLIED ANALYSIS-I

UNIT-I

Food analysis: Objectives of food analysis. Sampling procedures. Detection and determination of sugars and starch. Methods for protein determination. Oils and fats and their analysis-iodine value, saponification value and acid value. Rancidity-detection and determination (peroxide number). Tests for common edible oils. Analysis of foods for minerals-phosphorus, sodium, potassium and calcium. General methods for the determination of moisture, crude fibre and ash contents of food. Analysis of milk for fat and added water. Non-alcoholic beverages-determination of chicory and caffeine in coffee; caffeine and tannin in tea. Alcoholic beverages-methanol in alcoholic drinks and chloral hydrate in toddy. Food additives-chemical preservatives. Inorganic preservatives-sulphur dioxide and sulphites, their detection and determination. Organic preservatives-benzoic acid and benzoates, their detection and determination. Flavouring agents-detection and determination of vanilla and vanillin. Coloring matters in foods-classification, certified colors, detection of water soluble dyes, color in citrus fruits, beet dye in tomato products, mineral color. Pesticide residues in foods-determination of chlorinated organic pesticides. Control food quality-codex alimentaries, Indian standards.

[16 HOURS]

UNIT-II

Drugs and pharmaceutical analysis: Importance of quality control; drugs and pharmaceuticals. Sources of impurities in pharmaceutical chemicals. Analytical quality control in finished/final products. Common methods of assay. Analysis of common drugs; Analgesics-aspirin, paracetamol; Anthelmentics-mebendazole; Antiallergics-chlorpheneramine maleate; Antibiotics-penicillin, chloromycetin; Anti-inflammatory agents-Oxyphenbutazone; Antimalarials-primaquine phosphate; Antituberculosists-INH; Narcotics-nicotine, morphine; Expectorants-Benadryl; Sedative-diazepam; Vitamins-A. C, B1, B2, B6, niacin and folic acid. Estimation of drug residues in biological samples.

[16 HOURS]

REFERENCES

1. Food Analysis, A. G. Woodman, McGraw Hill. 1971.
2. Chemical Analysis of Foods, H. E. Cox and Pearson.
3. Analysis of Foods and Food Products, J. B. Jacob.
4. A First Course in Food Analysis, A. Y. Sathe, New Age Internationals (P) Ltd., Publishers, Bangalore, 1999.
5. Analytical Agricultural Chemistry, S. L. Chopra and J. S. Kanwar, Kalyani Publishers, New Delhi, 1999.
6. Pharmaceutical Analysis, Ed. T. Higuchi and E. B. Hanssen, John Wiley and Sons, New York, 1997.
7. Pharmaceutical Analysis-Modern Methods, Part A & B, Ed. James W. Hunson.
8. Quantitative Analysis of Drugs in Pharmaceutical Formulations, P. D. Sethi, 3rd Ed. CBS Publishers & Distributors, New Delhi, 1997.

CHI ELT: 1.2 INDUSTRIAL INORGANIC CHEMISTRY

UNIT – I

Nitrogen and nitrogen compounds: Industrial production and uses of ammonia and hydrazine.
Nitrides of sulphur: $(SN)_2$ and $(SN)_4$ – Preparation, properties, structure and applications. Phosphonitrile polymers and phosphazenes.
Mineral fertilizers: Phosphorous containing fertilizers - Economic importance, importance of superphosphate, ammonium phosphates and their synthesis.
Nitrogen containing fertilizers - Importance and synthesis of ammonium sulfate, ammonium nitrate and urea.
Potassium containing fertilizers - Economic importance and manufacture of potassium sulfate.
Silicon and its inorganic compounds: General information and manufacture of ferrosilicon, electronic grade silicon and metallurgical grade silicon. Applications.
Silicones: General methods of preparation (silicone oils and rubbers) and properties of silicones. Applications.

[16 HOURS]

UNIT –II

Zeolites: Introduction, types of zeolites, manufacture of synthetic zeolites and applications.
Inorganic fibers: Introduction, properties, classification, asbestos fibers, optical fibers, carbon fibers, Applications.
Ceramics: General information, classification of ceramic products, composition and raw materials, Applications of clay ceramic products.
Inorganic pigments: General information and economic importance,
White pigments – titanium dioxide pigments, zinc oxide pigments.
Colored pigments – Iron oxide, chromium oxide, mixed-metal oxide pigments and ceramic colorants.
Corrosion protection pigments, luster pigments, luminescent pigments, magnetic pigments.

[16 HOURS]

REFERENCES:

1. Chemistry of the Elements – N.N. Greenwood and A. Earnshaw, Pergamon Press (1985).
2. Industrial Inorganic Chemistry – 2nd edn. K.H. Buchel, H.H. Moretto and P. Woditsh, Wiley-VCH (2000).
3. Inorganic polymers – G.R. Chatwal, HPH (1996).

CHO ELT: 1.3 ORGANIC REACTION MECHANISMS - II

UNIT-I

Reaction Mechanism I: Clasification of reactions, meaning and importance of reaction mechanism.
Determination of reaction mechanism by kinetic and non-kinetic-methods:
Kinetic Method: Mechanistic implications from rate laws, the transition state theory, ambiguities in interpreting kinetic data, solvent effect, ionic effect, isotopic effect, solvent isotopic effect, substituent effect, steric effect, linear free energy relationships – Hammett equation and Taft treatment.
Non-kinetic methods; Energy profile diagram, identification of products, testing possible in termediates, trapping of intermediates, cross over experiments, isotopic labeling, sterochemical studies, limitations.

Theories of bonding – Valence and molecular orbital approaches. Huchel Molecular Orbital theory and its application to simple π-systems: ethylene, allyl, cyclopropyl, butadienyl, cyclopentadienyl, pentadienyl, hexatrienyl, cyclohexatrienyl, heptatreinyl, cycloheptatreinyl systems. Caculation of the total π-energy, delocalization energy, bond order and M. O. coefficients of the systems.

Aromaticity: Concept of aromaticity, Huckel's rule, Polygon rule, annulenes, heteroannulenes.

[16 HOURS]

UNIT – II

Reaction Mechanism II: mechanism of Addition reactions: Addition to C-C multiple bonds involving electrophiles, nucleophiles and free radicals. Markownikoff's rule and anti-Markownikoff's rule, Hydroboration and its application.

Typical additions to carbonyl compounds: Addition of hydride, water, alcohol, thioalcohol, bisulphate, HCN, Grignard reagents and amino compounds.
Mechanism of reactions of carboxylic acids and their derivatives: Mechanism of ester hydrolysis formation, formation and hydrolysis of amides, decarboxylation mechanisms.

Mechanism of electrophilic substitution reactions-Kinetics, mechanism and stereochemical factor affecting the rate of S_E1 & S_E2.
Elimination reactions: Mechanism and stereochemistry of eliminations-E1, E2, E1cb mechanism, cis elimination, Hofmann and saytzeff eliminations, competition between elimination and substitution, Chugaev reaction.

[16 HOURS]

REFERENCES:

1. H. Pine, Hendrickson, Cram and Hammond, Organic Chemistry, Mac Grow Hill, New York, 1987.
2. Organic Chemistry-Morrison & Boyd
3. Finar, Organic Chemistry, ELBS Longmann, Vol. I & II 1984.
4. Basic Principles of Organic Chemistry-Robert & Casereo
5. N. S. Issacs, Reactive intermediates in Organic Chemistry, Jhon Willey and Sons, New York. 1974.
6. R. K. Bansal, Organic Reaction Mechanism, Wiley Eastern Limited, New Delhi, 1993.
7. J. Marcdh, Advanced Organic chemistry, Willey Interscience, 194.
8. E. S. Gould, Mechanism and structure in Organic Chemistry, Halt, Rinhart & Winston, New York, 964.
9. A Guide book to mechanism in Organic Chemistry-Petersyke
10. F. A. Carey and Sundberg, Advanced Organic Chemistry-Part A & B, 3rd edition, Plenum Press, New York, 1990.

CHP ELT: 1.4 POLYMERS, SEMICONDUCTORS AND BIOPHYSICAL CHEMISTRY

UNIT I

Polymers: Fundamentals of polymers - Monomers, repeat units, degree of polymerization. Linear, branched and network polymers. Classification of polymers. Polymerization - condensation, addition, free radical, ionic, co-ordination polymerization and ring opening polymerization. Molecular weight and size. Polydispersion. Average molecular weight concepts – number, weight and viscosity average molecular weight. Determination of molecular weights - viscosity method, osmotic pressure method, sedimentation and light scattering method.
Semiconductors: Band theory, energy bands, intrinsic and extrinsic semiconductors. Conductivity: electrons and holes, temperature dependence on conductivity, optical properties: Absorption spectrum, photoconductivity, photovoltaic effect and luminescence. Junction Properties: Metal-metal junctions, metal-semiconductor junctions, p-n junctions, transistors, industrial applications of semiconductors: Mixed oxides, spinels and other magnetic materials.
Superconductors: Meissner effect, type I and II super conductors, isotope effect, basic concepts of BCS theory, manifestations of the energy gap, Josephson devices.

[16 HOURS]

UNIT II

Electrokinetic Phenomena: Electrophoresis - principles of free electrophoresis, zone electrophoresis, gel electrophoresis and its applications in qualitative and quantitative study of proteins. Determination of isoelectric point of a protein. Electro osmosis and streaming potential and its biological significance. Biological significance of Donnan membrane phenomenon. Micelles and its involvement during digestion and absorption of dietary lipids. Diffusion of solutes across biomembranes and its application in the mechanism of respiratory exchange. "Salting In" and "Salting out" of proteins. Osmotic behaviour of cells and osmo-regulation and its application in the evolution of excretory systems of organisms. Effect of temperature and pH on the viscosity of biomolecules (albumin solution). Significance of viscosity in biological systems - mechanism of muscle contraction, detection of intrastrand disulfide bonds in proteins, polymerization of DNA and nature of blood flow through different vessels. Effect of temperature, solute concentration (amino acids) on surface tension. Biological significance of surface tension - stability of Alveoli in lungs, interfacial tension in living cells (Danielli and Davson model). Application of sedimentation velocity and sedimentation equilibrium method for molecular weight determination of proteins.

REFERENCES

1. Text book of polymer Science. F.W. Billmeyer, Jr., John Wiley. London (1994).
2. Polymer Science. V. R. Gowrikar, N. V. Vishwanathan and J. Srreedhar, Wiley Eastern, New Delhi (1990).
3. Fundamentals of Polymer Science and Engineering. A. Kumar and S.K. Gupta, Tata – McGraw Hill New Delhi (1978).
4. Polymer Characterization, D. Campbell and J. R. White, Chapman and Hall, NewYork.
5. Fundamental Principles of Polymer materials, R. L. Rosen, John Wiley and Sons,New York.
6. Functional monomers and polymers by K. Takemoto, Y. Inaki and P. M. Ottenbrite, Marcel dekker, Inc., New York, 1987.
7. Solid State Chemistry and Its ApplicationsAnthony R. West.
8. Basic Solid State Chemistry, Second Edition, Anthony R. West.
9. Solid State Chemistry: An Introduction, 3rd editionLesley E. Smart and Elaine A. Moore.
10. Introduction to Solid state Physics—C. Kittel, 5th Edition, Wiley EasternLimited.
11. C.N.R. Rao and J. Gopalakrishna "New Directions in solid state Chemistry"Cambridge University Press, Cambridge (1999).
12. Binay Kumar, R.P. Tandon "Advances in technologically important crystals" Macmillan India Ltd.
13. Introduction to Physical Organic Chemistry, R. D. Gilliom, Madison – Wesley,USA (1970).
14. Physical Organic Chemistry, Reaction Rate and Equilibrium Mechanism – L. P. Hammett, McGraw HillBook, Co., (1970).
15. Biophysical Chemistry, Principle and Technique – A. Upadhyay, K. Upadhyayand N. Nath, Himalaya Publishing House, Bombay, (1998).
16. Essentials of Physical Chemistry and Pharmacy – H. J. Arnikar, S. S. Kadam, K. N. Gujan, Orient Longman, Bombay, (1992).

OPEN ELECTIVE/CROSS BORDER PAPER-I (FOR NON-CHEMISTRY STUDENTS ONLY)

CHAO CBT: 1.1 ANALYTICAL AND ORGANIC CHEMISTRY

UNIT-I

Principles of chromatography: Distribution coefficients, modes of chromatography, selection of stationary and mobile phases, analyte development and elution. Chromatographic performance parameters-Retention time and volume, capacity factor, plate height and resolution.
Gas-liquid chromatography: Principle. Apparatus-columns, sample application, mobile phase, stationary phases, detectors. Applications.
HPLC principles: Instrumentation-columns, stationary phase and matrices, sample application, mobile phases, pumps, detectors. Fast protein liquid chromatography [FPLC].
Ion-exchange chromatography: Principle, materials and applications.

Molecular exclusion chromatography: Principle, materials. Applications-purification, relative molecular mass determination, solution concentration, desalting.

Affinity chromatography: Principle, materials-matrix, liquid, practical procedure, applications. Lectin affinity chromatography, metal-chelate chromatography, covalent chromatography.

Thin layer chromatography: Principle, apparatus-preparation of plates, sample application, plate development, detection of analytes. Applications. Selection of chromatographic systems.

[16 HOURS]

UNIT-II

Introduction, classification of organic compounds with examples, classification of organic reactions with examples.
Namclature of organic compounds: IUPAC name of simple organic compounds
Structure and reactivity: Acids and bases, structural effects on acidity and basicity, hydrogen bonding, Resonance, inductive effect and hyperconjugation.
Appliction of Huckel's rule to simple organic molecules.
Insecticides: Introduction, classification, made of action of chlorinated insecticides, Synthesis of DDT, malathion and beygon.
Vitamins: Introduction, classification, deficiency diseases, Biological functions of vitamin B1, pyridoxine and Biotin.

REFERENCES

1. Modern Analytical Chemistry, David Harvey, McGraw Hill, New Delhi, 2000.
2. Principles and Techniques of Biochemistry and Molecular Biology, Wilson and Walker, 6th edition, 2006, Cambridge Univ. Press.
3. Fundamental of Analytical Chemistry, D.A. Skoog, D.M. West, Holler and Crouch 8th Edition, 2005, Saunders College Publishing, New York.

4. Analytical Chemistry, G.D. Christian, 5th ed., 2001 John Wiley & Sons, Inc, India.
5. Separation Techniques in Chemistry and Biochemistry, Roy Keller; M. Dekkar, Inc., 1967.
6. Organic Chemistry, zmorrison and Boyd
7. Advanced Organic Chemistry, Jerry march.
8. Organic Chemistry, I. L. Finar Vol.I & II.

CHIP CBT: 1.2 INORGANIC AND PHYSICAL CHEMISTRY-I

UNIT-I

Periodic properties: Atomic size, ionic radii, ionization potential, electron affinity and electronegativity. Applications of electronegativity.

General characteristics of s, p, d and f –block elements: Comparative study with reference to electronic configuration oxidation states, chemical properties, spectra and magnetic properties of d- and f- block elements.

Survey of essential and trace elements in biological systems.

Chemcial bonding: Ionic bond- size effect and solubility. Covalent bond- simple binary systems, Hydrogen bond-water and in biological systems.

Concepts of acids and bases: Arrhenius, Bronsted-Lowry, Lewis, Lux-Flood and solvent system concepts.

Non-aqueous solvents: Classification of solvents, properties of solvents (dielectric constant, donor and acceptor properties), protic (anhydrous, H_2SO_4, acetic acid) and aprotic solvents (liquid SO_2 and N_2O_4)

[16 HOURS]

UNIT-II

Microwave Spectroscopy: Rotation Spectra of Diatomic Molecules. Applications - Principles of determination of Bond length and Moment of inertia from rotational Spectra.

Infrared Spectroscopy: Vibration of diatomic molecules, vibrational energy curves for simple harmonic oscillator. Theory of infrared absorption. Types of absorption, intensity of absorption bands. Number of fundamental vibrations and Theoretical group frequencies. Identification, interpretation of infrared spectra – Correlation chart, important spectral regions, characterization of functional groups and structure determinations – CO_2 and H_2O, CH_3COCH_3

Applications of Physical chemistry: Concepts of entropy and free energy. Partial molar volume and its determination by density measurements. Symmetry elements and symmetry operations with examples of simple molecules. X-ray diffraction. Bragg equation and Miller indices. Order of a reaction and its determination. Energy of activation and its determination. Assumptions of activated complex theory. Fast reactions with examples. Polymers and their classification. Arrhenius theory of strong and weak electrolytes. Assumptions of Debye-Huckel theory of strong electrolytes. Types of electrodes. Corrosion and its prevention. Laws of photochemistry. Quantum yield and its determination. Photodegradation.

[16 HOURS]

REFERENCES:

1. Inorganic Chemistry, 3rd edn. G.L. Miessler and D.A. Tarr, Pearson Education (2004).
2. Inorganic Chemistry, 2nd edn. D.F. Shriver, P.W. Atkins and C.H. Langford, Oxford University Press (1994).
3. Inorganic Chemistry, 2nd edn. C.E. Housecroft and A.G. Sharpe, Pearson Education Ltd. (2005).
4. Basic Inorganic Chemistry – 3rd edn. F.A. Cotton, G. Wilkinson and P.L. Gaus, John Wiley and Sons (2002).
5. Inorganic Chemistry, 3rd edn. James E. Huheey, Harper and Row Publishers (1983).

6. Fundamentals of Molecular Spectroscopy, C. N. Banwell and E. M. McCash. 4th edition, Tata McGraw-Hill, New Delhi.
7. Introduction to Spectroscopy. Pavia, Lampman and Kriz, 3rd edition, Thomson.
8. Spectroscopy, B. P. Straughan and S. Walker, John Wiley & Sons Inc., New Yark, Vol. 1 & 2, 1976.
9. Vibration Spectroscopy Theory and Applications, D. N. Satyanarayana, New age International, New Delhi.
10. Organic Spectroscopy, William Kemp, 3rd edition, Palgrava, 1991.
11. Chemical Kinetics by K.J. Laidler.
12. Chemical Kinetics –Moore and Pearson.
13. Kinetics and Mechanism of Chemical Transformation by J. Rajaram and J.C. Kuriacose.
14. Introduction to electrochemistry by S. Glasstone.
15. Thermodynamics for chemists by S. Glasstone, Affiliated East-west press, New Delhi, (1965).
16. Advances in Photochemistry - Rohatgi Mukherjee.
17. Principle and applications of Photochemistry – R.P. Wayne, Elsevier, New York, (1970).
18. Elements of Physical Chemistry – Glasstone and Lewis

SECOND SEMESTER

CHA HCT: 2.1. TITRIMETRIC ANALYSIS AND SEPARATION TECHNIQUES

UNIT-I

Precipitation titrations: Titration curves, feasibility of precipitation titrations, factors affecting shape-titrant and analyte concentration, completeness of the reaction, titrants and standards, indicators for precipitation titrations involving silver nitrate, the Volhard, the Mohr and the Fajan's methods, typical applications.

Complexometric titrations: Complex formation reactions, stability of complexes, stepwise formation constants, chelating agents, EDTA-acidic properties, complexes with metal ions, equilibrium calculations involving EDTA, conditional formation constants, derivation of EDTA titration curves, effect of other complexing agents, factors affecting the shape of titration curves-completeness of reaction, indicators for EDTA titrations-theory of common indicators, titration methods employing EDTA-direct, back and displacement titrations, indirect determinations, titration of mixtures. **Redox titrations:** Balancing redox equations, calculation of the equilibrium constant of redox reactions, calculating titration curves, detection of end point, visual indicators and potentiometric end point detection. Quantitative applications-adjusting the analytes oxidation state, selecting and standardizing a titrant. Inorganic analysis-chlorine residuals, dissolved oxygen in water, water in non-aqueous solvents. Organic analysis-chemical oxygen demand (COD) in natural and waste waters,

titrations of mercaptans and ascorbic acid with I_3^- and titration of organic compounds using periodate.

[16 HOURS]

UNIT-II

Chromatography: Definition, principles and mechanism of separation, classification of chromatographic techniques. General descriptions of column chromatography-frontal analysis, displacement analysis and elution analysis. General theory of column chromatography: characterizing a chromatogram-retention time, retention volume and baseline width. Chromatographic resolution, capacity factor, column selectivity. Column efficiency-band broadening-rate theory and plate theory. Peak capacity, non ideal behavior. Optimizing chromatographic separations using capacity factor, column selectivity and column efficiency-Van Deemter equation, and its modern versions, Golay equation and Huber-Knox equations.

Gas chromatography (GC): Principles, instrumentation-mobile phase, chromatographic columns, stationary phases, sample introduction, temperature control, and detectors for gas chromatography. Quantitative and qualitative applications.

High performance liquid chromatography (HPLC): Principles, instrumentation- columns (analytical and guard columns), stationary phases, mobile phases, choosing a mobile phase, isocratic *Vs* gradient elution, HPLC plumbing, sample introduction. Detectors for HPLC-spectroscopic, electrochemical and others, quantitative applications.

Ion exchange chromatography (IEC): Definitions, requirements for ion-exchange resin, synthesis and types of ion-exchange resins, principle, basic features of ion-exchange reactions, resin-properties-ion-exchange capacity, resin selectivity and factors affecting the selectivity, applications of IEC in preparative, purification and recovery processes. Separation of chemically similar elements, determination of total cation concentration of a water sample.

Size-exclusion chromatography: Theory and principle of size-exclusion chromatography, experimental techniques of gel-filtration chromatography (GFC) and gel-permeation chromatography (GPC), materials for packing-factors governing column efficiency, methodology and applications.

Thin layer chromatography: Principle, apparatus and methodology, applications. HPTLC.

[16 HOURS]

UNIT-III

Affinity chromatography: Definitions, separation-mechanism-matrices, matrix activation, role of spacer arms and applications.

Supercritical fluid chromatography (SFC): Properties of supercritical fluids, instrumentation and operating variables, comparison of SFC with other types of chromatography, applications.

Supercritical fluid extraction: Advantages of supercritical fluid extraction, instrumentation, supercritical fluid choice, off-line and on-line extractions, typical applications of supercritical fluid extraction.

Electrophoretic methods-Electrophoresis & Capillary Electrophoresis**:** Theory-**e**lectrophoretic mobility, electroosmotic mobility, electroosmotic flow velocity, total mobility, migration time, efficiency, selectivity and resolution. Instrumentation-capillary tubes, hydrodynamic and electrokinetic methods of sample injection, applying electric field and detectors. Capillary electrophoresis methods-capillary zone electrophoresis, micellar electrokinetic capillary chromatography, capillary gel electrophoresis and capillary electrochromatography.

Solvent extraction: Theory-Nernst partition law, efficiency and selectivity of extraction.

Extraction systems**:** Extraction of covalent neutral molecules, extraction of uncharged metal chelates and synergic extraction, extraction of ion-association complexes-non chelated complexes, chelated complexes and oxonium systems. Use of salting out agents. Methods of extraction-batch and continuous extractions. Applications.

[16 HOURS]

REFERENCES

1. Fundamental of Analytical Chemistry, D.A. Skoog, D.M. West, Holler and Crouch 8th edition, 2005, Saunders College Publishing, New York.
2. Analytical Chemistry, G.D. Christian, 5th ed., 2001 John Wiley & Sons, Inc, India.
3. Quantitative Analysis, R.A. Day and A.L. Underwood, 6th edition,1993 prentice Hall, Inc. New Delhi.
4. Vogel's Textbook of Quantitative Chemical Analysis, J. Mendham, R.C. Denney, J.D. Barnes and M.J.K. Thomas, 6th edition, Third Indian Reprint.2003 Pearson Education Pvt. Ltd., New Delhi.
5. Analytical Chemistry Principles, John H. Kennedy, 2nd edition, Saunders College Publishing, California, 1990.
6. Introduction to Instrumental Analysis, Robert. D. Braun, Pharm. Med. Prem. India, 1987.
7. Instrumental Method of Analysis, W. M. Dean and Settle, 7th edition, 1986, CBS Publishers, New Delhi.
8. Instant Notes of Analytical Chemistry, Kealey and Haines, Viva books Pvt. Ltd., 2002.
9. Modern Analytical Chemistry, David Harvey, McGraw Hill, New Delhi, 2000.
10. Principles and Practice of Analytical Chemistry, F. W. Fifield and Kealey, 5th edition, 2000, Blackwell Sci., Ltd. Malden, USA.

CHI HCT:2.2 ADVANCED COORDINATION CHEMISTRY

UNIT-I

Symmetry and structure: Symmetry elements and symmetry operations, concept of a group, definition of a point group, classification of molecules into point groups. Mulliken symbols. Geometries of metal complexes of higher coordination numbers.

Stability of coordination compounds: Introduction, trends in stepwise stability constants, factors influencing the stability of metal complexes with reference to the nature of metal ion and ligands, the Irving-William series, chelate effect.

Determination of stability constants: Theoretical aspects of determination of stability constants of metal complexes by spectrophotometric, pH metric and polarographic methods.

Crystal field theory: Salient features of CFT, d-orbital splitting in octahedral, tetrahedral, square planar and tetragonal complexes, Jahn-Teller distortions, measurement of 10 Dq and factors affecting it. Evidences for metal-ligand covalency.

[16 HOURS]

UNIT II

Molecular Orbital Theory: MOT to octahedral, tetrahedral and square planar complexes without and with pi-bonding. MO energy diagrams for octahedral complexes with sigma ligands having pi-systems.

Electronic spectra: Introduction, selection rules and intensities, electronic spectra of octahedral and tetrahedral complexes, Term symbols for d^n ions, Orgel and Tanabe-Sugano diagrams, charge-transfer spectra. Ligand-field transition, Optical rotatory dispersion and Circular dichroism.

Magnetic properities: Introduction, Magnetic susceptibility and its measurements, Spin and orbital contributions to the magnetic moment, the effects of temperature on μeff, Spin-cross over, ferromagnetism, antiferromagnetism and ferrimagnetism.

[16 HOURS]

UNIT-III

Reaction and Mechanisms: Introduction

Substitution reactions- Inert and labile compounds, mechanisms of substitution.

Kinetic consequences of Reaction pathways- Dissociation, interchange and association. Experimental evidence in octahedral substitution- Dissociation, Associative mechanisms, the conjugate base mechanism, the kinetic chelate effect.

Stereochemistry of reactions- Substitution in trans and its complexes, isomerization of chelate rings.

Substitution reactions of square-planar complexes- Kinetics and stereochemistry of square-planar substitutions, evidence for associative reactions, explanations of the trans effect.

Electron-transfer processes: Inner-sphere mechanism and outer-sphere mechanism, conditions for high and low oxidation numbers.

Photochemical reactions: Prompt and delayed reactions, d-d and charge transfer reactions, transitions in metal-metal bonded systems.

Metal-metal bonding: Evidences and factors favoring of M-M bonding, Wade's-Mingo's-Lauher rules, bi, tri, tetra, penta and hexa nuclear metal clusters.

[16 HOURS]

REFERENCES:

1. Chemical Applications of Group Theory, 3rd edn, F.A. Cotton, John Wiley and Sons (2006).
2. Molecular Symmetry and Group Theory – Robert L Carter, John Wiley and Sons (2005).
3 Physical Inorganic Chemistry- A Coordination Chemistry Approach- S. F. A. Kettle, Spektrum, Oxford, (1996).
4 Inorganic Chemistry- 2nd edn, C. E. Housecroft and A. G. Sharpe, Pearson Education Ltd, (2005).
5 Inorganic Chemistry- 3rd edn, G. L. Miessler and D. A. Tarr, Pearson Education, (2004).
6 Inorganic Chemistry- 2nd edn, D. F. Shriver, P. W. Atkins and C. H. Langford, Oxford University Press, (1994).
7 Inorganic Chemistry- 3rd edn, James E. Huheey, Harper and Row Publishers, (1983).
8 Basic Inorganic Chemistry- 3rd edn, F. A. Cotton, G. Wilkinson and P. L. Gaus, John Wiley and Sons, (2002).

CHO HCT: 2.3 SYNTHETIC ORGANIC CHEMISTRY

UNIT-I

Reductions: Catalytica hydrogenations (homogeneous and heter;ogeneous)-catalysts, solvent, equipment and reduction of functional groups, catalytic hydrogen transfer reactions. Wilkinson cataluyust. Bakers yeast, $LiAlH_4$, $NaBH_4$, metal dissolving reactions (Birch reduction). Leukert reaction (reductive amination), diborance, Meerwein-Pondorf-Varley reduction, Wolf-Kishner reduction. Clemensen reduction.

Oxidations: Oxidation with chromium and manganese compounds (CrO_3, $K2Cr_2O_7$, PCC, PDC, Sarret reagent, Jones reagent, MnO_2, $KMnO_4$), oxygen (singlet and triplet), ozone, peroxides and peracids, lead tetra acetate, periodic acid, OsO_4, SeO_2, NBS, chloramines-T, Sommelet oxidation, Oppenauer.

[16 HOURS]

UNIT-II

Reagents in Organic synthesis: Use of following reagents in organic synthesis and functional group transformations: Lithium disopropylamide (LDA), Gilmann reagent, dicyclohexyl carbodimide (DCC), dichloro dicyano quinine (DDQ), trialkyl silyl halides, trimethyl silyl cyanide, phase transfer catalyst, crown ethers, cyclodextrins, Fenton's reagent, Ziegler-Natta catalyst, diazomethane, tributyl tinhydride, stannous chloride, Lawesson reagent, thiourea, Sharpless epoxidation, Woodward and Prevost hydroxylation, Stark enamine reaction, Phosphorus ylides – Wittig and related reactions, 1, 3-dithiane anions-Umpolung reaction, sulphur ylides – reactions with aidehydes and ketones, Peterson reactions-synthesis of alkenes.

Microwave induced organic synthesis, ionic liquids in organic synthesis, polymer supported reagents and synthesis, the use of ultra sound in organic synthesis.

UNIT-III

Protecting groups: Protection of hydroxyl, carboxyl, carbonyl, thiol and amino groups. Illustration of protection and deprotection in synthesis.

Aldol and related reactions: Keto-enol tautomerism, mechanism and synthetic applications of aldol condensations, Claisen reaction, Schmidt reaction, perkin raction, Knovenogal, benzoin. Stobbe condensation, Darzens Glysidic ester condenasation, Cannizaro reaction, Tschenko reaction. Michael addition, Robinson's annulation reaction.

Introduction to disconnection approach: Basic principles and terminologies used in disconnection approach. One group C-X and two group C-X disconnections. Synthons and synthetic equivalents.

Retrosynthesis: Benzofurans, p-methoxy acetophenone, saccharein, α-bisabolene, nuciferal, penicillin-V.

[16 HOURS]

REFERENCES

1. H. Pine, Hendrickson, Cram and Hammond, Organic Chemistry, Mac Grow Hill, New York, 1987.
2. Organic Chemistry-Morrison & Boyd
3. I. Finar, Organic Chemistry,m ELBS LOongmann, Vol 1 & II, 1984.
4. J. March, Advanced Organic Chemistry, Willey Interscience, 1994.
5. E. S. Gould, Mechanism Mechanism and structure in Organic Chemistry, Halt, Rinhart & Winston, New York, 1964.
6. F. A. Carey and Sundberg. Advanced Organci Chemistry – part A & B, 3rd edition, Plenum Press, New York. 1990.
7. Comprehensive Organic Synthesis – B. M. Trost and 1. Fleming series, Pergamon Press, New York, 1991.
8. A Guide book to mechanism in organic chemistry-Petersyke.
9. S. K. Ghosh, Advanced General organic chemistry, Book and Alleied (P) Ltd. 1998.

CHP HCT: 2.4 ELECTRO-, QUANTUM-, NUCLEAR- AND PHOTOCHEMISTRY

UNIT-I

Arrhenius theory of strong and weak electrolytes and its limitations, Debye-Huckel theory of strong electrolytes, Debye Huckel-Onsager equation, Debye-Huckel limiting equation for activity coefficients, Debye-Huckel equation for appreciable concentrations. A brief survey of Helmholtz- Perrin, Gouy-Chapman and Stern electrical double layer(No Derivation). Liquid junction potential and its determination. Transport Number**:** Determination of transport number by Hittorf method and e.m.f method. True and apparent transport numbers. Abnormal transport numbers, effect of temperature
and concentration on transport number.

Irrversible electrode process: Introduction, reversible and irreversible electrodes reversible and irreversible cells. Polarization, over voltage-ohmic over voltage, concentration overvoltage activation overvoltage, experimental determination of over voltage. Equations for concentration over potential, diffusion current –stationary current, potential curves, thickness of diffusion layer, diffusion controlled current –potential curves at a dropping mercury electrode, polarography, half wave potential,
application in qualitative and quantitative analysis. Energy barrier and electrode kinetics, Butler-Volmer equation, Tafel equation. Hydrogen over voltage and Oxygen over voltage.Effect of temperature, current density and pH on over voltage.

[**16 HOURS]**

UNIT II

Wave-particle duality of material particles, deBroglie equation, Heisenberg Uncertainty principle, Concept of operators (operator–operand), Algebra of operators, commutative and non-commutative operators, linear operator, Laplacian operator, Hamiltonian operator, eigen value, eigen function, class Q function, Hermitian operator, turn over rule, atomic units. Wave equation

for stretched strings, Schrodinger wave equation for particles, Eigen values and Eigen functions, postulates of quantum mechanics. Application of Schrodinger equation to a free particle and to a particle trapped in a potential field (one dimension and three dimensions). Degeneracy, Wave equation for H-atom, separation and solution of R, ϕ and θ equations. Application of Schrodinger equation to rigid rotator and harmonic oscillator. Approximate methods –Necessity of approximate methods, perturbation method, the theory of perturbation method –first order and second order correction, application to He-atom (first order correction only) – calculation of first ionization potential and binding energy. Variation theoremstatement and proof

[16 HOURS]

UNIT III

Nuclear chemistry: Radioactive decay – General characteristics, decay kinetics, parent – daughter decay growth relationships, determination of half-lives, Nuclear stability –packing fraction, binding energy, Brief survey of alpha, beta and gamma decays. Nuclear reactions – Bethe's notation, types of nuclear reactions – specific nuclear reactions, photonuclear reactions, Oppenheimer –Phillips process, spallation reactions. Definition of Curie and related calculations.. Szilard-Chalmers process. Geiger-Muller counters – G.M. Plateau, dead time, coincidence loss, determination of dead time,.

Photochemistry: Introduction to photochemistry, quantum yield and its determination, factors affecting quantum yield, Actinometry -Uranyloxalate and potassium ferrioxalate actinometers, acetone and diethylketone actinometers. Term symbols and significance. Photosensitization: by mercury, dissociation of H_2. Photochemical kinetics of: Decomposition of CH_3CHO, formation of HCl. Photodegradation: Photocatalyst – ZnO, TiO_2, principle, application of ZnO/TiO_2 in the photo degradation of dyes (IC), pesticides (DDT) and in industrial effluents. Effect of photo degradation on COD value.

Radiation chemistry: Introduction, units, interaction of electromagnetic radiation with matter, G-value, LET of radiation, dosimetry, Fricke and cericsulfate dosimeters. Radiolysis - cysteine, and biphenyl. Radioisotopes as tracers, use of isotopic tracers in the elucidation of reaction mechanism, structure determination and solubility of sparingly soluble substances. ^{14}C dating, isotope dilution, neutron activation analysis, radiometric titrations and medicinal applications of isotopic tracers. Hazards in radiochemical work and radiation protection.

[16 HOURS]

REFERENCES

1. Elements of Physical Chemistry –Lewis and Glasstone.
2. Physical Chemistry by P.W. Atkins, ELBS, 4th Edition, Oxford University Press(1990).
3. Basic Physical Chemistry by W.J. Moore, Prentice Hall, New Delhi, (1986).
4. Physical Chemistry –G.M. Barrow, McGraw Hill International service (1988).
5. Introduction to electrochemistry by S. Glasstone.
6. Modern electrochemistry Vol. I and II, by J.O.M. Bockris and A.K.N. Reddy, Pentium Press, New York (1970).
7. Electrochemistry –Principles and applications by E.G. Potter.
8. Electrochemistry by Reiger, Prentice Hall (1987).
9. Treatise on Electrochemistry, G. Kortum 2nd Edition, Elsevier, London (1965).
10. Quantum Chemistry – A.K. Chandra. Second Edition, Tata McGraw Hill Publishing Co. Ltd., (1983).

11. Quantum Chemistry – Eyring, Walter and Kimball. John Wiley and Sons, Inc., New York.
12. Quantum Chemistry –I.N. Levine. Pearson Education, New Delhi, (2000).
13. Theoretical Chemistry – S. Glasstone. East West Press, New Delhi, (1973).
14. Quantum Chemistry – R.K. Prasad, New Age International Publishers, (1996).
15. Valence Theory – Tedder, Murel and Kettle.
16. Quantum Chemistry – D.A. McQuarrie.
17. Theoretical Inorganic Chemistry – Day and Selbin.
18. Nuclear Chemistry by Friedlander and Kennedy, John Wiley and Sons (1987).
19. Nuclear Physics and Chemistry by G. Harvey.
20. Essentials of Nuclear Chemistry by H.J. Arnikar, Eastern Wiley (1990).
21. Nuclear Chemistry by U.N. Dash, Sultan Chand and Sons (1991).
22. Source book on atomic energy by S. Glasstone, 3rd edition Van Nonstrand (1967).
23. Nuclear chemistry by Friedlander and Kennedy, John Wiley and Sons (1987).
24. Essentials of nuclear chemistry by H.J. Arnikar, Eastern Wiley (1990).
25. Nuclear radiation detection by Price. Nuclear radiation detectors by S.S. Kapoor and Ramamoorthy, Wiley Eastern (1986).
26. Fundamentals of radiochemistry by D.D. Sood, A.V.R. Reddy and N. Ramamoorth

PRACTICALS

CHA SCP$_1$:2. 5. ANALYTICAL PRACTICALS - II A

1. Determination of percentage of chloride in a sample by precipitation titration- Mohr, Volhard and Fajan methods.
2. Determination of silver in an alloy and Na_2CO_3 in soda ash by Volhard method.
3. Mercurimetric determination of blood or urinary chloride.
4. Determination of total hardness, calcium and magnesium hardness and carbonate and bicarbonate hardness of water by complexation titration using EDTA.
5. Determination of calcium in calcium gluconate/calcium carbonate tablets/ injections and of calcium in milk powder by EDTA titration.
6. Analysis of commercial hypochlorite and peroxide solution by iodometric titration.
7. Determination of copper in an ore/ an alloy by iodometry and tin in stibnite by iodimetry.
8. Determination of ascorbic acid in vitamin C tablets by titrations with $KBrO_3$ and of vitamin C in citrus fruit juice by iodimetric titration.
9. .Determination of iron in razor blade by visual and potentiometric titration using sodium metavanadate.
10. Determination of iron in pharmaceuticals by visual and potentiometric titration using cerium(IV) sulphate.
11. Analysis of an industrial effluent for methyl orange and phenolphthalein acidity and chloride content by conductometric titration.
12. Determination of nickel in steel by synergic extraction and boron in river water/sewage using ferroin.
13. Determination of total cation concentration of tap water by ion-exchange chromatography.
14. Determination of magnesium in milk of magnesium tablets by ion-exchange chromatography.

15. Determination of caffeine in beverages by capillary zone electrophoresis.
16. Determination of nitrate and nitrite in water by capillary electrophoresis.
17. A fast and simple method for the determination of amino acid composition of proteins
18. Cation exchange chromatographic separation of cadmium and zinc and their estimation by EDTA titration.
19. Gas chromatographic determination of ethanol in beverages.
20. Determination of aspirin, phenacetin and caffeine in a mixture by HPLC.

[64 HOURS]

CHA SCP$_2$:2. 5. ANALYTICAL PRACTICALS - II B

1. Determination of purity of a commercial sample of mercuric oxide by acid-base titration.
2. Determination of formaldehyde content of a pesticide preparation and sodium benzoate content of catsup by acid-base titration.
3. Determination of potassium hydrogen phthalate in an impure sample by titration with $HClO_4$ in acetic acid medium.
4. Titrations of amino acids with $HClO_4$ in CH_3COOH medium.
5. Determination of benzoic acid in food products by titration with methanolic KOH in chloroform medium using thymol blue as indicator.
6. Determination of the pH of hair shampoos and pH determination of an unknown soda ash.
7. Spectrophotometric determination of pKa of an acid-base indicator.
8. Spectrophotometric determination of phosphorous in urine.
9. Spectrophotometric determination of lead on leaves using solvent extraction.
10. Solvent extraction of zinc.
11. Anion exchange chromatographic separation of zinc and magnesium followed by EDTA titration of the metals.
12. Separation and determination of chloride and bromide on an anion exchanger.
13. Thin layer chromatographic separation of amino acids.
14. Thin-layer chromatographic separation of nitro anilines on fluorescent sheets.
15. Determination of chloride concentration in water by capillary electrophoresis.
16. Separation of enantiomeric barbiturates by capillary electrophoresis using a cylcodextrin-containing run buffer.
17. Gas chromatographic analysis of a tertiary mixture.
18. Analysis of artificial sweetners and additives in beverages by HPLC.
19. Determination of caffeine in beverages by HPLC.
20. Quantitative HPLC analysis of a psychotherapeutic medication: Simultaneous determination of amitriptyline HCl and perphenazine.

[64 HOURS]

REFERENCES

1. Fundamental of Analytical Chemistry, D.A. Skoog, D.M. West, Holler and Crouch 8th edition, 2005, Saunders College Publishing, New York.
2. Analytical Chemistry, G.D. Christian, 5th ed., 2001 John Wiley & Sons, Inc, India.

3. Quantitative Analysis, R.A. Day and A.L. Underwood, 6th edition, 1993 Prentice Hall, Inc. New Delhi.
4. Vogel's Textbook of Quantitative Chemical Analysis, J. Mendham, R.C. Denney, J.D. Barnes and M.J.K. Thomas, 6th edition, Third Indian Reprint.2003 Pearson Education Pvt. Ltd., New Delhi.
7. Analytical Chemistry Principles, John H. Kennedy, 2nd edition, Saunders College Publishing, California, 1990.
8. Practical Clinical biochemistry methods and interpretations, R.Chawla, J.P. Bothers Medical Publishers (P) ltd., 1995.
9. Laboratory manual in biochemistry, J. Jayaraman, New Age International Publishers, New Delhi, 1981.
10. Practical clinical Biochemistry-Harold Varley and Arnold.Hein mann, 4th edn.

CHI SCP_1:2.6 INORGANIC PRACTICALS - IIA

1. Micro-titrimetric estimation of :
    a) Iron using cerium(IV)
    b) Calcium
    c) Magnesium and
    d) Chloride.

2. Quantitative estimation of copper(II), calcium(II) and chloride in a mixture.
3. Preparation of mercury tetrathiocyanato cobaltate(II) complex, and estimation of mercury as HgS gravimetrically.
4. Determination of nitrite in waste water using p-nitroaniline and acetylacetone by visible spectrophotometry.
5. Preparation and iodometric analysis of high temperature superconductor.
6. Semimicro qualitative analysis of mixtures containing **TWO** anions and **TWO** cations (excluding sodium, potassium and ammonium cations) and **ONE** of the following less common cations: W, Mo, Ce, Th, Ti, Zr, V, U and Li.

[64 HOURS]

CHI SCP_2:2.6 INORGANIC PRACTICALS -IIB

1. Microvolumetric determination of Ca^{2+} and Mg^{2+} in natural waters.
2. Preparation of potassium trisoxalte aluminate(III) trihydrate $K_3[Al(C_2O_4)_3]$ $3H_2O$.
3. Measuring manganese in steel by spectrophotometry with standard addition.
4. Determination of nitrite in pure water sample by $KMnO_4$ titration.
5. Semimicro gravimetric estimation of aluminium.
6. Semimicro qualitative analysis of mixtures containing **TWO** common cations and **TWO** less common cations of the following:
   W, Mo, Ce, Th, Zr, V, U and Li.

[64 HOURS]

REFERENCES

1. A Text Book of Quantitative Inorganic Analysis – A.I. Vogel, 3rd edition.
2. Vogel's Text Book of Quantitative Chemical Analysis – J. Basset, R.C. Denney, G.H. Jeffery and J. Mendhom.
3. Spectrophotometric determination of elements – Z. Marczenko.
4. Vogel's Qualitative Inorganic Analysis – Svelha.
5. Macro and Semimicro inorganic qualitative analysis – A.I. Vogel.
6. Semimicro Qualitative Analysis – F.J. Welcher and R.B. Halin.
7. Quantitative Chemical Analysis – Daniel C. Harris, 7th edition, (2006)

CHO HCP:2.7 ORGANIC PRACTICALS-II

Qualitative abalysis: Separation of binary mixtures, identification of functional groups and preparation of suitable solid derivatives.

[64 HOURS]

REFERENCES

1. Mannhual Organic Chemistry –Dey and Seetharaman
2. Natural Products Chemistry by Raphel Ikhan
3. Modern experimental Orgtanic Chemistry by John H. Miller and E.F. Neugil, p 289.
4. An introduction to practical Organic Chemistry-Robert, Vingrove etc.
5. A Text book of practical Organic Chemistry-A. I. Vogel Vol.I
6. Practical Organic Chemistry-Mann & Sunders.
7. An introduction to practical Organic chemistry-Robert, Vingrove etc.
8. Semimicro qualitative Organic Analysis by Cheronis, Entrikin and Hodnet.
9. R. K. Bansal, Laboratory Manual of Organic Chemistry, New PAGe International (P) Ltd, London, 3rd edition, 1996.
10. N. K. Visno, Practical Organic Chemistry, New PAGE Internaltional (P) Ltd. London, 3rd edition, 1996.

CHP HCP: 2.8 PHYSICAL PRACTICALS - II

1. Analysis of a binary mixture (Gylcerol & Water) by measurement of refractive index.
2. Determination of degree of association of benzoic acid in benzene by distribution method.
3. Binary analysis of two miscible liquids by viscometric method (Ethanol & Water)
4. To study the salt effects on kinetics of reaction between $K_2S_2O_8$ and KI.
5. Study of kinetics of reaction between CAT and indigocarmine spectrophotometrically and determination of rate constant.
6. Determination of energy of activation for the bromide-bromate reaction.
7. Conductometric titration of sodium sulphate against barium chloride.
8. Determination of equivalent conductance at infinite dilution of a strong electrolyte(NaOH) and verification of Onsager equation.
9. Determination of dissociation constant of a weak electrolyte (HCOOH) by conductivity method.
10. Potentiometric titration of a mixture of halides (KCl+KBr) against $AgNO_3$.

11. pH titration of (a) (CH_3COOH+HCl) Vs NaOH (b) $CuSO_4$ Vs NaOH and determination of Ka.
12. Determination of redox potential of Fe^{2+} ions by potentiometric method.
13. Determination of partial molar volume of (a) NaCl-H_2O systems.
14. G.M. Counter –determination of G.M. plateau and dead time.
15. Verification of inverse square law using gamma emitter.
16. Kinetics of acid hydrolysis of an ester and study of effect of dielectric constant of the medium (using CH_3OH).
17. Conductometric titration of formic acid/oxalic acid against NaOH and NH_4OH.
18. Conductometric titration of orthophosphoric acid against NaOH.
19. Determine the concentration of KI by potentiometrically by caliberation method

[64 HOURS]

REFERENCES

12. Practical Physical Chemistry – A.J. Findlay.
13. Experimental Physical Chemistry –F. Daniels et al.
14. Selected Experiments in Physical Chemistry – Latham.
15. Experiments in Physical Chemistry – James and Prichard.
16. Experiments in Physical Chemistry – Shoemaker.
17. Advanced Physico-Chemical Experiments –J. Rose.
18. Practical Physical Chemistry –S.R. Palit.
19. Experiments in Physical Chemistry – Yadav, Geol Publishing House.
20. Experiments in Physical Chemistry – Palmer.
21. Experiments in Chemistry –D.V. Jahagirdar, Himalaya Publishing House, Bombay, (1994).
22. Experimental Physical Chemistry –Das. R.C. and Behera B, Tata Mc Graw Hill.

M. Sc. DEGREE IN CHEMISTRY

THIRD SEMESTER

CHA HCT: 3.1. INSTRUMENTAL METHODS OF ANALYSIS-I

UNIT-I

UV-VIS Spectroscopy (outer shell electronic spectroscopy): Quantitative aspects of absorption-Beer's law. Terminology associated with absorption measurements. Limitation of the law: Real, chemical, instrumental and personal. Theory of molecular absorption. Vibration-rotation fine structure of electronic spectra. Types of absorption bands: $n \rightarrow \pi^*$, $\pi \rightarrow \pi^*$, $n \rightarrow \sigma^*$, $\sigma \rightarrow \sigma^*$, C-T & ligand field. Empherical rules for predicting the wavelength of maximum absorption: Olefins, conjugated dienes, cyclic trienes and polyenes- α, βunsaturated aldehydes and ketones-benzene and substituted benzene rings. Basic components of instrumentation, single and double beam designs. Applications: Qualitative and quantitative analysis of binary mixtures, measurement of dissociation constants of acids and bases, determination of molecular weight, photometric titrations, determination of stoichiometry and stability of the complexes and kinetic studies.

[16 HOURS]

UNIT-II

Flame photometry and Atomic absorption spectrometry: Energy level diagrams-atomic absorption spectra. Flame characteristics. Flame atomizers and electrothermal atomization. Comparison of spectral interferences, chemical and physical interferences in flame photometry (FP) and atomic absorption spectrophotometry (AAS). Use of organic solvents. Quantitative techniques-calibration curve procedure and the standard addition technique. Typical commercial instruments for FP and AAS. Applications. Qualitative analysis and quantitative evaluations. Relative detectabilities of atomic absorption and flame emission spectrometry.

Molecular luminescence spectrometry: Theoretical basis for fluorescence and phosphorescence. Singlet and triplet excited states. Variables affecting luminescence-quantum efficiency, transition types, structure and structural rigidity, temperature and solvent effects, effect of pH, dissolved oxygen and concentration effect. Excitation spectra *vs* emission spectra. Fluorescence instrumentation-fluorometers and spectrofluorometers. Sensitivity and selectivity. Modification necessary to measure phosphorescence. General scope of applications of luminescence.

Nephelometry and turbidometry: Principles, instrumentation and applications.

[16 HOURS]

REFERENCES

1. Fundamental of Analytical Chemistry, D.A. Skoog, D.M. West, Holler and Crouch 8th edition, 2005, Saunders College Publishing, New York.
2. Analytical Chemistry, G.D. Christian, 5th ed., 2001 John Wiley & Sons, Inc, India.
3. Quantitative Analysis, R.A. Day and A.L. Underwood, 6th edition,1993 prentice Hall, Inc. New Delhi.
4. Vogel's Textbook of Quantitative Chemical Analysis, J. Mendham, R.C. Denney, J.D. Barnes and M.J.K. Thomas, 6th edition, Third Indian Reprint.2003 Pearson Education Pvt. Ltd., New Delhi.
5. Analytical Chemistry Principles, John H. Kennedy, 2nd edition, Saunders College Publishing, California, 1990.
6. Instrumental Methods of Analysis by H.H. Willard, L.L. Merritt and J.A. Dean, 7th Edition, CBS Publishers, New Delhi, 1988.
7. Principles and Practice of Analytical Chemistry, F. W. Fifield and Kealey, 3rd edition, 2000, Blackwell Sci., Ltd. Malden, USA.
8. Modern Analytical Chemistry, David Harvey, McGraw Hill, New Delhi, 2000.
9. Introduction to Instrumental Analysis, Braun, Pharm. Med. Press. India.
10. Instant Notes of Analytical Chemistry, Kealey and Haines, Viva books Pvt. Ltd., New Delhi, 2002.

CHI HCT: 3.2 ORGANOMETALLIC CHEMISTRY AND CATALYSIS

UNIT-I

Fundmental concepts: Introduction, Classification of organmetallic compounds by bond type, Nomenclature, the Effective atomic number rule, complexes that disobey the EAN rule, common reactions used in complex formation.

Organometallics of transition metals: Preparation, bonding and structures of nickel, cobalt, iron and manganese carbonyls. Preparation and structures of metal nitrosyls in organometallics. Ferrocene and ruthenocene: Preparation, structure and bonding. Complexes containing alkene, alkyne, arene and allyl ligands: preparation, structure and bonding. The isolobal principles.

[16 HOURS]

UNIT-II

Homogeneous Catalysis - Industrial Applications: Alkene hydrogenation, hydroformylation, The Wacker process, Monsanto acetic acid process and L-DOPA synthesis, alkene oligomerizations, Water-gas shift reactions.

Heterogeneous catalysis - Commercial Applications: Alkene polymerization: Ziegler-Natta catalysis, Fischer-Tropsch carbon chain growth.

Zeolites as catalysts for organic transformation**:** Uses of ZSM -5

Alkene metathesis, hydroboration, Arylation or vinylation of olefins (Heck reaction).

[16 HOURS]

REFERENCES:

1. Organometallic Chemistry, 2 edn, R.C. Mehrothra and A. Singh, New Age International Publications (2006).
2. Fundamental Ttransition Metal Organometallic Chemistry- Charles M. Lukehart, Brooks/Cole Publishing Company (1985).
3. The Organometallic Chemistry of the Transition Metals, 4 edn, Robert H. Crabtree, Wiley Interscience, (2005).
4. Organometallics- A Concise Introdution, 2 edn, Chistoph Elschenbroich and Albert salzer VCH, (1992).
5. Inorganic Chemistry, 2 end- C. E. Housecroft and A. G. Sharpe, Pearson Education Ltd., (2005).
6. Inorganic Chemistry- 3rd edn, G. L. Miessler and D. A. Tarr, Pearson Education, (2004).
7. Basic Organometalic Chemistry-B.D. Gupta and A. J. Elias, Universities Press (2010).

CHO HCT: 3.3 IR-, MASS AND NMR SPECTROSCOPY

UNIT-I

IR Spectrosocpy: Introduction, Instrumentation, samples handling, Modes of vibrations, Hooks Law, Characteristic group frequencies and skeletal frequencies. Finger print region, Identification of functional groups- Alkenes, Aromatics, Cabonyl compounds (aldehydes and ketones, esters and lactones), halogen compounds, sulphur and phosphorus compounds, amides, lactums amino acids and amines. Factors affecting group frequencies and band shapes, conjugation, resonance and inductance, hydrogen bonding and ring strain. Tautomerism, Cis-trans isomerism. Applications of IR spectra.

Mass spectrometry: Principles, instrumentation, different methods of ionization. El, Cl, FD and FAB, lon separators-single focusing separator with magnetic diffraction, double focusing analyzer, time-of-fight separator and quadrupole analyzer, Mass spectra – nmolecular ion, base peak, meta-stable peak. General rules for gragmentation pattern. Nitrogen rule, Hydrogen, transfer rearrangement and McLafferty rearrangement. Mass spectral fragmentation of Organic compounds (acids, ester,

hydrocarbons, halogenated hydrocarbons, alcohols, carbonyl compounds, amines, ethers and hetero-cyclic compounds).

[16 HOURS]

UNIT-II

NMR Spectroscopy: Magnetic properties of nuclei (magnetic moment, g factor, nuclear spin), effect of external magnetic field on spinning nuclei, Larmor precession frequency, resonance conditions, population of nuclear magnetic energy levels, relaxation processes, relaxation time, line width and other factors affecting line width.

Chemical Shift: Standards employed in NMR, factors influencing chemical shift: electronegativity, shielding and deshielding, vander Walls deshielding magnetic anisotropy, H-bonding, diamagnetic and paramagnetic anisotropies, spin-spin coupling, chemical shift values and correlation for protons bonded to carbon and other nuclei, Instrumentation.

Chemical shift equivalence and magnetic equivalence, proton exreactions, effects of chiral centre, stereochemistry-hindered rotation, karplus curve-variation of coupling constants with dihedral angle.

Complex NMR Spectra: Simplification of complex spectra-isotopic substitution, increased magnetic field strength, double resonance and lanthanide shift reagents;, Nuclear Overhauser Effect (NOE), variable temperature probe, FT-NMR Spectroscopy and advantages.

^{13}C-NMR Spectroscopy: Comparison of 1H-NMR and 13C-NMR, multiplicity-Proton decoupling-Noise decoupling-Off resonance decoupling-Selective proton decoupling-Chemical shift, application of CMR.
NMR of ^{19}F, ^{31}P, ^{11}B and ^{15}N

Applications of NMR: Structural diagnosis, conformational nalysis, keto-enol tautomerism, H-bonding.
Two dimensional NMR Spectroscopy: COSY, NOESY, INDOR, SPI, DEPT Spectra, CIDNP technique, MRI.
Composite Problems. Problems involving the application of the above spectroscopic techniques (UV-Visible, IR, NMR and Mass) for structural elucidation of organic molecules.

[16 HOURS]

REFERENCES

1. Spectroscopy, B. P. Straughan and S. Salker, John Wiley and Sons Inc., New Yourk, Vol.2, 1976.
2. Organic Spectroscopy, William kemp, English Language Book society, Macmillm, 1987.
3. Application of Absorption Spectroscopy of Organic Compounds, John R. Dyer, Prentice/Hall of India Private Limited, New Delhi, 1974.
4. Spectrometric Identification of Organic Compounds, Fourth Edition, Robert M. Silverstein, G. Clayton Bassler and Terence C. Morrill, John Wiley & Sons, New York, 1981.

5. Organic Spectroscopy, V. R. Dani, Tata MeGraw-Hall Publishing Company Limited, New Delhi. 1995.
6. Spectroscopy, B. P. Straughan, S. Walker, Chapman and Hall John Wiley and Sons Inc., New York, Vol.I 1976.
7. Interpretation of Carbon-13 NMR Spectra, F.W. Wehrli and T. Wirthin, Heyden, London, 1976.
8. NMR spectroscopy-Powai

CHP HCT: 3.4 ADVANCED CHEMICAL KINETICS, MICROWAVE AND VIBRATION SPECTROSCOPY

UNIT I

Microwave spectroscopy: Rotation Spectra of Diatomic Molecules - Rigid and non rigid rotator model. Rotational quantum number and the selection rule. Effect of isotopic substitution on rotation spectra. Relative intensities of the spectral lines. Classification of polyatomic molecules based on moment of inertia - Linear, symmetric top, asymmetric top and spherical molecules. Rotation spectra of polyatomic molecules (OCS CH_3F and BCl_3). Moment of inertia expression for linear tri-atomic molecules. Experimental techniques - Microwave spectrometer. Applications - Principles of determination of Bond length and Moment of inertia from Rotational Spectra. Stark effect in rotation spectra and determination of dipole moments.

Vibration spectroscopy*:* Vibration of diatomic molecules, vibrational energy curves for simple harmonic oscillator. Effects of anharmonic oscillation. Vibration- rotation spectra of carbon monoxide. Expressions for fundamental and overtone frequencies. Vibration of polyatomic molecules – The number of degrees of freedom of vibration and their symmetry. Parallel and perpendicular vibrations (CO_2 and H_2O). Fundamental, overtone, combination and difference bands. Fermi resonance. Force constant and its significance. Theory of infrared absorption and theoretical group frequency. Intensity of absorption band and types of absorptions. Correlation chart. Important spectral regions- Hydrogen stretching region, double and triple bonds regions, fingerprint region. Applications: Structures of small molecules: XY_2 – linear or bent, XY_3 – planar or pyramidal. Factors affecting the group frequency – Physical state, vibrational coupling, electrical effect, hydrogen bonding, steric effect and ring strain.

Raman spectroscopy: Introduction, Raman and Rayleigh scattering, Stokes and anti-Stokes lines, polarization of Raman lines, depolarization factor, polarizability ellipsoid. Theories of Raman spectra - classical and quantum theory. Rotation-Raman and vibration- Raman spectra. Comparison of Raman and IR spectra, rule of mutual exclusion principle. Advantages of Raman spectra.

[16 HOURS]

UNIT II

Homogenous Catalysis: Acid-Base catalysis, specific acid and base catalysis. General acid and base catalysis. Oxidation of amino acids and carbohydrates in pressence of acid and base catalysis. Acidity functions - Bronstead, Hückel, Hammett and Bunnett hypothesis.

Enzyme kinetics: Effect of substrate concentration (Michaelis Menton equation), Effect of pH, effect of catalysts and inhibitors (substrate, zeolite, Cr^{3+}, Fe^{2+} ZnO, U.V light), effect of

temperature. A brief kinetic and mechanistic applications of glucose oxidase in the oxidation of glucose.

Linear Free Energy Relationship: Hammett equation, Taft equation, Okemoto Brown equation and its application to oxidation of amino acids and aromatic amines. Swain-Scott and Edward equation. Winstein - Grunwald relationship. Isokinetic relationship and significance of isokinetic temperature, Exner criterion.

Kinetic Isotope Effect: Theory of kinetic isotope effect - normal and inverse isotope effect, primary isotope effect, secondary isotope effect, solvent isotope effect.

[16 HOURS]

REFERENCES

1. Fundamentals of Molecular Spectroscopy, C. N. Banwell and E. M. McCash. 4th edition, Tata McGraw-Hill, New Delhi.
2. Introduction to Molecular Spectroscopy, G. M. Barrow,McGraw-Hill, New York.
3. Introduction to Spectroscopy. Pavia, Lampman and Kriz, 3rd edition, Thomson.
4. Spectroscopy, B. P. Straughan and S. Walker, John Wiley & Sons Inc., New York, Vol. 1 & 2, 1976.
5. Vibration Spectroscopy Theory and Applications, D. N. Satyanarayana, New age International, New Delhi.
6. Organic Spectroscopy, William Kemp, 3rd edition, Palgrava, 1991.
7. Elementary Organic Spectroscopy, Y. R. Sharma, S. Chand and Company, 2000.
8. Optical Method of Analysis, E. D. Olsen, McGraw Hill Inc, 1975.
9. Introduction to Physical Organic Chemistry, R. D. Gilliom, Madison – Wesley, USA (1970).
10. Physical Organic Chemistry, Reaction Rate and Equilibrium Mechanism – L. P. Hammett, McGraw HillBook, Co., (1970).
11. Biophysical Chemistry, Principle and Technique – A. Upadhyay, K. Upadhyay and N. Nath, Himalaya Publishing House, Bombay, (1998).

CHA HCP: 3.5. ANALYTICAL PRACTICALS - III

1. Determination of calcium in limestone by redox, acid-base and complexation titrations.
2. Determination of vitamin C in orange juice by titration with cerium (IV) and with 2, 6-dichlorophenol indophenol.
3. Determination of mercury in an algaecide by EDTA titration; and arsenic in ant control preparation by redox titration.
4. Determination of aluminium and magnesium in antacids by EDTA titration.
5. Analysis of a copper-nickel alloy sample for copper and nickel by EDTA titration using masking and selective demasking reactions.
6. Determination of zinc in a sample of foot powder and thallium in a sample of rodenticide by EDTA titration.
7. Determination of saccharin in tablets by precipitation titration.
8. Determination of iodine value and saponification value of edible oils.
9. Determination of ascorbic acid in goose berry/bitter gourd by titrimetry and spectrophotometry using N-bromosuccinimide (NBS).

10. Determination of sulpha drugs by potentiometry using $NaNO_2$ and iodometric assay of penicillin.
11. Electrolytic determination of copper and lead in brass.
12. Polarographic determination of copper and zinc in brass.
13. Determination of sodium, potassium and calcium in mineral waters by atomic emission spectrometry.
14. Determination of iron in mustard seeds and phosphorus in peas by spectrophotometry.
15. Analysis of waste water for anionic detergents and phenol by spectrophotometry.
16. Fluorimetric determination of riboflavin (vit.B_2) in tablets.
17. Analysis of sulphonamides by uv-spectrophotometry.
18. Colorimetric analysis of procaine by diazotization and coupling reaction.
19. Determination of manganese in steel by extraction-free spectrophotometry and molybdenum in steel by extractive spectrophotometry.
20. Development of a liquid-liquid extraction assay of ephedrine-phenobarbital mixtures.

[64 HOURS]

REFERENCES

1. Fundamental of Analytical Chemistry, D.A. Skoog, D.M. West, Holler and Crouch 8th edition, 2005, Saunders College Publishing, New York.
2. Analytical Chemistry, G.D. Christian, 5th ed., 2001 John Wiley & Sons, Inc, India.
3. Quantitative Analysis, R.A. Day and A.L. Underwood, 6th edition, 1993, prentice Hall, Inc. New Delhi.
4. Vogel's Textbook of Quantitative Chemical Analysis, J. Mendham, R.C. Denney, J.D. Barnes and M.J.K. Thomas, 6th edition, Third Indian Reprint.2003 Pearson Education Pvt. Ltd., New Delhi.
5. Analytical Chemistry Principles, John H. Kennedy, 2nd edition, Saunders College Publishing, California, 1990.
6. Pharmaceutical Drug Analysis by Ashutoshkar, New Age International Publishers, New Delhi, 2005.
7. Practical Pharmaceutical Chemistry, Ed. A. H. Geckett, J. B. Stenlake, 4th Ed. Part I and II, CBS Publishers, New Delhi.
8. Quantitative Analysis of Drugs in Pharmaceutical Formulations, P. D. Sethi, 3rd Ed. CBS Publishers & Distributors, New Delhi, 1997.

CHI HCP: 3.6 INORGANIC PRACTICALS -III

1. Determination of bismuth, cadmium and lead in a mixture: Analysis of a low melting alloy (Wood's alloy).
2. Simultaneous spectrophotometric determination of chromium and manganese in a steel solution.
3. Quantitative analysis of copper(II) and iron(II) in a mixture:
   i. Copper gravimetrically as CuSCN and
   ii. Iron volumetrically using cerium(IV) solution
4. Determination of chromium(III) and iron (III) in a mixture: Kinetic masking method.

5. Electrogravimetric determination of ;
    a) Copper in copper sulphate
    b) Nickel in nickel suphate
    c) Copper and nickel in alloy solution
    d) Lead in lead nitrate.
6. Flame photometric determination of the following metal ions from different samples:
   a) Sodium b) potassium c) calcium d) lithium and d) sodium and potassium in a mixture.
7. Polarographic estimation of cadmium and zinc.
8. Polarographic measurement of equilibrium constant.
9. Determination of iron as the 8- hydroxyquinolate by solvent extraction method.
10. Solvent extraction and spectrophotometric estimation of molybdenum by the thiocyanate method.
11. Quantitative determination of nickel using dithizone and 1,10-phenanthroline by synergistic extraction.
12. Spectrophotometric determination of the pKa value of methyl red.
13. Separation of cadmium and zinc on an anion exchanger and their estimation using EDTA titration.
14. Determination of aluminium, nickel, cobalt and iron(III) in a mixture by EDTA titration after ion-exchange separation.

[64 HOURS]

REFERENCES

1. Advanced physico-chemical experiments – J. Rose.
2. Instrumental analysis manual - Modern Experiments for Laboratory – G.G. Guilbault and L.G. Hargis.
3. A Text Book of Quantitative Inorganic Analysis – A.I. Vogel, 5th edition.
4. Quantitative Chemical Analysis – Daniel C. Harris, (2006) 7th edition.
5. Spectrophotometric determination of elements – Z. Marczenko.

CHO SCP$_1$: 3.7 ORGANIC PRACTICALS -IIIA

1. Determination of equivalent weight of acids by silver salt method.
2. Estimation of amino groups by acetylating method.
3. Estimation of keto group by haloform method.
4. Estimation of nitro group.
5. Estimation of sugars by Bertrands method.
6. Determination of saponification value of oils.
7. Determination of iodine value of oils.
8. Estimation of amino acids.
9. Estimation of polyhydroxy alcohols.
10. Determination of N-Acetyl groups.

[64 HOURS]

CHO SCP_2: 3.7 ORGANIC PRACTICALS -IIIB

1. Determination of equivalent weight of acids.
2. Estimation of hydronyl group by acetylation method.
3. Estimation of keto group by oxime method.
4. Estimation of sugars by Fehling's method.
5. Estimation of amino acids.
6. Estimation of methoxy group by ziesel's method.
7. Estimation of nitrogen by Kjaldhal's method.
8. Determination of enol content by Meyer's method.
9. Estimation imides.

[64 HOURS]

REFERENCES

1. Manual of Organic Chemistry-Dey and Seetharaman.
2. Modern experimental Organic Chemistry by John H. Miller and E. F. Neugil, p 289.
3. An introduction to practical Organic Chemistry-Robert, Wingrove etc.
4. A Text book of practical Organic Chemistry – A I. Vogel Vol.III
5. Practical Organic Chemistry-Mann & Saunders
6. An Introduction to Practical Organic Chemistry-Robert, Wingrove etc.
7. Semimicro qualitative Organic Analysis by Cheronis, Entrikin and Hodnet .
8. R. K. Bansal, Laboratory Manual of Organic Chemistry, New PAGE International (P) Ltd. London, 3rd edition, 1996.
9. N. K. Visno, Practical Organic Chemistry, New PAGE International(P) Ltd. London, 3rd edition, 1996.

CHP SCP_1: 3.8 PHYSICAL PRACTICALS -IIIA

1. Kinetics of reaction between sodium formate and Iodine, determination of energy of activation.
2. To study the kinetics of saponification of ethyl acetate by conductivity method, determination the energy of activation.
3. To study the kinetics of reaction between acetone and iodine-determination of order of reaction w.r.t. iodine and acetone.
4. Conductometric titration of thorium nitrate with potassium tartarate.
5. Determination of mean ionic activity coefficient of a weak electrolyte (acetic acid) by conductometric measurements.
6. To study the acid catalysed kinetics of oxidation of glycine by chloramine-T (CAT)-determination of order of reaction w.r.t. [CAT] and [glycine].
7. Kinetics of decomposition of benzene diazonium chloride, determination of energy of activation and thermodynamic parameters.
8. Potentiometric titration of $Pb(NO_3)_2$ Vs EDTA.
9. Preparation of Ag/AgCl electrode and to determine the activity of 0.2M HCl.
10. Determination of ionic product of water and study the effect of temperature.
11. Determination of transport number of H^+ by e.m.f. method.

12. Photolysis of monochloro acetic acid.
13. To determine the eutectic point of a two component system (Naphthalene-m-dinitrobenzene system).
14. Conductometric method of determination of solubility of sparingly soluble salt.
15. Potentiometric titration of mixture of KCl+KBr+KI vs $AgNO_3$.
16. Study of phase diagram of a three component system (Eg: acetic acid-chloroform water and system).
17. Thermodynamics of a cell reaction –construction of an electrochemical cell, study the effect of temperature on the cell reaction and calculation of thermodynamic parameters.
18. Determination of hydroxyl radicals scavenging (antioxidant activity) by spectrophotometric method.
19. Study of pH effect (by inhibitors) on electrochemical dissolution of a metal.

[64 HOURS]

CHP SCP_2:3.8 PHYSICAL PRACTICALS -IIIB

1. Determination of energy of activation and thermodynamic parameters (ΔH, ΔS, ΔG) for reaction between sodium formate and Iodine.
2. To study the kinetics of saponification of ethyl acetate by conductivity method, determination of order of reaction w.r.t. $[OH^-]$.
3. To study the kinetics of reaction between acetone and iodine-determination of order of reaction w.r.t. iodine and H_2SO_4.
4. Conductometric titration of thorium nitrate with potassium tartarate.
5. Determination of mean ionic activity coefficient of a weak electrolyte (formic acid) by conductometric measurements.
6. To study the acid catalysed kinetics of oxidation of glycine by chloramine-T (CAT)-determination of order of reaction w.r.t. [CAT] and $[H^+]$.
7. Kinetics of decomposition of benzene diazonium chloride, determination of energy of activation and thermodynamic parameters.
8. Potentiometric titration of $Pb(NO_3)_2$ vs. EDTA.
9. Determination of activity of 0.1M HCl by e.m.f method.
10. Determination of ionic product of water and study the effect of temperature by conductivity method.
11. Determination of transport number of $[Cl^-]$ by e.m.f. method.
12. Determination of rate of photolysis of trichloro acetic acid.
13. To determine the eutectic point of a two component system (Naphthalene-biphenyl system).
14. Conductometric method of determination of solubility of sparingly soluble salt.
15. Potentiometric titration of mixture of KCl+KBr+KI vs $AgNO_3$.
16. Study of phase diagram of a three component system (benzene-alcohol-water system).
17. Calculations of thermodynamic parameters by the study of effect of temperature, on the cell reaction for an electrochemical cell.
18. Determination of energy gap for semiconductor (Ge) and effect of temperature on semiconductor by four probe method.
19. Determination of hydroxyl radicals scavenging (antioxidant activity) by spectrophotometric method.
20. Study of pH effect (by inhibitors) on electrochemical dissolution of a metal.

[64 HOURS]

REFERENCES

23. Practical Physical Chemistry – A.J. Findlay.
24. Experimental Physical Chemistry –F. Daniels et al.
25. Selected Experiments in Physical Chemistry – Latham.
26. Experiments in Physical Chemistry – James and Prichard.
27. Experiments in Physical Chemistry – Shoemaker.
28. Advanced Physico-Chemical Experiments –J. Rose.
29. Practical Physical Chemistry –S.R. Palit.
30. Experiments in Physical Chemistry – Yadav, Geol Publishing House.
31. Experiments in Physical Chemistry – Palmer.
32. Experiments in Chemistry –D.V. Jahagirdar, Himalaya Publishing House, Bombay, (1994).
33. Experimental Physical Chemistry –Das. R.C. and Behera B, Tata Mc Graw Hill

ELECTIVE-II (FOR CHEMISTRY STUDENTS ONLY)

CHA ELT: 3.1 APPLIED ANALYSIS -II

UNIT-I

Air pollution: Types and sources of air pollutants; natural background concentrations of air pollutants; Principles and methods of sampling; a survey of reactions and methods involved in the determination of carbon monoxide, sulphur oxides, nitrogen oxides, hydrocarbons and particulates; Consequences of air pollution. **Water pollution:** Origin of waste water; types of water pollutants and their effects; Sources of water pollution; domestic, industrial and agricultural soil as sources of pollution. Objectives of analysis. Parameters of analysis: color, turbidity, total solids, conductivity, acidity, alkalinity, hardness, chloride, sulphate, fluoride, silica, phosphates and different forms of nitrogen; Heavy metal pollution: public health significance of cadmium, chromium, copper, lead, zinc, manganese, mercury and arsenic, general survey of instrumental techniques for the analysis of heavy metals in aquatic systems; Pesticides as water pollutants and their analysis; Water pollution laws and standards. **Radioactive pollution:** Sources of pollutants; effects on vegetation and health. Detection and monitoring of radioactive pollutants. Methods of safe disposal of radioactive waste.

[16 HOURS]

UNIT-II

Biomedical and forensic analysis: Composition of body fluids and detection of abnormal levels of certain constituents leading to diagnosis of disease. Sample collection and preservation of physiological fluids. Analytical methods for the constituents of physiological fluids (blood, serum, urine).

Blood-estimation of glucose, cholesterol, urea, haemoglobin and bilirubin.

Urine-urea, uric acid, creatinine, calcium phosphate, sodium, potassium and chloride.

Biological significance, analysis and assay of enzymes (pepsin, monoaminoxidase, tyrosinase); and hormones (progesterone, oxytocin, insulin). Chemical, instrumental and biological assays to be discussed wherever necessary.

Forensic analysis: General discussion of poisons with special reference to mode of action of cyanide, organophosphates and snake venom. Estimation of poisonous materials such as lead, mercury and arsenic in biological materials.

[16 HOURS]

REFERENCES

1. Standard Methods of Chemical Analysis, A. J. Welcher (Part B), Robert E. Kriegor Publishing Co. Usa, 1975.
2. Environmental Chemistry, S. E. Manahan, Willard Grant Press, London, 1983.
3. Environmental Chemistry Analysis, Lain L. Marr, Malcolm S. Cresser, Blackie and Son Ltd, London, 1983.
4. The Air Pollution HandBook, Richard Habey, Penguin, 1978.
5. Environmental Engineers Handbook, Part I and II, B. G. Liptak.
6. Hawk's Physiological Chemistry, Ed. B. L. Oser, 14th Edn, Tata McGraw Hill, 1976.
7. Analytical Biochemistry, Holmes and Peck, Longmans, 1983.
8. Practical Clinical Biochemistry, H. Varley, Arnold Heinmann.
9. A Biologist's Guide to Principles and Techniques of Practical Biochemistry, Wilson and Goulding, 1981.
10. Essentials of Forensic Medicine and Toxicology, K. S. Narayana Reddy, 2002.

CHI ELT: 3.2 STRUCTURAL METHODS IN INORGANIC CHEMISTRY

UNIT-I

NMR Spectroscopy: Basic principles, Chemical shift and factors affecting it, coupling constants. ^{19}F, ^{31}P -NMR and NMR of paramagnetic complexes. Double resonance technique, The nuclear overhauser effect, Magnetic susceptibility measurements by Evan's method. NMR to solids.

ESR Spectroscopy: Theory, presentation of the spectrum, hyperfine coupling, the 'g' values and factors affecting the magnitude of the 'g' values. Zero-field splitting and Kramers' degeneracy. Application to simple inorganic and organic free radicals and to metal complexes.

NQR Spectroscopy: Theory, Energies of the quadrupole transitions, Instrumentation, effect of magnetic field on the spectra, relationship between electric field gradient and molecular structures. Applications - interpreation of e^2Qq data, structural information from NQR data.

[16 HOURS]

UNIT-II

Vibrational spectroscopy: Introduction, Theory of infrared absorption, theoretical group frequencies, correlation chart. Applications to coordination compounds- Aquo, ammine, urea, DMSO, cis and trans metal complexes. Change in spectra accompanying change in symmetry upon coordination (nitrite, sulphate, nitrate, perchlorate and carbonate)

Mossbauer Spectroscopy: Theoretical basis, Interpretation of Mossbauer spectra-Isomer shift, Quadrupole splittings and magnetic hyperfine structures,
Application: $I_2Br_2Cl_4$, $Fe_3(CO)_{12}$. Prussian blue, nitroprusside, hexacyanoferrate.
Photoelectron spectroscopy: Introduction, principles, chemical shifts, photoelectron spectra of simple molecules, X-ray photoelectron and Auger electron spectroscopy. Applications.
Mass spectrometry: Theory, experimental techniques, molecular ions, fragmentation and ion reaction, Applications to coordination compounds.

[16 HOURS]

REFERENCES

1. Electronic absorption spectroscopy and related techniques – D.N. Sathyanarayana, Universities press (2001).
2. Structural Methods in Inorganic Chemistry – E.A.V. Ebsworth, D.W.H. Ranklin and Cradock, Blackwell Scientific Publications (1988).
3. Physical methods in Inorganic chemistry – R.S. Drago, Saunders Publishers (1966).

CHO ELT: 3.3 BIOORGANIC CHEMISTRY

UNIT-I

Amino Acids: General structure, Physiological properties
Peptides: Rumination and use of Hobt Peptide bond, structure determination C. & N-terminal residue determination, peptide synthesis, Merrifield's solid phase synthesis, selective cleavage of polypeptide bonds (Chemical and enzymatic).
Proteins: Classification, Isolation and purification, primary, secondary, tertiary and quartenary structure determination, denature and renaturing of proteins. Biological application of oxytocin and insulin.

Nucleic Acids: Introduction structure and synthesis of nucleosides and nucleotides. Structure of RNA and DNA Crick-Watson model role of nucleic acids in the biosynthesis of proteins. Chemical synthesis of Oligonucleotides.

[16 HOURS]

UNIT-II

Carbohydrates: Introduction, Ring size determination of monosaccharides, fonfiguration and conformations of monosaccharides, anomeric effect, Hudson's rules, epimerization and mutarotation.
Synthesis, industrial and biological importance of glycosides, amino sugars, sucrose, maltose and lactose.

Polysaccharides: General methods of structure elucidation. Industrial importance and Biological importance of cellulose, starch, glycogen, dextran, hemicellulose, pectin, agar-agar. Photosynthesis and biosynthesis of carbohydrates.

Lipids: Nomenclature, classification, purification, synthesis of lipids, phospholipids, sphingolipids, Biological importance of lipids: Lecithin, sphingolipids, oils and fats.

Prostaglandins: Introduction, classification and biological importance, Constitution of PGE_1.

[16 HOURS]

REFERENCES

1. Essentials of physiological chemistry-Anderson, John Wiley & Sons, New York, 1953.
2. K. Albert, L. Lehninger, D. L. Nelson, M. M. Cox, Principles of Biochemistry, CBZ publishers, ist edition, New Delhi, 1993.
3. Organic Chemistry –Morrison & Boyd
4. I. L. Finar, Organic chemistry, ELBS Longmann, Vo. I & II, 1984.
5. Harper's Biochemistry, Ed. R.Harper, 22nd edition, Prenctic Hall Press, New York, 1990.
6. Encyclopedia of Chemical technology-Kirck-Othmer series.
7. Harper's review of Biochemistry- P. W. Martin, P. A Mayer & V. W. Rodfwell, 15th edition, Maurzen Asian Edition, California, 1981.
8. Introdution to the Chemistry of fats and fatty acids-F. D. Gunstone.
9. Carbohydrates-Chemistry & Biochemistry-Pigmann & Harton
10. An introduction to carbohydrate chemistry- Guthri & Honeymon

CHP ELT: 3.4 PHARMACO KINETICS

UNIT I

Introduction: Biopharmaceutics, pharmacokinetics, clinical pharmacokinetics, pharmacodynamics, toxicokinetics and clinical toxicology. Measurement of drug concentration in blood, plasma or serum. Plasma level-time curve, significance of measuring plasma drug concentrations. One compartment open model: Intravenous route of administration of drug, elimination rate constant, apparent volume of distribution and significance. Calculation of elimination rate constant from urinary excretion data,
clinical application. Two compartment model: Plasma level-time curve, relationship between tissue and plasma drug concentrations, Apparent volumes of distribution. Drug clearance, clinical example. Plasma level-time curve for a three compartment open model. Drug absorption: Factors affecting the rate of drug absorption-nature of the cell membrane, Route of drug administration- oral drug absorption, Intravenous infusion and intravenous solutions, Effect of food on gastrointestinal drug absorption rate.

[16 HOURS]

UNIT II

Drug Bioavailability: Factors affecting the drug bioavailability, rate of dissolution, pH and drug absorption, particle size, clinical applications. *In vitro – In vivo* correlation of rate of dissolution. Drug release; Kinetics of extended- release dosage forms. Relative and absolute availability, Bioequivalence, clinical significance of bioequivalence studies. clinical examples. Kinetics of Protein binding with drugs: Effect of protein binding on the apparent volume of distribution. Determination of binding constants and binding sites by Invitro methods (known protein concentration and unknown protein concentration), Relationship between protein concentration

and drug concentration in drug-protein binding. Clinical significance. Kinetics of drug elimination and clearance. Renal drug excretion, relation of rate of drug excretion and drug in the plasma. Drug biotransformation reaction, effect of blood flow on elimination half-life and hepatic excretion., drug elimination by capacity limited pharmacokinetics for one component model (IV Bolus). Determination of Km and Vmax in patients, bioavailibility and protein binding reactions. A brief survey of applications of pharmacokinetics in clinical situations.

[16 HOURS]

REFERENCES

1. Applied Pharmaceuticals and pharmacokinetics, L.Shargel and Andrew Yu, 4th edition, Prentice Hall International, London.
2. Essentials of physical chemistry and pharmacy-HJ Arnikar, S. S. Kadam, K. N. Gujan Orient Longman, Bombay, 1992.

OPEN ELECTIVE /CROSS BORDER PAPER –II
(FOR NON-CHEMISTRY STUDENTS ONLY)

CHAO CBT: 3.1. ANALYTICAL AND ORGANIC CHEMISTRY-II

UNIT-I

Electrophoretic techniques: Electrophoresis & capillary electrophoresis**:** Theory-**e**lectrophoretic mobility, electroosmotic mobility, electroosmotic flow velocity, total mobility, migration time, efficiency, selectivity and resolution. Instrumentation-capillary tubes, hydrodynamic and electrokinetic methods of sample injection, applying electric field and detectors. Capillary electrophoresis methods-capillary zone electrophoresis, micellar electrokinetic capillary chromatography, capillary gel electrophoresis and capillary electrochromatography.

Concepts of distillation, crystallization, evaporation, dialysis, electro dialysis, osmosis and reverse osmosis.

Centrifugation: centrifugal force, centrifugal sedimentation, centrifugal decantation, centrifuges, selection of centrifuge tubes. Preparative, density gradient and isopycnic centrifugation. Applications.

Analytical sedimentation: sedimentation coefficient, sedimentation velocity, applications in biological separations.

Membrane separation: principles and applications.

[16 HOURS]

UNIT-II

Introduction, classification and industrial applications of Dyes, drugs, polymers, soaps and Detergents.

Industrial and Biological applications of sucrose, lactose, cellulose, starch, pectin, Agar-Agar, insulin, oxytocin, prostaglandins, some compounds of steroids and alkaloids, Biological importance of nucleic acids.

[16 HOURS]

REFERENCES

1. Modern Analytical Chemistry, David Harvey, McGraw Hill, New Delhi, 2000.
2. Principles and Techniques of Biochemistry and Molecular Biology, Wilson and Walker, 6th edition, 2006, Cambridge Univ. Press.
3. Fundamental of Analytical Chemistry, D.A. Skoog, D.M. West, Holler and Crouch 8th Edition, 2005, Saunders College Publishing, New York.
4. Analytical Chemistry, G.D. Christian, 5th ed., 2001 John Wiley & Sons, Inc, India.
5. Separation Techniques in Chemistry and Biochemistry, Roy Keller; M. Dekkar, Inc., 1967.
6. Organic Chemistry-Morrison & Boyd
7. I. L. Finar, Organic Chmistry, ELBS Longmann, Vol.I & II. 1984.
8. Essentials of physiological chemistry-Anderson, John Wiley & Sons, New York, 1953
9. K. Albert, L. Lehninger, D. L. Nelson, M. M. Cox, Principles of Biochemistry, CBZ publishers, ist edition, New Delhi, 1993.
10. Harper's Biochemistry, Ed. R.Harper, 22nd edition, Prenctic Hall Press, New York, 1990.
11. Encyclopedia of Chemical technology-Kirck-Othmer series.
12. Harper's review of Biochemistry- P. W. Martin, P. A Mayer & V. W. Rodfwell, 15th edition, Maurzen Asian Edition, California, 1981.
13. Introduction to alkaloids- G. A. Swan
14. The Alkaloids-K. W. Bently.
15. Steroids-L. Fiescher & M. Fiescher
16. Steroids-Shoppe.

CHIP CBT:3.2 INORGANIC AND PHYSICAL CHEMISTRY-II

UNIT-I

Inorganic elements in the biological system: Inorganic elements involved at the molecular, the cellular and at the physiological levels. The metabolism of inorganic elements.

Basic Coordination Chemistry: Introduction, ionic and covalent bonding, Hard and soft lignads, the chelate effect. Coordination geometry, crystal field theory and ligand field theory.

Transport, storage and homeostasis of metal ions: Iron, copper, zinc, phosphorous as phosphate, potassium, sodium and chloride ions. Calcium homeostasis.

Therapeutic medicine: The use of metal compounds in therapy, some applications of chelation therapy to metal intoxication (arsenic, iron, cadmium, lead and mercury). Metal complexes in cancer therapy.

[16 HOURS]

UNIT- II

Fast Reactions: Study of kinetics by flow techniques, equation for contact time, stopped flow and continuous flow methods. Relaxation method, equation for relaxation time, temperature jump and pressure jump methods, flash photolysis.

Enzyme kinetics: Effect of substrate concentration (Michaelis Menton equation), Effect of pH, effect of catalysts and inhibitors (substrate, zeolite, Cr^{3+}, Fe^{2+} ZnO, U.V light), effect of temperature.

Pharmacokinetics: Plasma level-time curve, significance of measuring plasma drug concentrations. Drug Bioavailability: Factors affecting the drug bioavailability

Polymers: Molecular weight and size. Polydispersion. Average molecular weight concepts-number weight and viscosity average molecular weight. Principles of determination of molecular weights-End group analysis, viscosity, osmometry, cryoscopy and ebulliometry method

Chemistry of Nanomaterials : Nano particles. Synthesis-Laser abalation chemical vapour transportor method (CVT) and sol-gel method. Carbon nanotube, Carbon Nanowires and its composites. Synthesis of metal oxides and its composite nanoparticles by solvothermal and hydrothermal method. Inorganic and organic Nano porous Aerogels.

[16 HOURS]

REFERENCES:

1. Biological Inorganic Chemistry- An Introduction, Robert R. Crichton, Elsevier, Oxford UK, (2008).
2. Bioinorganic Chemistry- A Short Course- 2nd edn, Rosette. M. Roat-Malone Wiley Interscience, (2007).
3. Bioinorganic Chemistry: A Survey, Eiichiro Ochiai, Elsevier-Academic Press, (2008).
4. Medicinal Applications of Coordination Chemistry, Chris Jones and John Thornback, RSC Publishing, (2007).
5. Applied pharmaceuticals and pharmacokinetics, L.Shargel and Andrew yu, 4th edition, Prentice Hall International, London.
6. Springer Hand book of Nanotechnolgy by Bharat Bhushan.
7. Nano Meterials, A. K. Bandyopadyay, NAI Publishers.
8. Nano Technology, Richard Booker and Earl Boysen

FOURTH SEMESTER

CHA HCT: 4.1. INSTRUMENTAL METHODS OF ANALYSIS-II

UNIT-I

Classification of electrochemical methods: Controlling and measuring current and potential, potentiometers, galvanostats and potentiostats.

Potentiometric methods of analysis. Potentiometric electrochemical cells. Potential and concentration. The Nernst equation. Liquid junction potentials. Reference electrodes-SHE, calomel electrode and silver/silver chloride electrode. Metallic indicator electrodes-electrodes of first kind and second kind. Redox electrodes. Membrane electodes –membrane potential, selectivity of memebranes. Glass ion selective electrodes. Crystalline solid state ion selective electrodes. Liquid-based ion selective electrodes. Gas sensing electrodes. Potentiometric biosensors. Quantitative applications. Activity *Vs* concentration. Quantitative analysis using external standards and the method of standard additions. Measurement of pH. Clinical and environmental applications.

Electrogravimetric analysis: Theory, apparatus, cell processes, deposition and separation, electrolytic separation of metals, applications.

Coulometric methods of analysis: General discussion, coulometry at controlled potential, apparatus and general technique. Applications - coulometric titrations (amperometric coulometric)-principles, apparatus, comparison of coulometric titrations with conventional titrations, automatic coulometric titrations, applications.
Voltammetry: Fundamentals of voltammetry. Cyclic voltammetry**:** Principles and applications. Stripping analysis: Stripping voltammetry-basic principles, electrodes used for stripping analysis, apparatus for stripping analysis, applications, determination of lead in water. Voltammetry with micro electrodes.

[16 HOURS]

UNIT II

Thermal method of analysis: Introduction, thermogravimetric analysis (TGA)-types of thermogravimetric analysis, principles. Factors affecting the results-heating rate, furnace, instrument control/data handling. Applications-purity and thermal stability, evaluation of correct drying temperature, analysis of complex mixture and determination of kinetic parameters of thermal degradation.
Differential thermal analysis (DTA): Theory-variables affecting the DTA curves. Differences between TGA and DTA. General principles. Instrumentation. Applications-analysis of the physical mixtures and thermal behaviour study. Determination of melting point, boiling point and decomposition point.
Differential scanning calorimetry (DSC): Basic principle. Differences between DTA and DSC. Instrumentation-power compensated DSC, heat flux DSC. Applications-Studies of thermal transitions and isothermal crystallization. Pharmaceutical industry for testing the purity of the samples.
Thermomechanical analysis. Dynamic mechanical analysis**.**
Enthalpimetric analysis: Thermometric titrimetry and direct injection enthalpimetry-principle, instrumentation, applications.

[16 HOURS]

UNIT-III

Kinetic methods of analysis: Introduction, basis of kinetic methods, rate law extressions. Classifying chemical kinetic methods-direct computation integral methods, direct-computation rate methods, curve-fitting methods. Instrumentation. Quantitative applications-enzyme catalyzed reactions, non-enzyme catalyzed reactions, non-catalytic reactions. Determining V_{max}, K_m for enzyme catalyzed reactions. Elucidating mechanism for the inhibition of enzyme catalysis. Determination of enzymes, LDH, GOT and GPT. Determination of substrates –urea, uric acid, blood glucose and blood alcohol. Analysis of closely related compounds-neglect of reaction of slow reacting component method and logarithmic extrapolation method.
Automated methods of analysis: An overview. Principles of automation. Automated instruments: process control. Continuous analyzers. Discrete autoanalyzers. Instruments used in automated process control. Automatic instruments-discrete and continuous flow sampling instruments. Flow injection analysis-principles-dispersion coefficient. Factors affecting peak height, sample volume, channel length and flow rate, and channel geometry. Applications-

limited dispersion applications, medium dispersion applications, stopped flow methods and flow injection titrations. Discrete automatic systems-centrifugal fast scan analyzer, automatic organic elemental analyzers.

Analysis based on multilayer films-general principles, film structures, instrumentation, performance and applications –blood urea nitrogen, blood glucose and potassium.

[16 HOURS]

REFERENCES

1. Fundamental of Analytical Chemistry, D.A. Skoog, D.M. West, Holler and Crouch 8th edition, 2005, Saunders College Publishing, New York.
2. Analytical Chemistry, G.D. Christian, 5th ed., 2001 John Wiley & Sons, Inc, India.
3. Quantitative Analysis, R.A. Day and A.L. Underwood, 6th edition,1993 prentice Hall, Inc. New Delhi.
4. Vogel's Textbook of Quantitative Chemical Analysis, J. Mendham, R.C. Denney, J.D. Barnes and M.J.K. Thomas, 6th edition, Third Indian Reprint.2003 Pearson Education Pvt. Ltd., New Delhi.
5. Analytical Chemistry Principles, John H. Kennedy, 2nd edition, Saunders College Publishing, California, 1990.
6. Instrumental Methods of Analysis by H.H. Willard, L.L. Merritt and J.A. Dean, 7th Edition, (1988).
7. Principles and Practice of Analytical Chemistry, F. W. Fifield and Kealey, 3rd edition, 2000, Blackwell Sci., Ltd. Malden, USA.
8. Modern Analytical Chemistry, David Harvey, McGraw Hill, New Delhi, 2000.
9. Introduction to Instrumental Analysis, Braun, Pharm. Med. Press. India.
10. Instrumental Method of Analysis, W. M. Dean and Settle, 7th edition, 1986, CBS Publishers, New Delhi.
11. Instant Notes of Analytical Chemistry, Kealey and Haines, Viva books Pvt. Ltd., 2002.

CHI HCT: 4.2 BIOINORGANIC CHEMISTRY

UNIT- I

Structural and molecular biology: Introduction, The structural building blocks of proteins, the structural building block of nucleic acids. Metal ion interactions with nucleosides and nucleotides.

General features of DNA- metal complex interaction.

A brief overview of molecular biology- Replication and Transcription, Translation.

Bioenergetics: Introduction, Redox reactions in metabolism, the central role of ATP in metabolism. Kinetic stability of ATP, Mitochondrial flow of electrons from NADH to O_2. Oxidative phosphorylation and respiratory chain.

Sodium and potassium-Channels and Pumps: Introduction, Transport across membranes. Potassium and sodium channels, The sodium-potassium ATPase, Macro cyclic crown ether compounds, cryptands and ionophores.

Biochemistry of calcium: Introduction-comparison of Ca^{2+} and Mg^{2+}. Biological roles of calcium, binding sites of calcium and proteins, storage of calcium, calcium in muscle contraction, calcium in blood cloting process.

Cobalt-Evolutionary Relics:

Vitamin B_{12} and Coenzymes: Structural feature, names of different forms, chemistry of cobalamin, biochemical functions of cobalamins, model compounds. Special characteristics of B_{12} Coenzyme.

[16 HOURS]

UNIT-II

Metal ion transport and storage:

Iron storage and transport: Transferrin, ferratin, phosvitin and gastroferrin.

Iron transport in microbes: siderophores, *in vivo* microbial transport of iron

Oxygen transport and oxygen uptake proteins: Properties of dioxygen(O_2): Thermodynamic and kinetic aspects of dioxygen as an oxidant, activation of dioxygen through complexation with metal ions.

Haemoglobin (Hb) and Myoglobin (Mb) in oxygen transport mechanism: Introduction to porphyrin system, substituent effects on porphyrin rings, functions of Hb and Mb. Characteristics of O_2-binding interaction with Hb and Mb. Model compounds for oxygen carriers (Vaska's complex and cobalt(III) –Schiff base complexes). Hemerythrin and hemocyanin.

Electron transport proteins and redox enzymes: Iron – sulfur proteins (rubredoxins and ferredoxins) and cytochromes including cytochrome P450. Catalase and peroxidase: Structure and reactivity .

Superoxide dismutase: Structure and reactivity.

Molybdenum containing enzymes: Aspects of molybdenum chemistry, Xanthine oxidase, aldehyde oxidase, sulfite oxidase, nitrogenase and nitrite reductase.

Non-redox metalloenzymes - Structure and reactivity : Carboxypeptidase-A, Alcohol dehydrogenase, Leucine aminopeptidase and carbonic anhydrase.

[16 HOURS]

UNIT- III

Therapeutic uses of Metals - Metals in Medicine: Introduction, Metals and human biochemistry, general requirements.

Disease due to metal deficiency and treatment: Iron, zinc, copper, sodium, potassium, magnesium, calcium and selenium.

Metal complexes as drugs and therapeutic agents; Introduction, antibacterial agents, antiviral agents, metal complexes in cancer therapy, Metal complexes for the treatment of rheumatoid arthritis, vanadium diabetes , Metal complexes as radio diagnostic agents.

Treatment of toxicity due to inorganics: General aspects of mechanism of metal ion toxicity,

(i)-Mechanism of antidote complex with poison, rendering it inert: arsenic, lead, mercury, iron, copper

(ii) Antidote accelerated metabolic conversion of poison to non-toxic product: cyanide and carbon monoxide

[16 HOURS]

REFERENCES:

1. The Inorganic Chemistry of Biological Process- 2nd edition , M. N. Hughes, John Wiley and Sons, (1988).
2. Bioinorganic Chemistry- R. W. Hay, Ellis Horwood Ltd, (1984).
3. Biological Inorganic Chemistry –An Introduction, R. R. Crichton, Elsevier, (2008).
4. Bioinorganic Chemistry- A. K. Das, Books and Allied(P) Ltd, (2007).
5. Bioinorganic Chemistry- K. Hussain Reddy, New Age International Ltd. (2003).
6. Bioinorganic Chemistry: A Survey- Eiichiro Ochiai ,Academic Press, (2008).
7. Bioinorganic Chemistry: A Short Course-2nd edition, R. M. Roat-Malone, Wilely Interscience,(2007).
8. Medicinal Applications of Coodination Chemistry- Chris Jones and John Thornback, RSC Publishing, (2007).
9. Transition Metal Complexes as Drugs and Chemotherapeutic Agents-N.Farrell, Kluwer Academic Publishers (1989).
10. The Biological Chemistry of the Elements: The Inorganic Chemistry of Life- 2nd edition , J.J. R. Frausto da Silva and R. J. P. Williams, Oxford University Press,(2001).

CHO HCT: 4.3 PHOTOCHEMISTRY, HETEROCYCLIC CHEMISTRY AND MOLECULAR REARRANGEMENTS

UNIT-I

Photochemistry and concerted reactions: Introduction, light absorption and electronic transitions, Jablonski diagram, intersystem crossing, energy transfer, sensitizers, quenchers.
Photochemistry of olefins, conjugated dienes, aromatic compounds, ketones, enones, photooxidations, photoreductions, Norrish type I and II reactions, Paterno-Buchi reaction, Barton reaction, Di-pi-rearrangements.

Pericyclic reactions:
Electrocyclic reactions: Stereochemistry, symmetry and Woodward-Hafmann rules for electrocyclic reactions, FMO theory of electrocyclic reactions, correlation diagram for cyclobutadiene and cyclohexadiene systems.

Cycloaddition reactions: [2+2], [3=2] and [4+2] cycloadditions analysis by FMO and correlation diagram method.
Sigamatropic reactions: Classification, stereochemistry and mechanisms.

[16 HOURS]

UNIT – II

Chemistry of heterocyclic compounds: Nomenclature of heterocyclic systems, structure, synthesis and reactions of benzofuran, benzothiophene, indazole, thiazole, pyrazole, triazole, pyrone, coumarin, chromones, pyrimidines purines, imidazole, oxazole, isoxazole synthesis and synthetic applications of : Pyrazine, pyridazine, azirines, and aziridines, diazines, azepines benzodiazepines.

[16 HOURS]

UNIT-III

Molecular rearrangements: Introduction.

Carbon-to carbon migrations: Pinacol-pinacolone, Wagner-Meerwein, Benzidine, Demjanov, Benzilic acid, Favorskii, Fries, Cope, Claisen rearrangement, von Richter raction.
Carbon-to nitrogen Migrations: Hofmann, Curtius, Lossen, Schmidt and Beckmann rearrangement.
Miscellaneous rearrangement: Stevenms, Sommelet-Hauser, Witting, Smiles, Neber, Japp-Klingermann rearrangement, Baeyer-Villeget rearrangement.

[16 HOURS]

REFERENCES

1. Photochemistry-Calvert & pitts, Wiley, New York, (1996)
2. Advances in Photochemistry-Rohatgi Mukherjee.
3. Principle and applications of Photochemistry-R. P. Wayne, Elsevier, New York.(1970)
4. Photochemistry, Paul Suppan, RSC. London, (1994)
5. Dupey and Chapmann, Molecular reactions and Photochemistry, Prenctic Hall-International, Tokyo, 1972.
6. H. Pine, Hendrickson, Cram and Hammond, Organic Chemistry, Mac Grow hill, New YTork 1987.
7. Organic Chemistry-Marrison & Boyd
8. I. Finar, Organic chemistry, ELBS Longmann, Vol. I & II, 1984.
9. J. March, Advanced Organic Chemistry, Willey Interscience, 1994
10. E. S. Gould, Mechanism Mechanism and Structure in Organic chemistry, Halt, Rinhart & Winston, New York. 1964.
11. F. A. Carey and Sundberg, Advanced Organic Chemistry-Part A & B. 3rd edition, Plenum press, New York. 1990.
12. Heterocyclic chemistry – Joule & Smith.
13. Heterocyclic Chemistry – Acheson.

CHP HCT: 4.4 APPLIED ELECTRO-, SOLID STATE AND QUANTUM CHEMISTRY

UNIT I

Phase Rule Studies: application of phase rule to the two component systems- compound formation with congruent melting point and incongruent melting points, Roozeboom's classification. Application of phase rule to three component systems. Systems of three liquids.
Energetics of cell reactions: Effect of temperature, pressure and concentration on energetics of cell reactions (calculation of ΔG, ΔH and ΔS). Electrochemical energy sources – Batteries, classification, characteristics, primary, secondary and lithium batteries.
Corrosion: Manifestations of corrosion, types of corrosion, basis of electrochemical corrosion, theories of corrosion. Local cell theory (Wagner and Traud theory) Current –potential relations (Evan diagram) in corrosion cells. Effect of pH, nature of metal and dissolved oxygen (principle of differential aeration) on corrosion. Corrosion inhibition and prevention by painting, phosphating and by using biomaterials, corrosion protection by anodic (passivation) and cathodic protection.

[16 HOURS]

UNIT II

Fundamentals of X-ray crystallography, law of interfacial angles, laws of symmetry, Miller indices, Bragg equation (no derivation), Experimental methods – powder and rotating crystal methods, indexing of powder and rotating crystal photographs. Atomic scattering factor, structure factor, Fourier synthesis and electron density diagrams. Electron diffraction of gases, experimental technique, Scattering-Intensity curves, Wierl equation (no derivation), Radial distribution method determination of bond lengths and bond angles.

Chemistry of Nanomaterials: Nano particles. Synthesis - Laser abalation, chemical vapour transportor (CVT) and sol-gel methods. Metal oxides nanoparticles with supercritical water and precursor method. Synthesis of metal oxides and its composite nanoparticles by solvothermal and hydrothermal methods. Carbon nanotube, carbon nanowires and its composites. Applications of nanomaterials in renewable energy. Inorganic and organic nanoporous aerogels. Heat capacity of solids: Einstein and Debye equations (With derivation).

[16 HOURS]

UNIT III

Statistical mechanics: Introduction, thermodynamic probability relation between entropy and thermodynamic probability. Partition function - translational, rotational and vibrational partition functions.

Pharmocokinetics: Plasma concentration time curve, drug dissolution rate, physico-chemical factors affecting bioavailability. Pharmocokinetics applied to one component open model. Calculation of elimination rate constant and metabolism constant, apparent volume of drug distribution and kinetics of drug clearance. Protein binding of drugs. Bioavailability and bioequivalence. Factors affecting bioavailability, route of drug administration and kinetics of protein binding.

Applications of quantum mechanics: Application of variation theorem to a particle in one dimensional box, linear oscillator, H and He-atoms, SCF method for many electron atom. Slater Orbitals –Effective nuclear charge (ENC), expressions for slater orbitals for 1s, 2s, 3s, 2p and 3d electrons (no derivation), Slater's rules for calculation of ENC-Slater's orbitals for He, Carbon and nitrogen. Theories of valence – Introduction, linear and non-linear variation functions, secular equations, coulombic, exchange, normalization and overlap integrals, secular determinants.

[16 HOURS]

REFERENCES

1. Text book of Physical Chemistry by Samuel Glasstone, MacMillan Indian Ltd., 2 nd edition, (1974).
2. Elements of Physical Chemistry, S. Glasstone, MacMillan.
3. Phase Rule, Gurthu and Gurthu.
4. Chemical and Electrochemical energy systems, by R. Narayan and B. Viswanathan, Universities Press (India) (1998).
5. Electrochemistry –Principles and applications by E.G. Potter.
6. Electrochemistry by Reiger, Prentice Hall (1987).
7. Solid State Chemistry – N.B. Hannay.
8. Introduction to solids – Azaroff.
9. Solid State Chemistry and its applications – A.R. West.
10. Principles of the Solid State – H.V. Keer.

11. A Text Book of Physical Chemistry – G.M. Barrow. M.C. Graw Hill – Tokyo, (1973).
12. Elements of Physical Chemistry – Lewis and Glasstone.
13. Solid State Chemistry and Its Applications Anthony R. West.
14. Basic Solid State Chemistry, Second Edition, Anthony R. West.
15. Solid State Chemistry: An Introduction, 3rd edition, Lesley E. Smart and Elaine A. Moore.
16. Introduction to Solid state Physics—C. Kittel, 5th Edition, Wiley Eastern, Limited.
17. C.N.R. Rao and J. Gopalakrishna "New Directions in solid state chemistry" Cambridge University Press, Cambridge (1999).
18. Binay Kumar, R.P. Tandon "Advances in technologically important crystals" Macmillan India Ltd.
19. Theoretical chemistry by S. Glasstone.
20. Statistical themodynamics by B.C. Meclelland, Chapman and Hall, London (1973).
21. Elementary statistical thermodynamics by N.D. Smith Plenum Press, NY (1982).
22. Elements of classical and statistical thermodynamics by L.K. Nash, Addison-Wesley(1970).
23. Statistical thermodynamics by I.M. Klotz.
24. Introduction to Statistical Thermodynamics by M. Dole, Prantice-Hall, (1962).
25. Applied Biopharmacokinetics and Pharmacokinetics- Leon Shargel, Andrew YuPrentice-Hall international, Inc (Fourth edition).
26. Essentials of Physical Chemistry and Pharmacy – H. J. Arnikar, S. S. Kadam, K. N. Gujan, Orient Longman, Bombay, (1992).
27. Quantum Chemistry – A.K. Chandra. Second Edition, Tata McGraw Hill Publishing Co. Ltd., (1983).
28. Quantum Chemistry – Eyring, Walter and Kimball. John Wiley and Sons, Inc., New York.
29. Quantum Chemistry –I.N. Levine. Pearson Education, New Delhi, (2000).
30. Theoretical Chemistry – S. Glasstone. East West Press, New Delhi, (1973).
31. Quantum Chemistry – R.K. Prasad, New Age International Publishers, (1996).
32. Valence Theory – Tedder, Murel and Kettle.
33. Quantum Chemistry – D.A. McQuarrie.
34. Hand Book of Nanotechnology, Bharat Bhushan, Springer Publisher.
35. Nanotechnology, Richard Booker and Earl Boysen, Wiley.
36. Nanometerials, A. K. Bandopadhyay, New age International, 2nd edition.
37. Nanotechnology- Importance and Applications, M. H. Fulekar, Ink International publishing.

CHA SCP$_1$: 4.5. ANALYTICAL PRACTICALS – IV A

1. Analysis of waste waters for DO and COD by titrimetry.
2. Analysis of a ground water sample for sulphate by titrimetry (EDTA) and turbidimetry.
3. Analysis of a wastewater for total acidity and total alkalinity by pH and conductometric titrations and comparison with visual methods.
4. Non-aqueous potentiometric titration of a mixture of aniline and ethanol amine.
5. Potentiometric determination of formula and stability constant of a silver-ammonia complex ion.
6. Kinetic determination of urinary creatinine and purity of a commercial H_2O_2 sample.
7. Determination of chromium (III) and iron (III) in a mixture by kinetic masking methods.

8. Catalytic determination of traces of selenium in biological materials and iodide in blood serum.
9. Photometric and potentiometric titration of iron (III) with EDTA.
10. Photometric and potentiometric titration of copper with EDTA.
11. Analysis of brackish water for chloride content by a**)** spectrophotometry (mercuric thiocyanate method), b) conductometry (silver nitrate) and c**)** potentiometry (silver nitrate).
12. Ascorbic acid determination in natural orange juice by coulometry.
13. Spectrophotometric determination of iron in natural waters using thiocyanate and 1, 10-phenanthroline as reagents.
14. Determination of fluoride in drinking water/ground water by spectrophotometry (alizarin red lake method).
15. Analysis of waste water for
    a) phosphate by molybdenum blue method
    b) ammonia-nitrogen by Nessler's method
    c) nitrite-nitrogen by NEDA method
16. Analysis of a soil sample for
    a) total nitrogen by Kjeldahl method.
    b) calcium and magnesium by EDTA titration.
17. Analysis of a soil sample for
    a) Available phosphorus by spectrophotometry.
    b) Nitrate-nitrogen/nitrite nitrogen/ammonia nitrogen by spectrophotometry.
    c) sodium and potassium by flame photometry.
18. Analysis of urine for
    a) urea and uric acid by titrimetry and spectrophotometry.
    b) Sulphate by precipitation titration after ion-exchange separation.
19. Analysis of blood for
    a) cholesterol by spectrophotometry
    b) urea and uric acid by spectrophotometry
20. Qualitative and quantitative analysis of fruit juices for vitamin-C using HPLC.

[64 HOURS]

CHA SCP$_2$: 4.5. ANALYTICAL PRACTICALS –IV B

1. Micro-scale quantitative analysis of hard water samples using an indirect permanganate redox titration.
2. Analysis of a mixture of iron (II) and iron (III) by EDTA titration using pH control.
3. Analysis of a sample of chromel alloy for nickel, iron and chromium by EDTA titration using masking reactions.
4. Potentiometric determination of fluoride in drinking water using a fluoride ion-selective electrode.
5. Potentiometric titration of a mixture of chloride and iodide.
6. Construction and use of salicylate electrode for the determination of acetyl salicylic acid in aspirin tablets.
7. Fabrication of an inexpensive Ag_2S/CuS ion-selective electrode.
8. Conductometric titration of sodium acetate with HCl and NH_4Cl with NaOH.
9. Polarographic determination of lead/cadmium in a river water sample.

10. Determination of iodine number of oils and fats by coulometric titration.
11. Constant-current coulometric titration of HCl.
12. Specrophotometric determination of inorganic phosphorus in serum.
13. Spectrophotometric determination of manganese and chromium in a mixture.
14. Kinetic-based indirect spectrophotometric method for the simultaneous determination of MnO_4^- and $Cr_2O_7^{2-}$.
15. Enzymetic determination of glucose in blood.
16. Ultraviolet spectrophotometric determination of aspirin, phenacetin and caffeine in APC tablets using solvent extraction.
17. Fluorimetric determination of zinc using oxine *via* standard-addition method.
18. Fluorimetric determination of quinine in an antimalarial tablet.
19. Analysis of riboflavin in urine by fluorescence.
20. Anion exchange separation of iron, cobalt and nickel.

[64 HOURS]

REFERENCES

1. Fundamental of Analytical Chemistry, D.A. Skoog, D.M. West, Holler and Crouch 8th Edition, 2005, Saunders College Publishing, New York.
2. Analytical Chemistry, G.D. Christian, 5th ed., 2001 John Wiley & Sons, Inc, India.
3. Quantitative Analysis, R.A. Day and A.L. Underwood, 6th edition,1993 prentice Hall, Inc. New Delhi.
4. Vogel's Textbook of Quantitative Chemical Analysis, J. Mendham, R.C. Denney, J.D. Barnes and M.J.K. Thomas, 6th edition, Third Indian Reprint.2003 Pearson Education Pvt. Ltd., New Delhi.
5. Analytical Chemistry Principles, John H. Kennedy, 2nd edition, Saunders College Publishing, California, 1990.
6. Practical Clinical biochemistry methods and interpretations, R. Chawla, J.P. Bothers Medical Publishers (P) Ltd., 1995.
7. Laboratory manual in biochemistry, J. Jayaraman, New Age International Publishers, New Delhi, 1981.
8. Practical clinical Biochemistry-Harold Varley and Arnold.Hein mann, 4th edn.
9. Environmental science: Laboratory Manual, Maurice A. Strabbe, The C.V.Mosbey Co. Saint Loucs, 1972.
10. Experiments on water pollution, D.I.Williams and D. Anglesia, Wayland Publishers Ltd, England, 1978.
11. Experiments on Land pollution D.I. Williams and D. Anglesia, Wayland Publishers Ltd, England, 1978.
12. Experiments in environmental chemistry, P.D. Vowler, and D.W. Counel, Pergamon press, Oxford 1980.
13. Manual soil Laboratory Testing-vol I, K.H. Head, Pentech Press, London 1980.

CHI SCP_1: 4.6 INORGANIC PRACTICALS -IVA

1. Preparation and characterization of ;
    a) Chloropentammine cobalt(III) chloride
    b) Estimation of chloride in a complex by potentiometric or ion-exchange method

c) Record the electronic absorption spectrum of a complex and verify Tanabe Sugano diagram

2. Synthesis and characterization of tris-triphenyl phosphine copper(II)nitrate. Estimate copper.
3. Preparation of *cis*- and *trans*- dichlorobis(ethylenediammine) cobalt(III)chloride. Record the UV-Vis spectra and compare it with *cis*-form. Measure the molar conductance.
4. Preparation of hexamine cobalt(III) chloride and estimate cobalt ion.
5. Synthesis of bis-dichlrotriphenyl phosphine nickel(II).
6. Determination of magnetic susceptibility of any two compounds/complexes by Gouy method.
7. Determination of the composition of iron-phenanthroline complex by:
   (a) Job's method
   (b) mole-ratio method and
   (c) slope-ratio method.
8. Determine the stability constant of iron-tiron/iron-phenanthroline by Turner-Anderson method.
9. Preparation and Kinetics of the acid hydrolysis of potassium trisoxalato cobaltate(III) trihydrate.
10. DNA interaction with metal complexes by UV-visible absorption and viscosity methods.
11. DNA cleavage by metal complexes: Gel electrophoresis method.

[64 HOURS]

CHI SCP2: 4.6 INORGANIC PRACTICALS -IVB

1. Preparation of tris(oxalate)ferrate(III) and estimate the metal ion.
2. Preparation of hexamine nickel(II) chloride.
3. Using chloropentamine cobalt(III) chloride, prepare nitro and nitritopentamine cobalt(III) chloride. Record the IR spectra of the isomers and interpret.
4. Solid phase synthesis of trans-bisglycinato copper(II). Estimate copper by iodometric titration, and measure the molar conductance.
5. Determination of the composition of a complex (nickel-ethylene diamine/ iron-phenanthroline) by:
   (a) Job's method and, (b) Mole-ratio method
6. By Turner-Anderson method, determine the stability of iron-phenanthroline complex.
7. Preparation of the EDTA complex of Mn(II).
8. Estimate the chloride ion in a given complex by silver nitrate titration after ion-exchange separation.
9. Using Gouy method, determine the magnetic susceptibility of any two compounds/complexes.
10. Binding studies of metal complexes with DNA by viscosity measurements.
11. DNA cleavage by metal complexes by gel electrophoresis technique.
12. Record electronic absorption spectra of at least four compounds/complexes and verify the spectrochemical series, and also evaluate the 10 Dq values.

[64 HOURS]

REFERENCES

1. Advanced physico-chemical experiments – J. Rose.
2. Instrumental analysis manual - Modern Experiments for Laboratory – G.G. Guilbault and L.G. Hargis.
3. A Text Book of Quantitative Inorganic Analysis – A.I. Vogel, 5th edition.
4. Experimental Inorganic Chemistry – G. Palmer.
5. Inorganic Synthesis – O. Glemser.
6. Experimental Inorganic/Physical Chemistry- Mounir A. Malati.
7. Quantitative Chemical Analysis – Daniel C. Harris, (2006) 7th edition.
8. Spectrophotometric determination of elements – Z. Marczenko

CHO HCP: 4.7 ORGANIC PRACTICALS-IV

1. Fractional crystallization: Separation of mixture of naphthalene and biphenyl.
2. Fractional distillation: Separation of Mixure of benzene and toluene.
3. Thin layer chromatography: Separation of plant pigments.
4. Column chromatography: Separation of mixture of O & P-nitroanilines.
5. Isolation of Piperine from pepper
6. Isolation of caffeine from tea
7. Diazotization (sandmeyer's reaction): Preparation of p-chlorobenzoic acid from p-toluidine.
8. Preparation of benzilic acid from benzoin.
9. Preparation of o-hydroxy benzophenone via Fries rearrangement.
10. Preparation of benzanilide from benzophenone oxime.
11. Preparation of paracetomol from p-nitrophenol.

[64 HOURS]

REFERENCES

1. Manual of Organic Chemistry-Dey and Seethr5aman
2. Natural Products Chemistry by Raphel Ikhan
3. Modern experimental Organic Chemistry by John H. Miller and E. F. Neugil. P 289.
4. An introduction to practical Organic chemistry-Robert, Vingrove etc.
5. A Text book of practical Organic Chemistry – A I Vogel VolI
6. Practical organic Chemistry-Mann & Saunders
7. An introduction to Practical Organic chemistry-Robert, Vingrove etc.
8. Semimicro qualitative Organic Analysis by Cheronis, Entrikin and Hodnet
9. R. K. Bansal, Laboratory Manual of Organic Chemistry, New PAGE International (P) LTD. London, 3rd edition, 1996.
10. N. K. Visno, Practical Organic Chemistry, New PAGE International (P) Ltd. London, 3rd edition, 1996.

CHP HCP: 4.8 PHYSICAL PRACTICALS -IV

1. Determination of thermodynamic parameters for the kinetics of decomposition of diacetone alcohol by NaOH.

2. Spectrophotometric kinetics of oxidation of indigocarmine by chloramine-T (CAT) (a) Determination of order of reaction w.r.t. [CAT] (b) Effect of pH and determination of order of reaction w.r.t. $[H^+]$.
3. Kinetic study on Ru(III) –catalysed reaction between primary amine and CAT (a) Determination of order of reaction w.r.t. [Ru(III)], (b) Determination of order of reaction w.r.t. $[H^+]$, (c) Determination of E_a and thermodynamic parameters.
4. Kinetics of saponification of ethyl acetate by conductivity method and study the effect of dielectric constant of the medium (using CH_3OH).
5. Study of photolysis of uranyl oxalate: (a) determination of intensity of light source (b) study of photocatalysis of oxalic acid.
6. Determination of rate for the photolysis of CAB solution.
7. Statistical aspects of radioactivity measurements.
8. Determination of maximum beta energy by Nomogram method.
9. Determination of half-life of ^{40}K.
10. Determination of ratio and product of two activities.
11. Study of salt effect on solubility and determination of activity coefficient.
12. Determination of pK value of an indicator (bromophenol blue).
13. Spectrophotometric analysis of a mixture of (a) $CuSO_4$ and K_2CrO_4.
14. Study of complex formation between ferric salt and salicylic acid.
15. Determination of half wave potential of metal ions in a mixture (Mn^{2+}, Pb^{2+} and Cu^{2+}).
16. Estimation of a metal ion in solution by polarographic method.
17. Amperometric titration of lead nitrate against potassium chromate/potassium dichromate.
18. Coulometric titrations - NaOH vs HCl.
19. Determination of energy gap for semiconductor (Ge) and effect of temperature on semiconductor by four probe method.

[64 HOURS]

REFERENCES

1. Practical Physical Chemistry – A.J. Findlay.
3. Experimental Physical Chemistry –F. Daniels et al.
4. Selected Experiments in Physical Chemistry – Latham.
5. Experiments in Physical Chemistry – James and Prichard.
6. Experiments in Physical Chemistry – Shoemaker.
7. Advanced Physico-Chemical Experiments –J. Rose.
8. Practical Physical Chemistry –S.R. Palit.
9. Experiments in Physical Chemistry – Yadav, Geol Publishing House.
10. Experiments in Physical Chemistry – Palmer.
11. Experiments in Chemistry –D.V. Jahagirdar, Himalaya Publishing House, Bombay, (1994).
12. Experimental Physical Chemistry –Das. R.C. and Behera B, Tata Mc Graw Hill.

CHHCD: 4.9 DISSERTATION / PROJECT WORK [64 HOURS]