

Gulbarga



University

Department of Studies and Research in Chemistry
Course Outline and Revised Syllabus for Master of Science (M. Sc.) in CHEMISTRY
Under CBCS and CAGP (Effective from the academic year 2017-2018)

Second		Hard Core							
	HCT2.1	Inorganic Chemistry-II	80	20	100	4	0	0	4
	HCT2.2	Organic Chemistry-II	80	20	100	4	0	0	4
		Soft Core (Any One)							
	SCT2.1	Analytical Chemistry-II	80	20	100	4	0	0	4
	SCT2.2	Applied Physical Chemistry-II	80	20	100	4	0	0	4
		Open Elective (Any One)							
	OET2.1	Essential of Analytical Chemistry	80	20	100	5	1	0	6
	OET2.2	Essential of Physical Chemistry	80	20	100	5	1	0	6
		Practical							
	HCP2.1	Inorganic Chemistry Practical –II	40	10	50	0	0	4	2
	HCP2.2	Organic Chemistry Practical –II	40	10	50	0	0	4	2
		Soft Core (Any One)							
	SCP2.1	Analytical Chemistry Practical-II	40	10	50	0	0	4	2
	SCP2.2	Applied Physical Chemistry Practical -II	40	10	50	0	0	4	2
		Total For Second Semester	440	110	550				24

Semester-II

HCT 2.1: Inorganic Chemistry – II

[64 Hours]

UNIT – I

Chemistry of Non-Transition Elements

Polymorphism of Phosphorous and Sulfur, Synthesis, Properties and Structures of Boranes.; Carboranes and Metallocarboranes; Sulfur-nitrogen ring compounds; Peroxy acids of nitrogen, phosphorous, sulfur and halogens; Chemistry of noble gas compounds (Xenon fluorides).

[16 Hours]

UNIT – II

Electronic Spectra of Transition Metal Complexes: Free ion terms and energy levels; configurations, Terms, States and Microstates; calculation of microstates for p^2 and d^2 configurations; L-S (Russel and Saunders) coupling schemes, J-J coupling scheme, derivation of terms for p^2 and d^2 configurations; Hole formulation, energy ordering of terms (Hund's Rules); Selections rules—Laporte orbital selection rule, spin selection rule; splitting of energy level and spectroscopic states; Orgel diagrams of d^1 to d^9 metal complexes; interpretation of electronic spectra of aqua complexes of Ti (III), V (III), Cr (III), Mn (II), Fe (II), Fe (III), Co (II), Ni (II) and Cu (II); calculation of Racah parameters (B and C) for d^8 metal complexes; Tanabe-Sugano diagrams for d^2 and d^6 octahedral complexes; Charge transfer spectra of metal complexes.

[16 Hours]

UNIT – III

Reaction Mechanism of Transition Metal Complexes:

Energy profile of a reaction, reactivity of metal complexes, introduction substitution reactions- Inert and labile complexes. Kinetic consequences of reaction pathways – Dissociation, association and Interchange; Experimental evidence in octahedral substitution – Dissociation, association mechanism, the conjugate base mechanism; Substitution reactions in square planar complexes – evidence for associative reactions, explanations of the trans effect. Recemisation and isomerisation; Redox reactions, Electron transfer reactions - mechanism of one electron, two electrons, complimentary and non-complimentary reactions, outer sphere and inner sphere type of reactions.

[16 Hours]

UNIT – IV

Organometallic Chemistry:

Nomenclature, general properties of organometallic compounds, d^n electronic configuration of transition metals – 16 and 18 electron rules; Metal alkyls, aryls, olefin, metallocenes and metal carbenes synthesis, structure and bonding in organometallic compounds. Reactions of organometallic complexes-substitution reactions, oxidative addition and reductive elimination reactions; insertion and elimination reactions. organometallic compounds in organic synthesis and applications.

Homogeneous catalysis: Introduction, Types of catalyst, alkene hydrogenation (Wilkinson's catalyst); Hydroformylation; Water-Gas shift reaction; Monosanto acetic

process; The Wacker process; Synthetic gasoline, Ziegler-Natta catalysis and activation of C-H bond.

[16 Hours]

Books Recommended:

1. Chemistry of Elements – N.N.Greenwood and Earnshaw - Pergamon
2. Concise Inorganic Chemistry - J.D. LEE, ELBS
3. Advanced Inorganic chemistry - F.A.Cotton and Wilkinson, John-Wily and sons
4. Chemistry of the Elements– N.N.Greenwood and A. Eamshaw, Pergaman
5. Inorganic Chemistry, Principles and Reactivity –J.E.Huheey, Harper and Row
6. Modern aspects of Inorganic Chemistry – H.J. Emuleus and A.G.Sharpe ELBS
7. Theoretical Inorganic Chemistry- M.C.Day, Jr. an J.Selbin East-West press
8. Concept and Model's in Inorganic Chemistry – Dougals, McDanial and Alexander John Wiley and sons.
9. Inorganic Qualitative Analysis- A.I.Vogel ELBS
10. Fundamentals of Analytical Chemistry- D.A.Skoog, D.M.West and F.T.Holler, Saunder college publishing
11. Inorganic Quantitative methods- Alexeev Mir publications
12. Principles of Inorganic Chemistry – Puri, Sharms and Kalia-Shobanlal-Nagin.
13. An Introduction to Inorganic Chemistry – Purcell and Kotz-Holt-Saunders
14. Coordination Chemistry-S.F.A. Kettle.
15. Comprehensive coordination Chemistry – G. Wilkinson, R.D. Gillars and J.A.Mcclevertry, Pergamon
16. Organometallic Chemistry – principles, structure and reactivity, 3rd ed. James E Huhee 1999.
17. Organgometallic Chemistry A Unified Approach - R.C.Mehrotra, A. Singh, New age international publishers
18. Organometallic compounds - Dr. Indrajeet kumar, pragathi prakashan

HCP 2.1: Inorganic Chemistry Practical-II

[64 Hours]

Quantitative Analysis:

Separation and determination of two metal ions involving volumetric and gravimetric methods from the following

- i) Fe + Ni
- ii) Cu + Fe

Preparation and quantitative analysis of inorganic complexes:

- i) Cis and trans–potassium dioxalatoaquachromium(III) complex [analysis of oxalate and chromium] present in the above complex.
- ii) Hexaminecobalt(III)chloride [analysis of cobalt]
- iii) Chloropentammine cobalt(III) chloride
- iv) Tris (acetylacetonate) copper (II) sulphate
- v) Mercuric tetrathicyrato cobalate (II).
- vi) Estimation of Ni⁺² as Ni-DMG.

Books Recommended:

1. Vogel's Text book of Quantitative Inorganic Analysis – J.Basett, R.C.Denney, G.H.Jeffery and J.Mendhaman, Longmans Green and Company Ltd.
2. Practical Inorganic Chemistry-G.Pass and H.Sutchliff, Chpman and Hall Ltd. (1968).
3. General Chemistry Experiment- A.J.Elias, University press.
4. Practical Inorganic Chemistry, G. Marr and B. W. Rockett, VonNostrand Reinhold Co., London 1972.

HCT 2.2: Organic Chemistry– II

[64 Hours]

UNIT-1

Reaction Mechanism:

Aliphatic Electrophilic Substitutions: Bimolecular pathways. SE^2 , SE^1 and SE^i mechanisms. Reactions involving double bond shifts.

Aromatic Electrophilic Substitutions: Halogenation, Isotope effects, Energy profile diagrams. Kinetic and Thermodynamic control.

Aromatic Nucleophilic Substitutions: $SNAr$, $SN1$ and Aryne pathways. Meisenheimer complexes, Various Nucleophilic displacement.

Addition Reactions: Electrophilic addition across alkenes and dienes.

Substitution Reactions: Mannich Reactions, Chloromethylation and Vilsmeier-Haack reaction. **Elimination reactions:** E_2 , E_1 , E_1C_B pathways, Stereochemistry, Hydrolysis of Esters, Mechanism: BA_{C2} and AA_{C2} .

[16 Hours]

UNIT-II

Advanced Stereochemistry:

Prochirality: Homotopic, Enantiotopic and Diastereotopic atoms, groups and faces. Optical activity due to molecular dissymmetry: Allenes, Spiranes, Biphenyles, Atropisomerism, Molecular Crowding.

Stereoselective synthesis: Classification, terminology, Cram's rule (open chain, cyclic and chelet and dipolar models), Prologs rule and principle of stereoselectivity. Strategy of stereoselective synthesis. Acyclic stereoselection. Enantioselective synthesis, diastereoselection in cyclic compounds. Stereoselective Catalytic hydrogenation and alkylation. Stereoselective formation of double bond, stereoselective cyclisation of polyenes. [16 Hours]

UNIT-III

Chemistry of Heterocycles:

Nomenclature, Structure, Reactivity, Synthesis and Chemical reactions of Indole, Benzofuran, Benzothiophene, Quinoline, Isoquinoline, Pyrazole, Imidazole, Benzimidazole, α -Pyrone, γ -Pyrone, Coumarins, Chromones and Flavones.

[16 Hours]

UNIT-IV

Medicinal Chemistry

Drug Design– A Rational Approach:

Introduction, concept of lead compound-crude drugs and analogues, factors governing drug design, rational approach to drug design, tailoring of drug. A brief introduction to quantitative structure activity relationship (QSAR),

Drug Metabolism: Absorption, Distribution, Elimination, Dissolution of drugs and factors affecting these properties. Passage of drugs across biological membrane, Construction of diffusion equation for complex systems, Factors influencing drug metabolism and drug availability. Phase-I reaction – active and inactive metabolites and Phase-II reaction (Discuss Phase I & Phase-II reactions by taking examples from various categories of drug molecules).

Synthesis and mode of action of each class of following drugs.

Sulfa Drugs: Sulfadiazines and Sulfaisoxazoles.

Antibiotics: Penicillins and Semisynthetic penicillins

[16 Hours]

Books Recommended:

1. Advanced Organic Chemistry Part A and B- F. A. Carey and R. J. Sundberg, 4th edition, Plenum publishers (2000).
2. Advanced Organic Chemistry, Reactions, Mechanism and Structure- J. March, Third Edition, Wiley-Eastern Ltd., (2004).
3. Guide Book to Mechanism in Organic Chemistry-Peter Sykes, Orient-Longman (1985).
4. Stereochemistry of Organic compounds, Principles and Applications- D. Nasipuri, Wiley Eastern Ltd. (1992).
5. Organic Chemistry Vol-II, III- S. M. Mukherji, S. P. Singh and R. P. Kapoor, New Age Internat, Ltd, New Delhi.
6. Organic Chemistry Vol-I, II- I. L. Finar, 6th Edition, ELBS London (2004).
7. Heterocyclic Chemistry- T. L. Gilchrist, 3rd Edition, Pearson Education Delhi, (2005).
8. Heterocyclic Chemistry- J. A. Joule and G. F. Smith, 2nd Edition, Van Nostrand London, (1978).
9. Heterocyclic Chemistry-R. K. Bansal, 3rd Edition, New-Age International, New Delhi, 2004.
10. Stereochemistry of Organic Cmpounds, E. L. Eliel et. Al John Wiley and sons Inc.

HCP 2.2: Organic Chemistry Practical-II [64 Hours]

Qualitative analysis:

Separation of a binary mixture, systematic analysis and identification of compounds.

Books Recommended:

1. Vogel's Textbook of Practical Organic Chemistry revised- B. S. Furniss, A. J. Hannaford, P. W. G. Smith, A. R. Tatchell, 5th Edition, Addison Wesley Longman Limited, UK, 1997.
2. A Hand book of Organic Chemistry- H. T. Clarke.
3. A Laboratory Manual of Organic Chemistry- B. B. Dey and M. V. Govindachari.
4. Experimental Organic Chemistry- L. M. Harwood and C.J.Moody, Blackwell Scientific, London, 1989.
5. Practical Organic Chemistry – W. Kemp, McGraw Hill, London, 1962.

SCT 2.1: Analytical Chemistry-II

[64 Hours]

UNIT - I

Pharmaceutical analysis: Identity and purity requirements, standard operating procedures (SOP) for the assay of tablets.

Preformulation studies. Solid-dosage form analysis. Analytical testing for finished parental products. Analysis of common drugs: Aspirin, paracetamol. Vitamins- B₁, B₂, B₆, niacin and folic acid. Antibiotics – penicillin and chloramphenicol.

Body fluids: Composition and detection of abnormal level of certain constituents leading to diagnosis, sample collection and preservation of physiological fluids, analytical methods for the constituents of physiological fluids (blood, urine).

Blood: Estimation of glucose, cholesterol, urea, haemoglobin and bilirubin.

Urine: Urea, uric acid, creatinine, calcium, phosphate, sodium, potassium and chloride.

[16 Hours]

UNIT -II

Assay of Enzymes, Vitamins and Hormones: Biological significance, analysis and assay of enzymes (pepsin, tyrosinase), vitamins (thiamine, ascorbic acid, vitamin A) and hormones (progesterone, oxytocin, insulin), chemical, instrumental and biological assay to be discussed wherever necessary.

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

Analysis of dairy products: Composition of milk, butter and Ghee, determination of water, solid ash, fat and lactose content in milk, analysis of fat content in butter and ghee.

[16 Hours]

UNIT-III

Soil Analysis: Inorganic and organic components of soil, collection and preparation of soil samples for analysis. Measurement of soil pH and conductivity. Determination of organic carbon, total nitrogen, available nitrogen, ammonia nitrogen, nitrate nitrogen, nitrite nitrogen. Available phosphorus and sulphur, their determination. Analysis of soil for sodium, potassium, calcium and magnesium. Micronutrient elements and their analysis. Pesticide residues in soil, their separation and determination, soil pollution and control.

Fuel Analysis: Definition and classification of fuels, characteristics of fuels, sampling, proximate and ultimate analysis of coal, and determination of calorific value. Liquid fuels: determination flash point, fire point, aniline point, knocking of petrol and diesel octane and cetenenumbers, carbon residue. Gaseous fuels-analysis of coal gas, water gas, producer gas, gobar gas and blast furnace gas. Calorific value, determination of Junker's gas calorimeter. Relative merits of solid, liquid and gaseous fuels.

[16 Hours]

UNIT-IV

Ultracentrifugation: Principle, sedimentation constant, sedimentation equilibrium, sedimentation velocity, methodology and applications.

Electrophoresis: Overview, types, the basic of electrophoretic separations, migration rates and plate heights, electro osmotic flow, instrumentation, capillary zone electrophoresis, capillary gel electrophoresis, capillary isoelectrophoresis, capillary isoelectric focusing.

Capillary electrochromatography: Packed column electrochromatography, micellar electro kinetic electro chromatography, capillary electro chromatography and applications.

Supercritical fluid chromatography: Properties of supercritical fluids, instrumentation and operating variables, comparison of supercritical to other types of chromatography, applications.

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

[16 Hours]

Books Recommended:

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 Text Book 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. Analytical chemistry, Alka. L. Gupta, A Pragati edition,
7. Introduction to chromatography, theory and practice by V. K. Srivastava and K. K. Srivastava., S. Chand and Co. Ltd.
8. Chromatography by B. K. Sharma, Goel publishing house, Meerut.
9. An introduction to practical biochemistry, 3rd edition by David T Plummer., Tata McGraw-Hill publishing company limited.
10. Principles of instrumental analysis, 5th edition, skoog, Holler and Nieman, Harcourt Asia PTE. LTD.
11. Modern analytical chemistry by David Harvey, McGraw-Hill publishing company limited.
12. Modern methods of chemical analysis, P. L. Descok, L. D. Shields, T. Carins and F. G. Milliam (II edn).
13. Industrial methods of chemical analysis, F. D. sneel (Encyclopedia)
14. Instrumental methods of analysis.L.L.Merutt, J.A.Dean, F.A., settle 6thEdn. (Van Nostnoand).
15. Principles of Instrumental Analysis.D.S.Kooj (Sander Colley).
16. Fundamentals of Analytical Chemistry.Skoog, West, Holler, 7thEdn. Harcourt Agra. Publication Harcourt College Publishers.
17. Principles of instrumental analysis.Skoog, Haller, Nieman, 5thEdn. Harcourt Agra. Publication Harcourt College Publishers.
18. Text Book of quantitative chemical analysis.A.I. Vogel (ELBS)
19. Standard Methods of chemical analysis.Wekin E. J.
20. Instrumental methods of chemical analysis, by Gurudeep R. Chatwal and Sham. K. Anand. Himalaya Publishing House.
21. Separation Chemistry. by R.P.Budhiraj, New age International(P) Limited, Publisher
22. Basic concepts of Analytical Chemistry, S.M. Khopkar, New age International(P) Limited, Publisher

SCP 2.1 : Analytical Chemistry Practical-II

[64 Hours]

1. Estimation of cholesterol in blood
2. Estimation of creatinine in urine sample
3. Estimation of nitrogen in soil sample
4. Determination of calcium and magnesium in soil sample
5. Determination of lactose present in milk
6. Determination of calcium in milk powder.
7. Separation of metal ions of group IV by ascending chromatography.
8. Separation of metal ions of group I by ascending chromatography.
9. Separation of the components in the indicator by TLC/ Paper chromatography.
10. Separation of amino acids by paper chromatography.

Books Recommended:

1. Fundamental of Analytical Chemistry. D.A. Skoog, D. M. West, Holler and Crouch 8th edition, 2005, Saunders College Publishing, New York.
2. Vogel's Text Book 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.
3. Introduction to chromatography, theory and practice by V. K. Srivastava and K. K. Srivastava., S. Chand and Co. Ltd.
4. Chromatography by B. K. Sharma, Goel publishing house, Meerut.

SCT 2.2: Applied Physical Chemistry-II

[64 Hours]

UNIT-I

Chemical Kinetics:

Chain reactions, Examples of chain reactions, General aspects of Chain reactions, elementary and complex reactions - parallel, consecutive and opposite reactions. Chain initiation, chain propagation and chain termination steps. Kinetics of formation of HBr, HI, HCl. Pyrolysis of acetyl aldehyde, decomposition of ethane, ozone and N₂O₅ molecules. Kinetics of inhibition, chain transfer, kinetics of branching chain reaction and explosion limits.

Kinetics of polymerization: Kinetics of linear step(Condensation) polymerization, Kinetics of condensation polymerization, Free radical, cationic and anionic polymerization and Co-polymerization.

[16 Hours]

UNIT-II

Catalysis and Molecular Group Theory:

Adsorption, adsorption isotherms- Langmuir, Freundlich, BET and Gibb's adsorption isotherms, adsorption with dissociation, competitive adsorption, mechanism of Unimolecular and bimolecular surface reactions.

Homogenous catalysis: Principle of general and specific acid-base catalysis, linear free energy relation and acidity function and Hamet equation, salt effect and base catalysis.

Heterogeneous catalysis: Study of solid surface, employing surface techniques viz. BET and N₂ adsorption.

Enzyme catalysis: single substrate mechanism, Michaelis-Menten equation, effect of pH, temperature and inhibition on kinetics of enzyme catalyzed reaction.

Group Theory: Symmetry operators and symmetry elements, products of symmetry operations C_{2v}, C_{3v}, C_{2h}, groups, point groups, group multiplication table, character table, matrix representation of groups, reducible and irreducible representations. Application of group theory to IR and Raman spectra of typical molecules (NH₃, H₂O and CO₂).

[16 Hours]

UNIT - III

Material and Nano materials:

Preparative methods: Solid state reaction, role of Chemistry in Materials design, chemical precursor

method, co-Precipitation, sol-gel, metathesis, self-propagating high temperature synthesis intercalation / deintercalation reactions; hydrothermal and template synthesis; High pressure synthesis

Organic Materials : Conducting organics - Metals from molecules, charge transfer materials and Organic

superconductors. Fullerenes. and optical data storage materials. Light emitting diodes (organic and polymer light emitting diodes).

Materials possessing high strain and energy: simple preparation techniques and properties (velocity of detonation) of organic molecules possessing cage structures.

Understanding the energetics and properties of these molecules. Examples of the molecules to be studied include; nitramines (1,3,5-Trinitroperhydro-1,3,5-triazine, **1,3,5,7-Tetranitro-[1,3,5,7]tetrazocane**, Hexanitrohexaazaisowurtzitane, cubanes).

Nanochemistry: classification of nanomaterials as zero, one and two dimensional materials. Synthesis of nanomaterials: chemical (sol gel, low temperature combustion, hydro and solvo thermal methods) and bio (microbial and plant extracts) routes. Synthesis of nanowires and nanorods with reference to carbon nanorods and nanowires (single- walled).

[16 Hours]

UNIT-IV

Atomic spectra and atomic structure:

Review of hydrogen spectrum, hydrogen like spectra. Terms, Term Symbols and multiplicities and couplings. Atomic spectra of alkali and alkali like elements. Atomic spectra of helium, atomic spectra of alkaline earth and alkaline earth like elements, prohibition of inter combination, Mosely lines, Multiplet structure, simple and compound doublets and triplets. Space quantization, Stern-Gerlach experiment, Normal Zeeman effect, Anomalous Zeeman effect, Paschen Back effect, Stark effect. Comparison between Stark and zeeman effect

[16 Hours]

Books Recommended:

1. Physical Chemistry by P. W. Atkins.
2. Introduction to kinetics of chemical chain reactions by Gimblett (TMH).
3. Chemical kinetics by Laidler.
4. X-ray diffraction by Clug and Alexander.

5. Elements of X-ray diffraction by Cullity.
6. Determination of molecular structure by P. J. Wheatley.
7. An Introduction to X-ray Crystallography by M. M. Woolson.
8. Atomic structure and Atomic spectra by G. Herzberg.
9. Introduction to Atomic spectra by White.
10. Polymer science by Gowrikar.
11. Polymer chemistry by Flory.
12. Advanced polymer chemistry - A problem solving guide by Manas Chanda.
13. Physical Chemistry of macromolecules by D. D. Deshpande.
14. Carbon nanomaterials, Edt., Yury Gogotsi, Taylor and Francis, 2006.
15. Biomedical applications of nanotechnology, eds by Vinod Labhsetwar and Diandra LL Wiley, 2007.
16. Organic Chemistry of Explosives, Wiley, Jaiprakash Agarwal and R. D. Hodgson, 2007.
17. Chemistry of Explosive materials, Jacqueline Akhavan, Cambridge Royal Society of Chemistry, 1998.
18. J.-M. Lehn; Supramolecular Chemistry-Concepts and Perspectives (Wiley-VCH, 1995)
19. P. D. Beer, P. A. Gale, D. K. Smith; Supramolecular Chemistry (Oxford University Press, 1999).

SCP 2.2: Applied Physical Chemistry Practical-II

[64 Hours]

PART-I

1. Determination of limiting equivalent conductance of a weak electrolyte.
2. Determination of Concentration of given solution by spectrophotometer (Cu^{2+} and NH_3).
3. Determination of optical rotation and rate constant by polarimeter.
4. Determination of standard electrode potential by potentiometry.
5. Determination of dissociation constant of dibasic acid potentiometrically.

PART-II

1. Determination of rate constant and order of reaction between $\text{K}_2\text{S}_2\text{O}_8$ and KI.
2. Determination of distribution coefficient for benzene, benzoic acid and water system.
3. Construction of phase diagram for three component system.
4. Determine the equilibrium constant for the reaction $\text{KI} + \text{I}_2 = \text{KI}_3$ by distribution method.
5. Determination of molecular weight of a given solute by Beckmann thermometer.

Note: the number of practical may be modified depending upon the facilities and requirements.

Books Recommended:

1. Fridley's Practical physical chemistry by B. P. Levitt.
2. Advanced practical physical chemistry by G. B. Yadhav.

3. Experiments in practical physical chemistry by Shomaker.
4. Systematic experimental physical chemistry by S.W. Rajbhoj and T K Chondeker.
5. Senior physical chemistry practical's by Khosla et. al.

OET 2.1: Essentials of Analytical Chemistry

[64 Hours]

UNIT-I

Statistical Treatment of Analytical Data and Sampling: Limitations of analytical methods. Classification of errors-systematic errors-sources, effects and their reduction. Random errors-sources and distribution. Accuracy and precision. Measures of central tendency and variability. Reliability of results-confidence interval. Comparison of results-Student's t-test, comparing the two means and standard deviations F-test, t-test and paired t-test. Rejection of a result Q-test. Number of replicate determinations. Control charts. Correlation and regression-correlation coefficient, linear regression, errors in slope and intercept, error in the estimate of concentration. Detection limits, Sampling and sample handling-representative sample, sample storage, sample pretreatment and sample preparation. Hazards in sampling. Quality in analytical laboratories-quality control and quality assurance, accreditation system.

[16 Hours]

UNIT-II

Gravimetric analysis: General principles, stoichiometry, calculation of results from gravimetric data. Properties of precipitates. Nucleation and crystal growth, factors influencing completion of precipitation. Co-precipitation and post-precipitation, purification and washing of precipitates. Precipitation from homogeneous solution, a few common gravimetric determinations-chloride as silver chloride, sulphate as barium sulphate, aluminium as the oxinate and nickel as dimethyl glyoximate.

Acid base titrations: Principles of titrimetric analysis, titration curves for strong acid-strong base, weak acid-strong base and weak base-strong acid titrations, poly protic acids, poly equivalent bases, determining the equivalence point-theory of acid base indicators, colour change range of indicator, selection of proper indicator.

Applications of acid-base titrations: Determination of nitrogen, sulphur, ammonium salts, nitrates, and nitrites, carbonates and bicarbonates, and organic functional groups like carboxylic acid, sulphonic acid, amine, ester, hydroxyl, carboxyl groups, air pollutants like SO₂.

Acid-base titrations in non-aqueous solvents: 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]

UNIT-III

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, selectivity, masking and demasking agents, typical applications of EDTA titrations-hardness of water, magnesium and aluminum in antacids, magnesium, manganese and zinc in a mixture, titrations involving unidentate ligands-titration of chloride with Hg^{2+} and cyanide with Ag^+ . [16 Hours]

UNIT-IV

Basic Concepts of Chromatography: General description, definitions, terms and parameters used in chromatography Classification of chromatographic methods. Criteria for selection of a stationary and mobile phase-nature of adsorbents, factors influencing the adsorbents, nature and types of mobile phases.

Elution chromatography: Theories, rate theory. Band broadening eddy diffusion, longitudinal diffusion and resistance to mass transfer. Column efficiency, plate theory and rate theory approach. Van Deemter's equation and its modern version. Inter relationship- capacity factor, selectivity factor and column resolution.

Thin layer Chromatography: Principle, methodology, determination of R_f value and its significance, variables that affect R_f value and applications. [16 Hours]

Books Recommended:

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 Chemical Analysis, Chatwal and Anand - 5th Edn.
7. Chromatography, E. Heftman (ed). 5th Edition, Part A. and Part B. Elsevier Science Publishers, 1992.
8. Chromatography Today, C. F. Poole & S. K. Poole, Elsevier Science Publishers (1991).
9. Analytical chemistry by Alka L. Guptha, A pragathi edition.
10. Separation methods by M. N. Sastri, Himalaya publisher.
11. Modern analytical chemistry, Harvey, Harcourt publishers.
12. An introduction to chromatography, theory and practical, V. K. Srivastav and K.K.

- Srivastav
13. Instrumental methods of chemical analysis, Gurudeep R Chatwal, Sharma K Anand. Himalaya publishers.
 14. Chromatography by B. K. Sharma, GOEL publishers.
 15. Basic concepts of Analytical chemistry, S. M. Khopakr, New Age International publications 3rd edition.

OET 2.2: Essentials of Physical Chemistry

[64 Hours]

UNIT - I

Electrochemistry :

Activity and Activity co-efficient, Mean activity co-efficient, Debye-Huckle limiting law (qualitative aspect only) and assumptions. Ionic strength, thickness of ionic atmosphere. Basic concept of acids and bases, pH, pKa, pK_w. Buffer action and capacity. Buffer solutions. Handerson Hassalback equation and its application in preparation of buffer. Importance of buffer in biological system.

UNIT - II

Thermodynamics:

Brief resume of concepts of laws of thermodynamics. Free energy, chemical potential and entropy. Gibb's-Helmholtz equation, Gibb's-Duhem and Maxwell's relation. Fugacity and its variation and determination of Duhem-Margulus Equation and its application to thermodynamics of ideal and non-ideal solutions.

[16 Hours]

UNIT - III

Polymer Chemistry:

Review of polymers, Basic concepts and classification of polymers - Monomer, Repeat units, Linear, Branched, Cross Linked, Straight, Copolymers and Network s and interpenetrating net works(IPN). Degree of polymerization. Molecular weight distribution - Average molecular weight concepts, Number Average, Weight Average, Viscosity Average and Z - Average molecular weights. Determination of molecular weights, Osmotic pressure method, viscosity method, light scattering (Debye and Zimm plots), Ultra centrifugation method, Polydispersity and molecular weight distribution, Practical significance of polymer molecular weight, Glass transition temperature (T_g) and Melting point and relation between them. Commercial importance of polymers. Size of Polymer molecules.

[16 Hours]

UNIT - IV

Chemical Dynamics-1:

A brief review of basic concepts and terminology in reaction kinetics. Methods of determining rate laws. Steady state approximation, Arrhenius equation. Collision state theory for bimolecular reaction rates, Transition state theory. Comparison between collision and transition state theories. Lindemann and RRKM theories of unimolecular reaction rates. Concepts and significance of energy of activation.

Dynamics in solution: Ionic reactions, effect of ionic strength. Primary and secondary salt effects. Dynamics of Fast reactions, Relaxation methods, Flow methods (stopped flow and plugged flow), Flash photolysis methods.

[16 Hours]

Books Recommended:

1. Molecular Quantum Chemistry P.W Atkins
2. Problems in Quantum Mechanics by G. L. Squires.
3. Introduction to Quantum Chemistry by A. K. Chandra, 4th Edn. TMH New Delhi.
4. Valence by C. A. Coulson.
5. Physical Chemistry by P. W. Atkins, ELBS London 1990.
6. Quantum Chemistry by Ira N. Levine, Prentiss Hall of India, New Delhi, India.
7. Quantum Chemistry by R. K. Prasad.
8. Electrochemistry by S. Glasstone.
9. Modern Electrochemistry by S. Bockris and A K N Reddy, Vol. 1 and 2, Butterworth London, 2006.
10. Thermodynamics by L. M. Koltz and R. M. Rosenberg.
11. An introduction to Chemical Thermodynamics by R. P. Rastogi and S. S. Mishra, Vikas publishing house Pvt limited, New Delhi.
12. Chemical Kinetics by K. J. Laidler, Pearson edition.
13. Polymer science by Gowrikar, New Age Pvt Limited publishers, Chennai.
14. Polymer chemistry by Flory.
15. Polymer chemistry by A. Tager.
16. Introduction to polymer chemistry Billmeyer(Jr)