M.Sc. CHEMISTRY Syllabus

(Two Year Course) Annual Exam. 2020-21, 2021-22

For Affiliated colleges

Examination Scheme

M.Sc. I Year (Previous)

Paper	Course No.	Course	Duration Hours	Max. Marks	Min. Marks
Paper-I	AN- CH-101	Inorganic Chemistry	3	100	36
Paper-II	AN- CH-102	Organic Chemistry	3	100	36
Paper-III	AN- CH-103	Physical Chemistry	3	100	36
Paper-IV	AN- CH-104	Analytical Chemistry	3	100	36
Practical	AN-CH-105	Spread in two days	16	200*	72
			Total Marks	600	

M.Sc. II Year (Final)

Paper	Course No.	Course	Duration Hours	Max. Marks	Min. Marks
Compulsory Papers					
Paper-I	CH-201	Group Theory & Inorganic Spectroscopy, Application of Spectroscopy	3	100	36
Paper-II	CH-202	Solid State Chemistry, Bio-Chemistry	3	100	36
Paper-III	CH-203	Elective Papers	3	50	18
Paper-IV	CH- 204	Elective Papers	3	50	18
Paper-V	CH-205	Elective Papers	3	50	18
Paper-VI	CH-206	Elective Papers	3	50	18
Practical	AN-CH-207	spread in two days	16	200*	72
			Total Marks	600	

*** out of 200 marks allocated for practicals, 30 marks are for sessionals and 170 marks are for University practical examination.**

M.Sc. CHEMISTRY

(Two Year Course) Annual Exam. 2020-21, 2021-22

For Affiliated colleges

M.Sc. I Year (Previous)

Paper	Course No.	Course	Periods/ Week
Paper-I	AN- CH-101	Inorganic Chemistry	6
Paper-II	AN- CH-102	Organic Chemistry	6
Paper-III	AN-CH-103	Physical Chemistry	6
Paper-IV	AN-CH-104	Analytical Chemistry	6
Practical	AN-CH-105	Inorganic, Organic, Physical & Analytical	24

M.Sc. II Year (Final)

Paper	Course No.	Course	Periods/ Week
Compulsory Papers			
Paper-I	AN-CH-201	Group Theory & Inorganic Spectroscopy, Application of Spectroscopy	6
Paper-II	AN-CH-202	Solid State Chemistry, Bio-Chemistry	6
Paper-III	AN-CH-203	Elective Papers	3
Paper-IV	AN-CH- 204	Elective Papers	3
Paper-V	AN-CH-205	Elective Papers	3
Paper-VI	AN-CH-206	Elective Papers	3
Practical	AN-CH-207	Inorganic, Organic, Physical & Analytical	24

The following groups of Elective Paper are approved for M.Sc. II Year (final) course. Choice any one group

Group-A	AN-CH-203A	Organotransition Metal Chemistry
	AN-CH-204A	Nanoscience and Nanotechnology
	AN-CH-205A	Industrial Chemistry
	AN-CH-206A	Polymers
Group-B	AN-CH-203B	Photochemistry
	AN-CH-204B	Organic Synthesis-I
	AN-CH-205B	Organic Synthesis-II
	AN-CH-206B	Advanced Electrochemistry and Applications

Group-C	AN-CH- 203C	Bioinorganic and Supramolecular Chemistry
	AN-CH-204C	Heterocyclic Chemistry
	AN-CH- 205C	Chemistry of Natural Products
	AN-CH- 206C	Environmental Chemistry

Group-D	AN-CH-203D	Nuclear and Radiochemistry
	AN-CH-204D	Medicinal and Pharmaceutical Chemistry
	AN-CH-205D	Physical Organic Chemistry
	AN-CH-206D	Chemistry of Materials

M.Sc. I YEAR-2020-21

AN-CH- 101: INORGANIC CHEMISTRY

Unit I

Stereochemistry and bonding in compounds : Mulliken symbols for s,p and d orbitals in C_{2v} , D_{3h} , D_{4h} , T_d, & O_h point groups, , d π -p π bonds and synergic bonding, Bent's rule and valence shell election pair repulsion(VSEPR) theory in structure elucidation with applications, Wave functions and Energetics of different types of hybridization. Simple reactions of covalently bonded molecules related to atomic inversion, Berry pseudo rotation, Nucleophilic displacement and free radical reactions. Limitations of crystal field theory, Jahn Tellor theorem and distortion of molecules

Molecular orbital theory (MOT) : Shapes of molecular orbitals, Walsh diagram of tri atomic molecules with special reference to H_2O, molecular orbital theory of hetero atomic molecules viz . BeH_2, CO_2, NO_2 , BF_3 . Coulson diagram of CO. Molecular orbital theory (MOT) of octahedral, tetrahedral and square planer complexes, π - bonding and molecular orbital theory, Comparison with VBT and CFT.

Unit II

Metal Ligand Equilibrium in solution : Thermodynamic and kinetic stability of compexes, stepwise and overall formation constant, trends in stepwise constants, factors affecting the stability of metal complexes with reference to the nature of metal ion and ligand, Chelate effect and its thermodynamic origin, determination of binary formation constants by pH metry and Spectrophotometry viz Bjerrum, Job, Dey and Mukherjee, Asmus methods.

Metal π-complexes: Metal carbonyls, structure and bonding in metal carbonyls, vibrational spectra of metal carbonyls for bonding and structure elucidation. Preparation, bonding, structure and important reactions of transition metal nitrosyls.

Unit III

Correlation diagrams of Transition Metal Complexes:Types of transitions, selection rules and relaxation for electronic transition, coupling and micro states, Spectroscopic ground States and Term symbols, correlation diagrams, Orgel and Tanabe sugano diagrams. Racah Paramerters and Calculations of Dq. B and β parameters for d^1 to d^{10} states in Transitions metal complexes

Electronic spectra and Magnetic properties of transitions metal Complexes

Charge transfer spectra, Spectroscopic methods of assignment of absolute configuration in optically active metal chelates and their stereo chemical information using ORD and CD based Cotton effect, Anomalous magnetic moment, spin crossover and it's affecting factors, magnetic exchange coupling for ferromagnetism and anti ferromagnetism, Curie temperature (T_C) and Neel Temrature (T_N)

UNIT IV

Reaction mechanism of Transitions metal complexes: Energy profile of a reaction (transition state or activated complex), Nucleophilic and Electrophilic Substitution, factors responsible for including SN_1 and SN_2 reaction, Lability and inertness of octahedral complexes acc to VBT and CFT. Acid hydrolysis, factor affecting acid hydrolysis, Base hydrolysis, Conjugate base mechanism (SN_1 CB),

Evidences in favour of conjugate base mechanism, anation reactions, Substitution reaction without metal-ligand bond cleavage (Special reference to Co(III) complexes).

Substitution in square planer complexes: Trans-effect, mechanism of substitution reaction, polarization theory and π bonding theory. Redox reaction : electron transfer reaction, mechanism of 1e-transfer reaction, outer sphere reaction, Inner sphere reaction, bridge intermediate mechanism.

UNIT V

Boranes : Structure and bonding in diborane, preparations of higher boranes, Lipscomb's concept of bonding elements in higher boranes. Preparation, properties and structure of borazines.

Metal clusters: Metal carbonyl and halide type clusters, compounds with metal-metal multiple bonds, Metalloboranes, Carboranes, Silicates: types and Uses

Books Suggested:

1. Advanced Inorganic Chemistry, F.A. Cotton and Wilkinson, John Wiley.
2. Inorganic Chemistry, J.E. Huhey, Harpes & Row.
3. Chemistry of the Elements, N.N. greenwood and A.Earnshow, Pergamon.
4. Inorganic Electronic Spectroscopy, A.B.P. lever, Elsevier.
5. Magnetochemistry, R.L.Carlin, Springer Verlag.
6. Comprehensive Coordination Chemistry eds., G. Wilkinson, R.D. Gillars and LA McCleverty, Pergamon.
7. F. Basolo and R.G. Pearson: Mechanism of Inorganic Reaction, Wiley Eastern

AN-CH-102: ORGANIC CHEMISTRY

UNIT I

Nature of Bonding in Organic Molecules

Delocalized chemical bonding-conjugation, cross conjugation, reasonance hyperconjugation, bonding in fullerenes, tautromerism.

Aromaticity in benzenoid and non-benzenoid compounds, alternate and non-alternate hydrocarbons, Huckel's rule, energy level of π-molecular orbitals, annulenes aromaticity, homo-aromaticity, Double aromaticity, excited state aromaticity, PMO (approach).

Bonds weaker than covalent- addition compounds, crown ether complexes, cryptands inclusion compounds, cyclodextrins, catenanes and rotaxanes.

Reaction Mechanism: Structure and Reactivity

Types of mechanisms, types of reactions, thermodynamic and kinetic requirements, Kinetic and thermodynamic control. Hammond's postulate, Curtin-Hammett principle, Potential energy diagrams, transition states and intermediates, methods of determining mechanism isotope effects. Hard and Soft acids and bases.

Generation, structure, stability and reactivity of carbocations, carbanions free radicals, carbenes and nitrenes.

Effect of structure on reactivity – resonance and field effects, steric effect, quantitative treatment. The Hammett equation and linear free energy relationship. substituent and reaction constants. Taft equation.

UNIT II

Stereochemistry

Conformational analysis of cycloalkanes, decalins, effect of conformation on reactivity conformation of sugars, steric strain due to unavoidable crowding. Stereochemistry of the compounds containing nitrogen, sulphur and phosphorus.

Elements of symmetry, chirality, molecules with more than one chiral center, threo and erythro isomers, methods of resolution, optical purity, enantiotopic and diastereotopic atoms, groups and faces, stereospecific and stereoselective synthesis. Asymmetric synthesis. Optical activity in the absence of chiral carbon (biphenyls, allenes and spiranes), chirality due to helical shape.

UNIT III

Pericyclic Reactions

Molecular orbital symmetry, Frontier orbitals of ethylene, 1,3- butadiene, 1,3,5-hexatriene and allyl system. Classification of pericyclic reactions. Woodward – Hoffmann correlation diagrams, FMO and PMO approach. Electrocyclic reactions – conrotatory and disrotatory motions, 4n, 4n+2 systems, 2+2 addition of ketenes, 1,3 dipolar cycloadditions and cheleotropic reactions.

Sigmatropic rearrangements – suprafacial and antrafacial shifts of H, sigmatropic shifts involving carbon moieties, 3,3- and 5,5- sigmatropic rearrangements. Claisen, Cope and Aza-Cope rearrangements. Fluxional tautomerism. Ene reaction.

Free Radical Reactions

Types of free radical reactions, free radical substitution mechanism, mechanism at an aromatic substrate, neighbouring group assistance.

Reactivity for aliphatic and aromatic substrates at a bridgehead. Reactivity in the attacking radicals. The effect of solvents on reactivity.

Allylic halogenation (NBS), oxidation of aldehydes to carboxylic acids, auto-oxidation, coupling of alkynes and arylation of aromatic compounds by diazonium salts, Sandmeyer reaction. Free radical rearrangement. Hunsdiecker reaction.

UNIT IV

Aliphatic Nucleophilic Substitution

The SN_2, SN_1, mixed SN_1 and SN_2 and SET mechanisms.

The neighbouring group mechanism, neighbouring group participation by π and σ bonds, anchimeric assistance.

Classical and nonclassical carbocations, phenonium ions, norbornyl system, common carbocation rearrangements. Application of NMR spectroscopy in the detection of carbocations.

The S_Ni mechanism.

Nucleophilic substitution at an allylic, aliphatic trigonal and a vinylic carbon.

Reactivity effects of substrate structure, attacking nucleophile, leaving group and reaction medium, phase transfer catalysis and ultrasound, ambident nucleophile, regioselectivity.

Aliphatic Electrophilic Substitution

Bimolecular mechanisms- S_E2 and SE^i. The S_E1 mechanism, electrophilic substitution accompanied by double shifts. Effect of substrates, leaving group and the solvent polarity on the reactivity.

Aromatic Electrophilic Substitution

The arenium ion mechanism, orientation and reactivity, energy profile diagrams. The ortho/para ratio, ipso attack, orientation in other ring systems. Quantitative treatment of reactivity in substrates and electrophiles. Diazonium coupling, Vilsmeir reaction, Gattermann-Koch reaction.

Aromatic Nucleophilic Substitution

The S_NAr S_N1, benzyne and $S_{RN}1$ mechanisms. Reactivity – effect of substrate structure, leaving group and attacking nucleophile. The von Ritcher, Sommelet-Hauser, and Smiles rearrangements.

UNIT V

Addition to Carbon-Carbon Multiple Bouds

Mechanistic and sterochemical aspects of addition reactions involving electrophiles, nucleophiles and free radicals, regio- and chemoselectivity, orientation and reactivity. Addition to cyclopropane ring. Hydrogenation of double and triple bonds, hydrogenation of aromatic rings. Hydroboration. Michael reaction. Sharpless asymmetric epoxidatio.

Addition to Carbon-Hetero Multiple Bonds

Mechanism of metal hydride reduction of saturated and unsaturated carbonyl compounds, acids, esters and nitriles. Addition of Grignard reagents, Organozinc and Organolithium reagents to carbonyl and unsaturated carbonyl compounds. Wittig reaction.

Meehanism of condensation reactions involving enolates – Aldol, Knoevenagel, Claisen, Mannich, Benzoin, Perkin and Stobbe reactions.

Hydrolysis of esters and amides, ammonolysis of esters.

Elimination Reactions

The E2, E1 and E1cB mechanisms and their spectrum, Orientation of the double bond. Reactivity – effects of substrate structures, attacking base, the leaving group and the medium.

Mechanism and orientation in pyrolytic elimination.

Books Suggested:

1. Advanced Organic Chemistry-Reactions, Mechanism and Structure, Jerry March, John Wiley.
2. Advanced Organic Chemistry, F.A. Carey and R.J.Sundberg, Plenum.

3. A Guide Book to Mechanism in Organic Chemistry, Peter Sykes, Longman.

4. Structure and Mechanism in Organic Chemistry, C.K.Ingold, Cornell University Press.

5. Organic Chemistry, R.T. Morrison and R.N.Boyd, Prentice-Hall

6. Modern Organic Reactions, H.O. House, Benjamin.

7. Principles of Organic Synthesis, R.O.C. Norman and J.M. Coxon, Blackie Academic & Professional.

8. Pericyclic Reactions, S.M.Mukherji, Macmillan, India.

9. Reaction Mechanism in Organic Chemistry S.M.Mukherji and S.P. Singh, Macmillan.

10. Stereochemistry Organic Compounds, D.N.asipuri, New Age International.

11. Stereochemistry of Organic Compounds, P.S.Kalsi, New Age Internationa.

12. Pericyclic Reactions by Jagdama Singh.

AN-CH-103: PHYSICAL CHEMISTRY

UNIT I

Chemical Kinetics

Chemical Dynamics: Ionic reactions, kinetic salt effects, steady state kinetics, kinetic and thermodynamic control of reactions.

Dynamic chain (hydrogen-bromine reaction, pyrolysis of acetaldehyde). photochemical (hydrogen-bromine and hydrogen-chlorine reactions) .

Homogeneous and heterogeneous catalysis, kinetics of enzyme reactions, general features of fast reactions, study of fast reactions by flow method, relaxation method, and flash photolysis method.

Dynamics of complex Reactions, Collision and Transition state, Theories of Rate Constant, dynamics of unimolecular reaction, Lindemann and Hinshelweed theories of unimolelcular reactions.

UNIT II

Adsorption

Surface tension, capillary action, pressure difference across curved surface (Laplace equation), vapour pressure of droplets (Kelvin equation) Gibbs adsorption isotherm, estimation of surface area (BET equation), surface films on liquids Electro-kinetic phenomenon and quantitative treatment of Zeeta potential.

Micelles: Surface active agents, classification of surface active agents, micellization, types of ionic micelles present in colloidal electrolytes, solubilization of surfactant solutions, critical micellar concentration (CMC), factors affecting the CMC of surfactants.

Macromolecules

Polymer – definition, types of polymers,, kinetics of polymerization, mechanism of polymerisation.

Molecular mass, number and mass average molecular mass, molecular mass determination (osmometry, viscometry, diffusion and light scattering methods), sedimention, calculation of average dimensions of various chain structures.

UNIT - III

Partial molal properties; free energy – chemical potential, Gibbs – Duhem equation, physical significance of chemical potential, variation of chemical potential with temperature and pressure, chemical potential for ideal gas and mixture of ideal gases, Thermodynamic derivation of law of mass action.

Concept of fugacity, Change in fugacity with temperature and pressure, physical significance of fugacity, fugacity of a gas in a mixture of real gases, determination of fugacity (graphical method).

Electrochemistry

Electrochemistry of solutions. Debye-Huckel – Onsagar treatment and its extension, Debye-Huckel-Jerrum mode, ion - solvent interactions, Born model.

Thermodynamics of electrified interface; Derivation of electrocapillary Lippmann equation (surface excess), Structure of electrified interfaces. Helmholtz, Guoy-Chapman and Stern models.

UNIT IV

Statistical Thermodynamics

Concepts of phase space, microstate and macrostate, ensemble, canonical, grand canonical and microcanonical ensembles, ensembles averaging, Maxwell-Boltzmann distribution law using Lagrange's method of undetermined multipliers.

Bose-Einstein statistics, Fermi-Dirac statistics and Maxwell-Boltzman statistics.

Partition functions – translational, rotational, vibrational and electronic partition functions, calculation of thermodynamic properties in terms of partition functions- Energy, specific heat at constant volume and constant pressure, entropy, work function, pressure and Gibb's free energy.

UNIT V

Quantum Chemistry

Introduction to Exact Quantum Mechanical Results: The Schrodinger's wave equation and its Hamiltonian operator form, postulates of quantum mechanics, operators. Discussion of solutions of the Schrodinger's wave equation to some model systems viz; particle in one dimensional box, particle in three dimensional box, the linear harmonic oscillator, the Hydrogen atom.

Concepts of spatial quantization and spinning electron hypothesis, Quantum numbers, Russell-Saunders terms and coupling schemes (L-S and j-j Coupling), spectral terms for p^n and d^n configurations, Magnetic effects: Normal and anomalous Zeeman effects.

Books Suggested :

1. Physical Chemistry, P.W. Atkins, ELBS.
2. Chemical Kinetics, K.J.Laidler, Megraw-Hill
3. Kinetics and Mechanism of Chemical Transformation, J.Rajaraman and J.Kuriacose, McMillan.
4. Micelles, Theoretical and Applied Aspects, V.Moroi, Plenum.
5. Modern Electrochemistry Vol. I and Vol. II, J.O.M. Bockris and A.K.N.Reddy, Plenum.
6. Introduction to Polymer Science, V.R.Gowarkar, N.V.Vishwananathan and J.Sridhar, Wiley Eastern.
7. Introduction to Quantium Chemistry, A.K. Chandra, Tata McGraw Hill.
8. Quantum Chemistry, Ira N. Levine, Prentice Hall.
9. Coulson's Valence, R. McWeeny, ELBS.
10. Theoretical Chemistry, S. Glasston, Princeton, London.
11. Fundamentals of Chemical GThermodynamics, E.N.Yeremin, Mir Publishers.

AN-CH- 104: ANALYTICAL CHEMISTRY

UNIT I

Instrumental analytical methods: Types and range of determination. Accuracy and minimization of errors, Precision and its determination (Standared deviation, R.S.D, C.V). confidence limit and confidence level significance and tapes of "t" test in analytical chemistry.

Analysis of variance (ANOVA), Correlation coefficient and linear regression. Numericals based on above concepts

Introduction to Instrumentation: Basic components of analytical instruments, Analog & digital signals, Basic digital circuit components, DAC & ADC. Operational Amplifiers (for current, potential, resistance/conductance), Automation in analysis: Automatic & Automated instruments, Process control analyzer, Continuous analyzer & Discrete analyzer, Flow injection analysis, Microprocessor controlled smart instruments

UNIT II

UV Visible Spectrophotometry: Colorimetric estimation of metal ion with specific reagents: Iron with 8-Hydroxyquinoline ; Lead with Dithizone, Technique of dual wavelength and derivative spectroscopy and their applications.

Fluorescence Photometry: Theory with partial energy diagram, instrumentation and applications.

Atomic spectral analytical techniques: Atomic absorption Spectrophotometry: Theory, Chemical and Spectral interferences , Instrumentation and Application.

Emission spectroscopy: Principle and application of Flame photometry; ICPAES- Salient features and application on multi element determination

UNIT III

Chromatography – Introduction and terms related to chromatography; Classification of Chromatographic techniques ; Selection of mobile phase.

Thin Layer Chramatographic technique (TLC):Principle, methodology and applications.

Gas chromatography (GC): Principle, Layout of instrument and types of columns; Detectors (TCD, FID, and Electron Capture) and applications.

Introduction to GC-MS

High performance liquid chromatography (HPLC)

Principle, Layout of instrument with columns, detectors (UV-Visible, RI and electro chemical) and applications.

Introduction to Super Critical Fluid chromatography (SCFC)

Unit IV

Thermal Analysis: Introduction to thermal Analysis**;** Thermogravimetric Analysis(TGA) : Basic Principle , Instrumentation and applications. Differential thermal Analysis (DTA) : Principle , Instrumentation and Applications of (DTA) . Introduction to Differential scanning calorimetry (DSC).

Electrochemistry : Electrochemical Cell, Ion Selective Electrodes: Types (Glass membrane, Precipitate, Solid State, Liquid-Liquid, Enzyme), Mechanism of Glass membrane ISE , Advantages and limitations of ISEs. Introduction to Sensors and their types , Design & working of Glucose Amperometric biosensor.

Unit V

Electroanalytical Methods: dc Polarography: theoretical principle, Ilkovic equation, Half wave potential and their significance. Different wave forms & Current-Voltage Curves. Cyclic Voltammetry: Theoretical Principle, Randle-Sevick Equation, Determination of Heterogenous Rate Constant (K_s), Criteria of reversibility by CV.

Theoretical Principle, Methodology and applications, Differential Pulse Voltammetry ; Square Wave Voltammetry, Stripping Voltammetry (Anodic, Cathodic and Adsorptive Stripping techniques). Application of Voltammetry in Inorganic & Organic Analysis

Books Suggested:

1. Instrumental Methods of Analysis, H.H. Willard, L.L. Merritt, J.A. Dean and F.A. Settle, CBS Publ. Delhi.
2. Principles of Instrumental Analysis, D.A. Skoog and J.L. Loary, Publ. W B Saunders
3. Instrumental Methods of Analysis, Strobel
4. Vogel's Textbook of Quantitative Chemical Analysis, G.H.Jeffery, J.Bassett, J. Mendham and R.C. Denney, Publ ELBS, Longman, UK
5. Instrumental Analysis: Skoog, Hollar and Crouch, Cengage learning.
6. Analytical Chemistry, G.D. Christian, John Willy & Sons.
7. Basic Concepts of Analytical Chemistry, S. M. Khopkar, Wiely Eastern.
8. Fundamentals of Analytical Chemistry, D.A. Skoog, D.M. West and F.J.Holler. Publ. W B Saunders.

AN-CH-105: Laboratory Course-

Inorganic Chemistry

Qualitative Analysis

Eight component mixture including two less common metal ions (TI, Mo, W, Ti, Zr, Th, V, U in cationic/anionic forms) and insoluble – oxides, sulphates and halides.

Quantitative Analysis

Separation and estimation of metal ions in a binary mixture Cu-Ni, Ni-Zn, Cu-Ag etc. involving volumetric and gravimetric methods.

Chromatography

Separation of cations and anions by

(a) Paper Chromatography: Separation of chloride, bromide and iodide

(b) Column Chromatography – separation of Cu, Ni, Co by Ion exchange.

Preparations

Preparation of selected inorganic compounds and their studies by I.R., electronic Mossbauer, E.S.R. and magnetic susceptibility measurements. Handling of air and moisture sensitive compounds.

(1) $VO(acac)_2$

(2) $Cis\text{-}K[Cr(C_2O_4)_2(H_2O)_2]$

(3) $Na[NH_3)_2(SCN)_4]$

(4) $Mn(acac)_3$

(5) $K_3[Fe(C_2O_4)_3]$

(6) Prussian Blue, Turnubull's Blue

(7) $[Co(NH_3)_6][Co(NO_2)_6]$

(8) $Cis\text{-}[Co(trine)(NO_2)_2]Cl.H_2O$

(9) $Hg[Co(SCN)_4]$

(10) $\{Co(Py)_2Cl_2]$

(11) $[Ni(NH_3)_6]Cl_2$

(12) Ni $(dmg)_2$

(13) $[Cu(NH_3)_4]SO_4.H_2O$

ORGANIC CHEMISTRY

Qualitative Analysis

Separation, purification and identification of compounds of binary mixture (one liquid and one solid), chemical tests, Interpretation of IR Spectra of simple compounds.

Two Step Organic Synthesis

Acetylation: Acetylation of glucose and hydroquinone.

Oxidation: Adipic acid by chromic acid oxidation of cyclohexanol.

Cannizzaro reaction: 4-Chlorobenzaldehyde as substrate.

Aromatic electrophilic substitutions: Synthesis of p-nitroaniline and p-bromoaniline.

Quantitative Analysis

Determination of the percentage or number of hydroxyl group in an organic compound by acetylation method.

Estimation of amines/phenols using bromate bromide solution/or acetylation method.

Determination of Iodine and Saponification values of an oil sample.

Determination of DO, COD and BOD of water sample.

Physical Chemistry

Surface Tension

(i) To determine the parachor of carbon and hydrogen atoms by drop weight method.

(ii) To determine the relative efficiencies of different detergents by surface tension measurements.

Chemical Kinetics

(i) To compare the strengths of HCl and H_2SO_4 by studying the kinetics of hydrolysis of an ester.

(ii) Determination of the effect of

(a) Change of temperature

(b) Change of concentration of reactant and catalyst.

(c) Ionic strength of the media on the velocity constant of acid hydrolysis of an ester

(iii) To study the effect of acid strength on the reaction of acetone and iodine.

Adsorption

(i) To study surface tension-concentration relationship for solutions (Gibbs equation) and hence determine the limiting cross-sectional area of molecule.

(ii) To study the adsorption of acetic acid/oxalic acid by activated charcoal and verification of Freundlich and Langmuir's isotherms.

Book Suggested:

1. Vogel's Textbook of Quantitative Analysis, revised, J.Bassett, R.C. Denney, GH.H. Jeffery and J. mENDHAM, elbs.
2. Synthesis and Characterization of Inorganic Compounds, W.L.Jolly, Prentice Hall.
3. Practical Physical Chemistry, A.M.James and F.E. Prichard, Longman.
4. Findley's Practical Physical Chemistry, B.P.Levitt, Longman.
5. Experimental Physical Chemistry, R.C.Das and B.Behera, Tata McGraw Hill.
6. Advanced Practical Physical Chemistry, J.B.Yadav, Goel Publishing House.
7. Advanced Experimental Chemistry, Vol. I Physical, J.N.Gurtu and R.Kapoor, S.Chand & Co.

ANALYTICAL CHEMISTRY

Conductometry:

(1) Estimation of Oxalic acid by Conductometric Titration in following solutions

(a) A solution of pure oxalic acid

(b) A solution of oxalic acid and HCl

(2) To titrate a given mixture of sulphuric acid, acetic acid and Copper Sulphate conductometrically.

Environmental Analysis:

(1) Determination of carbon dioxide, carbon monoxide, oxygen and nitrogen in air sample using Orsat apparatus.

(2) Determination of NO_x by 19pectrophotometry in environmental samples.

Electrophoresis:

(1) To study the separation of amino acids in a mixture by electrophoresis.

(2) To Determine isoelectric point of glutamic acid by paper electrophoresis.

TLC :

(1) Separation of dyes by TLC

(2) Separation of pharmaceutical Samples by TLC

(3) Study of reaction monitoring by TLC

Books Suggested:

1. Vogel's Textbook of Quantitative Chemical Analysis, G.H.Jeffery, J.Bassett, J. Mendham and R.C. Denney, Publ ELBS, Longman, UK
2. Handbook of Organic Analysis – Qualitative and Quantitative, H. Clark, Adward Arnold.
3. Vogel's Textbook of Practical Organic Chemistry, John Wiley. Experiments and Techniques in Organic Chemistry, D. Pasto, C.Johnson and M.Miller, Prentice Hall
4. Macroscale and Microscale Organic Experiments, K.L. Williamson, D.C. Heath.
5. Systematic Qualitative Organic Analysis, H. Middleton, Adward Arnold.
6. Instrumental Methods of Analysis, H.H. Willard, L.L. Merritt, J.A. Dean and F.A. Settle, CBS Publ. Delhi.
7. Principles of Instrumental Analysis, D.A. Skoog and J.L. Loary, Publ. W B Saunders
8. Instrumental Methods of Analysis, Strobel

Marking Scheme for M.Sc. Practicals

AN-CH-105: Laboratory Course-

Inorganic

1.	Gravimetric OR Inorganic Mixture Eight component	25 Marks
2.	Inorganic Preparation OR Separation of cations and anions by Paper / Column Chromatography	15 Marks

Organic

1.	Qualitative Analysis OR Two step organic synthesis	25 Marks
2.	Quantitative Analysis	15 Marks

Physical

1.	Major Experiment	25 Marks
2.	Minor Experiment	15 Marks

Analytical

1.	Conductometry	25 Marks
2.	Environmental Analysis/Electrophoresis OR TLC	15 Marks

Viva	20 Marks
Record	20 Marks
Total	200 Marks