MAHARAJA GANGA SINGH UNIVERSITY,
BIKANER

SCHEME OF EXAMINATION AND
COURSES OF STUDY

SYLLABUS

FACULTY OF SCIENCE

M.SC.

CHEMISTRY

M.Sc. Previous Examination - 2021

M.Sc. Final Examination – 2022

SYLLABUS & SCHEME OF EXAMINATION
FOR M.Sc. CHEMISTRY
(Two Year Course)

M.Sc. (Previous) Chemistry, 2021.

	Papers	Max. Marks
I	Inorganic Chemistry	75
II	Organic Chemistry	75
III	Physical Chemistry	75
IV	Analytical Chemistry	75
	Practical	150
	Total Marks	**450**

M.Sc. (Final) Chemistry, 2022.

V	Spectroscopy, Photochemistry and Computer in Chemistry	75
VI	Modern Techniques and scope of Chemical Biology	75

Elective Pool (Candidate is required to select any one of the following groups):

	Group-A	
VII(a)	Advanced Inorganic Chemistry	75
VII(b)	Metal Complexes, Polymers and ceramics	75
	Group-B	
VIII(a)	Organic Synthesis	75
VIII(b)	Heterocyclics and Natural Products	75
	Group-C	
IX(a)	Recent Trends in Physical Chemistry	75
IX(b)	Computational Chemistry	75
	Group-D	
X(a)	Analytical chemistry	75
X(b)	Applied Analytical Chemistry	75
	Practical	150
	(Including 20 marks for Project work and Seminar)	
	Total Marks	**450**
	Grand Total	**900**

Note:-

1- Papers with 75 marks will be taught for four hours/week.

2- Practical (both M.Sc. Previous & Final will cover 24 hours/ week).
3- Project work and seminars (case study report with presentation) will be assigned one hour/week for M.Sc. Final Year.
4- **Panel of Examiners** - A panel of Three examiners will conduct Practical examination (for each batch of M.Sc. Previous and Final) among which at least One will be External Examiner.
5- Marking scheme & pattern of each Theory paper is given as -

1. Each Theory paper will be of 75 marks (Minimum passing marks-19 each paper). There will be Four theory papers and total marks in Theory papers will be 300 (Aggregate minimum passing marks-108). Time duration for each paper will be 3 hours
2. The Practical exam will be of 150 marks (minimum passing marks 54). Practical exam will be of 14 hours spread over 2 days.
3. Each Theory paper will be divided into three Sections i.e. A, B and C.
4. Section A will contain 10 questions (two questions from each unit), all questions are compulsory carrying 2 marks (Answer limit 50 words).
5. Section B will contain 10 questions (two questions from each unit), Student will have to answer total 5 questions (attempting 1 question from each unit) carrying 5 marks (Answer limit 200 words).
6. Section C will contain 5 questions (one question from each unit). Student will have to answer total 3 questions as per their choice, out of these 5, carrying 10 marks each question (Answer limit 500 words).

M.Sc. (PREVIOIUS) CHEMISTRY,2021.
PAPER-I CH-401 INORGANIC CHEMISTRY

Time : 3 Hours Max. Marks :75

Unit-I

(a) Stereochemistry and Bonding in main group compounds : VSEPR, Walsh diagrams (Tri and penta- atomic molecules), dp-pp bonds, Bent rule and energetics of hybridization, some simple reactions of covalently bonded molecules.

(b) Metal-Ligand Equilibria in Solution : Stepwise and overall formation constants and their interaction, trends in stepwise constant, 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.

Unit-II

Reaction Mechanism of Transition Metal Complexes: Energy profile of a reaction, reactivity of metal complexes, inert and labile complexes, kinetic application of valence bond and crystal field theories

kinetics of octahedral substitution, acid hydrolysis, factors affecting acid hydrolysis, base hydrolysis, conjugate base mechanism, direct and indirect evidences in favour of conjugate mechanism, anation reactions, reactions without metal ligand bond cleavage. Substitution reactions in square planner complexes, the trans effect, mechanism of the substitution reactions. Redox reactions, electron transfer reactions, mechanism of one electron transfer reactions, outer sphere type reactions, cross reactions and Marcus Hush theory, inner sphere type reactions.

Unit-III

(a) Metal - Ligand Bonding : Limitation of crystal field theory, molecular orbital theory, octahedral, tetrahedral and square planar complexes, bonding and molecular orbital theory.

(b) Metal Clusters : Higher boranes, carboranes, metalloboranes and metallocarboranes. Metal carbonyl and halide clusters, compounds with metal-metal multiple bonds.

(c) Symmetry and Group theory in chemistry- symmetry elements and symmetry operation, definition of group sub group, relation between orders of a finite group and subgroup conjuugacy relation and classes. Point symmetry group Schonfiles symbols representation of groups by matrices. Character of a representation. The great orthogonality theorem and its importance Charater tables and their use.

Unit-IV

Electronic spectra and magnetic properties of transition metal complexes spectroscopic ground states, correlation, Orgel and Tanabe-sugano diagram for transition metal complexes (d^1-d^9- states) calculations of Dq, B and b parameters, charge transfer spectra spectroscopic method of assignment of absolute configuration in optically active metal chelates and their chemical information, magnetic moments magnetic exchange coupling and spin crossover.

Unit-V

(a) Metal p Complexes : Metal carbonyls, structure and bonding, vibration spectra of metal carbonyls for bonding and structural elucidation, important reactions of metal carbonyls; preparation, bonding, structure and important reactions of transition metal nitrosyl, dinitrogen and deoxygenate complexes; tertiary phosphine as ligand.

(b) Green chemistry Principles and applications in synthesis and analysis. Safety rules and safe use of different materials and chemical and biochemical weapons.

Books Suggested :

1- Advanced inorganic Chemistry, F.A. Cotton and Wilkinson, john Wiley.
2- Inorganic Chemistry, J.E. Huhey, Harpers & Row.
3- Chemistry of the elements, N.N. Greenwood and A. Earnsho, Pergamon.
4- Inorganic Electronic Spectroscopy, A.B.P. Lever, Elsevier.
5- Magneto chemistry, R.L. Carlin, Sringer Verlag.
6- Comprehensive Coordination Chemistry eds. G. Wilkineson, R.D. Gillars and J.A. McCleverty, Pergamon.
7- Green Chemistry Theory and Practice, Paul T. Anastas and John C. Warner, Oxford University Press.

PAPER-II CH-402 ORGANIC CHEMISTRY

Time : 3 Hours Max. Marks :75

Unit-I

(a) Nature of Bonding in organic Molecules : Delocalized chemical bonding–conjugation, cross conjugation, resonance, hyperconjugation, bonding influence tautomerism.

Aromatictiy in benzenoid and non- benzenoid compounds alternant and non alternant hydrocarbons, Huckel's rule, energy level of molecular orbital, annulenes, anti aromaticity, Psi aromaticity homo aromaticity. PMO approach. Bonds weaker than covalent- addition compounds, crown ether complexes and cryptands, inclusion compounds cyclodextrins, catenane and rotaxanes.

(b) Stereochemistry : Conformational analysis of cycloalkanes, decaline, effect of conformation on reactivity, conformation of sugars, steric strain due to unavoidable crowding. Elements of symmetry, chirality, molecules with more than one chiral center, threo and erythro isomers method of resolution, optical purity enantiotropic and diastereotopic atoms, groups and faces, stereospecific and stereo selective synthesis. Asymmetric synthesis. Optical activity in the absenece of chiral carbon (biphenyls, allenes and spiranes), chirality due to Helical Shape.

Stereochemistry of the compounds containing nitrogen, sulphur and phosphours.

Unit-II

(a) Reaction Mechanism : Structure and Reactivity : Type of mechanisms, types of reaction, thermodynamic and kinetic requirements, kinetic and thermodynamic control, Hammonds'Postulates,curtin Hammett Principle Potential energy Diagrams, transition states and intermediates, methods of determining mechanisms, isotope effects. Hard and soft acids and bases.

Generation, structure stability and reactivity of carbocations, carbanions, free radical, carbenes and nitrenes. Effect of structure on reactivity of carbocations, carbanions, free radicals, carbenes and nitrenes. Effect of structure on reactivity- resonance and field effects, steric effect, quantitiative treatment. The hammett equation and linear free energy relationship, substituent and reaction constants. Taft equation.

(b) Aliphatic Nucleophilic Substitution : The SN^1, SN^2, mixed SN^1 and $SN^2$and SET mechanisms, neighbouring group participation by Sigma and Pie bonds. Anchimeric assistance. Classical and nonclassical carbocations, phenonium ions norbornyl system, common carbocations rearrangements. Application of NMR spectroscopy in the detection of carbocations. The SN mechanisms. 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, ambidentate nucleophile, regioselectivity.

Unit-III

(a) Aliphatic Electrophilic Bimolecular mechanism SE^1 and SE^2 the SE mixed mechanism, electrophilic substitution accompanied by double bond shifts. Effect of substrates, leaving group and the solvent polarity on the reactivity.

(b) 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.

(c) Aromatic Nucleophilic substitution : the SN Ar, SN, Benzyne and SRN mechanisms. Reactivity- effect of substrate structure, leaving group and attacking nucleophile. The Von richter, sommelet- Hauser and Smiles rearrangements.

(d) Free Radical Reactions : Types of free radical reactions, free radical substitution mechanisms, 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

(a) Addition to Carbon- Carbon Multple Bonds : Mechanistic and stereochemical aspects of addition reactions involving electrophiles, nucleophiles and free radicals, regio- and chemoselectivity, orientation and reactivity addition to cyclopropane ring, hydrogenatin of double and triple bonds , hydrogenation of aromatic rings. Hydroboration. Micahel reaction sharpless asymmetric epoxidation.

(b) Addition to carbon- Hetero Multiple Bonds : Mechanism of metal hydride reduction of saturated and unsaturated carbonyl compound, acids, esters and nitriles. Addition of Grignad regents, organozinc and organolithium reagents to carbonyl and unsaturated carbonyl compounds. Wittig reactions. Mechanism of condensation reactions, involving enolates- Aldol, Knoevenagel Calsien, Mannich Benzoin, Perkin and Stobee reactions. Hydrolysis of esters and amides ammonolysis of esters.

Unit-V

(a) Elimination Reactions : The E_2, E_1 and E_1cb mechanisms and their spectrum. Orientation of the double bond, reactivity effects of substrate structures, attacking base, the leaving groups and the medium. Mechanism & orientatin in pyrolytic elimination.

(b) Pericyclic Reactions : Molecular orbital symmetry, frontier orbital of ethylene, 1, 3- butadiene, 1,3, 5 hexatriene and allyl system. Classification of pericyclic reactions, Wood ward Hoffmann correlation diagrams FMO and PMO approach. Electrocyclic reactions- conrotatory and disrotatory motions, 4n, 4n+2 and allyl systems. Cycloadditions- antarafacial and suprafacial additions, 4n and 4n+2 systems, 2+2 additin of ketenes, 1,3 dipolar cycloadditions and cheleotropic reactions. Sigmatropic rearrangements – suprafacial and antrafacial shifts of H sigmatropichshifts involving carbon moeties, 3,3, - and 5,5- sigmatropic rearrangements. Claisen, cope and aza-cope rearrangements. Fluxional tatutomerism. Ene reaction.

Books Suggested :

1- Advanced Organic Chemistry – Reactions, Mechanism and Structure, Jerry March, John Wile.
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, RT Morrison and R.N. Boyd, Prentice Hall.
6- Modern Organic synthesis, R.O.C. Norman and J.M. Coxon Blackie Academic & Professional.

7- Principles of Organic Synthesis, R.O.C. Norman and J.M. Coxon, Blackie Academic & Professional.
8- Pericylic Reactions, S,M. Mukherji, Macmillian India.
9- Reactoins Mechanism in Organic Chemistry, S.M. Mukkerji and S.P. Singh Macmillian.
10- Stereochemistry of Organic Compounds. P.S. Kalasi, New Age International.

PAPER-III CH-403 PHYSICAL CHEMISTRY

Time : 3 Hours **Max. Marks :75**

Unit-I

Quantum Chemistry

(a) Introduction to Exact Quantum Mechanical Results : The Schrödinger equation and the postulates of quantum mechanics. Discussion of solutions of the Schrödinger equation to some model systems viz., particle in a box, the harmonic oscillator, the rigid rotator, the hydrogen atom.

(b) Approximate Methods : The variations theorem, linear variation principle. Perturbation theory (first order an non- degenerate). Application of variation methods and perturbation theory to the Helium atoms.

(c) Angular momentum : Ordinary angular momentum, generalized angular momentum, eigenfunctions for angular momentum, eigenvalues of angular momentum, operator using ladder operations, addition of angular, momenta, spin, antisymmetry and Pauli exclusion principle.

(d) Electronic Structure of Atoms : Electronic configuration, Russel Saunders terms and coupling schemes, Slater- Condon parameters, term separation energies of the Pn configuration, term separation energies for the dn configurations, magnetic effects- spin orbit coupling and Zeeman splitting, introduction to the methods of self consistent field, the virial theorem.

(e) Molecular Orbital Theory : Huckel theory of conjugated systems, bond order and charge density calculations. Applications to ethylene. Butadiene, cyclopropenyl radical, cyclobutadiene etc.Introduction to extended Huckel theory.

Unit-II

Thermodynamics

(a) Classical Thermodynamics : Brief resume of concepts of laws of thermodynamics, free energy potential and entropies. Partial molar properties: practical molar free energy, partial molar volume and partial molar heat content and their significances.

Determinations of these quantities concept of fugacity and determination of fugacity.

Non-ideal systems : Excess functions for non-ideal solutions. Activity, activity coefficient, Debye- Huckel theory for activity coefficient of electrolytic solutions; determination of activity and activity coefficient, ionic strength. Application of phase rule to three component systems; second order phases transitions.

(b) Statistical Thermodynamics : Concept of distribution, thermodynamics probability and most probable distribution. Ensemble averaging, postulates of ensemble and everaging. Canonical, grand canonical and micro canonical ensembles, corresponding distribution laws (using Lagrange's method of undetermined multipliers). Partition functions translational, rotational, vibrational and electronic partition functions, calculating of thermodynamic properties in terms of partition functions applications of partition functions.

Heat capacity behaviour of solids chemical equilibria and equilibrium constant in terms of partition functions, Fermi-Dirac Statistics, Distribution law and applications to metal. Bose-Einstein Statistics-distribution law and applications to helium.

(c) Non-Equilibrium Thermodynamics : Thermodynamic criteria for non equilibrium states, entropy production and entropy flow, entropy balance equation for different irreversible processes (e.g., heat flow, chemical reaction etc.) transformations of the generalized fluxes and forces , non equilibrium stationary states, phenomenological equations, microscopic reversibility and Onsager's reciprocity relations, electro kinetic phenomena diffusion, electric conduction , irreversible thermodynamics for biological systems , coupled reactions.

Unit-III

Chemical Dynamics :

Methods of determining rate laws, collision theory of reaction rates, steric factor, activated complex theory, arrhenius equation and the activated complex theory, ionic reactions, kinetic salt effects, steady state kinetics, kinetic and thermodynamic control of reactions, treatment of unimolecular reactions.

Dynamic chain (hydrogen-bromine reaction, pyrolysis of acetaldehyde, decomposition of ethane), photochemical (hydrogen –bromine and hydrogen chlorine reactions) and oscillatory reactions (Belousov-zhabotinsky reaction), homogeneous catalysis, kinetics of enzyme reactions, general features of Fast reactions, study of fast reactions by flow method, relaxation method, flash photolysis and the nuclear magnetic resonance method.

Dynamics of molecular motions, probing the transition state, dynamics of barrier less chemical reactions in solution, dynamics of unimolecular reactions (Linde-mann-Hinshelwood and Rice- Ramsperger-Kassel-Marcus [RRKM] theories of unimolecular reactions).

Unit- IV

Surface Chemistry

(a) Adsorption : Surface tension, capillary action, pressure difference: across curved surface (laplac-equation), vapour pressure of droplets (Kelvin equation) , Gibbs adsorption , isotherm , estimation of surface area (BET equation), Surface films on liquids (Electro-kinetic phenomenon) Catalytic activity at surfaces.

(b) Micelles : Surface active agents, classification of surface active agents, micellization, hydrophobic interaction, critical micellar concentration (CMC) , factors affecting the CMC of surfactants, counter ion binding to micelles, thermodynamics of micellization-phase separation and mass action models , solubilization, micro emulsion, reverse micelles.

(c) Macromolecules : Polymer-definition, types of polymers, electrically conducting, fire resistant, liquid crystal polymers, kinetics of polymerization, mechanism of polymerization. Molecular mass, number and mass average, molecular mass determination (osmometry, viscometry, diffusion and light scattering methods), sedimentation, chain configuration of macromolecules, calculation of average dimensions of various chain structures.

Unit-V Electrochemistry

Electrochemistry of solutions, Debye-Huckel-Onsager treatment and its extension, ion solvent interactions, Debye-Huckel-Jerum mode. Thermodynamics of electrified interface equations, Derivation of electrocapillarity, Lippmann equations (surface excess), methods of determination. Structure of electrified interface. Guoy-Chapman, Stern, Graham-Devanathan-Mottwatts, Tobin, Bockris, Devanathan model.

Over potentials, exchange current density, derivation of Butler-Volmer equations, Tafel plot. Quantum aspects of charge transfer at electrodes-solution interfaces, quantization of charge transfer, tunneling.

Semiconductor in terfaces-theory of double layer at semiconductor, electrolyte solution interfaces, structure of double layer interfaces. effect of light at semiconductor solution interface.

Electro catalysis-influence of various parameters. Hydrogen electrode Bioelectrochemistry, threshold membrane phenomena, Nemst-Planck equation, Hodge-Huxley equations, core conductor models, electrocardiography.

Polarography theory, Ilkovic equation; half wave potential and its significance. Introduction to corrosion, homogenous theory, forms of corrosion, corrosion monitoring and prevention methods.

Books Suggested:

1. Physical Chemistry, P.W. Atkins, ELBS.
2. Introduction to Quantum Chemistry, A.K. Chandra, Tata McGraw Hill.
3. Quantum Chemistry, Ira N. Levine, Prentice Hall.
4- Coulson's Valence, R. McWeeny, ELBS.
5. Chemical Kinetics, K.J. Laidler, McGraw Hill.
6. Kinetics and Mechanism of Chemical Transformations, J. Rajaraman and J. Kuriacose, McMillan.
7. Micelles, Theoretical and Applied Aspects, V. Moroi, Plenum.
8. Modern Electrochemistry Vol. 4 and Vol. II, J.O.M. Bockris and A.K.N. Reddy,. Plenum.
9. Introduction to Polymer Science, V.R. Gowarikar, N.V. Vishwanathan and J. Sridhar, Wiley Easter.

Paper-IV : CH-404 ANALYTICAL CHEMISTRY

Time: **3 Hours** **Max. Marks : 75**

Unit-I

(a) Drug analysis - Principles of determination of functional groups ; Protocols fot the analysis of standard drugs. Food standards and Specifications Anti microbial agents / Class I and Class II preservatives as per PFA Act.

(b) Soil and water analysis

Unit II

Electroanytical Methods:

(a) Potentiometry/ pH- metry: Basic principles, instrumentation, experimental technique, electodes-reference, indicate-ion sensitive and recent advances in potentionmetry and application.

(b) Conductometry: Basic Principle, instrumentation, experimental technique, Low & High frequency titration.

(c) Voltammetry of Alternating Current (AC), Linear potential sweep (DC) cyclic potential swep voltammetry (CV) and strpping (Anodic & Cathoding) Analysis.

(d) Thermal Analysis Methods: Basic principles, instrumentation, experimental technique of Differential Scanning Calorimetry and Differential analysis, Thermo gravimetry, Thermo mechanical analysis, Dynamic mechanical analysis, thermometric titrimetry and direct injection Enthalpimetry.

Unit-III

(a) Atomic Spectroscopy : Energies of atomic orbitals, vector representation of momenta and vector coupling, spectra of hydrogen atom and alkali metal atoms.

Molecular Spectroscopy : Energy levels, molecular orbitals, vibronic transitions, vibrational progressions and geometry of the excited states, Franck-Condon principle, electronic spectra of polyatomic molecules. Emission spectra; radiative and non-radiative decay, internal conversion.

(b) Photoelectron Spectroscopy : Basic principles; photo-electric effect, lonization process, Koopman's theorem. Photoelectron spectra of simple nolecules, ESCA, chemical information from ESCA.

Auger electron spectroscopy-basic idea.

Photoacoustic Spectroscopy : Basic principles of photoacoustic spectroscopy (PAS), PAS-gases and condensed systems, chemical and surface applications.

Unit-IV

Theory Principle, experimental techniques and application of IR, Raman, Microwave and NMR spectroscopy. Special emphasis on FTIR and FTNMR.

Unit-V

(a) X-Ray Diffraction : Bragg condition, Miller indices, Laue methods, Bragg method Debye Scherrer method of X-ray structural analysis of crystal, index reflections, identification of unit cells from systematic absences in diffraction pattern. Structure of simple lattices and X-ray intensities, structure factor and its relation to intensity and electron density, phase problem. Discription of the procedure for an X-ray structure analysis, absolute configuration of molecules, Ramchandran diagram.

(b) Electron Diffraction : Scattering intensity vs. scattering angle, Wierl equation, measurement technique, elucidation of structure of simple gas phase molecules, Low energy electron diffraction and structure of surfaces.

(c) Neutron Diffraction : Scattering of neutrons by solids and liquids, Magnetic scattering, measurement techniques. Elucidation of structure of magnetically ordered unit cell.

Books Suggested:

1. Modern Spectroscopy, J.M. John Wiley.
2. Applied Electron Spectroscopy for Chemical Analysis Ed. H. Windawi and F.L Ho, Wiley Interscience.

3. NMR, NQR, EPR and Mossbaur Spectroscopy in Inorganic Chemistry, R.V. Parish, Ellis Harwood.
4. Physical Methods in Chemistry, R.S. Drago, Saunders College.
5. Chemical Applications of Group Theory, FA. Cotton.
6. Introduction to Molecular Spectroscopy, R. Chang, McGraw Hill.
7. Basic Principles of Spectroscopy, R. Chang, McGraw Hill.
8. Theory and Applications of UV Spectroscopy, H.H. Jaffeand M. Orchin,
9. Introduction to Photoelectron Spectroscopy, P.K; Ghosh, John Wiley.
10. Introduction to Magnetic Resonance, A. Carrington and A.D. Carrington and AD. Maclachalan, Harper & Row.

M.Sc. (PREVIOUS) CHEMISTRY PRACTICAL

Time: 14 Hours (Spread over Two days)
Max. Marks : 150 **Min.Marks :54**
Identification of safety symbols
Qualitative Analysis:
(a) Analysis of Inorganic mixture containing eight radicals, out of which at least one should be less common metal ion
(b) Insolubles-oxides, sulphates and halides. Interfering radicals
Quantitative Analysis
(c) separation and determination of two metal ions Cu-Ni, Ni-Zn, Cu-Fe etc. involving volumetric and gravimetric methods.
(d) Determination of DO, COD and BOD of water sample.
Chromatography:
separation of cations and anions by
(a) Paper chromatography
(b) column chromatography-ion exchange.
Preparations
Preparations of selected inorganic compounds and their studies by I.R., electronic spectra, Mossbauer, E.S.R and magnetic susceptibility measurements. Handling of air and moisture sensitive compounds. Study of instruments related to various techniques described in syllabus.

(1) VO (acac) (2) $TiO(C_9H_8NO)_2H_2O$
(3) cis-K $[Cr(C_2OH)_2(H_2O)_2]$ (4) $Na[Cr(NH_3)_2(SCN)_4]$
(5) $Mn(acac)_3$ (6) $K_2[Fe(C_2O_4)_3]$
(7) Prussian blue, Turnbul's Blue (8) $[CO(NH_3)_6][Co(NO_2)_6]$

(9) Green Synthesis (a) Synthesis of Bis (acetylacetanato) Copper (II)

(b) Synthesis of Bis (acetylacetanato) Iron (III)

(10) Nanoparticles synthesis – Zn/ZnO/Ag/MnO etc.

Virtual Chemistry Experiments

AR & VR Based experiments - Experiments related with molecular modeling, virtual synthesis, virtual titrations, virtual chromatography etc. can be performed.

ORGANIC CHEMISTRY

Qualitative Analysis

Separation, purification and identification of compounds of binary mixture (one liquid and one solid) using TLC and column chromatorgaphy, chemical tests. IR spectra to be used for functional group identification.

Organic Synthesis (Any Five)

1- Acetylation : Acetylation of cholesterol and separation of cholestryl acetate by column chromatography.
2- Oxidation : Adipic acid by chromic acid oxidation of cyclohexanol.
3- Grignard reaction : synthesis of triphenyl methanol from benzoic acid.
4- Aldol condensation : Dibenzal acetone from bezaldehyde.
5- Sandmeyer reaction : p chlorotoluene from p-toluidine.
6- Acetoacetic ester condensation : synthesis of ethyl-n-butylacetoacetate by A.E.E. condensation.
7- Cannizzaro reaction : 4-chlorobenzaldehyde as substrate.
8- Friedel craft's reaction : b- Benzoyl propionic acid from succinic anhydride and benzene.
9- Aromatic electrophilic substitutions : synthesis of p-nitroanilline and b-bromoaniline.

The products may be characterized by spectral techniques.

Quantitative Analysis:

1- Determination of the percentage or number of hydroxyl groups in an organic compound by acetylation method.
2- Estimation of amines / phenols using bromate bromide solution /or acetylation method.
3- Determination of Iodine and Saponification values of an oil sample.

Physical chemistry

Number of hours for each experiment : 3-4 hours. A list of experiments under different headings is given below typical experiments are to be selected from each type. Students are required to perform at least 10 experiments.

Error Analysis and Statistical Data Analysis:

Errors, type of errors, minimization of errors, error distribution curves, precision, accuracy and combination, statistical treatment for error analysis, student 'T' test null hypothesis, rejection criteria F& Q test; linear regression analysis, curve fittings,.

Calibration of voumetre apperatus, burette, pipette and standard flask.

Absorption.

To Study surface tension-concentration relationship for solutions (Gibb's equations)

Phase Equilibria

(i) Determination of congruent composition and temperature of a binary system (e.g.) diphenylamine- benzophenone system)

(ii) Determination of transition temperature of a given salt(e.g., $CaCl_2$) conductometrically.

(iii) To construct the phase diagram for three component system (e.g.) chloroform -acetic acid-water).

Chemical Kinetics :

(i) Determination of the effect (a) Change of temperature (b) Change of concentration of reactants and catalyst and (c) Ionic strength of the media on the velocity constant of hydrolysis of an ester / ionic reactions.

(ii) Determination of the velocity constant of hydrolysis of an ester / ionic reaction in micellar media.

(iii) Determination of the rate constant for the oxidation of iodide ions by hydrogen peroxide studying the kinetics as iodine clock reaction.

(iv) Flowing clock reactions (Ref. :Experiments in Physical chemistry by Showmaker).

(v) Determination of the primary salt effect on the kinetics of ionic reactions and testing of the Bronsted relationship (iodide ion is oxidized by persulphate ion)

(iv) Oscillatory reaction.

Solutions

(i) Determination of molecular weight of non- volatile and non- electrolyte by cryoscopic method and to determine the activity coefficeint of an electrolyte.

(ii) Determination of the degree of dissociation of weak electrolyte and to study of deviation from ideal behaviour that occurs with a strong electrolyte.

Electrochemistry :

A- Conductometry :

(i) Determination of the velocity constant, order of the reaction and energy of activation for saponification of ethyl acetate by sodium hydroxide conductometrically.
(ii) Determination of the degree of dissociation of weak electrolyte and to study of deviation from ideal behaviour that occurs with a strong electrolyte.
(iii) Determination of the strength of strong and weak acids in a given mixture conductometrically.
(iv) To study the effect of solvent on the conductance of $AgNO_3$/ acetic acid and to determine the degree of dissociation and equilibrium constant in different solvents and in their mixtures (DMSO DMF dioxane, acetone, water) and to test the validity of Debye Huckels limiting law.

B- Potentiometry / pH metry:

(i) Determination of strengths of halides in a mixture potentiometrically.
(ii) Determination of the valence of mercurous ions potentiometrically.
(iii) Determination of the strength of strong and weak acids in a given mixture using a potentiometer / pH meter.
(iv) Determination of temperature dependence of EMF of a cell.
(v) Determination of the formation constant of sliver- ammonia complex and stoichiometry of the complex potentiometrically.
(vi) Acid-base titration in a non-aqueous media using a pH meter.
(vii) Determination of activity and activity coefficient of electrolytes.
(viii) Determination of the dissociation constant of acetic acid in DMSO, DMF, acetone and dioxane by titrating it with KOH.
(ix) Determination of the dissociation constant of monobasic/ dibasic acid by Albert - Serjeant method.
(x) Determination of thermodynamic constants, DG, DS and DH for the reaction by e.m.f. method.

Polarimetry:

(i) Determination of rate constant for hydrolysis/ inversion of sugar using a polarmeter.
(ii) Enzyme - kinetic - inversion of sucrose.

Computational chemistry

Experiments on molecular modeling, computational chemistry, metal-drug, metal-protein interaction etc. can be performed.

Reference Books:

1- Vogel's Textbok of Quantitative Analysis, revised, J. Bassett, R.C. Denney, G.H. Jeffrey and J. Mendham, ELBS.

2- Experiments and Techniques in Organic Chemistry, D.P. Pasto, C Johnson and M. Miller, Prentice Hall.
3- Macroscale and Microscale Organic Experiments, K.L. Williamson D.C. Health.
4- Systematic Qualitative Organic Analysis, H. Middleton, Adward Arnold.
5- Vogel's Textbook of Practical Organic Chemistry, A.R. Tacthell,
6- Practical Physical chemistry, A.M. James and F.E. Porichard, Longman.
7- Findley's Practical Physical Chemistry, B.P. Levitt, Longman.
8- Experimental Physical Chemistry R.C. Das and B. Behera,
9- Green Chemistry : An experimental study, R.K. Sharma, N. Bhojak, I.T. Sidhwani and M.K. Choudhary

INSTRUCTIONS OF THE EXAMINERS.
M.Sc. (Previous) Chemistry Practical,
Inorganic Chemistry.

Qualitative and Quantitative Analysis:-

(i) Analysis of mixture containing 8 radicals including two radicals of rare elements.

OR

Separation and determination of two metal ions Cu- Ni, Ni-Zn, Cu Fe etc. involving volumetric and gravimetric method. 25

(ii) Separation of cations and anions by paper chromatography or column chromatography.

OR

Preparation of one selected inorganic compound and its study by IR, electronic spectra, Mossbauer, ESR and magnetic susceptibility measurements. 15

Organic Chemistry.

(i) Qualitative Analysis Separation, purification and identification of the components of binary mixture (one liquid and one solid) using TLC and column chromatography, chemical tests, IR spectra to be used for functional group determination.

OR

organic synthesis perform one of the 9 organic synthesis as mentioned in the syllabus and product may be characterized by spectral techniques. 25

(ii) Quantitative Analysis Perform one the of four quantitative analysis.

(a) Estimation of amines / phenols using bromate- bromide method or acetylation method.

(b) Determination of the percentage or number of hydroxyl groups it organic compound by acetylation method.

(c) Determination of iodine and saponification values of an oil sample.

(d) Determination of DO, COD and BOD water sample. 15

Physical Chemistry

Perform any two physical experiments (both experiments should not be from same topic). 20+20

A list of experiments under different headings is given in the syllabus. Typical experiments are to be selected from each types. Students are required to perform at least 10 experiments in the class. Identification of safety symbols to be performed in Record and shall be examined during viva.

The candidate must perform at least four experiments based on four different instruments like – Uv-vis spectrophotometer, FTIT, Conductometer, Colorimeter, pH meter, Flame photometer, Polarimeter, Potentiometer and / or any other sophisticated instrument.

Spotting

In spotting there should be 5 spots related with instruments, techniques, spectra, safety symbols etc. from the syllabus ; time of spotting is 20 minutes and a separate copy shall be used for the purpose. 10

Viva	**10**
Record	**10**
Total	**150**

M.Sc. (FINAL) CHEMISTRY,2022.
PAPER-V CH-501: SPECTROSCOPY
PHOTO CHEMISTRY AND COMPUTER IN CHEMISTRY

Time : 3 Hours **Max. Marks : 75**

Unit-I

(a) Vibrational Spectroscopy : Symmetry and shapes of AB_2, AB_3, AB_4, AB_5 and AB_6, mode of bonding of ambidentate ligands, ethylenediamine and diketonato complexes, application of resonance Raman spectroscopy particularly for the study of active sites of metallo proteins.

(b) Ultraviolet and Visible spectroscopy :

Various electronic transitions (185-800mm), Beer Lambert law, effect of solvent on electronic transitions, ultraviolet bands for carbonyl