Maharaja Surajmal Brij University

Bharatpur (Raj.)

SYLLABUS

CHEMISTRY

M.Sc. Previous

Only For Session
2020-21

अकादमिक प्रभारी
महाराजा सूरजमल बृज विश्वविद्यालय
भरतपुर (राज.)

M.Sc. Chemistry (Previous)

(Two Year Course)

Note: In each question paper 10 questions will be set. Candidates have to answer any 5 questions selecting at least one question from each unit.

M.Sc. 1 Year (Previous)

Paper	Course No.	Course	Duration Hours	Max. Marks	Min. Marks
Paper-I	CH-401	Inorganic Chemistry	3	100	36
Paper-II	CH-402	Organic Chemistry	3	100	36
Paper-III	CH-403	Physical Chemistry	3	100	36
Paper-IV	CH-404	Spectroscopy-I	3	75	27
Paper-V	CH-405	Spectroscopy-II	3	75	27
Practical			18 hrs.	200	72
*For students without Mathematics in B.Sc. **For students without Biology in B.Sc.			**Total Marks :**	**650**	

M.Sc. 2nd Year (Final)

Paper	Course No.	Course	Duration Hours	Max. Marks	Min. Marks
Paper-I	CH-501	Applications of Spectroscopy, Photochemistry and Solid State Chemistry	3 hrs.	100	36
Paper-II	CH-502	a) Bioinorganic Chemistry b) Bioorganic Chemistry c) Biophysical Chemistry	3hrs.	75	27
Paper-III	CH-503	Elective Paper	3hrs.	50	18
Paper-IV	CH-504	Elective Paper	3hrs.	50	18
Paper-V	CH-505	Elective Paper	3hrs.	50	18
Paper-VI	CH-506	Elective Paper	3hrs.	50	18
Paper-VII	CH-507	Elective Paper	3hrs.	50	18
Seminars	Internal	-	3hrs.	25	9
Practical			18 hrs.	200	72
		Total Marks :		**650**	

Grand Total: M.Sc. 1st Yr. (Previous) & 2nd Yr. (Final): 1300

The following alternative groups of elective paper are approved for M.Sc. 2 Yr. course

Group-I	CH-504	Organ transition Metal Chemistry
	CH-505	Bioinorganic and Supramolecular Chemistry
	CH-506	Photo inorganic Chemistry
	CH-507	Polymers
Groups-II	CH-504	Organic Synthesis-I
	CH-505	Organic Synthesis-II
	CH-506	Heterocyclic Chemistry
	CH-507	Chemistry of Natural Products
Groups-III	CH-504	Analytical Chemistry
	CH-505	Physical Organic Chemistry
	CH-506	Chemical Dynamics
	CH-507	Electrochemistry

Only For Session 2020-21

अकादमिक प्रभारी
महाराजा सूरजमल बृज विश्वविद्यालय
भरतपुर (राज.)

M.Sc. I YEAR (PREVIOUS)

Paper 1: CH-401 Inorganic Chemistry

Duration: 3 hrs. Max. Marks: 100

Unit-I

Symmetry and Group Theory in Chemistry Symmetry elements and symmetry operation, definition of group. subgroup, relation between orders of a Finite group and its subgroup. Conjugacy relation and classes. Point symmetry group. Schonflies symbols, representations of groups by metrics (representation for the C_n, C_{nv}, D_{nh} etc., groups to be worked out explicitly). Character of a representation. The great orthogonality theorem (without proof) and its importance. Character tables and their uses

Unit-II

Stereochemistry and Bonding in Main Group Element Compounds

VSEPR, dπ-pπ bond. Bent rule and energetics of hybridization, some simple reactions of covalently bonded molecules.

Metal-Ligand bonding

Limitations of crystal field theory. Molecular orbital theory: octahedral, tetrahedral and square planar complexes and -bonding complexes.

Metal πt-Complexes

Metal carbonyls, structure and bonding, important reactions of metal carbonyls; preparation, bonding, structure and important reactions of transition metal nitrosyl, dinitrogen and dioxygen complexes; tertiary phosphine as ligand.

Metal Clusters

Higher boranes, carboranes, metalloboranes and compounds with metal-metal multiple bonds

Unit-III

Electronic Spectra and Magnetic Properties of Transition Metal Complexes

Spectroscopic ground states, correlation. Orgel and Tanabe-Sugano diagrams for transition metal complexes (d^1-d^9 states), charge transfer spectra, spectroscopic method of assignment of absolute configuration in optically active metal chelates and their stereochemical information, magnetic exchange coupling and spin crossover.

Metal-Ligand Equilibria in Solution

Stepwise and overall f rmation constants and their interactions, 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.

अकादमिक प्रभारी
महाराजा सूरजमल बृज विश्वविद्यालय
भरतपुर (राज.)

Unit-IV

Reaction Mechanism of Transition Metal Complexes Energy profile of a reaction, reactivity of metal complexes, inert and labile complexes, 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. Substitution reactions in square planar complexes, trans effect, mechanism of the substitution reaction.

Redox reactions, electron transfer reactions, mechanism of one electron transfer reactions, outer sphere type reactions, cross reactions and inner sphere type reactions.

Unit-V

Nuclear and Radiochemistry: Laws of radioactive decay; Detection of radiations; Geiger-Nuttal rule; GM tubes and their characteristics; Ionization chamber, Proportional counters, Scintillation counters: Solid state detectors: Calibration of counti .g equipments; Determination of absolute disintegration rates.

Books Suggested :

1. Chemical Applications of Group Theory. FA. Cotton
2. Advanced Inorganic Chemistry, F.A. Cotton and Wilkinson, John Wiley.
3. Inorganic Chemistry, J.E. Hubeey, Harper & Row,
4. Chemistry of the Elements. N.N. Greenwood and A. Earnshow, Pergamon.
5. Inorganic Electronic Spectroscopy, A.B.P. Lever, Elsevier,
6. Magnetochemistr /, R.I. Carlin, Springer Verlag,
7. Comprehensive Coordination Chemistry eds., G. Wilkinson. R.D. Gillars and J.A. McCleverty. Pergallon.
8. Nuclear and Radiochemistry; G. Friedlander, J. W. Kennedy, E. S. Macias and J. M. Miller; 3 Edi.. Wiley: NY, 1981.
9. Essentials of Nuclear Chemistry, H. J. Arnikar, 4 Eds., New Age International: N Delhi, India, 2011.
10. Nuclear and Radiochemistry: Fundamental and Applications, 2 Vols., Jens-Volker Kratz and Karl Heinrich Lieser; 3 Edn., John Wiley & Sons: UK, 2013.

Paper II : CH-402 Organic Chemistry

Duration: 3 hrs. **Max. Marks : 100**

Unit-I

Nature of Bonding in Organic Molecules

Aromaticity in benzenoid and non-benzenoid compounds, alternant and non-alternant hydrocarbons. Huckel's rule, energy level of n-molecular orbitals. anti-

aromaticity, homo aromaticity, Bonds weaker than covalent - addition compounds, Crown other complexes and cryptands.

Stereochemistry

Conformational analysis of cycloalkanes, decalins, effect of conformation on reactivity, conformation of sugars, strain due to unavoidable crowding, Elements of symmetry, chirality, molecules with more than one chiral centre, threo and erythro isomers, methods of resolution, optical purity. Enantiotopic and diasterectopic atoms, groups and faces. Stereospecific and stereoselective synthesis.

Stereochemistry of the compounds containing nitrogen, sulphur and phosphorus.

Unit-II

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.

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

Aliphatic Nucleophilic Substitution

The $S_{N}2$-$S_{N}1$, mixed $S_{N}1$-$S_{N}2$, and SET mechanisms.

The neighbouring group mechanism, neighbouring group participation by it and a bonds, anchimeric assistance. Classical and nonclassical carbocations, phenonium ions, norbonyl system, common carbocation rearrangements. Application of NMR spectroscopy in the detection of carbocation. The $S_{N}i$ mechanism Nucleophilic substitution at the allylic, aliphatic trigonal and a vinylic carbon.

Unit-III

Aliphatic Electrophilic Substitution

Bimolecular mechanisms - $S_{E}2$ and $S_{E}i$. The $S_{E}1$ mechanism - electrophilic substitution accompanied by double bond shifts. Effect of substrates, leaving group and the solvent polarity on the reactivity.

Aromatic Electrophiiic 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.

Aromatic Nucleophilic Substitution

The $S_{N}Ar$, $S_{N}I$, benzyne and $S_{RN}I$ mechanisins. Reactivity - effect of substrate structure, leaving group and attacking nucleophile.

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 salvents on reactivity. Allylic halogenation (NBS), oxidation of aldehydes to carboxylic acids, auto-oxidation,

Unit-IV

Addition to Carbon-Carbon Multiple Bonds

Mechanistic and stereochemical 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.

Addition to Carbon-Hetero Multiple Bonds

Mechanism of metal hydride reduction of saturated and unsaturated carbonyl compounds, acids, esters and nitrites. Addition of Grignard reagents, organozinc and organolithium reagents to carbonyl and unsaturated carbonyl compounds, Wittig reaction.

Elimination Reactions

The E2. El and ElcB 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.

Unit-V

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 and allyl systems. Cycloadditions - antarafacial and suprafacial additions. 4n and 4n+2 systems, 2+2 addition of ketones. 1,3-dipolar cycloadditions and chelotropic reactions.

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. HO. House, Benjamin.
7. Principles of Organic Synthesis. ROC 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. Stcreochemistry of Organic Compounds, D. Nasipuri, New Age International.
11. Stereochemistry of Organic Compounds, P.S. Kalsi. New Age International

Paper III: CH-403
Physical Chemistry

Duration: 3 hrs. **Max. Marks : 100**

Unit-I

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

Approximate Methods: The variation theorem, linear variation principle. Perturbation theory (up to second order and non-degenerate). Applications of variation method and perturbation theory to Helium atom.

Angular Momentum: Ordinary angular momentum, generalized angular momentum, eigen functions for angular momentum, eigen values of angular momentum, operator using ladder operators.

Unit-II

Thermodynamics

Classical Thermodynamics : Brief resume of concepts of laws of thermodynamics, free energy, chemical potential and entropies. Partial molar properties, partial 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 coefficients, ionic strength.

Statistical Thermodynamics : Concept of distribution, thermodynamic probability and most probable distribution. Ensemble averaging, postulates of ensemble averaging. Canonical, grand canonical and micro canonical ensembles, corresponding distribution laws (using Lagrange's method of undetermined multipliers). Partition functions-Translation, rotational, vibrational and electronic partition functions, calculation of thermodynamic properties in terms of partition functions Fermi-Dirac statistics, distribution law. Bose-Einstein statistics distribution Law.

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 reactions (hydrogen-bromine reaction, pyrolysis of acetaldehyde, decomposition of ethane), photochemical reactions (hydrogen-bromine and hydrogen-chlorine) and homogeneous catalysis, kinetics of enzyme reactions, dynamics of unimolecular reactions (Lindemann. Hinshelwood theories of unimolecular reactions).

Unit-IV

Surface Chemistry

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).

Micelles : Surface active agents, classification of surface active agents, micellization hydrophobic interaction, critical micellar concentration (CMC), factors affecting the CMC of surfactants, counter ionbinding to micelles.

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, molecular mass determination (osmometry, viscometry, diffusion and light scattering methods), sedimentation.

Unit-V

Electrochemistry

Electrochemistry of solutions. Debye-Huckel-Onsager treatment and its extension, ion solvent interact ons. Debye-Huckel-Jerum mode. Thermodynamics of electrified interface equations. Derivation of electro capillarity, Lippmann equations (surface excess), methods of determination. Structure of electrified interfaces. Guoy-Chapman, Stern, Graham Devanathan-Mottwatts, Tobin Bockris, Devananthan models, Overpotentials, exchange current density, derivation of Butler-Volmer equation, Tafelplot.

Polarography theory, Ilkovic equation, half wave potential and its significance.

Books Suggested

1. Physical Chemistry. P.W. Atkins, ELBS.
2. Introduction to Q antum 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. KJ. Laidler, McGraw-Hill.
6. Kinetics and Mechanisin of Chemical Transformation. J. Rajaraman and I. Kuriacose. McMillan.
7. Micelles, Theoretical and Applied Aspects, V. Moroi, Plenum.
8. Modern Electrochemistry Vol. I and Vol. II, I.0'M. Bockris and A.K.N. Reddy, Plenum.
9. Introduction to Polymer Science, V.R. Gowarikar, N.V. Vishwanathan and J. Sridhar, Wiley Eastern

Paper IV: CH 404 - Spectroscopy-I

Duration: 3 hrs. **Max. Marks : 75**

Unit-I

Unifying Principles

Electromagnetic radiation, interaction of electromagnetic radiation with matter - absorption, emission, transmission, reflection, retraction. dispersion, polarisation and scattering, Uncertainty relation and natural line width and natural line broadening, selection rules, intensity of spectral lines.

Unit-II

Microwave Spectroscopy.

Classification of molecules, rigid rotor model, effect of isotopic substitution on the transition frequencies, intensitics, non-rigid rotor, stark effect

Unit-III

Ultraviolet and Visible Spectroscopy

Various electronic transitions (185-800 nm), Beer-Lambert law, effect of solvent on electronic transitions ultraviolet spectra of carbonyl compounds, unsaturated carbonyl compounds, dienes, conjugated polyenes, Fieser-Woodward rules for conjugated dienes and carbonyl compounds.

Unit-IV

Infrared Spectroscopy: Review of linear harmonic oscillator, vibrational energies of diatomic molecules, zero point energy, force constant and bond strengths; anharmonicity, Morse potential energy diagram, vibration-rotation spectroscopy. PQR branches. Breakdown of Oppenheimer approximation; Vibrations of polyatomic molecules. Selection rules, normal modes of vibration, group frequencies, overtones, hot bands, factors affecting the band positions and intensities, far IR region.

Unit-V

Raman Spectroscopy: Classical and quantum theories of Raman effect. Pure rotational, vibrational and Vibrational-rotational Raman spectra, selection rules,

mutual exclusion principle. Resonance Raman spectroscopy, coherent antistokes Raman spectroscopy (CARS).

Books Suggested :

1. Modern Spectroscopy, JM Hollas, John Wikey.
2. Introduction to Molecular Spectroscopy GM Borrow; McGrow Hill.
3. Basic principles of Spectroscopy, R. Charge, McGrow Hill.
4. Theory and Applications of UV Spectroscopy, H.H. Jaffe and M. Orchin IBH Oxford.
5. NMR, NQR, EPR and Morsbaver Spectroscopy in Inorganic Chemistry R.V. Parish. Ellis Harwo.

Paper V: CH 405 - Spectroscopy-II

Duration: 3 hrs. **Max. Marks : 75**

Unit-I

Electronic Spectroscopy

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.

Unit-II

Photoelectron Spectroscopy: Basic principles; photo-electric effect, ionization process. Koopman's theorem. Photoelectron spectra of simple molecules, ESCA.

Unit-III

Nuclear Magnetic Resonance Spectroscopy : General introduction, Nuclear spin, nuclear resonance, shielding mechanism, chemical shift and its measurements, factors influencing chemical shift, deshielding. Chemical shift values and correlation for protons bonded to carbon (aliphatic, olefinic, aldehydic and aromatic) and other nuclei (alcohols, phenols, enols, carboxylic acids, amines, amides & mercapto). Spin-spin interactions, coupling constant J, factors influencing coupling constant. Complex spin-spin interaction between two, three, four and five nuclei (ABX, AMX, ABC. A2B2, etc.).

Unit-IV

Electron Spin Resonance Spectroscopy : Basic principles, zero field splitting and Kramer's degeneracy. Isotropic and anisotropic Hyperfine coupling, spin-orbit coupling and significance of g-tensors, factors attecting the 'g' value, application to transition metal complexes; spin Hamiltonian, spin densities and McConnell relationship,

Unit-V

X-ray Diffraction : Bragg condition, Miller indices, Laue Method, Bragg method. Debye Scherrer method of X-ray structural analysis of crystals, index reflections, identification of unit cells from systematic absences in diffraction pattern.

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.

Books suggested :

1. Modern Spectroscopy, J.M. Hollas, John Wiley,
2. Applied Electron Spectroscopy for Chemical Analysis, Ed. H Windawi & FL. Ho, Wiley Interscience.
3. NMR. NOR, EPR and Mossbauer Spectroscopy in Inorganic Chemistry, R.V. Parish, Ellis Harwood.
4. Physical Methods in Chemistry, R.S. Drago, Saunders College.
5. Introduction to Molecular Spectroscopy, G.M. Barrow, McGraw Hill.
6. Basic Principles of Spectroscopy, R. Change, McGraw Hill.
7. Theory and Application of UV Spectroscopy, H.H. Jaffe and M. Orchin, IBH Oxford.
8. introduction to Photoelectron Spectroscopy, P.K. Ghosh, John Wiley.
9. Introduction to Magnetic Resonance, A Carrington and A.D. Maclachalan, Harper & Row.

अकादमिक प्रभारी
महाराजा सूरजमल बृज विश्वविद्यालय
भरतपुर (राज.)

3. dis-$K(Cr(C_2O_4)_2(H_2O)_2]$
4. $Na[Cr(NH_3)_2(SCN)_4]$
5. $[Mn(acac)_2]$
6. $K_3(Fe(C_2O_4)_3]$
7. Prussian Blue, Turnbull's Blue.
8. $[Co(NH_3)_6]\,[CO(NO_2)_6]$
9. cis-$[Co(trien)(NO_2)_2Cl.H_2O$
10. $Hg[Co(SCN)_4)$
11. $[Co(Py)_2Cl_2]$
12. $[Ni(NH_3)_6]Cl_2$
13. $[Ni(dmg)_2]$
14. $(Cu(NH_3)_4]SO_4.H_2O$

ORGANIC CHEMISTRY

Qualitative Analysis

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

Organic Synthesis (at least six to be carried out)

a) One step Preparations :

1. Acetylation : Acetylation of cholesterol and separation of cholesterol acetate by column chromatography.
2. Oxidation : Adipic acid by chromic acid oxidation of cyclohexanol / cyclohexene.
3. Aldol condensation : Dibenzal acetone from benazaldehyde.

b) Two step Preparations

1. Aniline → Sym. Tribromoaniline → Sym. Tribromobenzene
2. Benzoin → Benzil → Dibenzyl
3. Anuline → Dibenzoaminobenzene → p-Aminoazobenzene
4. Nitrobenzene → m-Dinitrobenzene → m-Nitroaniline
5. Phthalic anhydride → Fluorescein → Eosin

The products may be characterised by Spectral Techniques.

Quantitative Analysis (At least 3 to be performed)

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. Estimation of Sulphur by Messenger or Fusion method.
4. Estimation of Nitrogen by Kjeldahl's method.
5. Determination of Iodine number and Saponification value of an oil sample.
6. Determination of DO, COD and BOD of water sample.

PHYSICAL CHEMISTRY

Number of hours of each experiment 3-4 hours. A list of experiment under different headings is given below. Typical experiments are to be selected from each type. Students are required to perform at least 30 experiments.

PART A

Error Analysis and Statistical Data Analysis

Errors, types of errors, minimization of errors 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 fitting.

Calibration of volumetric apparatus, burette, pipette and standard flask.

PART B

Adsorption

To study surface tension-concentration relationship for solutions (Gibbs equation).

Phase Equilibria

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

(ii) Determination of glass 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 of (a) Change of temperature (b) Change of concentration of reactant 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 an iodine clock reaction.

(iv) Flowing clock reaction (Ref: Experiments in Physical Chemistry by Snowmaker) (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).

(vi) Oscillatory reaction.

Solutions

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

(ii) Determination of the degree of dissociation of weak electrolyte and to study the 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 solubility and solubility product of sparingly soluble salts (e.g., $PbSO_4$, $BaSO_4$) conductometrically.

(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. DMP diaxare, acetone, water) and to test the validity of Debye-Huckel-Onsager theory.

(v) Determination of the activity coefficient of zinc ions in the solution of 0.002 M zinc sulphate using · Debye Huckel's limiting law.

B. Potentiometry/pH metry

(i) Determination of strengths of halides in a mixture potentiometrically.

(ii) Determination of the valency 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 silver-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. AG, AS, and AH for the reaction by e .m.f. method.

$$Zn + H_2SO_4 \rightarrow ZnSO_2 + 2H$$

Polarimetry

(i) Determination of rate constant for hydrolysis/inversion of sugar using a polarimeter.

(ii) Enzyme kinetics - inversion of sucrose.

Reference Books :

1. Vogel's Textbook of Quantitative Analysis, revised. J. Bassett. R.C. Denney, G.H. Jeffrey and J Mendhan, ELBS.
2. Synthesis and Characterization of Inorganic Compounds, W.L. Jolly. Prentice Hall.
3. Experiments and Techniques in Organic Chemistry, D.P. Pasto. C. Johnson and M. Miller, Prentice Hall.
4. Macroscale and Microscale Organic Experiments, K.L. Williamson, D.C. Health.
5. Systematic Qaulitatitve Organic Analysis, H. Middleton. Adward Amold.
6. Handbook of Organic Analysis-Qualitative and Quantitative. H. Clar. Adward Arnold.
7. Vogel's Textbook of Practical Organic Chemistry. A.R. Tatchell, John Wiley.
8. Practical Physical Chemistry, A.M. James and F.E. Porichard, Longman.
9. Findley's Practical Physical Chemistry, B.P. Levitt, Longman,
10. Experimental Physical Chemistry, R.C. Das and B. Behera, Tata-McGraw Hill.

INSTRUCTIONS TO THE EXAMINERS

M.Sc. (Previous) Chemistry Practical

Duration of Exam: 14 hrs (spread in 2 days)

Max Marks: 200 **Min. Marks: 72**

Inorganic Chemistry

Qualitative and Quantitative Analysis

(i) Analysis of mixture containing 8 radicals including one radical of rare elements. 30

Or

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

(Both these exercises should be given in equal ratio by lots.)

(ii) Separation of cations and anions by payer chromatography or column chromatography. 20

Or

Preparation of one selected inorganic compound and its study by IR.

Organic Chemistry

(i) Qualitative and Quantitative Analysis

Separation, purification and identification of compounds 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

Perform one of the quantitative analysis given in syllabus. 30

(Both these exercises should be given in equal ratio by lots.)

(ii) Organic synthesis **20**

Perform one of the 8 organic syntheses as mentioned in the syllabus and may be characterized by spectral techniques.

Physical Chemistry

(i)	One physical experiment (minor) from Part A of syllabus.	30
(ii)	One physical experiment (major) from Part B of syllabus.	20
Viva		30
Record		20

अकादमिक प्रभारी
महाराजा सूरजमल बृज विश्वविद्यालय
भरतपुर (राज.)

DIMENSION, DO statement, FUNCTION and SUBROUTINE, COMMON and DATA statement (students learn the programming logic and these language features by 'hands on' experience on a personal computer from the very beginning of this topic).

Unit-III

Programming in Chemistry

Developing of small computer codes (FORTRAN / C/ BASIC) involving simple formulae in Chemistry such as Van der Waals equation. Chemical kinetics (determination of Rate constants), Radioactive decay (Half Life and Average Life). Determination of Normality, Molarity and Molality of solutions. Evaluation of Electronegativity of atom and Lattice Energy from experimental data. Determination of molecular weight and percentage of elements in organic compounds using data from experimental methods. Representation of molecules in terms of elementary structural features such as bond lengths, bond angles, dihedral angles, etc.

Unit-IV

Use of computer Programmes

Operation of PC. Data Processing. Running of standard Programs and Packages such as MS WORD, MS EXCEL - special emphasis on calculations and chart formations. X-Y plot. Simpson's Numerical Integration method.

Unit-V

Programmes with data preferably from physical chemistry Laboratory. Introduction of working of any one of the packages such as LOTUS / EXCEL / FOXPRO / MOPAC and Word Processing software such as WORDSTAR/ MS WORD.

Books Suggested:

1. Fundamentals of Computers - V. Rajaraman (Prentice Hall)
2. Computers in Chemistry - K.V. Raman (Tata McGraw Hill)
3. Computer Programming in FORTRAN IV - V Rajaraman (Prentice Hall)

M.Sc. (Prev.) PRACTICAL

Duration 14 hrs. (2 days) Max. Marks : 200

INORGANIC CHEMISTRY

Qualitative and Quantitative Analysis

a) Less common metal ions - Tl, Mo, W, Ti, Zr, Th, V, U (two metal ions in cationic/anionic forms)

b) Insolubles - oxides, sulphates and halides.

c) Separation and determination of two metal ions - Cu-Ni, Ni-Zn, Cu-Fe involving volumetric and gravimetric methods.

Chromatography

Separation of cations and anions by

a) Paper Chromatography

b) Column Chromatography - Ion exchange.

Preparations

Preparation of selected inorganic compounds and their studies by IR, electronic spectra, Mossbauer, ESR and magnetic susceptibility measurements. Handing of air and moisture sensitive compounds.

1. $[VO(acac)_2]$
2. $TiO(C_9H_8NO)_2.2H_2O$

3. cis-$K[Cr(C_2O_4)_2(H_2O)_2]$
4. $Na_3[Cr(NH_3)_2(SCN)_4]$
5. $[Mn(acac)_2]$
6. $K_3[Fe(C_2O_4)_3]$
7. Prussian Blue, Turnbull's Blue.
8. $[Co(NH_3)_6]$ $[CO(NO_2)_6]$
9. cis-$[Co(trien)(NO_2)_2]Cl.H_2O$
10. $Hg[Co(SCN)_4]$
11. $[Co(Py)_2Cl_2]$
12. $[Ni(NH_3)_6]Cl_2$
13. $[Ni(dmg)_2]$
14. $[Cu(NH_3)_4]SO_4.H_2O$

ORGANIC CHEMISTRY

Qualitative Analysis

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

Organic Synthesis (at least six to be carried out)

a) One step Preparations :

1. Acetylation : Acetylation of cholesterol and separation of cholesterol acetate by column chromatography.
2. Oxidation : Adipic acid by chromic acid oxidation of cyclohexanol / cyclohexene.
3. Aldol condensation : Dibenzal acetone from benazaldehyde.

b) Two step Preparations

1. Aniline → Sym. Tribromoaniline → Sym. Tribromobenzene
2. Benzoin → Benzil → Dibenzyl
3. Aniline → Dibenzoaminobenzene → p-Aminoazobenzene
4. Nitrobenzene → m-Dinitrobenzene → m-Nitroaniline
5. Phthalic anhydride → Fluorescein → Eosin

The products may be characterised by Spectral Techniques.

Quantitative Analysis (At least 3 to be performed)

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. Estimation of Sulphur by Messenger or Fusion method.
4. Estimation of Nitrogen by Jeldahl's method.
5. Determination of Iodine number and Saponification value of an oil sample.
6. Determination of DO, COD and BOD of water sample.

PHYSICAL CHEMSITRY

Number of hours of each experiment 3-4 hours. A list of experiment under different headings is given below. Typical experiments are to be selected from each type. Students are required to perform at least 30 experiments

PART A

Error Analysis and Statistical Data Analysis

Errors, types of errors, minimization of errors 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 fitting.

Calibration of volumetric apparatus, burette, pipette and standard flask.

PART B

Adsorption

To study surface tension-concentration relationship for solutions (Gibbs equation).

Phase Equilibria

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

(ii) Determination of glass 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 of (a) Change of temperature (b) Change of concentration of reactant 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 an iodine clock reaction.

(iv) Flowing clock reaction (Ref: Experiments in Physical Chemistry by Snowmaker)

(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).

(vi) Oscillatory reaction.

Solutions

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

(ii) Determination of the degree of dissociation of weak electrolyte and to study the 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 solubility and solubility product of sparingly soluble salts (e.g., $PbSO_4$, $BaSO_4$) conductometrically.

(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-Huckel-Onsager theory.

(v) Determination of the activity coefficient of zinc ions in the solution of 0.002 M zinc sulphate usi
Debye Huckel's limi ng law.

B. Potentiometry/pH metry

(i) Determination of strengths of halides in a mixture potentiometrically.
(ii) Determination of the valency of mercurous ions potentiometrically.
(iii) Determination of the strength of strong and weak acids in a given mixture using a potentiometer/p meter.
(iv) Determination of temperature dependence of EMF of a cell.
(v) Determination of the formation constant of silver-ammonia complex and stoichiometry of th 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 b titrating it with KOH
(ix) Determination of the dissociation constant of monobasic/dibasic acid by Albert-Serjeant method.
(x) Determination of thermodynamic constants. ΔG, ΔS, and ΔH for the reaction by e.m.f. method.
$Zn + H_2SO_4 \rightarrow ZnSO_4 + 2H$

Polarimetry

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

Reference Books :

1. Vogel's Textbook of Quantitative Analysis, revised, J. Bassett. R.C. Denney, G.H. Jeffrey and J Mendham, ELBS.
2. Synthesis and Characterization of Inorganic Compounds, W.L. Jolly. Prentice Hall.
3. Experiments and Techniques in Organic Chemistry, D.P. Pasto. C. Johnson and M. Miller, Prentice Hall.
4. Macroscale and Microscale Organic Experiments, K.L. Williamson, D.C. Health.
5. Systematic Qaulitatitve Organic Analysis, H. Middleton. Adward Arnold.
6. Handbook of Organic Analysis-Qualitative and Quantitative. H. Clar. Adward Arnold.
7. Vogel's Textbook of Practical Organic Chemistry. A.R. Tatchell. John Wiley.
8. Practical Physical Chemistry, A.M. James and F.E. Porichard, Longman.
9. Findley's Practical Physical Chemistry, B.P. Levitt, Longman.
10. Experimental Physical Chemistry, R.C. Das and B. Behera, Tata-McGraw Hill.

INSTRUCTIONS TO THE EXAMINERS

M.Sc. (Previous) Chemistry Practical

Max Marks: 200 Duration of Exam: 14 hrs (spread in 2 days) Min. Marks: 72

Inorganic Chemistry

Qualitative and Quantitati Analysis

(i) Analysis of mixture containing 8 radicals including one radical of rare elements. 30

Or

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

(Both these exercises should be given in equal ratio by lots.)

(ii) Separation of cations and anions by paper chromatography or column chromatography. 20

Or

Preparation of one selected inorganic compound and its study by IR.

Organic Chemistry

(i) Qualitative and Quantitative Analysis

Separation, purification and identification of compounds 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

Perform one of the quantitative analysis given in syllabus. 30

(Both these exercises should be given in equal ratio by lots.)

(ii) Organic synthesis 20

Perform one of the 8 organic syntheses as mentioned in the syllabus and may be characterized by spectral techniques.

Physical Chemistry

(i) One physical experiment (minor) from Part A of syllabus. 20

(ii) One physical experiment (major) from Part B of syllabus. 30

Viva 30

Record 20