INTRODUCTION

Jai Narain Vyas University, Jodhpur, established in July 1962. It is a regional University and operate in limits of Jodhpur, Jalore, Barmer, Pali and Jaiselmer districts. The Department of Chemistry is situated in the New Campus of the University, near the Bhagat-ki Kothi Railway Station, along Pali Road.

The Department imparts post-graduate education in the field of chemistry and has made impressive progress in research activities. More than 700 candidates have been awarded the Ph.D. degree and three have been awarded D.Sc. degree. About 1700 research papers from faculty and research workers have been published in International and National Scientific Journals. The Department has received research projects from different agencies like U.G.C., C.S.I.R., D.S.T., D.B.T., I.C.A.R., DRDO, DAE etc.. In 1983, U.G.C. has formulated a programme under which certain departments, selected on the basis of their achievement in the field of teaching and research, are provided with infrastructure for raising the standard of their post-graduate education and research to international level. The programme has been formulated by the Committee on Strengthening of Infrastructure of Science and Technology (COSIST) of U.G.C. The Department is amongst the few Chemistry department of the country, which were selected for this programme. The M.Sc. course under this new scheme was in operation between July 1985-2003. Now in the lines COSIST, University Department of Chemistry has identified by U.G. C. under Special Assistance Program (SAP) of Departmental Research Support under which autonomy has been assigned to the PG course in the Department of Chemistry since year 2010. Further, the Department of Chemistry has also been awarded second level FIST programme by DST, New Delhi in year 2010.

Awards

Apart from the university gold medal for securing highest marks in M.Sc., following awards have been instituted in the Department of Chemistry for the meritorious students:

1. Professor R.C. Kapoor Gold Medal for securing highest marks in M.Sc. (Chemistry)

2. Professor J.P. Saxena Award for excellence in Organic Chemistry

3. Sushila Bhandari Ugam Kanwar Bhandari Memorial Abhay-II Award for excellence in Physical Chemistry

4. Dr. Kamla Tandon Memorial Award for excellence in Inorganic Chemistry.

5. B.M.Gang Memorial Award for excellence in Analytical Chemistry

Academic and Research Programme

Under Special Assistance Program (SAP), Department of Chemistry offers a two year (4 semesters) integrated programme leading to the Master's degree in Chemistry in two sections of 40 students each. Syllabus is designed to cover all four branches of chemistry viz. Inorganic Chemistry, Organic Chemistry, Physical Chemistry and Analytical Chemistry. Fourth semester offers a choice of sixteen electives to strengthen diverse field of interdisciplinary nature.

Department of Chemistry has advanced facilities for research in major areas of Chemistry leading to Ph.D.. The major research interests of the faculty members includes: Nanotechnology, Biosensors; Electrochemistry & Electroanalytical Chemistry, Chemical Dynamics & Reaction Mechanism; Mineral Beneficiation; Oil & Fats; Natural Products; Synthetic Heterocyclics; Chemical Spectroscopy; Synthetic & Structural Organo & Organometallic Chemistry; Effluent Treatment; Environmental Chemistry; Synthetic Organic Chemistry; Photochemistry; Solar Energy Conversion & Storage; Co-ordination Chemistry; Green Chemistry and Applied Chemistry.

ADDMISSION

The minimum qualification for admission to M.Sc. course is B.Sc. (10+2+3) degree with Chemistry as a major subject. The details of the eligibility conditions and admission procedures are given in the admission forms. The admission would be done on the basis of merit as per university rules. Reservation for SC, ST and OBC would also be done as per J.N.V. University, Jodhpur rules. Candidates are required to attend minimum 75% of the classes in theory and practicals both.

FACILITIES

The Department of Chemistry possesses several sophisticated, advanced and modern equipments required for teaching and research. The specialized instruments includes Electrochemical Analysers, Surface plasmon Resonance Spectrometer, Fluorescence Spectrophotometer, FTIR, UV-VIS spectrophotometers, Stoped-flow spectrophotometers, HPLC, Low temperature thermostats, Flame photometers, Ion meters, Centrifuge and computers for networking. In addition, certain facilities related to equipments are also available with USIC in the Faculty of Science.

FACULTY MEMBERS

PROFESSOR & HEAD

Dr. M.R.K. Sherwani Ph.D.	Oils and Fats

PROFESSOR

Prof. P.K. Sharma(M) Ph.D.	Analytical Electrochemistry Environmental Chemistry
Prof. (Mrs.) Sunita Kumbhat Ph.D.	Biosensors, Electrochemistry & Electro analytical Chemistry Environmental Chemistry
Dr. R.S. Sindal Ph.D.	Electrochemistry, Physicochemical Studies of coordination compounds of transition and inner-transition elements, Photochemistry Chemical Kinetics
Dr. (Miss) Seema Kothari Ph.D.	Reactions Kinetics, Correlation Analysis
Dr. P.K. Sharma (B) Ph.D.	Electrochemistry, Chemical Kinetics & Correction Analysis.
Dr. (Mrs.) Seema Acharya Ph.D.	Fluorescence Studies
Dr. (Mrs.) Pramila Sah Ph.D.	Natural Products and Medicinal Chemistry
Dr. Kailash Daga Ph.D.	Co-ordination Chemistry
Dr. (Mrs.) Vinita Sharma Ph.D.	Organic Chemistry Reaction Mechanism
Dr. (Mrs.) S. Loonker Ph.D.	Polymers, Environmental and applied Chemistry

ASSOCIATE PROFESSORS

Dr. (Miss) S. Sharma Ph.d.	Co-ordination Chemistry Environmental Chemistry
Dr. (Mrs.) V. Choudhary Ph.D.	Co-ordination Chemistry
Dr. (Mrs.) S. Gaur Ph.D.	Co-ordination Chemistry
Dr. J.S. Rathore Ph.D.	Analytical Chemistry Environmental Chemistry
Dr. V. Gupta Ph.D.	Applied Chemistry Effluent Treatment Studies
Dr. A.V. Singh Ph.D.	Physical Chemistry Mineral beneficiation and Environmental Chemistry
Dr. (Mrs.) P. Mishra Ph.D.	Organic Reaction Mechanism
Dr. K.R. Genwa Ph.D.	Photochemistry
Dr. R.C. Meena Ph.D.	Photochemistry
Dr. A. Arora Ph.D.	Natural products, Oils and fats Photochemistry
Dr. Rajendra Mathur Ph.D.	Polymer chemistry

ASSISTANT PROFESSORS

Dr. P. Koli Ph.D.	Organic Chemistry and Solar Energy Conversion and storage

Ms. Jaishree Rathore M.Sc.	Organic Chemistry
Ms. Meenakshi Jonwal M.Sc.	Inorganic Chemistry
Ms. Anita Meena M.Sc.	Physical Chemistry
Dr. S.L. Meena Ph.D.	Physical Chemistry(Corrosion Science)
Dr. Priyanka Purohit Ph.D.	Organic Chemistry
Dr. Rajani Bais Ph.D.	In organic Chemistry
Dr. Sangeeta Parihar Ph.D.	Analytical Chemistry
Dr. Om Prakash Ph.D.	Physical Chemistry
Dr. Anurag Choudhary Ph.D.	Physical Chemistry
Dr. Ram Lal Saini Ph.D.	Organic Chemistry
Dr. Seema Parveen Ph.D.	Organic & PhytoChemistry
Dr. Amita Dhariwal Ph.D.	Analytical Chemistry

M.Sc. Chemistry (Under SAP identified University Department of Chemistry)

Jai Narain Vyas University, Jodhpur

First Year (2015)

(Two Semesters each of 15 weeks)

TEACHING AND EXAMINATION SCHEME:

M.Sc. Previous I Year

I SEMESTER

1. THEORY PAPERS	**Periods/Wk**	**Internal**	**External**	**Total**
(Four Papers)				
CH 401 Inorganic Chemistry	**6**	**50**	**50**	**100**
CH 403 Organic Chemistry	**6**	**50**	**50**	**100**
CH 405 Physical Chemistry	**6**	**50**	**50**	**100**
CH 407 Analytical Chemistry	**6**	**50**	**50**	**100**
			Grand Total	**400 marks**

PRACTICAL EXAMINATIONS:

	Periods/Wk	**Internal**	**External**	**Hrs.**	**Total**
CH-409 (A) Inorganic Lab	**16**	**25**	**75**	**12**	**100**
CH-410 (B) Physical & Anal. Lab	**8**	**12**	**38**	**6**	**50**
			Grand Total		**150**
			Total marks of I Semester		**550**

II SEMESTER

1. THEORY PAPERS (Four Papers)	Periods/Wk	Internal	External	Total
CH 402 Inorganic Chemistry	6	50	50	100
CH 404 Organic Chemistry	6	50	50	100
CH 406 Physical Chemistry	6	50	50	100
CH 408 Analytical Chemistry	6	50	50	100
			Grand Total	400 marks

PRACTICAL EXAMINATIONS:

	Periods/Wk	Internal	External	Hrs.	Total
CH 411 (A) CH-Organic Lab	16	25	75	12	100
CH 412 (B) Physical & Anal. Lab	8	12	38	6	50
			Grand Total		150
			Total marks of I Semester		550
			Total marks of M. Sc. I Year		1100

M.Sc. Chemistry

(Under SAP Programme)

Second Year (2015)

(Two Semesters each of 15 weeks)

TEACHING AND EXAMINATION SCHEME:

III SEMESTER

1. THEORY PAPERS	**Periods/Wk**	**Internal**	**External**	**Total**
(Four Papers)				
CH 501 Group Theory &				
Inorganic Spectroscopy	**6**	**50**	**50**	**100**
CH 502 Application of Spectroscopy	**6**	**50**	**50**	**100**
CH 503 Solid State Chemistry	**6**	**50**	**50**	**100**
CH 504 Biochemistry	**6**	**50**	**50**	**100**
		Grand Total		**400 marks**

PRACTICALS:

Practicals	**4 pds.**	**24 pds./week**	**360 pds./semester**

There will be 4 Labs. Namely Lab. 1, Lab. 2, Lab. 3 and Lab.4. Students will be divided into four groups. Each group of students will work for 7 weeks for two Lab Courses in one semester.

CH 511	**Lab. Course 1 (Inorganic)**
CH 512	**Lab. Course 2 (Analytical)**
CH 513	**Lab. Course 3 (Organic)**
CH 514	**Lab. Course 4 (Physical)**

PRACTICALS EXAMINATION SCHEME

	Pds/Wk	Internal	External	Hrs.	Total
Lab Course					
Lab Course 1 / Lab Course 3	12	10	55	12	65
Lab Course 2 / Lab Course 4	12	10	55	12	65

				Total	**130**

		Total marks of III Semester			**530**

IV SEMESTER

A student will opt for any one of the four elective groups.

Elective Group A C. No. 601/602/603/604

Elective Group B C.No.611/612/613/614

Elective Group C C.No.621/622/623/624

Elective Group D C.No.631/632/633/634

1. THEORY PAPERS (Four Papers)	**Periods/Wk**	**Internal**	**External**	**Total**
Elective Group A	**6X4**	**50**	**50**	**100**
Elective Group B	**6X4**	**50**	**50**	**100**
Elective Group C	**6X4**	**50**	**50**	**100**
Elective Group D	**6X4**	**50**	**50**	**100**
				_____
		Grand Total		**400 marks**

PRACTICALS EXAMINATION SCHEME

	Pds/Wk	Internal	External	Hrs.	Total
Lab Course					
Lab Course 3 / Lab Course 1	12	10	55	12	65
Lab Course 4 / Lab Course 2	12	10	55	12	65

				Total	130

Total marks of IV Semester					**530**
Field Training/ Dissertation*					**40**

		Total Marks of M.Sc. II year			**1100**
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*Field training will started after II semester and report will be submitted in the beginning of IV semester. A separate board of examination consisting of one external and Head of Department of Chemistry would be constituted to evaluate the field training / dissertation report.

Minimum pass marks for each theory paper = 40%

Minimum pass marks for Practical = 48%

A candidate must get 48% marks in aggregate in theory papers for passing the semester examination.

In the University Examination each paper shall consist of five units and two questions from each unit. Each question shall have internal choice. All the theory papers will be evaluated externally.

Internal Evaluation:

Each paper shall be evaluated through four Quizzes, two term tests and seminar; out of four quizzes the best three shall be considered. Following shall be the marking scheme:

Each quiz: 20 marks: 3 Quiz (3 x 20)	60
Seminar	20
One Mid Term Test (1 Hrs. each)	60
One Term Test (2 Hrs. each)	*60*

	200

M.Sc Chemistry (Under SAP)

M.Sc. I YEAR-2015

SEMESTER – I

CH 401 INORGANIC CHEMISTRY:

Unit I

Stereochemistry and bonding in compounds of main group elements: Walsh diagram of tri atomic molecules, d π -p π bonds and synergic bonding, equivalent and in equivalent hybridization and Bent-rule. Energetics of hybridization Simple reactions of covalently bonded molecules, atomic inversion. Berry pseudo rotation and Nucleophilic displacement, Free radical reactions. Applications of valance shell election pair repulsion(VSEPR) theory in structure elucidation.

Unit II

Metal Ligand Bonding :Limitations of crystal field theory, Jahn Tellor theorem. and distortion of molecules. Molecular orbital theory of hetero triatomic molecules viz . BeH_2 , CO_2 ,NO_2 , H_2O, Coulson diagrams of tri atomic molecules CO_2 , NO_2 , H_2O. Molecular orbital theory (MOT): octahedral, tetrahedral and square planer complexes and π - bonding complexes, Comparison with CFT.

Unit III

Metal Ligand Equilibrium in solution : stepwise and overall formation constant and their interaction, 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.

Unit IV

Correlation diagrams of Transition Metal Complexes:Types of transitions, selection rules for electronic transition, Spectroscopic ,ground States, correlation diagrams, Orgel and Tanabe sugano diagrams for d_1 to d_9 states in Transitions metal complexes. Calculations of Dq. B and β parameters.

Unit V

Electronic spectra and Magnetic properties of transitions metal Complexes, Spectroscopic methods of assignment of absolute configuration in optically active, metal chelates and their stereo chemical

information, Charge transfer spectra, Anomalous magnetic moments, magnetic exchange coupling and spin crossover.

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.

CH 403 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, alternant and non-alternant hydrocarbvonds, Huckel's rule, energy level of π-molecular orbitals, annulenes aromaticity, homo-aromaticity, PMO (approach).

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

UNIT II

Stereochemistry I

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.

UNIT III

Stereochemistry II

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 IV

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 V

Pericyclic Reactions

Molecular orbital symmetry, Frontier orbitals of ethylene, buta-1,3- diene, hexa-1,3,5-triene 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.

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.

CH 405 PHYSICAL CHEMISTRY

UNIT I

Chemical Kinetics-I

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) and oscillagtory reactions (Belousov Zhabotinsky reaction).

UNIT II

Chemical Kinetics-I

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 molecular motions, probing the transition state, dynamics of barrierless chemical reactions in solution, dynamics of unimolecular reaction, Lindemann and Hinshelweed theories of unimolelcular reactions.

UNIT III

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, hydrophobic interaction, critical micelle concentration (CMC), factors affecting the CMC of surfactants, counter ion binding to micelles,

UNIT IV

Macromolecules

Polymer – definition, types of polymers, electrically conducting, fire resistant, liquid crystal 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, chain configuration of macromolecules, calculation of average dimensions of various chain structures.

UNIT V

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.

Over potentials, exchange current density, Butler – Volmer equation, Tafel plot.

Introduction to corrosion, theories, forms of corrosion, corrosion monitoring and prevention methods.

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.

CH 407 ANALYTICAL CHEMISTRY

Unit I

Fundamentals of Chemical Analysis

Analytical method: Types and range of determination, Sampling Data handling: Significant figures, Accuracy & Precision, Standard Deviation, Student 't' test., Analysis of Variance (ANOVA) ; Quantitation: Calibration Curve, Correlation Coefficient, Linear regression, Standard Addition Method; Numericals based on above methods.

Unit II

Solvent Extraction

Distribution Coefficient(K_D), Distribution ratio(D), Percent Extraction (%E), Multiple batch extraction; Solvent Extraction of metals and separation efficiency (β) of metal complexes, Important examples: Oxime for determination of Iron, Acetylacetone for determination of Beryllium, Diethyldithiocarbamate for determination of Copper, Dithizone for determination of Lead. Ion Association Complexes, determination of Boron as ion association complex; Synergistic Extraction, determination of Ni by Synergistic Extraction.

Unit III

Atomic Spectroanalytical Techniques:

Atomic Absorption Spectroscopy: Theory, instrumentation, methodology and applications.

Emission Spectroscopy based on flame, arc, Spark and Plasma: Theory, instrumentation, methodology and applications.

Unit IV

Chromatography–I

Ion Chromatography (IC): Principle, layout of instrument and applications, Determination of anions by IC. Gas Chromatography (GC): Principle, layout of instrument, column, detectors (TCD, FID, Electron Capture, MS), Quantitation and applications of GC & GC-MS.

Unit V

Chromatography –II

High-performance liquid Chromatography (HPLC): Principle, layout of instrument, column, detectors (UV-Vis, RI, Amperometric,), Quantitation and applications.

Supercritical Fluid Chromatography: theory &application.

Books:

1. Vogel's Textbook of Quantitative Chemical Analysis, G.H.Jeffery, J.Bassett, J. Mendham and R.C. Denney, Publ ELBS, Longman, UK
2. Basic Concepts of Analytical Chemistry, S. M. Khopkar, Wiely Eastern.
3. Fundamentals of Analytical Chemistry, D.A. Skoog, D.M. West and F.J.Holler. Publ. W B Saunders.
4. Analytical Chemistry, G.D. Christian, John Willy & Sons.

CH 409 Laboratory Course-I

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-$K[Cr(C_2O_4)_2(H_2O)_2]$

(3) $Mn(acac)_3$

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

(5) $Fe_4[Fe(CN)_6]_3$; $KFe[Fe(CN)_6]$

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

(7) Cis-$[Co(trine)(NO_2)_2]Cl.H_2O$

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

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

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

(11) $[Ni\ (dmg)_{2]}$

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

CH 410 Physical Chemistry

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 and (c) Ionic strength of the media on the velocity constant of an acid hydrolysis of an ester.
(iii) Determination of the velocity constant of hydrolysis of an ester/ionic reaction in micellar media.
(iv) Determination of the rate constant for the oxidation of iodide ions by hydrogen peroxide by studying the kinetics as an iodine clock reaction.
(v) To study the effect of acid strength on the reaction of acetone and iodine.

Colorimeter

(i) To test the validity of Beer-Lambert law using colorimeter/spectrophotometer and determination of the unknown concentration of a solution.

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 suface tension measurements.

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. 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. Handbook of Organic Analysis – Qualitative and Quantitative, H. Clark, Adward Arnold.
7. Vogel's Textbook of Practical Organic Chemistry, John Wiley.
8. Practical Physical Chemistry, A.M.James and F.E. Prichard, Longman.
9. Findley's Practical Physical Chemistry, B.P.Levitt, Longman.
10. Experimental Physical Chemistry, R.C.Das and B.Behera, Tata McGraw Hill.
11. Advanced Practical Physical Chemistry, J.B.Yadav, Goel Publishing House.
12. Advanced Experimental Chemistry, Vol. I – Physical, J.N.Gurtu and R.Kapoor, S.Chand & Co.

M.Sc Chemistry (Under SAP)

M.Sc. I YEAR-2015

SEMESTER II

CH 402 INORGANIC CHEMISTRY

UNIT I

Reaction mechanism of Transitions metal complexes: Energy profile of a reaction (transition state or activated complex), Nucleophilic and Electrophilic Substitution, factors responsible for including $S_N1$and S_N2 reaction, Lability and inertness of octahedral complexes acc to VBT and CFT. Acid hydrolysis, factor affecting acid hydrolysis, Base hydrolysis, Conjugate base mechanism (S_N1CB), Evidences in favour of conjugate base mechanism, anation reactions, Substitution reaction without metal-ligand bond cleavage (Special reference to Co(III) complexes).

UNIT II

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

UNIT III

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 IV

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.

UNIT V

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

Books Suggested:

1. F.A. Cotton and Wilkinson: Advanced Inorganic Chemistry, John Wiley.
2. J.E. Huhey: Inorganic Chemistry, Harper and Row.
3. N.N.Green Wood and A. Eafnshow: Chemisry of the element, Pergamon.
4. A.B.P. Lever: Inorganic Electronic Spectroscopy, Elsevier
5. R.L.Carlin: Magnetochemistry, Verlag.
6. G. Wilkinson, R.D. Gillars and J.A. MCeLEVERTY: Comprehensive Coordination Chemistry eds. Pergamon.
7. F. Basolo and R.G. Pearson: Mechanism of Inorganic Reaction, Wiley Eastern

CH 404 ORGANIC CHEMISTRY

UNIT I

Aliphatic Nucleophilic Substitution

The S_N2, S_N1, mixed $S_N1$and $S_N2$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 S_EiThe S_E1 mechanism, electrophilic substitution accompanied by double shifts. Effect of substrates, leaving group and the solvent polarity on the reactivity.

UNIT II

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 III

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

Addition to Carbon-Carbon Multiple Bonds

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.

UNIT V

Elimination Reactions

The E2, E1 and E1C_B 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. Stereochemistry of Organic Compounds, D. Nasipuri, New Age International.

CH 406 PHYSICAL CHEMISTRY

UNIT I

Quantum Chemistry I

Introduction to Exact Quantum Mechanical Results:

The Schrodinger equation and the postulates of quantum mechanics. Physical Interpretation of the wave function, Discussion of solutions of the Schrodinger equation to some model systems viz., particle in 1 and 3-dimensional box, the harmonic oscillator, the hydrogen atom.

Approximate methods of quantum mechanics: Variation principle; perturbation theory up to first order in energy.

UNIT II

Quantum Chemistry II

Electronic Structure of Atoms

Russell-Saunders terms and coupling schemes, spectral terms for p^n and d^n configurations, Magnetic effects: Normal and anomalous Zeeman effects.

Molecular Orbital Theory

Huckel theory of linear conjugated systems, bond order and charge density calculations. Applications to ethylene, butadiene.

UNIT III

Classical Thermodynamics:

Partial molal properties; free energy – chemical potential, partial molal volume and partial molal heat content. Gibbs – Duhem equation, variation of chemical potential with temperature and pressure,

chemical potential for ideal gas. Thermodynamic derivation of law of mass action. Concept of fugacity, Change in fugacity with temperature and pressure, determination of fugacity (graphical method).

Themodynamic derivation of phase rule, application of phase rule to three component systems.

UNIT IV

Statistical Thermodynamics I

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

Bose-Einstein statistics, Fermi-Dirac statistics, Maxwell-Boltzman statistics, comparison of three statistics.

UNIT V

Statistical Thermodynamics II

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, Gibb's free energy and chemical potential.

Chemical equilibria and equilibrium constant in terms of partition functions.

Books Suggested:

1. Physical Chemistry, P.W. Atkins, ELBS.
2. Introduction to Quantium Chemistry, A.K. Chandra, Tata McGraw Hill.
3. Quantum Chemistry, Ira N. Levine, Prentice Hall.
4. Coulson's Valence, R. McWeeny, ELBS.
5. Theoretical Chemistry, S. Glasston, Princeton, London.
6. Fundamentals of Chemical Thermodynamics, E.N.Yeremin, Mir Publishers.

CH 408 ANALYTICAL CHEMISTRY

Unit I

Introduction to Basic components of analytical instruments, Analog &digital signals

Electronic Spectroanalytical Technique: Fluorescence Spectrophotometry: Principle of fluorescence, Chemical structure & fluorescence, instrumentation and applications; Fluorimetric determination of riboflavin (vitamine B_2), Fluorimetric determination of Zn using oxine.

Unit II

Thermal and Radiochemical Methods

Introduction to thermal methods of analysis TGA and DTA Principle with illustration design of instruments and application in relevant fields.

Neutron activation analysis and Iso topic dilution analysis

Unit III

Potentiometry & Coulometry

Electrochemical Cell, Measurement of Potential, Determination of Concentration from potential measurements, theory and application of Ion selective electrodes Controlled-potential Coulometry ; Controlled-current Coulometry.

Unit IV

Voltammetry-I

Voltammetric Cell, Wave form & Current-Voltage Curves, Supporting Electrolyte, Reversible and Irreversible redox process, Working Potential range. Polarography: DME, Residual Current, Oxygen wave, Ilkovic Equation, Half wave potential.

Cyclic Voltammetry(CV), Randle-Sevick Equation, Determination of Heterogenous Rate Constant (K_s), Criteria of reversibility by CV.

Unit V

Voltammetry-II

Normal Pulse Voltammetry, Differential Pulse Voltammetry, Voltammetry in Inorganic Analysis, Voltammetry in Organic Analysis.

Stripping Voltammetry: Anodic, Cathodic and Adsorptive Stripping techniques..

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

CH 411 LABORATORY COURSE II

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.

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.

CH 412 PHYSICAL CHEMISTRY

Adsorption

(a) To study surface tension – concentration relationship for solutions (Gibbs equation) and hence determine the limiting cross-sectional area of molecule.
(b) To study the adsorption of acetic acid/oxalic acid by activated charcoal and verification of Freundlich and Langmuir's isotherms.

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. $CaCl_2$) by solubility method.

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

Conductometry

(i) To determine the strength of weak acid using NaOH conductometrically.

(ii) To determine the strength of strong and weak acids in a given mixture conductometrically.
(iii) To find out basicity of given acid (mono- di-and tribasic) conductometrically.

Polarimetry/Refractometry

(i) To determine the specific rotation of a given optically active compound.
(ii) To verify the law of refraction of mixture (e.g. glycerol and water) using Abbe's refractometer.

Books Suggested:

1. Vogel's Textbook of Quantitative Analysis, (revised)
2. Synthesis and Characterization of Inorganic Compounds, W.L. Jolly Prentice Hall.
3. 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. Handbook of Organic Analysis – Qualitative and Quantitative, H. Clark, 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. Prichard, Longman
9. Findley's Practical Physical Chemistry, B.P.Levitt, Longman
10. Experimental Physical Chemistry, R.C. Das and B. Behera, Tata McGraw Hill
11. Advanced Practical Physical Chemistry, J.B. Yadav, Goel Publishing House.
12. Adevanced Experimental Chemistry, Vol. I – Physical J.N.Gurtu and R.Kapoor, S. Chand & Co.