Curriculum & Syllabus for M.Sc. (Chemistry)

(WITH EFFECT FROM THE ACADEMIC YEAR 2014-15)

The department of chemistry offers full time M.Sc (Chemistry) program. The revised syllabus is drafted and recommended by the BOS for further approval in the academic council with effect from the academic year 2014-2015.

SEMESTER-I						
Subject Code	Title of the Paper	Credits/ Hrs. per week	Duration of Semester Exam	Marks		Total Marks
				CIA	External Exam	
CY1411	Crystalline State and Inorganic Clusters	4	3	40	60	100
CY1412	Principles of Organic Chemistry	4	3	40	60	100
CY1413	Chemical Kinetics and Group Theory	4	3	40	60	100
CY1414	Analytical Chemistry	4	3	40	60	100
CY14L1	Inorganic Chemistry Laboratory	(6*)	To be continued in semester II			
CY14L2	Organic Chemistry Laboratory	(6*)	To be continued in semester II			
CY14L3	Physical Chemistry Laboratory	(6*)	To be continued in semester II			
Distribution of working hours / Week		Theory 20 Hours	Practical 18 Hours		Seminar 2 Hours	
SEMESTER -II						
CY1421	Coordination chemistry	4	3	40	60	100
CY1422	Organic Transformations	4	3	40	60	100
CY1423	Thermodynamics and Quantum Chemistry	4	3	40	60	100
CY1424	Advanced Analytical Methods	4	3	40	60	100
CY14L1	Inorganic Chemistry Laboratory	6	6	40	60	100
CY14L2	Organic Chemistry Laboratory	6	6	40	60	100
CY14L3	Physical Chemistry Laboratory	6	6	40	60	100
Distribution of working hours / Week		Theory 20 Hours	Practical 18 Hours		Seminar 2 Hours	
SEMESTER-III						
CY1431	Physical Methods in Inorganic Chemistry	4	3	40	60	100
CY1432	Organic Spectroscopy	4	3	40	60	100
CY1433	Electrochemistry and Spectroscopy	4	3	40	60	100
CY14E1	Organic Reagents & Reactions	4	3	40	60	100
CY14E2	Macromolecules and Nanomaterials	4	3	40	60	100
CY14L4	Analytical Chemistry Laboratory	6	6	40	60	100
Distribution	Theory 20 Hours	Practical 10 Hours	Seminar 4 Hours		Pre-project 6 Hours	
SEMESTER-IV						
CY1441	Nuclear and Bioinorganic Chemistry	4	3	40	60	100
CY1442	Synthetic Organic Chemistry	4	3	40	60	100
CY1443	Surface Chemistry and Photo Chemistry	4				100
CY14SS	Soft Skills and Scientific Writing	2				100
CY14CV	Comprehensive Viva	2	-	-	-	100
CY14PW	Project Work and Viva-Voce	8	-	-	100	100
Distribution of working hours / Week		Theory 12 Hours	Seminar 4 Hours		Project 24 Hours	
			TOTAL CREDITS		100	
(*) total credits for one year			TOTAL MARKS		2300	

Semester I: CY1411 Crystalline State and Inorganic Clusters

Unit I	**Crystal structure**
1	Types of solids – crystalline state – order – unit cell- lattice – types – lattice planes- Miller indices.
2	Crystal geometry – symmetry – symmetry elements –space groups – types of crystals
3	Reciprocal lattice – construction – properties – reciprocal lattices of SC,BCC and FCC lattices - Ewald's sphere
4	X-ray Diffraction – Bragg's law – methods of diffraction – single crystal –powder crystal and rotating crystal methods.
5	Crystal structure determination – scattering factor – structure factor – phase problem –space group determination.
Unit II	**Structure of Ionic Solids**
6	Properties of ionic solids – lattice energy – Born-Haber cycle - uses
7	Packing of atoms – AB and ABC structures – radius ratio rules -
8	Structure of simple ionic solids - AX type NaCl, CsCl, ZnS – AX_2 type CaF_2, TiO_2 – layered structures NiAs,CdI_2 and MoS_2
9	Structures of spinels and Perovskite
Unit III	**Defects and electronic structure of solids**
10	Crystal defects – types - point, line and plane defects – Schottky and Frenkel defects – colour centers thermodynamics of defect formation – non stoichiometric crystals – consequences of defects.
11	Band theory – refinement of simple band theory – k-space – conductors, insulators and semiconductors on the basis of band theory.
12	Superconductivity – photoconductivity – dielectric properties – pyroelectricity and piezoelectricity (Basic concepts only)
Unit IV	**Properties and applications of solids**
13	Magnetic materials - metals and alloys – metal oxides –garnets – ilmenites – magneto plumbites – applications – transformer cores – information storage – memory devices – permanent magnets.
14	Solid state electrolytes – types - examples – applications – electrochemical cells – batteries- sensors and fuel cells.
15	Crystallization – growth of single crystals – Czochralski – Bridgman and Stockbarger – zone melting - melt :flux methods
Unit V	**Inorganic Rings chains and Clusters**
13	Silicates – chain silicates - 2D and 3D silicates – Beryls – Muscovite – aluminosilictaes – zeolites(structures only)
14	Carboranes – types- nomenclature – metalloboarnes (Structures only)
15	Metal clusters – Re2Cl8 type clusters – structure – qualitative MO diagram – quadruple bond

Text Books

I. Inorganic Chemistry Principles of Structure and Reactivity, Fourth edition, James Huheey, Ellen A.Keiter and Richard L.Keiter, Pearson Education Asia, 2001.

II. Inorganic Chemistry, Third edition, Shriver and Atkins, Plenum Press,

III. Selected Topics in Inorganic Chemistry, First Edition, Wahid U.Malik, G.D.Tuli and R.D.Madan, S.Chand and Company Ltd., 1976 (Reprint 1998).

IV. Concise Coordination Chemistry, First edition, R.Gopalan and V.Ramalingam, Vikas Publishing House Private Ltd., 2001 (Third reprint 2007).

Reference Books

1. Advanced Inorganic Chemistry, Sixth edition, F.Albert cotton, Geoffrey Wilkinson, Carlos.A.Murilo and Manfred Bochmann, Wiley India, 2004 (Reprint 2008).
2. Advanced Inorganic Chemistry, Eleventh edition, Vol. II, Gurdeep Raj, Goel Publishing House, 2008,
3. Advanced Inorganic Chemistry, Eleventh edition, Agarwal and Keemti Lal, Pragati Prakashan, 2012.
4. Concise Inorganic Chemistry, Sixth edition, J.D. Lee, Wiley India Ltd., 2008.

Semester I: CY1412 Principles of Organic Chemistry

S. No.	Topics
Unit I	***Reaction intermediates***
	Stability, generation and applications of carbocations, carbanions, free radicals, carbenes, nitrenes, benzynes.ylides, enamines.
Unit II	***Stereochemistry I***
	Stereoisomerism: Introduction, molecular representation, classification of isomers based on: symmetry criterion, energy criterion, stereoisomerism, conformation and chirality.
	Nomenclature: Fischer's D and L and R and S.
	E and Z nomenclature
	Stereochemistry of allenes
	Biphenyl derivatives and atropisomerism
	Stereoselective and stereospecific reactions
	Homotopic, enantiotopic and diastereotopic ligands (definitions only)
Unit III	***Organic Reaction Mechanisms***
	Equilibria and free energy, free energy change in relation to bond strengths, activation energy, measurement of activation energy, reaction profile diagrams, rate determining step, thermodynamic and kinetic control, applications of kinetic principles (Hammond postulate, effect of solvent on reaction rate), Curtin-Hammett principle, microscopic reversibility, methods of determining mechanisms.
Unit IV	***Nucleophilic Substitution Reactions***
	Aliphatic nucleophilic substitution reactions- Introduction, S_N2 mechanism, S_N1 mechanism, (effects of substrate, attacking nucleophile, leaving group and solvent), S_N1 vs S_N2 reactions, neighboring group participation and non classical carbocations.
	Aromatic nucleophilic substitution reactions – S_NAr general mechanism, Aryl cation mechanism, benzyne mechanism.
Unit V	***Electrophilic Substitution Reactions***
	Arenium ion mechanism -S_E2 reaction (nitration, sulphonation, halogenation, Friedel-Crafts alkylation, acylation), substitution on monosubstituted benzenes – orientation and reactivity – activation and deactivation (inductive effect, mesomeric effect), examples of ortho & para directing groups, meta directing groups, activating and deactivating substituents and their synthetic applications.

Text Books

I. Stereochemistry of Organic Compounds, Principles and Applications, Second edition, D. Nasipuri, New Age International (P) Ltd., 1994, Reprint 2008.

II. Stereochemistry conformation and mechanism, Seventh edition, P.S. Kalsi, New Age International Publishers, 2008.
III. Organic reactions and their mechanisms, Third edition, P.S. Kalsi, New Age International Publishers, 2010.

Reference Book

1. Advanced Organic Chemistry: Reactions, Mechanisms and Structure, Jerry March, Wiley Student Edition, 2006.

Semester I: CY1413 Chemical Kinetics and Group Theory

S. No.	Topics
Unit I	***Theories of reaction rates***
1	Effect of temperature on reaction rates,
2	Arrhenius equation for simple reactions,
3	Energy of activation,
4	Potential energy surfaces, an introduction,
5	Collision theory, factors affecting effective collision,
6	Weakness of collision theory, reaction cross section, comparison with Arrhenius equation,
7	Transition state theory, thermodynamic treatment,
8	Unimolecular reactions, Lindemann's mechanism,
9	Rice Ramsperger Kassel (RRK) model.
Unit II	***Complex reactions***
10	Kinetics of reversible reactions, consecutive and parallel reactions,
11	Kinetics of chain reactions, H_2&Br_2, H_2 & O_2, decomposition of CH_3CHO & N_2O_5,
12	Study of fast reactions, flow technique, stopped flow techinique, temperature and pressure jump methods, shock tubes.
Unit III	***Reactions in solutions***
13	Solvent effects, factors affecting reactions rates, ARRT as applied to solution phase, effect of internal pressure, reactions between ions, single sphere and double sphere mechanisms, influence of ionic strength, pressure and dielectric constant, volume of activation, diffusion controlled reactions: an introduction,
14	Linear free energy relations, Hammett equation.
Unit IV	***Group theory - fundamentals***
15	Theory of groups, classes, sub groups, similarity transformations, point group classification, isomorphism,
16	Matrix representation of symmetry operations, reducible and irreducible representations, decomposition of irreducible representation in to reducible representation, properties of irreducible representation, notations and theorems related to irreducible representations,
17	Projection operator, theorems of representation, construction of character tables for C_{2v} and C_{3v} point groups, direct product representation.
Unit V	***Group theory - applications***
18	Applications of group theory to molecular vibrations (H_2O & ethylene), group theoretical treatment of hybridization (methane & boron trifluoride), SALC procedure for butadiene. Electronic spectrum of formaldehyde.
19	Selection rules for IR and Raman spectrum, Woodward and Hoffmann rules.

Text Books

Kinetics and Mechanisms of Chemical Transformations, First edition, J. Rajaram, J. C. Kuriacose, Macmillan, 1993, reprint 2011.

I. Physical Chemistry, Eighth edition, Peter Atkins, Julio de Paula, Oxford press, 2006.
II. Engineering Chemistry, 15th edition, P.C. Jain and Monika Jain, Dhanpat Rai Publishing Co., 2008.
III. Chemical Kinetics, Third Edition, Keith J. Laidler, Pearson Education, 2004.
IV. Chemical Applications of Group Theory, Third edition, F.A. Cotton, John Wiley & Sons, 1990, reprint 2006.
V. Group theory in Chemistry, Second edition, M.S.Gopinathan and V. Ramakrishnan, Vishal Publications, 1991, reprint 2001.

Reference Books

1. Physical Chemistry, First edition, Donald A. Mcquarrie, John D. Simon, Viva Books,1998.
2. Symmetry and Spectroscopy of Molecules, Second edition, K. Veera Reddy, New Age International, 2009.

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Semester I: CY1414 Analytical Chemistry

S. No.	Topics
Unit I	***Errors & Laboratory Procedures***
1	Significant figures, rules for determination, definition and classification of errors, accuracy and precision, methods of expressing accuracy (absolute error, relative error), comparison between accuracy and precision, methods of expressing precision (mean, median, range, standard deviation, variance), test of significance (F-test, chi square test, Q-test).
2	Classification of chemicals, rules for handling reagents and solutions, measurement of mass (Electronic analytical balance only)
Unit II	***Wet Analysis***
3	Volumetric analysis – acid base, redox & complexometric titrations- theory and experiment.
4	Gravimetric analysis - precipitation methods- homogeneous precipitation- filtration, washing, drying, weighing.
5	Colorimetric analysis – photoelectric colorimeter – single beam and double beam schematic diagrams, applications.
Unit III	***Thermal and Spectral Methods***
6	***Thermal Analysis:*** TGA, DTA, DSC - principles, instrumentation and applications.
7	***Spectral Methods:*** UV-Visible spectroscopy- Beer Lamberts Law
8	Description of UV-Vis spectrophotometer
9	Applications of UV- Visible spectroscopy
10	Infrared spectroscopy – instrumentation, single beam and double beam spectrometers, sample handling, FTIR spectrometer,
Unit IV	***Chromatographic Techniques***
11	Paper chromatography – theory, techniques and applications.
12	Column chromatography – principles, experimental requirements, identification of compounds and applications
13	High Performance Liquid Chromatography – instrumentation and applications.
14	Thin layer chromatography – theory, techniques and applications.
15	Gas Chromatography – principle, theory, instrumentation, identification of chromatogram.
Unit V	***Electroanalytical Methods***
16	Conductometric titrations – principle, practice and applications.
17	Amperometric titrations – principle, instrumentation and applications.
18	Potentiometry – instrumentation, electrodes, potentiometric titrations.
19	pH metry
20	Glass electrode and Ion selective electrodes
21	Electrogravimetry – theory, electrolysis at constant current and constant voltage- principle, experimental set up and applications.
22	Coulometry – coulomb calculation, silver coulometer, constant current Coulometry.

Text Books

I. Analytical Chemistry, Dhruba Charan Dash, PHI Learning Private Ltd., 2011.

II. Instrumental Methods of Chemical Analysis, Sixth edition, H. Kaur, Pragati Prakashan, 2010.
III. Analytical Chemistry An Introduction, Sixth Edition, Douglas A. Skoog, Donald M. West, F. James Holler, Saunders College Publishing, 1994.

Reference Books

1. Instrumental Analysis, Douglas A. Skoog, F. James Holler, Stanley R. Crouch, Brooks/Cole Cengage Learning (I) Pvt. Ltd.,, First Indian Reprint 2008.
2. Instrumental Methods of Chemical Analysis, Fifth edition, Gurdeep R. Chatwal, Sham K. Anand, Himalaya Publishing Company, 2007.
3. Instrumental Methods of Analysis, Seventh edition, H.H. Willard, L.L. Merritt Jr., J.A. Dean, F.A. Settle, CBS Publishers & Distributors, 1986.

Semester II: CY1421 Coordination chemistry

Unit I	**Theories of metal complexes**
1	Co-ordination compounds – detection of formation – isomerism in complexes
2	Historical background of theories of metal complexes – Werner's –Sidgwick and valence bond theories
3	Crystal field theory(CFT) – assumptions – splitting of d orbitals in different fields – CFSE calculations – evidences for splitting
4	factors affecting splitting –spectrochemical series – Jahn-teller distortion – limitations of CFT
5	Ligand Filed Theory (LFT) – sigma and pi bonding in complexes – evidences for pi bonding – MO diagrams for Oh and Td complexes – effects of pi donors and pi acceptors on splitting – nephelauxetic effect and series
Unit II	**Stability and reactions of complexes**
6	Stability of complexes kinetic and thermodynamic stabilities- formation constants – stepwise and overall formation constants- factors affecting stability of the complexes
7	Kinetics and mechanisms of ligand substitution reactions in Oh complexes- acid hydrolysis – base hydrolysis - factors affecting the rate of reactions- anation reactions
8	Substitution in SP complexes – trans effect- theories of trans effect -applications
9	Redox reactions of complexes – inner sphere and outer sphere mechanisms- Marcus theory
Unit III	**Magnetic properties of metal complexes**
10	Basic definitions in magneto chemistry – thermal energy and magnetic properties-magnetism on the basis of crystal field model.
11	Zeeman effect – second order Zeeman effect on Sm(III)
12	Spin pairing - applications
13	Anomalous magnetic moments - reasons
14	Co-operative magnetism – antiferro magnetism – direct M- M interaction – super exchange – examples – Ferro magnetism (Concept only)
Unit IV	**Organometallics**
13	Types of organometallics – 18 $\mathbf{e}^-$ rule –alkene complexes – Zeise's salt – Hapticity Metal allyl complexes – metal acetylene complexes
14	Metal sandwich complexes – Ferrocene – preparation structure and reactivity
15	Reactions of organometallics – oxidative addition reductive elimination – industrial applications of organometallics – Wilkinson's catalysts- Reppe's process- Oxo process- Wacker's process and Ziegler-Natta catalysts.
Unit V	**Metal carbonyls and nitrosyls**
13	Metal carbonyls – classification – description of M-CO bond- terminal and brdging CO groups – carbonyls of V, Mn, Fe and Co.
14	Metal carbonyl hydrides and metal carbonyl halides
15	Metal nitrosyls - liner and bent nitrosyls- preparation and properties - nitrosyls of iron

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I. Inorganic Chemistry Principles of Structure and Reactivity, Fourth edition, James Huheey, Ellen A.Keiter and Richard L.Keiter, Pearson Education Asia, 2001.

II. Inorganic Chemistry, Third edition, Shriver and Atkins, Plenum Press, .

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2. Advanced Inorganic Chemistry, Eleventh edition, Vol. II, Gurdeep Raj, Goel Publishing House, 2008,
3. Advanced Inorganic Chemistry, Eleventh edition, Agarwal and Keemti Lal, Pragati Prakashan, 2012.
4. Concise Inorganic Chemistry, Sixth edition, J.D. Lee, Wiley India Ltd., 2008.

Semester II: CY1422 Organic Transformations

S. No.	Topics
Unit I	***Stereochemistry II***
	Stereochemistry of cyclic and acyclic systems, conformations of ethane, 1,2-disubstituted ethanes, effect of conformation on reactivity (E2 elimination, Curtin-Hammett principle, Wagner-Meerwein rearrangement.
	Conformations of cyclopentane, cyclohexane, methyl cyclohexane, 1,2-, 1,3- and 1,4-dimethyl cyclohexanes.
	Molecular dissymmetry and chirotropic properties, circular birefringence, and circular dichroism, Cotton effect, applications of ORD and CD, Axial halo ketone rule, Octant rule.
Unit II	***Addition and elimination reactions***
	Addition to double bonds: Addition of Halogens & Hydrogen Halides, Electrophilic addition to alkynes, Nucleophilic addition to alkenes and alkynes, Nucleophilic addition to carbonyl compounds.
	E2 mechanism, direction of elimination in E2, rate of E2 reactions, stereochemistry of E2 elimination, E2 elimination from acyclic systems & cyclohexane systems, E1 mechanism, direction of elimination, E1 elimination from cyclic compounds, Curtin-Hammett principle.
Unit III	***Molecular rearrangements***
	Wagner-meerwein, pinacol-pinacolone, wolf, benzyl-benzilic acid, Beckmann, Hofmann, Curtius, Lossen, Schmidt, Baeyer-Villiger, Hydroperoxide, Dakin, Favorskii, Stevens, Sommelet-Hauser, Wittig, Neber, Fries, Claisen – rearrangements and their mechanisms.
Unit IV	***Organometallic compounds***
	Grignard reagents, organolithium, organocopper, organozinc, organoiron, organopalladium compounds- preparation and reactions.
Unit V	***Alkaloids***
	Occurrence-functions-nomenclature-classification-isolation-general structure determination-synthesis and structural elucidation of quinine, papaverine, morphine,

Text Books

I. Organic Reactions and Their Mechanisms, Third edition, P.S. Kalsi, New Age International Publishers, 2010.

II. Organic Reaction Mechanisms, Third edition, V.K. Ahluwalia, R.K. Parashar, Narosa Publishing House, 2009.

Reference Book

1. Advanced Organic Chemistry: Reactions, Mechanisms and Structure, Jerry March, Wiley Student Edition, 2006.

Semester II: CY1423 Thermodynamics and Quantum Chemistry

S. No.	Topics
Unit I	***Thermodynamics of open systems***
1	Partial molar properties, chemical potential, partial molar volume, partial molar heat content, variation of chemical potential with temp. and pressure, fugacity, determination of fugacity, variation with temp., and pressure.
2	Thermodynamics of ideal and non-ideal solutions.
3	Excess functions for non-ideal solutions.
4	Concepts of activity and activity coefficients, detn. of activity and standard free energy, choice of standard states.
Unit II	***Third law of thermodynamics & classical statistics***
5	Nernst heat theorem, need for third law, third law of TD's, experimental verification of third law, entropies of real gases, entropy changes in chemical reactions, Boltzmann entropy equation, residual entropy, statistical meaning of third law.
6	Introduction to statistical thermodynamics, terminologies, Liouville's theorem, statistical equilibrium, thermodynamic probability, Boltzmann statistics, partition function, translational, rotational, vibrational and electronic partition function, partition functions and thermodynamic functions (internal energy, heat capacity, entropy, work function), partition function for monatomic and diatomic molecules, limitations of Boltzmann's statistics.
Unit III	***Quantum statistics***
7	Bose-Einstein statistics, Bose-Einstein condensation, Fermi-Dirac statistics, Fermi energy, Fermi energy of electron gas in a metal, thermionic emission, comparison between MB, FD & BE statistics.
Unit IV	***Basics of quantum mechanics***
8	Inadequacy of classical mechanics, black body radiation, photoelectric effect, Bohr's quantum theory, Davisson & Germar experiment, wave particle duality, Compton effect, De-broglie's equation,
9	Uncertainty principle, theory of wave motion, Schrodinger's equation for particle waves, wave function and its physical meaning,
	Postulates of quantum mechanics, operator algebra, Eigen values, Eigen functions, particle in a box (1-D and 3-D), quantum numbers, zero point energy. *Self Study (not for exams): Harmonic oscillators and rigid rotors*.
9	Electron in a ring.
Unit V	***Applications of quantum mechanics***
10	Approximation methods, perturbation and variation methods, application to hydrogen and helium atom, R-S coupling and term symbols for atoms in the ground state, HFSCF theory, Slater determinant,
11	Born-Oppenheimer approximation, hydrogen molecule ion, hydrogen molecule,
12	Concept of hybridization, Huckel's theory (ethylene, 1,3-butadiene and benzene).

Text Books

I. Principles of Physical Chemistry, 42nd edition, B.R. Puri, L.R. Sharma & Madan S. Pathania, Vishal Publishing Company, 2008.

II. An Introduction to Chemical Thermodynamics, Sixth edition, R.P. Rasthogi & R.R. Misra, Vikas Publishing House, 2008.
III. Introduction to Statistical Mechanics, First edition, S.K. Sinha, Narosa Publishing House, 2005.
IV. Quantum Chemistry, Third edition, R. K. Prasad, New Age International, 2007.
V. Advanced Physical Chemistry, 22nd edition, Gurdeep Raj, Goel Publications, 1998.

Reference Books

1. Physical Chemistry, First edition, Donald A. Mcquarrie, John D. Simon, Viva Books,1998.
2. Physical Chemistry, Eighth edition, Peter Atkins, Julio de Paula, Oxford press, 2006.

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Semester II: CY1424 Advanced Analytical Methods

S. No.	Topics
Unit I	***Separation techniques***
	Capillary electrophoresis: Theory, instrumentation and applications. Ion Chromatography: Theory, instrumentation, and applications.
Unit II	***AAS & ICP***
	Atomic Absorption Spectrometry: Introduction, basic principles, instrumentation, quantification of elements, applications. Inductively coupled Plasma Atomic Emission Spectroscopy: Introduction, physical and chemical principles, instrumentation, applications.
Unit III	***NMR & XRD***
	NMR: Theory, instrumentation, and applications. X-ray diffraction: Introduction, theory, instrumentation and applications.
Unit IV	***Fluorescence Spectroscopy & Radiochemical Methods***
	Theory, instrumentation and applications of Fluorescence spectroscopy. Radiochemical Methods: Measurement of radioactivity, Neutron sources, Activation analysis, isotope dilution.
Unit V	***Techniques of Mass Spectrometry***
	Different ionization techniques, and detectors in mass spectrometers, basic instrumentation of MS, and applications, GC-MS, LC-MS.

Text Books

I. Instrumental Analysis, Skoog, Holler, and Crouch, Brooks/Cole, 2007.
II. Instrumental Methods of Analysis, Seventh edition, Willard, Merrit, Dean, Settle, CBS publishers and distributors, 1986.
III. Analytical Chemistry: An Introduction, Sixth edition, Skoog, West, Holler, Saunders College Publishing, 1994.

Reference Book

1. Handbook of Instrumental Techniques for Analytical Chemistry, Frank Settle, Pearson education, 1997.
2. Spectrometric identification of organic compounds, Silverstein, Bassler, Morrill, John Wiley & Sons, 1991.

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Semester II: CY14L1 Inorganic Chemistry Laboratory

1. **Separation and Analysis** of an "Inorganic mixture containing two common and two less common metal ions" including the following:
   Common Ions: Pb, Cu , Bi, Cd, Al, Ni, Co, Mn, Zn, Ba, Ca, Sr and Mg; **Less common Ions**: W, Se, Te, Mo, Ce, Th, Zr, Ti, V, U, and Li

2. **Estimation of metals in a mixture (Volumetry and Gravimetry)**
   - Copper (V) - Nickel (G)
   - Copper (G) – Zinc (V)
   - Iron (V) – Nickel (G)
   - Iron (V) – Magnesium (G)
3. **Colorimetric Estimation** of Cu,Cr,Fe,Ni and Mn

4. **Preparation** of *any five* of the following complexes:

   i. Tetraamminecopper(II) sulphate,
   ii. Potassium trioxalatochromate(III),
   iii. Hexaureachromium(III) chloride,
   iv. Sodium trioxalatoferrate(III),
   v. Tris(acetylacetanato)copper(II),
   vi. Tris(ethylenediamine)nickel(II) chloride

Reference Books

1. *Inorganic Semi-micro Analysis*, V.V. Ramanujam, 3rd edition, The National publishing companay, **1997**.
2. *Advanced Inorganic Practical*, Gurdeep Raj, Pragathi Prakasan , Meerut.
3. *Vogel's Text book of Quantitative Analysis*, Longman Group publishers, 5 th edition, **1994**.
4. *Inorganic Coordination Compounds*, G.B.Kauffmann, Heyden and Son Ltd.
5. *Synthesis of Inorganic Complexes*, Burger, **1973**.

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Semester II: CY14L2 Organic Chemistry Laboratory

1. **Separation and Analysis** of an organic binary mixture and derivatisation of the components.

2. **Preparation** of organic compounds (Any 8 from the following list): 1. Benzoic acid from benzaldehyde, 2. Salicylic acid from methyl salicylate, 3. o-chlorobenzoic acid from anthranillic acid, 4. Resacetophenone from resorcinol, 5. Para bromoacetanilide from acetanilide, 6. para-nitroacetanilide from acetanilide, 7. Dibenzalacetone from acetone, 8. Benzhydrol from benzophenone, 9. Phenylazo-2-naphthol from aniline, 10. Glucose penta acetate from glucose, 11. Piperidone from ethyl acetoacetate, 12. Naphthylmethyl ether from β-naphthol

Reference Books

1. *Organic, Analytical chemistry, theory and practice.* Jag mohan,Narose publishing House, 2006.
2. *Organic chemistry lab manual.* Gnanaprakasam, Ramamurthy.

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Semester II: CY14L3 Physical Chemistry Laboratory

Electrochemistry Experiments

Conductometry Experiments

1. Titration of : 1. Strong acid Vs strong base, 2. Weak acid Vs Strong base, 3. Weak acid Vs weak base
2. Titration of a strong base Vs mixture of acids.
3. Precipitation titration: 1. $BaCl_2$ Vs $MgSO_4$, 2. $AgNO_3$ Vs mixture of halides
4. Verification of Debye - Huckel – Onsager relation for a strong electrolyte
5. Dissociation constant of a weak electrolyte.
6. Solubility and solubility product of a sparingly soluble salt.

Potentiometry Experiments

1. Dissociation constant of a weak acid: titration method
2. Dissociation constant of a weak acid: Henderson method
3. Redox titration: $KMnO_4$ Vs Fe^{2+} / $KMnO_4$ Vs KI
4. Precipitation titration: $AgNO_3$ Vs mixture of halides
5. Standard reduction potential of Cu / Zn / Ag electrode
6. Formal redox potential of Fe^{2+} / Fe^{3+} or Ce^{3+} / Ce^{4+} system
7. Solubility product of a sparingly soluble salt by (i) Single electrode method (ii) Concentration cell method.

Non- Electrochemistry Experiments

1. Determination of partition coefficient of I_2 between water and CCl_4.
   Equilibrium constant for the formation of I_3^- ion.
2. Construction of phase diagram for a pair of partially miscible liquids and the effect of added impurity.
3. Construction of phase diagram for a three partially miscible liquids.
4. Construction of phase diagram for a simple eutectic system.
5. Construction of phase diagram for a system with compound formation
6. Determination mol.wt of a non-volatile solute by Rast's method
7. Determination mol.wt of a non-volatile solute by transition temperature method
8. Study of adsorption of oxalic acid on charcoal. (Verification of Freundlich's isotherm)
9. Determination of integral heat of solution by solubility method.
10. Determination of heat hydration of anhydrous $CuSO_4$.
11. Determination of rate, order of the reaction between $K_2S_2O_8$ and KI (clock reaction method)
12. Verification of Bronsted –Bjerrum equation with reaction between $K_2S_2O_8$ and KI.
13. Determination of order of the reaction for base hydrolysis of an ester- Condutomentric method
14. Kinetics of acid catalyzed iodination of acetone – spectrophotometeric method.
15. Determination of Arrhenius parameters for acid catalyzed hydrolysis of ester.

Reference Books

1. *Practical Physical Chemisty*, A.Finlay and J.A.Kitchener, Longman, **1973**.
2. *Experimental Physical Chemistry*, F.Daniels and J.H.Mathews, Longman, **1985**.
3. *Practical Physical Chemistry*, A.M.James, J.A.Churchil, **1961**.
4. *Instrumental Methods of Analysis*, H.H.Willard, L.L.Merritt and J.A.Dean, Affiliated East-West Press, **1965**.
5. *Experimental Physical Chemistry*, D.P.Shoemaker and C.W.Garland, McGraw-Hill, **1974**.

Semester III: CY1432 Organic Spectroscopy

S. No.	Topics
Unit I	***UV-Vis spectroscopy***
1	Electronic transitions, red shift, blue shift – effects of solvents, calculation of λmax for isolated double bonds, conjugated double bonds, polyenes, carbonyl compounds (Woodward-Fieser rules), aromatic systems. Spectral problems.
Unit II	***Infra Red spectroscopy***
	Absorption of IR radiation, Molecular vibrations (Vibrational motion is quantized, dipole moment and IR spectra, fundamental vibrations, symmetry and IR spectra, Overtones and combination bands, coupled vibrations, Fermi resonance), calculation of vibrational frequencies, Interpretation of IR spectra of alkanes, alkenes, alkynes, aromatic rings, alcohols, phenols, ethers, carbonyl compounds, aldehydes, ketones, carboxylic acids, esters, amides, acid chlorides, amines, nitro compounds. Spectral problems.
Unit III	***H^1NMR & C^{13}NMR spectroscopy***
	Introduction-chemical shift-TMS scale-spectrum-shielding effect and spin-spin splitting-theory of PMR-internal standard-factors affecting chemical shift-equivalent and non-equivalent protons-theory of spin-spin splitting-magnitude of coupling constant- 2D NMR – ROESY- COSY - NOE-NOESY-DOSY. Spectral problems.
	Introduction-spectrum-operating frequency-off resonance decoupling-chemical shift equivalence-chemical shifts. Spectral problems.
Unit IV	***Mass spectrometry***
	Introduction-EI ionization method-base peak-molecular ion peak-instrumentation-fragmentation pattern of general and simple organic molecules and derivatives.
Unit V	***Combined spectral problems***
	Combined spectral problems.

Text Books

I. Spectroscopy of Organic Compounds, Fifth edition, P.S. Kalsi, New Age International Publishers, 2004.

II. Spectroscopy, Pavia, Lampman, Kriz, Vyvyan, Brooks/Cole, 2007.

Reference Book

3. Spectrometric identification of organic compounds, Silverstein, Bassler, Morrill, John Wiley & Sons, 1991.
4. Organic Spectroscopy, William Kemp, Palgrave, 1991.

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Semester III: CY1433 Electrochemistry and Spectroscopy

S. No.	Topics
Unit I	***Theory of Electrolytic Conductance***
1	Degree of dissociation, ionic atmosphere, Debye-Huckel theory, mechanism of electrolytic conductance, DHO equation, validity of DHO eqn., deviations from DHO eqn., significance of degree of dissociation, determination of degree of dissociation, conductance ratio and DHO, Debye-Falkenhagen and Wien effects.
2	Debye-Huckel limiting law, Debye-Huckel Bronsted equation, test for DH limiting eqn., extension of DH theory, triple ions (concept only).
Unit II	***Electrified Interface***
3	Thermodynamics of electrified interface, Lippmann equation, electro-capillary curves, surface excess, determination of surface excess, structure of electrical double layer, Helmholtz-Perrin model, Guoy-Chapman model, Stern model.
4	Electro-kinetic Phenomena, Zeta potential, electro-osmosis, streaming potential, electrophoresis, determination of zeta potential, effect of ions on electro-kinetic phenomena.
Unit III	***Irreversible electrode processes & Electrodics***
5	Theories of overvoltage and its determination, factors affecting overvoltage, exchange current density, polarization.
6	Irreversible electrode processes, polarography, theory and experimental set up, Ilkovic equation derivation, Halfwave potential, applications of polarography, amperometric titrations, kinetics of electrode reactions, Butler-Volmer equation derivation, Tafel equation, transfer coefficient (concept only).
Unit IV	***Physical principles of spectroscopy, IR & Raman spectra***
7	EM radiation, quantization of energy, regions of spectrum, interaction of radiation with matter, representation of spectra, spectrometers, signal to noise ratio, resolving power, parameters for a spectral line (position, intensity, width), factors affecting them, FT spectroscopy, computer averaging.
8	Infra red spectroscopy, the vibrating diatomic molecule, simple harmonic oscillator model, the anharmonic oscillator, diatomic vibrating rotator, break down of Born-Oppenheimer approximation, vibrations of polyatomic molecules, overtones and combination frequencies, influence of rotation on the spectra of polyatomics, parallel and perpendicular vibrations, skeletal vibrations and group frequencies.
9	Raman effect, classical and quantum theories, rotational raman spectra, symmetric tops and asymmetric tops, vibrational raman spectra, role of mutual exclusion, polarization of light and raman effect, combined use of raman and IR.
Unit V	***Electronic and Spin Resonance Spectroscopies***
10	Electronic spectroscopy of molecules, Born-Oppenheimer approximation, vibrational coarse structure, progressions and sequences, Frank-Condon principle, dissociation energy, rotational fine structure, Fortrat diagram, pre-dissociation.
11	NMR Spectroscopy: Interaction of spin and applied field, population of energy levels, Larmor precision, relaxation, FTNMR, multiple pulse FTNMR, NMR spectrum of hydrogen nuclei, chemical shift, coupling constant, Quadrupole effect.
12	ESR Spectroscopy: Position of ESR absorption, hyperfine structure, fine structure of ESR spectrum, zero filed splitting, calculation of electron density.

Text Books

I. An Introduction to Electrochemistry, First edition, Samuel Glasstone, Affiliated East West Press Private Ltd., 1942, reprint 1999.

II. Advanced Physical Chemistry, Eighth revised edition, J. N. Gurtu & A. Gurtu, Pragati Prakashan, 2006.

III. Principles of Physical Chemistry, 37th edition, B.R. Puri, L.R. Sharma & Madan S. Pathania, Shoban Lal Nagin Chand and Co., 1998.
IV. Fundamentals of Molecular Spectroscopy, Fourth edition, C. N. Banwell & Elaine McCash, Tata McGraw-Hill Publishing Co. Ltd., 1994, reprint 2001.

Reference Books

1. Instrumental Analysis, Skoog, Holler, and Crouch, Brooks/Cole, 2007.
2. Instrumental Methods of Chemical Analysis, Sixth edition, H. Kaur, Pragati Prakashan, 2010.

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Semester III: CY14E1 Organic Reagents & Reactions

S. No.	Topics
Unit I	***Oxidation reactions***
	Mn(VII) oxidants: for the oxidation of alcohols, alkenes, alkynes, aromatic side chains and rings, aldehydes, ketones, amines, nitro, and carbonyl compounds. Oxidation by MnO2. *Cr(VI) oxidants*: for the oxidation of alcohols, phenols- Jones reagent, Chromium trioxide-pyridine complex, pyridinium chlorochromate complex, pyridinium dichromate, Oxidation of alkanes, alkenes, and aromatic side chains and nucleus. *Oxidation with peracids*: Alkenes, ketones, N-heterocycles. *Oxidizing agents*: O3, H2O2, t-Bu hydroperoxide, Al tri-isopropoxide, Lead tetra-acetate, SeO2, OsO4, periodic acid, NBS, DDQ.
Unit II	***Reduction reactions***
	Reduction using: Copper Chromite, LiAlH4, Sodium borohydride, Sodium cyanoborohydride, Diborane, Sodium/alcohol, Sodium/liq. NH3, Magnesium, Zinc Chloride acid, Hydazine, Di-amide, Formic acid, silanes, stannous chloride, Sn/HCl, Zn/CH3COOH, Zn/NaOH, Sodium metabisulphite, Sodium dithionite, Mg/alcohol.
Unit III	***Organic name reactions***
	Aldol condensation, Diels Alder reaction, Enamine reaction, Elbs persulfate oxidation, HVZ reaction, Perkin reaction, Riemer-Tiemann reaction, Rosenmund reaction, Swern oxidation, Wurtz reaction, Suzuki coupling, Shapiro reaction, Robinson annulation .
Unit IV	***Photochemical reactions***
	Laws of photochemistry, electronic excitation, excited states, chemistry of excited molecules, difference between photochemical and thermal reactions, photochemical reactions of carbonyl compounds and olefins, photoisomerization of cis-trans stilbenes, photochemical cycloaddition reactions.
Unit V	***Terpenoids***
	Nomenclature-properties-isolation-isoprene rule-special isoprene rule-gem dialkyl rule-classification-general methods for structure determination-synthesis and structural determination of α pinene-camphor.

Text Books

I. Organic Reaction Mechanisms, Third edition, V.K. Ahluwalia, R.K. Parashar, Narosa Publishing House, 2009.
II. Organic reactions and their mechanisms, Third edition, P.S. Kalsi, New Age International Publishers, 2010.
III. Advanced Organic Chemistry, Part A & B, 5th Ed., F.A. Cary and R.I. Sundberg, Springer, 2009.
IV. Organic Chemistry of Natural Products, Vol-I, Fifth edition, Gurdeep R. Chatwal, Himalaya Publishing Company, 2011.
V. Organic Chemistry of Natural Products, Vol-II, Fifth edition, Gurdeep R. Chatwal, Himalaya Publishing Company, 2011.

Reference Book

1. Organic Chemistry, Vol I and II, I.L. Finar, Longman, 1963.

Semester III: CY14E2 Macromolecules and Nanomaterials

S. No.	Topics
Unit I	**Basic concepts, analysis and testing of polymers**
1	Importance of polymers - Monomers - Degree of polymerization – Linear - Branched and Network polymers - Classification of polymers – Polymerization Methods: Condensation, Addition - Radical chain - Ionic and Co-ordination and Co-polymerization – kinetics of polymerizations-Polymerization conditions and reactions - Polymerization in homogeneous and heterogeneous systems. Synthesis and Applications of: LDPE, HDPE, PP, SBR, PS, PMMA, PA, PVA, PVC, PTFE, PU
Unit II	**Polymer characterization**
2	Polydispersion - *Molecular weight*: Number, Weight and Viscosity average molecular weights - Polydispersity and molecular weight distribution - Practical significance of molecular weight - *Measurement of molecular-weights*: End-group, Viscosity, Light scattering, Osmotic and Ultracentrifugation methods –
Unit III	**Structure, properties and processing of polymers**
3	Chemical analysis of polymers - Spectroscopic methods - X-ray diffraction studies - Thermal analysis - Physical testing: Tensile strength – Fatigue – Impact - Tear resistance - Hardness and Abrasion resistance. Polydispersion - Molecular weight: Number, Weight and Viscosity average molecular weights - Polydispersity and molecular weight distribution - Practical significance of molecular weight - Measurement of molecular-weights: End-group, Viscosity, Light scattering, Osmotic and Ultracentrifugation methods.
Unit IV	**Chemistry of Nanomaterials**
4	Introduction-Various methods for the synthesis of nanodimensional materials-general methods-reactive methods in high boiling point solvents-hydrothermal and solvothermal methods-synthesis in structured medium-phase transfer process-sonochemical methods- microwave methods-template methods.
Unit V	**Nanotubes and Nanowires**
5	Carbon nanotubes – synthesis – multiwalled – single walled nanotubes – structure and characterization – mechanism of formation – chemically modified carbon nanotubes – opening – filling – and functionalization of nanotubes – electronic structure and properties – Nanocomposites-Inorganic nanotubes – nanowires – synthetic strategies – vapour phase growth – solution based growth – properties and applications (selected examples).

Text Books

I. Textbook of Polymers Science, Second Edition, F.W. Billmeyer Jr., Wiley-India, **2007**.
II. Polymer Science, First edition, V.R. Gowarikar, N.V. Viswanathan, Jayadev Sreedhar, New Age International (P) Ltd., Publishers, Reprint **2005**.
III. Nanomaterials, First edition, B. Viswanathan, Springer, 2009.
IV. Nanoparticles from Theory to Applications, Edited by G. Schmid, Wiley Verlag, GmbH KGaA, **2004**.

Reference Books

1. The Chemistry of Nanomaterials, Vol 1 and 2, Edited by C.N.R. Rao, A. Muller and A.K. Cheetham, Wiley VCH Verlag GmbH KGaA, **2004**.
2. Nanoparticles from Theory to Applications, Edited by G. Schmid, Wiley Verlag, GmbH KGaA, **2004**.
3. Contemporary Polymer Chemistry, H.R. Al cock and F.W. Lambe, Prentice Hall, **1981**.

Semester III: CY14L4 Analytical Chemistry Laboratory

1. Estimation of $KMnO_4$ by Visible Spectrophotometery.
2. Estimation of Dye by Visible Spectrophotometery.
3. Estimation of Surfactant by UV-Visible Spectrophotometery.
4. Determination of Kinetics by UV-Visible Spectrophotometery.
5. Qualitative analysis of organics by FT-IR Spectrometer – KBr – technique.
6. Qualitative analysis of organics by FT-IR Spectrometer – ATR-technique.
7. Pot. Ferri cyanide and Ferro cyanide by Cyclic Voltammetry.
8. Electrochemical Oxidation of Organics by Cyclic Voltammetry.
9. Estimation of Fluorescence Dye by Spectrofluorometer.
10. Estimation of Quantum Yield by Spectrofluorometer.
11. Estimation of Alkali metals by Flame Photometry.
12. Determination of Reaction Kinetics by FT-IR spectrometer.
13. Analysis of water quality parameters.
14. Estimation of COD of waste water by spectrophotometer.

Reference Book

1. Course material developed by the department of chemistry, SCSVMV.

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Semester IV: CY1441 Nuclear and Bioinorganic Chemistry

Unit I	**Structure of nucleus**
1	size and shape of nucleus – nuclear stability - nuclear angular momentum – magnetic properties of nuclei – quadrupole moment –nuclear parity-forces and interactions.
2	Nuclear models: Shell, liquid drop and Fermi gas models – collective model –optical model.
3	Detection and measurement of radioactivity: Radio activity – units of radio activity - characteristics of decay – decay kinetics – theories of alpha and beta decay(primitive treatment only) – gamma emission – artificial radio activity – detectors –ionization chamber scintillation and – semiconductor detectors.
Unit II	**Nuclear reactions and applications**
4	Nuclear reactions: Bethe's notation – types of reactions –cross section- compounds nuclear theory – photo and thermo nuclear reactions – fusion reactors – origin and evolution of elements.
5	Applications of radioactivity: Nuclear reactors – breeder reactor –India's nuclear energy – recovery of U and Pu from spent fuel – applications of radio isotopes – probing – Szilard-Chalmers' reaction – cow and milk systems –tracers.
6	Elementary particles of nucleus: classification – particles and antiparticles – Parton structure –Quarks and Gluons – classification of Quarks – Higgs Boson.
Unit III	**Bioinorganic *Chemistry***
6	Metal ions in biological systems: Electron transfer systems –cytochrome and Fe –S proteins -Structure and functions
7	Transport and storage of oxygen – Haemoglobin –structure and functions –cyanide poisoning – Myoglobin
8	Chlorophyll – Cyanocobalamine- structure and functions
9	Calcium in biological systems –sodium-potassium ion pumps
10	Metals in medicine – Pt binding to DNA.
Unit IV	**Acids, Bases and Non-Aqueous Solvents**
11	Acids and Bases: Arrhenius theory –Bronsted –Lowry theory –Lux-Flood definition – Solvent system definition – Lewis concept – Usanovich definition – generalized acid base concept - HSAB concept – basis of classifications – applications – pi bonding contributions –electro negativity and hard soft species – limitations of the principle.
12	Non aqueous solvents: classification of solvents – leveling and differentiating solvents ionizing solvents –Liq.NH_3 – Liq.SO_2 - Liq.N_2O_4 - Liq. BrF_3 – acetic acid.
Unit V	**Inorganic nomenclature and redox stbility**
13	Affixes used in naming- general naming – names of ions- radicals –acids – salts and salt like compounds- boron hydrides-isopolyanions and heteropolyanions- organometallics
14	Redox stability in water – hydrogen over voltage – oxygen over voltage – Latimer, Frost and Pourbaix diagrams – Elctrometallurgy - Ellingham diagram.

Text Books

I. Essentials of nuclear chemistry, Revised Fourth edition, H.J.arnikar, 1995, New Age International Publishers, Reprint 2009.

II. Bioorganic, Bioinorganic and Supramolecular chemistry, Fourth edition, P.S.Kalsi and J.P.Kalsi, New Age International Publishers, 2007.

III. Concise coordination chemistry, First edition, R.Gopalan and V.Ramalingam, 2001, Vikas Publishing House Private Ltd., Third reprint, 2007.

IV. Selected Topics in Inorganic Chemistry, First edition, Wahid U.Malik, G.D.Tuli and R.D.Madan, S.Chand and Company Ltd., 1976 (Reprint 1998).

V. Advanced inorganic chemistry, Sixth edition, F.Albert Cotton, Geoffrey Wilkinson, Carlos. A.Murilo and Manfred Bochmann, Wiley India, 2004 (Reprint 2008).

VI. Theoretical principles of Inorganic chemistry, First edition, G.S.Manku, Tata McGraw-Hill Publishing Company Ltd., 1980 (Twentieth reprint).

Reference Books

1. Concepts and Models of Inorganic Chemistry, Third edition, Bodie Douglas, Darl McDaniel and John
2. Alexander, Wiley India Ltd., 2006.
3. Bioinorganic Chemistry, First edition, Asim.K.Das, Books and Allied (P) Ltd., 2007 (Reprint 2009).
4. Bioinorganic Chemistry, First edition, M.Satake and Y.Mido, Discovery Publishing House, 2001
5. (Reprint 2003).

Semester IV: CY1442 Synthetic Organic Chemistry

S. No.	Topics
Unit I	***Heterocyclic compounds***
	Chemistry of heterocyclic compounds, synthesis and reactivity of the following systems- pyridine, quinoline, isoquinoline, indole, benzofuran, benzothiophene, pyrazole, imidazole, oxazole, isoxazole, thiazole, isothiazole, pyridazine, pyrimidine, and pyrazine.
Unit II	***Protecting groups***
	Protection and deprotection of hydroxyl, carboxyl, carbonyl, carboxy amino groups and carbon-carbon multiple bond; chemo- and regioselective protection and deprotection; illustration of protection and deprotection in synthesis.
Unit III	***Reagents in organic synthesis***
	Preparation and reactions of: Aluminium isopropoxide, NBS, Diazomethane, DDQ, DCC, LTA, LAH, OsO_4, Sodium borohydride, Wittig reagent.
Unit IV	***Modern synthetic methods***
	Baylis-Hillman reaction, Henry reaction, Nef reaction, Kulinkovich reaction, Ritter reaction, Sakurai reaction, Tishchenko reaction and Ugi reaction. Brook rearrangement; Tebbe olefination. Metal mediated C-C and C-X coupling reactions: Heck, Stile, Suzuki, Negishi and Sonogashira, Nozaki-Hiyama, Buchwald-Hartwig, Ullmann coupling reactions.
Unit V	***Pericyclic reactions***
	Types of Pericyclic reactions, stereochemistry of Pericyclic reactions, M.O. theory, symmetry properties of reactant and product orbitals, 2+2 cycloadditions, 4+2 cycloadditions, cyclization of 4n systems, 4n+2 systems, correlation diagram, sigmatropic rearrangements.

Text Books

I. Organic Reaction Mechanisms, Third edition, V.K. Ahluwalia, R.K. Parashar, Narosa Publishing House, 2009.

II. Organic reactions and their mechanisms, Third edition, P.S. Kalsi, New Age International Publishers, 2010.

III. Advanced Organic Chemistry, Part A & B, 5th Ed., F.A. Cary and R.I. Sundberg, Springer, 2009.

IV. The Disconnection Approach, S. Warren, John Wiley & Sons, 2004.

Reference Book

2. Advanced Organic Chemistry: Reactions, Mechanisms and Structure, Jerry March, Wiley Student Edition, 2006.

Semester IV: CY1443 Surface Chemistry and Photo Chemistry

S. No.	Topics
Unit I	***Adsorption***
1	Gas-Solid interface, types of adsorption, factors affecting adsorption, physical adsorption, adsorption isotherms, Freundlich's adsorption isotherm, Langmuir adsorption isotherm, BET equation, modification of BET equation, determination of surface area, Harkins and Jura method, Benton and White method, point B method, importance of surface area, heat of adsorption.
2	Adsorption from solutions, types, Gibbs adsorption equation, verification of Gibbs equation, Domain & Barker method, tracer method, surface tension and surface free energy, capillary condensation, wetting phenomena, applications of adsorption.
Unit II	***Reaction on Surfaces***
3	Mechanisms of surface reactions, effect of surface heterogeneity, unimolecular surface reactions, bi-molecular surface reactions, combination and formation of atoms at surfaces, exchange reactions, transition state theory of surface reactions, comparison of homogeneous and heterogeneous reaction rates.
4	Classification of catalytic reactions, types of catalysts, metals, semi-conductors, insulators, energetic of adsorption processes.
Unit III	***Colloids***
5	Emulsions, types, characteristics of emulsions, emulsifiers, theories of emulsification, importance of emulsion, micellar emulsion, applications, micelles, structure of micelles, ionic micelles, CMC, determination of CMC, solubilization, Donnan membrane equilibrium and its application. Applications of colloids.
Unit IV	***Excitation of Molecules***
6	Mechanism of radiation absorption, electric dipole transitions, Einstein's treatment, intensity of electronic transitions, selection rules, directional nature of light absorption, life times of excited states, types of transitions, two photon absorption spectroscopy.
7	Physical properties of excited molecules, changes on electronic excitation, potential energy diagram, shape of absorption band and Frank-Condon principle, emission spectra, environmental effect, dipole moment, acidity constant, redox potential in excited states, geometry of electronically excited molecule, flash photolysis.
Unit V	***Photophysical Processes***
8	Types of Photophysical pathways, Jablonski diagram, radiationless transition, internal conversion, intersystem crossing, fluorescence, phosphorescence, emission property and electronic configuration, kinetics of unimolecular processes, state diagram, delayed fluorescence, effect of temperature on emission processes.
9	Kinetic collisions and optical collisions, mechanism of fluorescence quenching in gases, collisions in solution, Stern-Volmer equation, concentration dependence of quenching, excimer formation.
10	Quenching by foreign substances, photosensitization, charge transfer mechanisms, energy transfer mechanism, donor acceptor interaction in energy transfer (qualitative treatment), sensitized delayed emission.

Text Books

I. Advanced Physical Chemistry, 22nd edition, Gurdeep Raj, Goel Publications, 1998.

II. Chemical Kinetics, Third Edition, Keith J. Laidler, Pearson Education, 2004.

III. Kinetics and Mechanisms of Chemical Transformations, First edition, J. Rajaram, J.C. Kuriacose, Macmillan, 1993, reprint 2011.

IV. Fundamentals of Photochemistry, K.K. Rohatgi-Mukherjee, New Age International Publishers, 1978, revised edition 2002.

Reference Book

1. Physical Chemistry, Eighth edition, Peter Atkins, Julio de Paula, Oxford press, 2006.

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Semester IV: CY14SS Soft Skills and Scientific Writing

S. No.	Topics
Unit I	***Memory and study skills***
	Definition and importance of memory-Causes of forgetting-How to forget (thought stopping), how to remember (techniques for improving memory)-The technique of passing exams-management of examination fear.
Unit II	***Power of positive thinking***
	Nurturing creativity, decision-making and problem solving-Thinking power- seven steps for dealing with doubt-Traits of positive thinkers and high achievers-Goals and techniques for positive thinking-Enhancement of concentration through positive thinking-Practicing a positive life style-Advantages of time management.
Unit III	***Literature survey***
	Chemical nomenclature and literature primary sources - secondary sources including reviews. Treatise and monographs, literature searching, Review of work relevant to the chosen problems. Abstraction of a research paper.
Unit IV	***Writing a thesis or paper***
	General format - page and chapter formation. The use of quotation - footnotes - tables and figures - referencing - appendixes - revising the paper or thesis - editing and evaluating the final product - proof reading the final typed copy - Publication of Research paper.
Unit V	Oral presentation skills – structure, voice, appearance, body language – delivery. Presentation a scientific seminar – appearing in interviews.

Reference Books

1. Power of positive thinking, D.J. Mile, Rohan Book Company, Delhi, 2004.
2. Double your learning power, G.A. Dudley, Thomas Publishing Group Ltd., Delhi, 2004.
3. How to develop a super power memory, H. Lorayne, Thomas Publishing Group Ltd., 2004.
4. Thesis and Assignment Writing, J. Anderson, B.H. Dursten and M. Poole, Wiley Eastern, 1977.

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