

KADI SARVA VISHWAVIDYALYA

Kadi Sarva Vishwavidhyalaya

M.Sc. Chemistry
Syllabus

Sem-I and Sem-II w.e.f June 2017

KADI SARVA VISHWAVIDYALYA

KADI SARVA VISHWAVIDYALAYA-GANDHINAGAR

Teaching & Examination scheme Effective from Academic Year

June 2017 on wards

M.Sc. Chemistry

Semester -I

Course	Subject Title	Credit	Theory (hr/week)	Practical (Hrs/week)	External Marks	Internal Marks	Total Marks
CH101	Inorganic Chemistry-1	4	4	-	70	30	100
CH102	Organic Chemistry-1	4	4	-	70	30	100
CH103	Physical Chemistry-1	4	4	-	70	30	100
CH104	Analytical Chemistry-1	4	4	-	70	30	100
CH105	Practical's	8	-	16	200	-	200
Total	-	24	-	-	-	-	600

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Teaching & Examination scheme Effective from Academic Year

June 2017 onwards

M.Sc. Chemistry

Semester -II

Course	Subject Title	Credit	Theory (hr/week)	Practical (Hrs/week)	External Marks	Internal Marks	Total Marks
CH201	Inorganic Chemistry-2	4	4	-	70	30	100
CH202	Organic Chemistry-2	4	4	-	70	30	100
CH203	Physical Chemistry-2	4	4	-	70	30	100
CH204	Analytical Chemistry-2	4	4	-	70	30	100
CH205	Practical's	8	-	16	200	-	200
Total	-	24	-	-	-	-	600

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Semester-I

Paper-I Inorganic Chemistry-1 (CH101)

Credit: 04

Course	Subject Title	Credit	Theory (hr/week)	Practical (Hrs/week)	External Marks	Internal Marks	Total Marks
CH101	Inorganic Chemistry-1	4	4	-	70	30	100

Rationale of the Paper: To provide the basic knowledge of very important concepts of the inorganic chemistry (group theory, organometallics, and reagents in inorganic chemistry and reaction mechanism of transition metal complexes). To provide overview of the applications of the concepts in applied field to the students is also an objective.

Learning outcome:

1. Students will be able to understand the geometry and structure of different molecules.
2. They can understand bonding nature of different compound.
3. How to make reagents and its properties also can understand reaction mechanisms.

Unit	Topics of paper CH 101 Inorganic Chemistry-1	Teaching Hours	Marks
Section A			
1	Group Theory Representation of groups: Preparation of matrices and vectors, Matrix notations for geometrical transformations, Orthogonality theorem and its consequences, Reducible and irreducible representations and their relation, Preparation of character table for C_{2v} , D_{2h} , C_{3v} and D_{3h} point groups. Application of group theory for IR and RAMAN Spectroscopy– Transformation properties of atomic crystals, Hybridization scheme for σ and π - bonding, Spectroscopy	15	13
2	Bioinorganic Chemistry: Essential and trace elements in Biological processes, metal porphyrins with special references to hemoglobin and myoglobin. Biological role of alkali and alkaline earth metal ones with special reference to Ca^{+2} . Nitrogen fixation.	15	12
Section B			
3	Organo metallic compounds Introduction and Nature of bonding in organo metallic compounds of transition metals: σ -bonded organo metallic compounds: Introduction, Classification and synthesis of σ - bonded organotransition metal compounds, general characteristics, chemical reactions, bonding and structure. π- bonded organometallic compounds: Introduction and Classification of π -bonded organometallic compounds (a) η^2 -alkene complexes: Preparative methods, physical properties, chemical properties, bonding of structure. (b) η^3 allyl (or enyl) complexes preparation, physical of chemical properties.	15	13
4	Stereochemistry and bonding in main group compound: VSEPR, Wales diagrams (tri - atomic molecules), dnpn bonds, Bent rule and energetics of hybridization, some simple reactions of covalently bonded molecules	15	12
Objective question from above four units		****	20

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Total Hrs of Lectures: 60 Methodology of Teaching

Classroom sessions

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Reference Books

1. Advanced Inorganic Chemistry, Cotton Wilkinson, WSE Wiley.
2. Inorganic Chemistry, J.E.Huhey, Harpes &Row.
3. Principle and Application of Organo transition Metal Chemistry, Collman & Hegsdus, University Science Books.
4. The Organometallic Chemistry of the Transition Metals, R.H.Crabtree, John Wiley.
5. Organometallic Chemistry, R.C.Mehrotraand A. Singh, New Age International.
6. Principle of Bioinorganic Chemistry,S.J.Lippardand J.M. Berg, University Science Books.
7. The Inorganic Chemistry of Biological Processes, M.N. Hughes,John Wiley & Sons.
8. Bioinorganic Chemistry, R. Chatwalanda. K.Bhagi, Himalaya Publishing House.
9. Textbook of Inorganic Chemistry Vol. I & II, A.Singh & R.Singh, Campus International Publication.
10. Vogel's Textbook of Quantitative Inorganic Analysis, ELBS.
11. Chemical Application of Group Theory, F.A.Cotton, WES Wiely.
12. Introduction to Ligand Field, B.N.Figgis, Inc. NewYork.
13. Coordination Compounds, S.F.A.Kettle, ELBS.
14. Introduction to Ligand Field Theory, Bell Hausen, McGraw Hill.
15. Group Theory and Its Application to Chemistry, K.V. Raman.
16. Symmetry and Spectroscopy of Molecules, K.Veera Reddy, New Age International Publishers.
17. Inorganic Reaction Mechanism, J.O. Edwards, Benjamin.
18. Mechanism of Inorganic Reactions, F.Basolo & R.G.Pearson, Wiley New York.
19. Coordination Chemistry, D Benerjia, Tata McGraw Hill.
20. Chemical Applications of group theory, Wiley stern Pvt. Ltd, New Delhi.
21. Shriver and Atkins Inorganic Chemistry, P. Atkins, T. Overton, J. Rourke, M. Weller & F. Armstrong, Oxford University Press (2006).
22. Group Theory and its Chemical Applications, P.K. Bhattacharya, Himalaya Publishing House.
23. Molecular Symmetry and Group Theory, Robert L. Carter.
24. Advanced inorganic chemistry by F.A. Cotton

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Paper–II OrganicChemistry-1(CH 102)

Credit: 04

Course	Subject Title	Credit	Theory (hr/week)	Practical (Hrs/week)	External Marks	Internal Marks	Total Marks
CH101	Organic Chemistry-1	4	4	-	70	30	100

Rationale of the Paper: To provide the basic and advanced knowledge of very useful concepts of organic chemistry i.e. aromaticity, reactive intermediate, rearrangements and organic named reactions. To provide overview of the applications of these concepts in applied field to the students is also an objective.

Learning Outcomes:

1. Students can understand the atomic and molecular basis of organic chemistry.
2. They can know the impact of organic chemistry on the fields of medicine, pharmacy and its impact on the global economy.
3. They can understand the fundamental principles of molecular structure and shape as they relate to organic molecules and their properties.
4. They can identify organic molecules by functional group: alkane, alkene, alkyne, haloalkane, alcohol, thiol, ether, sulfide, amine, aldehyde, ketone, carboxylic acid and carboxylic acid derivatives.
5. How to do organic nomenclature and its symbol list and can learn also the fundamental principles of functional group conversion and organic synthesis.

Unit	Topics of paper CH 102 Organic Chemistry-1	Teaching Hours	Marks
	Section A		
1	<p>Aromaticity Aromaticity and aromatic character, Frost circle diagram for cyclobutadiene, benzene and others. Concepts of aromaticity resonance and chemical stabilization–aromatic character based on NMR- criteria to check aromaticity character. Crown ether complexes and cryptands, inclusion compounds, cyclodextrins, catenanes and rotaxanes. Huckel rule, energy level of n molecular orbitals, Huckel molecular orbitals (HMO) method, orbital symmetry, M.O. of simple organic systems such as ethene, allyl and butadiene. Aromaticity in benzenoid and non-benzenoid compounds and charged rings, annulenes,</p>	15	13
2	<p>Reactive Intermediate Carbocations (classical and non-classical): stability, structure, generation and fate. Carbanions: stability, structure, generation and fate. Carbenes: stability and structure, the generation and fate Free radicals: stability, structure, generation and fate, NBS Bezyne: stability, structure, generation and fate. Nitrene: stability, structure, generation, reactions.</p>	15	15

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Section B			
3	<p>Molecular arrangements General mechanistic considerations, nature of migration, migrat or yaptitude, and memory effects in respect of following.</p> <p>Carbon to Carbon migration of R, H and Ar: Pinacol- Pinacolone rearrangement, Favorski rearrangement</p> <p>Carbon to Nitrogen migrations: Curtius rearrangement, Schmidt rearrangement</p> <p>Carbon to oxygen migration of and Ar: Baeyer- villager rearrangement, Rearrangement of hydro peroxide</p>	15	13
4	<p>Organic Named Reactions Robins on Annulation reaction, Stork-Enamine reaction, Gilman reaction, Umpolung of reactivity, Diels-Alder reaction, Wittig reaction, Hydroboration, Ene reaction, Shapiro reaction, Peterson olefin synthesis, Organolithiation reaction, Thallation reaction, Wilkinson catalyst.</p>	15	15
	Objective question from above four units	***	10

Total Hrs of Lectures: 60 Methodology of Teaching

Classroom sessions

Explanation using multimedia projector Surprise test

Reference Books

1. F.A. Carey and R.J. Sundberg : Advanced Organic Chemistry Part B, Plenum Press.
2. March Jerry: Advanced Organic Chemistry, 4th Ed, Wiley Eastern Ltd. New Delhi (1985).
3. Morrison R and Boyd RN: Organic Chemistry, Prentice Hall of India Pvt Ltd., 6th Ed (2003).
4. R.O.C. Norman and J.M. Coxon: Principles in Organic Synthesis, Blackie Academic & Professional.
5. Carruthers: Some Modern Methods of Organic Synthesis, Cambridge Univ. Press.
6. Mc Marry: Organic chemistry- (Vedition)
7. Finar IL: Organic Chemistry, Vol 1 (The Fundamental Principles) 6th Ed Longman (1973).
8. Finar IL : Organic Chemistry, Vol 2 (Stereochemistry and chemistry of Natural Products) 6th Ed Longman (1973).
9. V K Ahluwalia, R K Parasar: Organic Reaction Mechanism, 2nd Ed.
10. GR Chatwal: Reaction Mechanism and Reagents in Organic Chemistry.
11. JP Trivedi: Reaction Intermediates in Organic chemistry, University Granth Nirman Board, Ahmedabad.
12. Peter Sykes, Longman: A Guide Book to Mechanism in Organic Chemistry.
13. H.O. House, W.A. Benjamin: Modern Synthetic Reactions.
14. Rodd's Chemistry of Carbon Compounds. Ed. S. Coffey, Elsevier.
15. Organic reactions and their mechanism by P.S. Kalsi

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Paper–III Physical Chemistry-1(CH 103)

Credit: 04

Course	Subject Title	Credit	Theory (hr/week)	Practical (Hrs/week)	External Marks	Internal Marks	Total Marks
CH 103	Physical Chemistry-1	4	4	-	70	30	100

Rationale of the Paper: To provide the basic knowledge of very important concepts of the physical chemistry (chemical thermodynamics, surface chemistry, macromolecules, electro chemistry and chemical dynamics). To provide overview of the applications of these concept sin applied field to the students is also an objective.

Learning Out comes:

1. Students can able to state the Third Law and to define heat, work, thermal efficiency and the difference between various forms of energy.
2. They should understand the mechanism of adsorption and associated principles.
3. Importance of electrochemical measurements and its applications.

Unit	Topics of paper CH 103 Physical Chemistry-1	Teaching Hours	Marks
	Section A		
1	Chemical Thermodynamics Nernst heat theormandits and its applications to gaseous system, Third law of thermodynamics and its application to evaluate absolute entropies of solids, liquids and gases; Partial molar quantities and t h e i r determination, Gibbs-Duhem equation, Gibbs Duhem- Margules equation and its application, Chemical potential and its applications, Activity and activity co-efficients , Methods of determination of activity and activity coefficients, Concept of Fugacity and its determination methods. Examples.	15	13
2	Surface Chemistry Physical and Chemical adsorption, Adsorption isotherms, Multi molecular Theory O R B.E.T. Adsorption Isotherm, Gibbs Adsorption Equation, Surface active agent OR Surfactants, Micellisation, Critical Micellar Concentration(CMC)	15	12
	Section B		
3	Electrochemistry Debye-Hackle Theory(Mathematical Derivation), Thermodynamics of electrified interfaces Lipmann's Equation, Determination of dissociation constant of mono basic acids by conductometry and potentiometry, Gouy-Chapman Theory, Polarization and Overvoltage, Bulter-Volmer equation, Principle of polarography, Equation of polarographic wave, Ilkovic equation.	15	13
4	Chemical Dynamics Unimolecular reaction (Lindeman's Theory), Chain reactions and branched chain reactions, Chain reaction between hydrogen and bromine, Transition State Theory, Reaction Kinetics of Thermal and Photochemical Hydrogen-Bromine Reaction, Kinetics of Fast Method reaction(Flow & Flash photolysis), Enzyme catalyzed reactions, mechanism kinetics, Examples. (Arrhenius Equation)	15	12
	Objective question from above four units	***	20

Total Hrs of Lectures: 60 Methodology of

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Teaching Class room sessions

Explanation using multimedia projector Surprise test

Reference Books:

1. Advanced Physical Chemistry-J.N.Gurtu, A.Gurtu.
2. Text book of Physical Chemistry-W.J. Moore.
3. Textbook of Physical Chemistry-Glass tone.
4. Textbook of Physical Chemistry- P. Atkins.
5. Thermodynamics for Chemist-Glass tone.
6. Advanced Physical Chemistry- Gurdeep Raj.
7. Surface Chemistry- Admanson.
8. Surface Chemistry- Osipov.
9. Electro chemistry– Bockrisand Reddy
10. Chemical Kinetics– Ladler.
11. Chemical Kinetics– Fro stand Pearson
12. Principle of physical chemistry by Puri, Sharma and Pathania
13. Physical Chemistry by K.L. Kapoor

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Paper–IV Analytical Chemistry-1(CH 104)

Credit: 04

Course	Subject Title	Credit	Theory (hr/week)	Practical (Hrs/week)	External Marks	Internal Marks	Total Marks
CH 104	Analytical Chemistry-1	4	4	-	70	30	100

Rationale of the Paper: To provide the basic knowledge of very important concepts of the analytical chemistry (Sampling and Calibration Methods, Volumetric Method of Analysis, Instrumental Analysis). To provide overview of the applications of these concepts in applied field to the student so as to be objective.

Learning Outcome:

1. Students can learn the basic analytical and technical skills to work effectively in the various fields of chemistry.

To know and understand the issues of safety regulations in the use of chemicals in their laboratory work.

Unit	Topics of paper CH 104 Analytical Chemistry-1	Teaching Hours	Marks
	Section A		
1	Concepts involved in Analysis and Statistics Scope of analytical chemistry (dyes, drugs, forensic, agriculture, food and nutrition), classification of analytical methods-classical and instrumental, types of instrumental analysis, selecting analysis method, Accuracy, Precision, errors and its causes and way for minimization, absolute error, relative error, Standard deviation, relative standard deviation, mean, median, laboratory operations and practices, good laboratory practices (GLP), Consideration with value of significance, Q-Test for R.G, laboratory notebooks, safety in the analytical laboratory, calibration and detection limits, proficiency testing.	15	13
2	Sampling and Calibration Methods Sampling and sample preparation, general steps in chemical analysis, calibration of glass wares. Finding the best straight line-least square regression, correlation coefficient; Calibration curves, standard addition technique and internal standards. Chemical concentrations.	15	12
	Section B		
3	Volumetric Method of Analysis Primary and Secondary standards, Principles of volumetric analysis, Acid-base titration. Titration in non-aqueous solvents, Complex metric titrations, Precipitation titrations (Mohr's titration, Volhard's titration, adsorption indicators, Fajan's titration), Redox titrations, Theoretical aspects of titration curves and end point evaluation, Choice and suitability of indicator in each case.	15	13
4	Instrumental analysis pH metry (Principle of instrumentation and mechanism of pH by glass electrode), Potentiometry, Conductometry and types of electrodes and explanation of the nature of titration curves	15	12
	Objective question from above four units	***	10

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Total Hrs of Lectures: 60 Methodology of Teaching

Class room sessions

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Reference Books:

1. Quantitative Chemical Analysis –by Daniel C. Harris, 5th Edition, W.H. Freeman and Company, New York.
2. Analytical Chemistry –by Gary D. Christian, 6th Edition, John Wiley and Sons Inc. New Jersey.
3. Principles of Instrumental Analysis –by Douglas A. Skoog, 3rd Edition, Holt-Saunders International Edition.
4. Instrumental Methods of Chemical Analysis - by Galen W. Ewing, 4th Edition, International Student Edition.
5. Quantitative chemical analysis by A.I. Vogel (Longman Series).

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Semester –I

CH 101 Practical's

Credit: 08

Course	Subject Title	Credit	Theory (hr/week)	Practical (Hrs/week)	External Marks	Internal Marks	Total Marks
CH 105	Practicals	8	--	16	200	--	200

Rationale of the Paper: To enhance practical skills of the student's inorganic qualitative analysis, inorganic qualitative analysis, inorganic synthesis, quantitative analysis and instrumental methods of analysis. To provide overview of the applications of these experiments in applied field to the students is also an objective.

Teaching and Evaluation Scheme:

Each practical's listed in the syllabus will be explained and demonstrated in the laboratory. Students are evaluated based on the marks obtained in writing part as well as performance in the laboratory. Viva-voce will be conducted based on practical performed by the students during the examinations.

Inorganic Chemistry (Minimum 08)

1. Alloy (Steel / Gunmetal / Bronze – Any 2)
2. Qualitative Analysis: Six radical's separation with one less common ion.

References books for Inorganic Chemistry Practical

- ✓ A textbook of quantitative inorganic analysis including elementary instrumental analysis by A.I. Vogel.

Organic Chemistry (Minimum 08)

1. Organic preparation with IR / TLC / crystallization (Included TLC / IR of starting material and for finish product).
2. Organic Estimation. **(Any 3)**

References books for Organic Chemistry Practical

- ✓ Vogel's Textbook of practical organic chemistry by Fumiss Brain S.
- ✓ Elementary practical organic chemistry Part-1 (small scale preparation) by A.I. Vogel.
- ✓ Elementary practical organic chemistry Part-2 (Qualitative organic chemistry) by A.I. Vogel.
- ✓ Elementary practical organic chemistry Part-3 (Quantitative organic chemistry) by A. I. Vogel.
- ✓ Comprehensive practical organic chemistry: preparation and quantitative analysis by V.K. Ahluwalia.
- ✓ Comprehensive practical organic chemistry: qualitative analysis by V.K. Ahluwalia.
- ✓ Practical organic chemistry by Mann and Saunders, 1960, 4 Edition.

Physical Chemistry (Minimum 08)

1. Adsorption & Kinetics

- a. Study the variation of surface tension of solution of n-propyl alcohol with concentration.
- b. Study the kinetic of the reaction between Potassium per sulphate and Potassium Iodide.
 - i. Determine rate constant and order of the reaction
 - ii. Study the influence of ionic strength on the rate constant.

2. **pH metry:** Determination of dissociation constant of weak like acetic or monochloro acetic acid.

3. Conductometry:

- a. To determine the solubility product and solubility of sparingly soluble salts-PbSO₄ and BaSO₄.

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4. Potentiometry : (Any One)

- a. Redox Titration Ferrous ammonium sulphate – $K_2Cr_2O_7$.
- b. To determine potentiometrically the formula of Silver ammonia complex.

5. Distribution method (Any Two)

- a. To determine the solubility & heat of solution of benzoic acid in benzene / Toluene
- b. To determine the partial molar volume and the composition of the unknown mixture of methano/ethanol/acetone and water
- c. To determine the composition of binary mixture containing potassium permagnate and potassium dichromate
- d. To study the variation of refractive index with composition of given liquid and also be determine the composition of unknown mixture.

References books for Physical Chemistry Practical

- ✓ Practical in Physical Chemistry-P. S. Sindhu.
- ✓ Practical Physical Chemistry–J. B. Yadav.
- ✓ Experiments in Physical Chemistry– R.C.Das, B.Behra.
- ✓ Experiments in Physical chemistry–P.H. Parsania, F.Karia.

Analytical Chemistry (Minimum 08)

1. Water Analysis for TDS.
 2. Water Analysis for Ca and Mg.
 3. Water Analysis for carbonate and bicarbonate.
 4. Water Analysis for Sulphate.
 5. Water Analysis for Total hardness.
 6. Water Analysis for Nitrate. (Colorimetry)
 7. Fajan's method for the chloride determination.
 8. Volhard's method for the determination of silver content.
 9. Calibration of volumetric glassware.
 10. Sampling techniques for solid & liquid samples. (Spectroscopy)
 11. Preparation of primary and secondary standard solution.
 12. Measurement of optical rotation using polarimeter instrument. (Glucose)
 13. Measurement of optical rotation using polarimeter instrument. (Tartaric acid)
 14. Water analysis for dissolved oxygen.
 15. Water analysis for chemical oxygen demand.
- } Any One

References books for Analytical Chemistry Practical

1. British Pharmacopoeia.
2. Indian Pharmacopoeia.
3. U. S. Pharmacopoeia.
4. Qualitative Chemical analysis by A. I. Vogel.
5. Modern analytical chemistry (ISBN 0-07-237547- By David Harvey.
6. Standard Analytical Procedures for water analysis (Hydrology project) Govt. of India and Govt. of Netherlands.
7. Fundamental of Analytical chemistry by Skoog.
8. Instant notes Analytical chemistry by D.Kealey and P.J. Haines.
9. Analytical chemistry for technicians 3rd Edition by John Konkd. (CRC press).
10. Analytical Chemistry" by Gary D. Christian, 6th Edition, John Wiley and Sons Inc. New Jersey.

Viva –voce based on chemistry practical.

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Semester-II

Paper-I Inorganic Chemistry-2 (CH 201)

Credit: 04

Course	Subject Title	Credit	Theory (hr/week)	Practical (Hrs/week)	External Marks	Internal Marks	Total Marks
CH 201	Inorganic Chemistry-2	4	4	--	70	30	100

Rationale of the Paper: To provide the basic knowledge of very important concepts of the inorganic chemistry. To provide overview of the applications of the seconcepts in applied field to the students is also an objective.

Learning outcome:

1. Students will be able to understand the geometry and structure of different molecules.
2. They can understand bonding nature of different compound.
3. How to make reagents and its properties also can understand reaction mechanisms.

Unit	Topics of paper CH201 Inorganic Chemistry-2	Teaching Hours	Marks
	Section A		
1	Reaction mechanism of transit on metal complexes Energy profile of are reaction , Reactivity of metal complexes, Inert and labile complexes, Kinetic application of VBT and CFT, Kinetics of octahedral substitution, acid hydrolysis, factors affecting acid hydrolysis, base hydrolysis, conjugate base mechanism, direct and indirect evidence in favor of conjugate mechanism, An atoner action, reaction without metal ligand bond cleavage, substitution reaction in square planar complexes, the trans effect, mechanism of the substitution reaction , red ox reaction , electron transfer reaction , mechanism of on electron transfer reaction, outer sphere type reaction, cross reactions and Marcus-hush theory, Inner sphere type reactions.	15	13
2	Mossbauer Spectroscopy Basic applications of Mossbauer spectroscopy, hyperfine structure, quadruple splitting, instrumentation and applications of Mossbauer spectroscopy, problems related to Mossbauer spectra (Fe and Sh)	15	12
	Section B		
3	ORGANOMETALLIC COMPOUNDS Catalytic Aspects, Biological Applications and Environmental Aspects of Organometallic Compounds -Introduction -Synthetic & Catalytic Aspects of OMC -Synthetic Applications of Main Groups of Organometallic Compounds -Organometallic In Medicines -Organometallic compounds In Agriculture and Horticulture -Organometallic In Industry -Environmental Aspects of Organometallic Compounds	15	13
4	d¹-d⁹ spectra Selection rule for transition, factor affecting an electronic spectrum, or gel diagram with example d ¹ -d ⁹ , d ² -d ⁸ , d ³ -d ⁷ , d ⁴ -d ⁶ , Tanabe-Sugano diagram (d ²), weak field limit. Correction diagram for d ²	15	12
	Objective question from above four units	----	20

Total Hrs of Lectures: 60 Methodology of

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Reference Books:

1. Fundamentals of molecular spectroscopy by C.N. Barnwell.
2. Physical Chemistry by P.W. Atkins. ELBS 1986.
3. Introduction to molecular spectroscopy by G. M. Barrow.
4. Molecular spectroscopy by I.N. Levis, Wiley interscience.
5. Nuclear Magnetic Resonance by J.D. Roberts, McGraw Hill.
6. Introduction to magnetic resonance by A. Carrington and A.D. McLachlan. Harper and Row.
7. Electron Spin Resonance, Elementary theory and practical applications by J.E. Wets and J.R. Buoulton, Mc Grew Hill.

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Paper–II OrganicChemistry-2(CH 202)

Credit: 04

Course	Subject Title	Credit	Theory (hr/week)	Practical (Hrs/week)	External Marks	Internal Marks	Total Marks
CH 202	Organic Chemistry-2	4	4	--	70	30	100

Rationale of the Paper:

To provide the basic knowledge of classical branches of the organic chemistry (heterocyclic chemistry and photochemistry) and very widely develops in new branches of the organic chemistry (disconnection approach and green chemistry). To provide overview of the applications of the second concepts in applied field to the students is also an objective.

Learning Outcomes:

1. Students will have acquired an understanding of synthesis and mechanism of Hetero cyclic compounds.
2. Knowledge of aromaticity and the chemistry of five and six member hetero cycles.
3. They learn about various aspects of Photochemistry

Unit	Topics of paper CH 202 Organic Chemistry-2	Teaching Hours	Marks
	Section A		
1	Retro Synthesis An introduction to synthons and synthetic equivalents. Disconnection approach, functional group inter-conversions, the importance of the order of events in organic synthesis, one group C-X and two group C-X disconnections, chemo selectivity, reversal of polarity, cyclisation reaction, amine synthesis. Principle of protection of alcohol, amine, carbonyl and carboxyl groups.	15	13
2	Photochemistry Basic of Photochemistry: Absorption, excitation, photochemical laws, quantum yield, and electronically excited states- life times- measurements of the times. Flash photolysis stopped Flow techniques, Energy dissipation by radioactive and non-radioactive processes, absorption spectra, Franck-Condon principle, and photochemical stages-primary and secondary processes. Photochemical Reactions: Interaction of electromagnetic radiation with matter, types of excitations, fate of excited molecule, transfer of excitation energy, acidometer.	15	12
	Section B		
3	Green chemistry Brief introduction, principles, green catalysts-acid catalyst, basic catalyst, oxidation catalysts, polymer supported catalysts, photo catalyst, green synthesis-phase transfer catalyst, green synthesis of polycarbonates, paracetamol, ibuprofen, citral, urethane, adipic acid and styrene.	15	13
4	Heterocyclic chemistry (5, 6 member & Bicyclic Group) Nomenclature of Hetero cycles: Replacement and systematic Nomenclature for monocyclic, fused and bridged hetero cycles. Aromatic Hetero cycles and Heterocyclic Synthesis: General chemical behavior of aromatic hetero cycles, Classification of heterocyclic compounds, Principles of heterocyclic synthesis involving cyclization reactions and reactivity and tautomerism of aromatic, heterocyclic compounds and their mechanism containing two heteroatoms.	15	12
	Objective question from above four units	----	20

Total Hrs of Lectures: 60 Methodology of Teaching

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Class room sessions

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Reference Books

1. Designing Organic Synthesis, S. Warren. Wiley.
2. Organic Synthesis: The Disconnection Approach, S. Warren, Wiley.
3. Organic Synthesis-Concept, Method and Starting Materials, J. Fuhrhop.
4. Some Modern Methods of Organic Synthesis. W. Carruthers, Cambridge Univ. Press.
5. Modern Synthetic Reactions H.O. House, W.A. Benjamin.
6. Advanced Organic Chemistry: Reactions, Mechanisms and Structure, J. March. Wiley.
7. Principles of Organic Chemistry Part B.F. a. Carey and R.J. Sundberg, Plenum Press.
8. Fundamentals of photo chemistry, K.K. Rothagi-Mukherji, Wiley- Eastern.
9. Essentials of Molecular Photochemistry, A. Gilbert and J. Baggott, Blackwell Scientific Publication.
10. Molecular Photochemistry, N.J. Turro, W.A. Benjamin.
11. Introductory Photochemistry, A. Cox and t. Camp, McGraw Hill.
12. Photochemistry, R.P. Kundall and A. Gilbert. Thomson Nelson.
13. Organic Photochemistry, J. Cox on and B. halton, Cambridge University Press.
14. Chemistry of Heterocyclic Compounds by Badger (Academic Press, 1963).
15. Heterocyclic Compounds by R.C. Elder field (Ed.), Vol.1-9 (Wiley, New York, 1960-65).
16. An Introduction to the Chemistry of Heterocyclic Compounds by
17. R.M. Aches on (John Wiley & Sons Ltd. New York, 1967).
18. Heterocyclic Chemistry (2/e) by J.A. Joule and G.F. Smith (Van Nostrand Reinhold (UK) Co.Ltd.1978).
19. The Chemistry of Carbon Compounds by Rodd, E.R.(Ed.), Vol.4A to 4C(Elsevier, Amsterdam,1957 1973).
20. Ring Index by Patterson, Capell and Walker (American Chemical Society, New York, 1960).
21. New Trend sin Green Chemistry by V .K. Ahluwalia, M. Kidwai Second Edition, 2004.
22. Green Chemistryll theory and practice, P.T. Anastas and J.C. Warner, New York Oxford university press, 1998.

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Paper–III Physical Chemistry-2(CH 203)

Credit: 04

Course	Subject Title	Credit	Theory (hr/week)	Practical (Hrs/week)	External Marks	Internal Marks	Total Marks
CH 203	Physical Chemistry-2	4	4	--	70	30	100

Rationale of the Paper: To provide overview of the applications of these concepts in applied field to the students is also an objective.

Learning Outcome:

1. Students can able to state about the nuclear chemistry and statistical thermo- dynamics.
2. They can understand about the mechanism of polymerization, property of polymer and its application.
3. Also identify different polymerization and polymer analytical technique.

Unit	Topics of paper CH 203 Physical Chemistry-2	Teaching Hours	Marks
Section A			
1	Statistical Thermodynamics Concepts of distribution of molecules, thermodynamic probability, permutations and combinations, Boltzmann's most probable distribution, partition function- translational, vibrational, rotational, electronic nuclear partition functions, calculation of thermodynamics, properties in terms of partition function, Internal energy, Examples.	15	13
2	Nuclear Chemistry Nuclear properties-nuclear radius, columbic and nuclear potential spin and angular momentum, magnetic moment, nuclear binding energy, nuclear models-shell model, liquid drop model, Fermi gas model, collective model, radioactive decay, nuclear reactions, evaporation, spallation, fragmentation, fission and fusion reactions, accelerators, reaction cross section, use of radioisotopes as tracers.	15	12
Section B			
3	Solid State Chemistry Bonding in solids and electronic structure in solids, bond theory- metals, semiconductors and insulators, defects in crystals, calculation of schotky and Frenkel defects using statistical method, non-stoichiometry, solid electrolytes, diffusion in solids, electrical conductivity in solids, super conductivity, perovskites.	15	13
4	Macromolecules Types of polymers, Polymerization reaction with example. Kinetics and Mechanism of Polymerization, Molecular weight of Macromolecules (Number average and weight average Molecular weight), Methods of determining molecular weight of polymers, Properties of polymers and applications, Examples.	15	12
Objective question from above four units		----	20

Total Hrs of Lectures: 60 Methodology

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Reference Books

1. Textbook of physical chemistry –W.J. Moore.
2. Textbook of physical chemistry – Glass tone.
3. Textbook of physical chemistry – P. Atkins.
4. Advanced physical chemistry – Gur deep raj.
5. Advanced physical chemistry – J. N. Gurtu, A. Gurtu.
6. Statistical thermodynamics – M.C. Gupta.
7. Polymer Chemistry –Gowariker.
8. Polymer Chemistry –Billmayer.
9. Principles of polymer science – Bahadur & Sastry.
10. Polymer science & technology – Fried.
11. Polymer Chemistry – Malcom P. Stevens.
12. Nuclear Chemistry – Arniker.
13. Nuclear and radio chemistry – J.W. Kannedy, G. Friedlander.
14. Polymer Chemistry– Gowariker.
15. Polymer Chemistry-Billmayer.
16. Polymer Chemistry-Malcolm P. Stevens
17. Polymer Science and Technology-Fried.
18. Principles of Polymer Science– Bahadurand Sastry.

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Paper–IV Analytical Chemistry-2(CH 204)

Credit: 04

Course	Subject Title	Credit	Theory (hr/week)	Practical (Hrs/week)	External Marks	Internal Marks	Total Marks
CH 204	Analytical Chemistry-2	4	4	--	70	30	100

Rationale of the Paper: To provide the basic knowledge of the various spectroscopic techniques (UV, IR, MASS and CMR). To provide overview of the applications of these concepts in applied field to the students is also an objective.

Learning Outcome:

1. Students can define and calculate their retention factor, R_f , and describe how TLC and column chromatography can be used for separation and qualitative analysis.
2. How to operate gas–solid and gas–liquid chromatography instruments and explain how analytical data can be obtained.
3. How to use gas chromatography–mass spectrometry to find the concentrations and identities of component in a mixture.
4. Account for the general features of chromatography systems.

Unit	Topics of paper CH 204 Analytical Chemistry-2	Teaching Hours	Marks
	Section A		
1	Fundamentals of Spectrophotometry and UV-Visible Spectroscopy Properties of light, absorption of light, interaction of light with matter and origin of spectra. The spectrophotometer-calibration, sources of light, monochromators and detectors. Beer's law in chemical analysis, photometric accuracy-Ringbom Plot, derivative spectrophotometry. Circular Dichroism (CD) and Optical Rotatory Dispersion (ORD)	15	13
2	Fundamental of NMR & CMR Spectroscopy Principal, basic of NMR (Peak height, Peak signal, Chemical shift,) instrumentation and applications of NMR, Criteria for a compound to be NMR active. Basic components of instrumentation of PMR and CMR. Shielding- deshielding, splitting, TMS. Resolution and multiplicity.	15	12
	Section B		
3	MASS Spectroscopy Theory, instrumentation and modifications; Unit mass and molecular ions; Important terms-singly and doubly charged ions, metastable peak, base peak, isotopic mass peaks, relative intensity, etc.; Recognition of M+ion peak; General fragmentation rules: Fragmentation of various classes of organic molecules, including compounds containing oxygen, sulphur, nitrogen and halogens; α -, β -, allylic and benzylic cleavage.	15	13
4	FT-IR Principal, Types of vibrations in IR, Different important group frequency criteria for compound to be IR active, Instrumentation of FT-IR. Examples of Organic compounds. Structural elucidation of organic compound using UV, NMR & IR Techniques.	15	12
	Objective question from above four units	----	20

Total Hrs of Lectures: 60 Methodology of Teaching Class room sessions

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Reference Books

1. Quantitative Chemical Analysis by Daniel C. Harris, 5th Edition, W.H. Freeman and Company, New York.
2. Analytical Chemistry by Gary D. Christian, 6th Edition, John Wiley and Sons Inc. New Jersey.
3. Principles of Instrumental Analysis by Douglas A. Skoog, 3rd Edition, Holt-Saunders International Edition.
4. Instrumental Methods of Chemical Analysis by Galen W. Ewing, 4th International Student Edition.
5. Kemp, W. Organic Spectroscopy 3rd Ed., W. H. Freeman & Co. (1991).
6. Silverstein, R. M., Bassler, G. C. & Morrill, T. C. Spectroscopic Identification of Organic Compounds John Wiley & Sons (1981).
7. Carruthers, W. Modern Methods of Organic Synthesis Cambridge University Press (1971).
8. March, J. Advanced Organic Chemistry John Wiley & Sons (1992).
9. Practical NMR Spectroscopy, M.L. Martin, J.J. Delpuch and G.J. Martin, Heyden.23.
10. Spectrometric identification of Organic Compounds, R. M. Silverstein, G. C. Bassler and T. C. Morrill, John Wiley.
11. Introduction to NMR Spectroscopy, R. J. Abraham, J. Fisher and P. Loftus, Wiley.
12. Application of Spectroscopy of Organic Compounds, J. R. Dyer, Prentice Hall.
13. Spectroscopy Methods in Organic Chemistry, D. H. Williams, I. Fleming, Tata McGraw- Hill.
14. Spectroscopy of Organic Compounds, P. S. Kalsi, New Age International Ltd

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Semester-II

CH 205 Practical's

Credit: 08

Rationale of the Paper: To enhance practical skills of the students in organic synthesis, estimations and separation techniques. To provide overview of the applications of these experiments in applied field to the students is also an objective.

Course	Subject Title	Credit	Theory (hr/week)	Practical (Hrs/week)	External Marks	Internal Marks	Total Marks
CH-205	Practical's	8	--	16	200	--	200

Inorganic Chemistry (Minimum 08)

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

1. VO(acac)₂
2. Ti O(C₉H₈NO)₂·2H₂O (3) Cis-K[Cr(C₂O₄)₂(H₂O)₂]
3. Na[Cr(NH₃)₂(SCN)₄]
4. Mn(acac)₂
 - a. K₃[Fe(C₂O₄)₃]
 - b. (7) Prussian Blue, Turnbull's Blue
(8) [Co(NH₃)₆][Co(NO₂)₆]
5. Cis-[Co(trien)(NO₂)₂Cl]·H₂O
6. Hg[Co(SCN)₄]
7. [Co(Py)₂Cl₂]
8. [Ni(NH₃)₆]Cl₂
9. Ni(DMG)₂
10. [Cu(NH₃)₄]SO₄·H₂O
 - a. EDTA binary mixture (any 4)

Organic Practical's (Minimum 08)

Organic Mixture (Semisolids and Liquids)

References books for Organic Chemistry Practical

- 1) Vogel's Textbook of practical organic chemistry by Fumiss Brain S.
- 2) Comprehensive practical organic chemistry: preparation and quantitative analysis by V. K. Ahluwalia.
- 3) Comprehensive practical organic chemistry: qualitative analysis by V. K. Ahluwalia.
- 4) Practical organic chemistry by Mann and Saunders, 1960, 4th Edition.

Physical Chemistry (Minimum 08)

1. Distribution

- a) Distribution of I₂ between H₂O and CCl₄.

2. pH metry

- a) To determine the strength of strong and weak base in a given mixture using a pH meter.d.

3. Conductometry (Any One)

- a. To determine the strength of strong and weak acids in a given mixture using a conduct meter.
- b. Determination of the velocity constant, order of the reaction and energy of activation for sponification of ethyl acetate by sodium hydroxide conduct metrically.

4. Polymer Chemistry

- c. Determination of molecular weight of a polymer by Viscosity Method.

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5. Spectrophotometer

- a. To determine the concentration of nitrate (NO_2^{-1}) in the given solution.
- b. To study Beer's law and determine the concentration of an unknown solution of Cu^{+2} by ammonia complex method.

6. Potentiometer

- a) To determine the strength of strong and weak acids in a given mixture using a potentiometer.
- b) To determine the solubility of the given salts, $\text{AgCl}/\text{AgBr}/\text{AgI}$ using a potentiometer.

7. Chemical Kinetics

- a) To determine the temperature coefficient and energy of activation of the reaction between KBrO_3 and KI . At two different temperature.
- b) To study the effect of concentration of reactants on the rate of hydrolysis of an ester.
- c) Determination of the effect of Change of concentration of reactants on the velocity constant of hydrolysis of an ester / Ionic reactions.
- d) To determine the heat and entropy of vaporization of a given liquid by kinetic approach
- e) To determine the concentration and dissociation constant of dibasic acid by Ph metry / Potentiometer.
- f) To determine the concentration and dissociation constant of dibasic acid by potentiometry.
- g) To determine the concentration of an unknown optically active compound (polarimetry).

Analytical Chemistry (Minimum 08)

1. Determination of "Na" by flame-photometric method.
 2. Determination of "K" by flame-photometric method.
 3. Determination of "Ca" by flame-photometric method.
 4. Determination of "Li" by flame-photometric method.
 5. Determination of Ester value of given oil samples.
 6. Estimation of paracetamol by UV-visible spectrophotometry (colourimetry).
 7. Estimation of ibuprofen by UV-visible spectrophotometry (colourimetry).
 8. Graphical interpretation of IR, NMR & Mass spectra.
 9. Estimation of Aspirin by UV-visible spectrophotometry (colourimetry).
 10. Estimation of caffeine by UV-visible spectrophotometry (colourimetry).
 11. Estimation of Phenacetin by UV-visible spectrophotometry (colourimetry).
 12. Estimation of binary mixture by EDTA. (Cr(III)-Fe(III))
 13. Estimation of binary mixture by EDTA. (Zn-Mg)
 14. Estimation of binary mixture by EDTA. (Cu-Zn)
- } ANY ONE

References books for Analytical Chemistry Practical

1. British Pharmacopoeia.
2. Indian Pharmacopoeia.
3. U.S. Pharmacopoeia.
4. Qualitative chemical analysis by A. I. Vogel.
5. Modern analytical chemistry (ISBN 0-07-237547-7) by David Harvey.
6. Standard Analytical Procedures for water analysis (Hydrology project) Govt. of India and Govt. of Netherlands.
7. Fundamental of Analytical chemistry by Skoog.
8. Instant notes Analytical chemistry by D. Kealey and P. J. Hainies.
9. Analytical chemistry for technicians 3rd Edition by John Konkd. (CRC press
10. Analytical Chemistry" by Gary D. Christian, 6 Wiley and Sons Inc. New Jersey Edition, John

Viva-voce based on organic and analytical chemistry practicals.