

Lecture Plan

Name of the college: Government College of Arts, Science & Commerce, Sankhali, Goa		
Name of Faculty: Dr. Dipesh Sakharam Harmalkar	Subject: Concepts in Organic and Analytical Chemistry	
Paper code: CHC-201	Program/Course: S.Y.BSc.	Division:
Academic year: 2025 - 2026	Semester: III	Total Lectures: 45
Credits: 3		
Course Objectives: • To understand the preparation of aromatic compounds, organic halides, alcohols, phenols and carbonyl compounds. • To study the reactions of aromatic compounds, organic halides, alcohols, phenols and carbonyl compounds. • To understand scope and importance of analytical chemistry and to interpret steps involved in chemical analysis. • To study concepts of data analysis for determining central tendency and dispersion. • To study classical methods of analysis inclusive of principles and instrumentation of UV – Visible spectrophotometry and solvent extraction.		
Expected Course Outcome: At the end of the course students will be able to: CO1: state and explain fundamental concepts, definitions, and reactions related to key organic compounds and analytical techniques including gravimetric and titrimetric analysis, solvent extraction, and UV-Visible spectroscopy. CO2: describe the basic principles, preparation methods, and reactions of key organic compounds, and describe the fundamental concepts of analytical techniques such as gravimetric and titrimetric analysis, solvent extraction, and UV-Visible spectroscopy. CO3: apply the concepts of organic chemistry to synthesize and solve problems related to the preparation and reactions of key organic compounds, to apply analytical procedures, statistical tools, spectroscopic methods to perform qualitative and quantitative analysis of chemical substances and analytical techniques. CO4: analyze the chemical behavior of major organic functional groups and apply analytical techniques to interpret data, evaluate accuracy and precision, and differentiate instrumental and classical approaches in chemical analysis.		
Learning Outcome: At the end of the course students will be able to: LO1: define and explain fundamental concepts and reactions of key organic compounds, and describe basic analytical techniques such as		

gravimetric analysis, titrimetric analysis, solvent extraction, and UV-Visible spectroscopy.

LO2: describe the methods for the preparation and reactions of selected organic compounds and explain the theoretical basis of analytical methods including gravimetric and titrimetric techniques, solvent extraction, and UV-Visible spectroscopy.

LO3: apply knowledge of organic synthesis and reaction mechanisms to solve problems, and carry out analytical experiments using classical and instrumental methods. Use statistical tools to interpret qualitative and quantitative data accurately.

LO4: analyze the behavior of organic functional groups in chemical reactions and interpret data from analytical techniques to evaluate the accuracy, precision, and suitability of classical versus instrumental analysis methods.

Month	Lectures From	Lectures To	No. of lectures allotted	Topic, Subtopic to be covered	Exercise /Assignment	ICT Tools	Reference books
June	20-06-2025	30-06-2025	05	1. Aromatic hydrocarbons: Preparation (case benzene): from phenol, from acetylene. Reactions: (case benzene): electrophilic substitution: nitration, halogenation and sulphonation. Friedel-Craft's reaction (alkylation and acylation): Preparation of toluene, ethylbenzene, isopropylbenzene, acetophenone, propiophenone, butyrophenone, n-propylbenzene, n-butylbenzene, t-butylbenzene, isobutylbenzene.		Smart board, Power point presentation, Google classroom	[1-5]
July	01-07-2025	08-07-2025	02	1. Aromatic hydrocarbons: Side chain oxidation of following alkyl benzenes to benzoic acid: Toluene, ethylbenzene, isopropylbenzene. o-xylene to phthalic acid, p-xylene to terephthalic acid.		Smart board, Power point presentation, Google classroom	[1-5]
July	01-07-2025	24-07-2025	07	2. Alkyl and Aryl Halides: Alkyl Halides: IUPAC Nomenclature (examples upto 5 Carbons), Preparation: from alkenes and alcohols. Reactions: hydrolysis, nitrite & nitro formation. Types of Nucleophilic Substitution (SN1 & SN2) reactions (mechanism without stereochemistry). Aryl Halides: Preparation: (chloro, bromo and iodobenzene): Sandmeyer reaction. Reactions (Chlorobenzene): Aromatic nucleophilic substitution SNAr-mechanism (replacement by – OH group to give phenol and effect of nitro substituent). Benzyne Mechanism: KNH ₂ /NH ₃ (or NaNH ₂ /NH ₃).		Smart board, Power point presentation, Google classroom	[1-5]
July	25-07-2025	31-07-2025	03	3. Alcohols, Phenols, Ethers and Carbonyl Compounds: Alcohols: IUPAC Nomenclature (examples upto 5 Carbons), Preparation of 1°, 2° and 3° alcohols: using Grignard reagent			[1-5]
August	01-08-2025	11-08-2025	05	3. Alcohols, Phenols, Ethers and Carbonyl	ISA I	Smart	[1-5]

				Compounds: Preparation of 1°, 2° and 3° alcohols: using Grignard reagent, Ester hydrolysis, Reduction of aldehydes, ketones, Reactions: With sodium, HX (Lucas test), esterification, oxidation (with PCC, alk. KMnO₄). Phenols: Preparation: Cumene hydroperoxide method, from diazonium salts. Reactions: Electrophilic substitution: nitration, halogenation and sulphonation. Ethers (aliphatic and aromatic): Williamson's synthesis of ethers. Cleavage of ethers with HI. Aldehydes and ketones (aliphatic and aromatic): (acetaldehyde, acetone, benzaldehyde and acetophenone) Preparation: from alcohols and acid chlorides. Reactions—with HCN, ROH, NH₃, 2,4-DNP, NH₂OH, Iodoform test. Aldol condensation-only reaction for preparation of chalcone.		board, Power point presentation, Google classroom	
August	11-08-2025	28-08-2025	08	4. Introduction to analytical techniques: Chemical analysis and analytical chemistry, Scope and importance of analytical chemistry, Classification of instrumental methods, analytical process (steps involved in chemical analysis): defining the problem, sampling, separation of desired components, actual analysis, presentation and interpretation of results. 5. Evaluation of analytical data Errors: Classification of errors - determinate and indeterminate error, constant and proportionate errors, absolute and relative error, correction and minimization of errors. Accuracy and precision, determination of accuracy in terms of relative error. Measures of central tendency and dispersion – Mean, Median, Mode, Range, Relative Deviation, Average Deviation, Relative Average		Smart board, Power point presentation, Google classroom	[6-9]

				Deviation (RAD), Standard deviation, Variance and Coefficient of variance.			
August	29-08-2025	31-08-2025	01	5. Evaluation of analytical data Errors: Significant figures and rounding off, Significance of zero in computation, Rules of computation. (Numericals to be solved)		Smart board, Power point presentation, Google classroom	[6-9]
September	01-09-2025	19-09-2025	09	6. Classical methods of analysis: Principles of gravimetric analysis: precipitation, coagulation, peptization, coprecipitation, post precipitation, digestion, filtration and washing of precipitate, drying and ignition. Principles of titrimetric analysis: Theories of acid-base, redox (including iodometric/iodimetric), complexometric, and precipitation titrations - choice of indicators for Acid base titrations. 7. Solvent Extraction: Basic Principle, percentage extraction (derivation not required), role of complexing agents in solvent extraction, separation factor, types of extraction (batch, continuous, counter current),	ISA II	Smart board, Power point presentation, Google classroom	[6-9]
September	20-09-2025	30-09-2025	05	8. UV-Visible Spectroscopy: Interaction of electromagnetic radiation with matter, Beer's and Lambert's law, derivation of Beer-Lambert's law, deviations from Beer's law, Quantitative calculations. Principles of instrumentation: Sources, monochromators, cells. Types of instruments: Photoelectric colorimeters and Spectrophotometers: Single & Double beam; comparison		Smart board, Power point presentation, Google classroom	[6-9]
October	01-10-2025	18-10-2025	07	Revision	ISA III	Smart board, Power point presentation, Google classroom	

References:

- [1] Graham Solomons, T.W., Fryhle, C.B. and Snyder, S. A., Organic chemistry, 12th ed., John Wiley & Sons, UK, 2016.
- [2] McMurry, J., Fundamentals of organic chemistry, 7th ed., Cengage Learning India Edition, Noida, India, 2013.
- [3] Sykes, P., A guide book to mechanism in organic chemistry, 6th ed., Longman Scientific & Technical, England, UK, 1985.
- [4] Morrison, R.T., Boyd, R.N. and Bhattacharjee, S. K., Organic Chemistry, 7th ed., Pearson, Bangalore, India, 2010.
- [5] Bahl, A. and Bahl, B. S., Advanced Organic Chemistry, S. Chand, New Delhi, India, 2012.
- [6] B. K. Sharma. Instrumental Methods of Chemical Analysis, 5th ed. Goel Publishing House, Meerut. 2004.
- [7] K. Raghuraman, D. V. Prabhu, C. S. Prabhu and P. A. Sathe, Basic principles in Analytical Chemistry, 5th edition, Shet Publications Pvt. Ltd.
- [8] G. Chatwal and S. Anand, Instrumental Methods of Chemical Analysis, 5th edition Himalaya publication. 2003.
- [9] H. Willard, L. Meritt and J.A. Dean. Instrumental Methods of Analysis, 7th edition, HCBs publication. 2004.

* Assessment Rubrics	
Component	Max Marks
ISA	15
Practical	25
Semester End Exam	60