

SANKALCHAND PATEL UNIVERSITY, VISNAGAR

Faculty of Science and Humanities



**Structure, Teaching Scheme and Syllabus of
B.Sc. (Honours and Honours with Research) Chemistry
Semester- VII
as per NEP 2020
Program Code: SC103
With effect from: 2023-24**

Branch Name:	B.Sc. Chemistry
Program Code:	SC103
Course Name:	Organometallic Chemistry
Course Code:	17-CHM401-4C
Pre-requisite Course:	-

Course Objectives:

- The objective of the course is to appraise the students about the organometallic Chemistry.
- To learn about the 18 e⁻ rule and its violation.
- To learn about synthesis, structure, bonding and application aspects metal-organic framework.
- To develop an appreciation for the scope, diversity, and application of organometallic chemistry.
- To learn about the common organometallic reactions and to be able to draw reasonable reaction mechanisms.

Teaching and Examination Scheme:

Teaching Scheme (Hours per week)				Evaluation Scheme (Marks)				
Lecture (L)	Tutorial (T)	Practical (P)	Credit	Theory (Marks)		Practical (Marks)		Total (Marks)
				University Assessment	Continuous Assessment	University Assessment	Continuous Assessment	
3	--	2	4	50	25	-	25	100

Subject Contents:

Sr. No	Topic	Total Hours	Weightage
1	Organometallic compounds Definition, classification, 18 e ⁻ rule for O.M.C, Grignard reagents, Organolithium compounds, Organocopper compounds, Organozinc compounds, Organosilicon compounds, Organomercury compounds, Organopalladium compounds, Organoiron compounds.	15	33%
2	Reactions of organometallic compounds Introduction, Oxidative-addition reaction, Reductive-elimination reaction, Insertion reaction. Homogeneous catalysis: General features, types & catalytic steps, Hydrogenation of alkenes, Ziegler-Natta polymerization of alkenes, The Wacker process, Monsanto acetic acid synthesis, Water-gas shift reaction, The Fischer-Tropsch synthesis.	15	34%
3	Metal clusters Introduction, Carbonyl cluster: Low nuclearity carbonyl clusters, High nuclearity carbonyl clusters, Electro counting scheme for HnCCs, Wade rules. Halide type cluster: Dinuclear clusters, Trinuclear clusters, Tetranuclear clusters, Hexanuclear clusters. Chabrel phases and Zintl ions, carboranes, metalloboranes, Metallocarborane.	15	33%

Text Books:

1. Organometallic & Bioinorganic chemistry by Ajai Kumar, Aaryush aducation.

Reference Books:

1. Organometallic Compounds by Indrajit Kumar, Pragati Prakashan.
2. Organometallic & Bioinorganic chemistry by Ajai Kumar, Aaryush aducation.
3. A Logical approach to Modern Organic Chemistry by Jagdamba singh & S. Anandvardhan, A Pragati prakashan

List of Open Source Software/learning website:

1. https://youtu.be/8XF6xWaGxHY?si=3VzaXbuSc_Mk2Dx6

List of Experiments:

Sr.No	Practical Exercise
1.	Qualitative analysis (Minimum 6) Inorganic mixture should be comprised of six radicals. Candidate if required should be guided once for the wrong group and marks deducted for wrong group. Maximum of five marks can be deducted for wrong group. There shall be no deduction of marks for reporting wrong radicals

Course Learning Outcomes (CLO): On completion of this course, the students will be able to:

CLO	Description	Bloom's Taxonomy Level
CLO1	To understand terminology, classification and some concepts about organometallic compounds	1.Remembering 2.Understanding
CLO2	To understand chemistry of different types of organometallic compounds.	2.Understanding
CLO3	To understand and analyse reactions of organometallic compounds.	2.Understanding 4.Analyzing
CLO4	To understand metal clusters including Carbonyl cluster and Halide type clusters.	2.Understanding
CLO5	To gain knowledge about Chevrel phases and Zintl ions and different types of boranes.	2.Understanding 3.Applying

Mapping of CLO with PO and PSO:

Course Learning Outcomes	Program Outcomes (POs)																PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	1	2
CLO1																	1	1
CLO2														1			1	2
CLO3	1	1				2								1			2	3
CLO4																	1	1
CLO5		1				1											2	1

3:High, 2:Medium, 1:Low

Branch Name:	B.Sc. Chemistry
Program Code:	SC103
Course Name:	Advance Chromatography
Course Code:	17-CHM402-4C
Pre-requisite Course:	-

Course Objectives:

- To demonstrate practical skills in operating advanced chromatographic instruments and handling real-world samples from pharmaceutical, environmental, biochemical, and industrial sources.
- To integrate chromatography with hyphenated techniques (GC–MS, LC–MS, and HPLC–DAD) for advanced structural and trace-level analysis.
- To interpret chromatographic data, including retention time, resolution, efficiency, selectivity, and peak symmetry, for qualitative and quantitative analysis.
- Students can apply knowledge of mobile phase selection, stationary phases, detectors, and column chemistry to optimize chromatographic separations.

Teaching and Examination Scheme:

Teaching Scheme (Hours per week)				Evaluation Scheme (Marks)				
Lecture (L)	Tutorial (T)	Practical (P)	Credit	Theory (Marks)		Practical (Marks)		Total (Marks)
				University Assessment	Continuous Assessment	University Assessment	Continuous Assessment	
3	--	2	4	50	25	-	25	100

Subject Contents:

Sr. No	Topic	Total Hours	Weightage
1	Gas Chromatography GC principle, theory, instrumentation applications and advantages, types of columns, packed columns, Capillary columns, Bonded phase columns, detector types and applications in pharmaceutical analysis.	15	33%
2	Liquid chromatography-mass spectrometry LC-MS Principle, theory, instrumentation and applications of liquid chromatography-mass spectrometry (LC-MS) and its comparison with Mass Spectroscopy.	15	34%
3	Supercritical fluid chromatography SFC Principle, theory, instrumentation and applications of supercritical fluid chromatography (SFC) and its comparison with HPLC.	15	33%

Text Books:

1. A Textbook of Chromatography by Rajbir Singh
2. Instrumental methods of chemical analysis by B. K. Sharma, GOEL publishing house, Meerut, 2005

Reference Books:

1. Analytical Chemistry by Gurdeep Chatwal(Author), Himalaya Publishing House (Contributor), Mahu Arora(Editor), 2019
2. Sethi's HPLC High Performance Liquid Chromatography: Quantitative Analysis of Pharmaceutical Formulations, Volume 5 by P.D. Sethi, 28 February 2015

List of Open Source Software/learning website:

1. <https://epgp.inflibnet.ac.in/Home/ViewSubject?catid=1+p0z2ZbAGSfsyflITzgZQ==>
2. <https://www.youtube.com/playlist?list=PLAFyoFAPvecDImcggKOS8K4P5bV-aFu5y>

List of Experiments:

Sr.No	Practical Exercise
(A)	Add mixture (any 3)
(B)	Water analysis (any 3)

Course Learning Outcomes (CLO): On completion of this course, the students will be able to:

CLO	Description	Bloom's Taxonomy Level
CLO1	Recall the basic terminology, components, and working principles of Gas Chromatography.	1. Remembering
CLO2	Explain the fundamental principles of Gas Chromatography, including partitioning behaviour, retention mechanism, and factors affecting separation.	2. Understanding 3. Applying
CLO3	Explain the working principles of LC–MS, including the role of liquid chromatography in separation and mass spectrometry in detection and identification.	2. Understanding
CLO4	Analyze LC–MS data by interpreting chromatograms, mass spectra, molecular ions, and fragmentation patterns.	2. Understanding 4. Analyzing
CLO5	Recall the basic concepts, terminology, and components of Supercritical Fluid Chromatography, including the properties of supercritical CO ₂ .	1. Remembering 2. Understanding

Mapping of CLO with PO and PSO

Course Learning Outcomes	Program Outcomes (POs)																PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	1	2
CLO1					1												1	2
CLO2	1					1											1	2
CLO3	1					2				1							2	3
CLO4	1				1	2				1							1	3
CLO5										1							1	2

3:High, 2:Medium, 1:Low

Branch Name:	B.Sc. Chemistry
Program Code:	SC103
Course Name:	Chemistry of Natural Products
Course Code:	17-CHM403-4C
Pre-requisite Course:	-

Course Objectives:

- The objective of the course is to appraise the students about the Chemistry of Natural Products.
- Students will be able to classify and explain the chemistry, biogenesis, and structural features of alkaloids and relate them to their natural sources and significance.
- To develop understanding of the chemical structures, properties, and biological roles of vitamins and hormones.
- To highlight the biological, medicinal, and pharmaceutical importance of natural products.

Teaching and Examination Scheme:

Teaching Scheme (Hours per week)				Evaluation Scheme (Marks)				
Lecture (L)	Tutorial (T)	Practical (P)	Credit	Theory (Marks)		Practical (Marks)		Total (Marks)
				University Assessment	Continuous Assessment	University Assessment	Continuous Assessment	
3	--	2	4	50	25	-	25	100

Subject Contents:

Sr. No	Topic	Total Hours	Weightage
1	Alkaloids Classification of alkaloids, General biogenetic study of alkaloids, Chemistry and Structure elucidation of Papavarine, Reserpine, Conine, Narcotine, Strychnine and Colchicine.	15	33%
2	Vitamins & Hormones Introduction of Vitamins, Detailed Study of Chemistry of Vitamin A, Thiamine (Vitamin-B1), Pantothenic Acid (Vitamin-B2), Pyridoxine (Vitamin-B6), Ascorbic Acid (Vitamin-C) and Biological importance of Vitamins. Introduction of Hormones, Types of Hormones: Classification based on chemical structure (steroid hormones, peptide hormones, and amino acid-derived hormones)	15	34%
3	Terpenoids & Flavonoids Introduction, Classification, Chemistry of Abietic Acid, Squalene, Phytol, Cadinene, Zingiberene. Introduction to flavonoids, classification, Biosynthesis study of anthocynins, flavanols, flavones and isoflavones.	15	33%

Text Books:

1. Natural Product by O. P. Agrawal, vol. 1 & 2.

Reference Books:

1. Organic Chemistry volume 2 Stereochemistry and the Chemistry of Natural Products, 5th edition, I. L. Finar, Pearson
2. Organic Chemistry of Natural Product by G. R. Chatwal, Vol. 1 & 2.

List of Open Source Software/learning website:

1. https://youtube.com/playlist?list=PLDjIJRH6sIC6FGU6bER5_haD8_6Glsbbu&si=7DV_iFEF3G5jBG0-
2. https://youtube.com/playlist?list=PLDjIJRH6sIC6FKUDAJ1SjY35_VHgZffON&si=nDRpfdciNKk1CmhI

List of Experiments:

Sr.No	Practical Exercise
1.	Functional group estimation (Minimum 3)
2.	Natural Product Isolation (Minimum 3)

Course Learning Outcomes (CLO): On completion of this course, the students will be able to:

CLO	Description	Bloom's Taxonomy Level
CLO1	Learn and understand to define and classify alkaloids, vitamins, hormones, terpenoids, and flavonoids based on their chemical nature and sources.	1.Remembering 2.Understanding
CLO2	To Understand the chemistry, structure, and biological importance of major alkaloids, vitamins, hormones and biological importance of major vitamins and hormones, including their classification based on chemical nature.	2.Understanding
CLO3	To apply knowledge of chemical structures to identify and relate natural products with their biological functions.	3.Applying
CLO4	To learn the analyze structure–function relationships and biosynthetic pathways of terpenoids and flavonoids with suitable examples.	2.Understanding 4. Analyzing
CLO5	To evaluate the significance of natural products in biological systems and pharmaceutical applications.	2.Understanding 3.Applying 5. Evaluating

Mapping of CLO with PO and PSO

Course Learning Outcomes	Program Outcomes (POs)																PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	1	2
CLO1																	3	2
CLO2		1															1	1
CLO3	1	2															1	2
CLO4	2	1			2												1	3
CLO5			1														1	1

3:High, 2:Medium, 1:Low

Branch Name:	B.Sc. Chemistry
Program Code:	SC103
Course Title:	Industrial Chemistry-I
Course Code:	17-CHE401-4C
Pre-requisite Course:	Basic Chemistry up to T.Y.B.Sc.

Course Objectives:

- To meet the growing demand of advanced Courses in Industrial chemistry.
- To help the colleges to update and modernize their laboratories.
- To redesign the courses, the special emphasis on local requirements, environment, to link the courses with requirements of the industries and research.

Teaching and Examination Scheme:

Teaching Scheme (Hours per week)				Evaluation Scheme (Marks)				
Lecture (L)	Tutorial (T)	Practical (P)	Credit	Theory (Marks)		Practical (Marks)		Total (Marks)
				University Assessment	Continuous Assessment	University Assessment	Continuous Assessment	
3	-	2	4	50	25	-	25	100

Course Contents:

Unit	Topic	Total Hours	Weightage
1	Unit Processes in manufacturing of Organic Chemicals-I Nitration: Introduction, nitrating agents, mechanism and nitration of paraffin hydrocarbons - benzene to nitrobenzene, m-dinitrobenzene, chlorobenzene to o- & p-nitro chlorobenzenes. Acetanilide to p-nitro acetanilide, toluene, continuous Vs batch nitration. Halogenation: Introduction, reagents for halogenations, halogenations of aromatics side chain and nuclear halogenations, commercial manufacture of chlorobenzene, chloral, monochloroacetic acid and chloromethanes	15	34%
2	Unit Processes in manufacturing of Organic Chemicals-II Alkylation: Introduction, types of alkylation, alkylating agents, mechanism of alkylation reactions, manufacture of phenyl ethyl alcohol and ethyl benzene. Sulphonation: Introduction, sulphonating agents, chemical and physical factors in sulphonation, mechanism of sulphonation, commercial sulphonation of benzene, naphthalene, alkyl benzene, batch Vs continuous sulphonation.	15	33%
3	Unit Processes in manufacturing of Organic Chemicals-III Oxidation: Introduction, types of oxidation reactions, oxidizing agents, mechanism of oxidation, liquid phase oxidation and vapor phase oxidation, commercial manufacture of benzoic acid, maleic anhydride, phthalic anhydride, acetaldehyde, acetic acid. Esterification: Introduction, Hydrodynamics and kinetic of Esterification Reactions, Esterification by organic acids, Esterification of carboxy acid derivatives, Commercial manufacture of Ethyl acetate.	15	33%

Text Books:

1. A Textbook of Industrial Chemistry · by Dr. Farooqui Maqdoom

Reference Books:

1. Chemical Process Principles: (Part I), Haugen, Watson and Regatz (Asia Pub. House).
2. Chemistry of Engineering Materials by C. V. Agrawal (Tara Publication).
3. Industrial chemistry by B. K. Sharma (Goel publishing House)

List of Open-Source Software/learning website:

1. https://prsuniv.ac.in/Syllabus/BSC_Industrial_Chemistry.pdf

List of Experiments:

Sr.No	Practical Exercise
•	Preparation (Nitration, sulfonation, halogenations)
1.	Preparation of m-Dinitro benzene from Nitrobenzene
2.	Preparation of 2,4,6-Tribromo aniline from Aniline [Liquid component must be neutral in nature]
3.	Sulfonation of naphthalene

Course Learning Outcomes (CLO): On completion of this course, the students will be able to:

CLO	Description	Bloom's Taxonomy Level
CLO1	Learn fundamentals of unit processes.	1.Remembering
CLO2	Understand basic concepts of nitration, halogenation, alkylation for manufacturing of chemicals.	2.Understanding 5.Evaluating
CLO3	Understand basic concept of sulphonation, oxidation, esterification for manufacturing of chemicals.	2.Understanding 5.Evaluating
CLO4	Students will demonstrate an advanced level of knowledge in industrial chemistry.	3.Applying

Mapping of CLO with PO and PSO

Course Learning Outcomes	Program Outcomes (POs)																PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	1	2
CLO1	1		2														3	1
CLO2		2					2										2	2
CLO3					1												2	3
CLO4													1				1	1

3:High, 2:Medium, 1:Low

Branch Name:	B.Sc. Chemistry
Program Code:	SC103
Course Name:	Surface Chemistry
Course Code:	17-CHE401-4O
Pre-requisite Course:	-

Course Objectives:

- The objective of the course is to gain a knowledge regarding Surface chemistry.
- To understand Types, Measurements and analyze Equations of Adsorption Isotherms.
- To understand Types, preparation, structure, properties and applications of emulsions.
- Students can gain knowledge about Colloidal electrolytes and Surfactants in detail.

Teaching and Examination Scheme:

Teaching Scheme (Hours per week)				Evaluation Scheme (Marks)				
Lecture (L)	Tutorial (T)	Practical (P)	Credit	Theory (Marks)		Practical (Marks)		Total (Marks)
				University Assessment	Continuous Assessment	University Assessment	Continuous Assessment	
3	--	2	4	50	25	-	25	100

Subject Contents:

Sr. No	Topic	Total Hours	Weightage
1	Interface Chemistry Introduction, Basic terms: Adsorption, Adsorbent, Adsorbate, Absorption, Sorption, Specific Surface area, Desorption, Difference between Adsorption and Absorption, Types of Adsorption, Characteristics of Chemisorption and Physisorption, Surface Tension, Curved Surfaces: The Laplace-Young equation, pressure across a spherical surface, Capillary action, Laplace equation, Vapour pressure of droplets: Kelvin equation, Surface films.	15	33%
2	Adsorption Adsorption of gases by solids, Measurements of Adsorption, Factors affecting adsorption, Types of adsorption curves, Equations of Adsorption Isotherms with limitations: 1) Freundlich adsorption isotherm, 2) Langmuir adsorption isotherm, 3) B.E.T isotherm, Heat of Adsorption, Applications of Adsorption.	15	33%
3	Micelles Emulsion, Types of Emulsions, Test for types of emulsions, preparation and structure of emulsions, properties of emulsions, breaking of emulsions, Emulsifiers, Micro-emulsions, Applications of Micro-emulsions, Electrokinetic effects, Zeta potential: measurements and importance, Colloidal electrolytes : Introduction, Classification & Types, Micellization, Reverse micelles, CMC, Surfactants : Introduction & Classification, Solubilization of Surfactant solutions.	15	34%

Text Books:

1. *A Text Book of Physical Chemistry*; A.S. Negi, S.C. Anand; New Age International (P) Limited, New Delhi, 2002
2. *Physical Chemistry*, Dr. R. L. Madan & G. D. Tuli, S. Chand publication

Reference Books:

1. *Advanced Physical Chemistry*, Gurtu-Gurtu, A Pragati Edition
2. *Advanced Physical Chemistry*, D.N.Bajpai, S.Chand.
3. *Physical Chemistry*, Walter J. Moori. 5th Edition

List of Open Source Software/learning website:

1. <https://onlinecourses.nptel.ac.in/>
2. <https://epgp.inflibnet.ac.in/Home/ViewSubject?catid=13G8VouhmrFfuhs6rkiyTA==>

List of Experiments:

Sr.No	Practical Exercise
	Distribution & partition co-efficient (any 2)
1.	To study the adsorption of acetic acid on charcoal and prove the validity of Freundlich's adsorption isotherm.
2.	To determine the value of distribution co-efficient of iodine between carbon tetrachloride and water at room temperature
3.	To determination the surface tension of ethanol with respect to water at room temperature by stalagmometer

Course Learning Outcomes (CLO): On completion of this course, the students will be able to:

CLO	Description	Bloom's Taxonomy Level
CLO1	To learn basic terms regarding Interface Chemistry	1.Remembering
CLO2	To understand different types of theories of interface chemistry.	2.Understanding
CLO3	To understand Types, Measurements and Factors affecting adsorption.	2.Understanding
CLO4	To understand and analyze Equations of Adsorption Isotherms	2.Understanding 4.Analyzing
CLO5	To study Types, preparation, structure, properties and applications of emulsions.	2.Understanding 3.Applying
CLO6	To understand Colloidal electrolytes and Surfactants in detail.	2.Understanding

Mapping of CLO with PO and PSO:

Course Learning Outcomes	Program Outcomes (POs)																PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	1	2
CLO1																	2	1
CLO2		1				1											2	1
CLO3										1							1	1
CLO4		1															1	1
CLO5						1											2	2
CLO6																	1	2

3:High, 2:Medium, 1:Low