

SANKALCHAND PATEL UNIVERSITY, VISNAGAR

Faculty of Science and Humanities



**Structure, Teaching Scheme and Syllabus of
B. Sc. (Chemistry) Honours with Research**

Sem-6 as per NEP 2020

Program Code: SC103

With effect from: 2023-24

Semester-6

Branch Name:	B.Sc. Chemistry
Program Code:	SC103
Course Title:	Coordination Chemistry
Course Code:	16-CHM304-3C
Pre-requisite Course:	-

Course Objectives:

- The students should be able to give the systematic names of simple coordination compounds.
- To explain the science of Coordination Compounds and the types of the ligands.
- To study and compare between the various theories of coordination.
- To study about various types of reaction mechanism, kinetics and thermodynamics possible in coordination chemistry.

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	Coordination Compounds: Introduction Introduction, Classification, Nomenclature, 18 e- rule, EAN rule for complexes, Electronic interpretation of co-ordination compounds, factors affecting the formation of complex ions, Isomerism, Chelation, factor influencing the stability of metal chelates, importance of complexation and chelates.	15	34%
2	Coordination Complexes: Bonding Theories Valence bond theory (VBT), Limitations of VBT, Molecular orbital theory (MOT), Crystal field theory (CFT), Ligand field theories (LFT), Magnetic properties of complexes, Ligand field stabilization energy (LFSE), Thermodynamic effects: Stability of complexes, Kinetic effects: Lability of complexes.	15	33%
3	Reaction Mechanism of Coordination Compounds Possible mechanism reactions, Substitution reaction of square planar complexes, Substitution reaction in octahedral complexes, Reaction of Platinum II complexes, the trans effect, theories of trans effect, use of synthesis in trans effect and analysis, Ligand displacement reaction in octahedral complexes, acid hydrolysis, Base hydrolysis, Electron transfer reaction, mechanism of redox reaction.	15	33%

Text Books:

1. Text Book of Coordination Chemistry - R. K. Sharma

Reference Books:

1. Coordination chemistry by D. Banerjee
2. Coordination by Ajai Kumar, 7th addition, 2020.

List of Open-Source Software/learning website:

1. <https://epgp.inflibnet.ac.in/Home/ViewSubject?catid=13G8VouhmrFfuhs6rkiyTA==>
2. <https://youtu.be/Yr9p8JS01tl?si=EPmOyN6qS4KZnQLv>

List of Experiments:

Sr.No	Practical Exercise
	Alloy
1.	Brass alloy ----- Zn (Gravimetric) and Cu (Volumetric)
2.	German silver alloy -----Ni (Gravimetric) and Cu (Volumetric)
3.	Bronze alloy -----Sn (Gravimetric) and Cu (Volumetric)
4.	Solder alloy-----Sn (Gravimetric) and Pb (Volumetric)
	Inorganic preparation (any 4)
5.	Ferrous Sulphate or Green vitriol ($\text{FeSO}_4 \cdot 7\text{H}_2\text{O}$)
6.	Sodium cobaltinitrate $\text{Na}_3 [\text{Co}(\text{NO}_2)_6]$
7.	Tetra amine cupric sulphate
8.	Hexa thio urea plubous nitrate
9.	Cuprous chloride

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

CLO	Description	Bloom's Taxonomy Level
CLO1	To understand basic term and classification of Coordination Compounds	1-Remembering 2-Understanding
CLO2	To understand deep knowledge about Chelation and its importance in complexes.	2- Understanding 3- Applying
CLO3	To understand basic principles and uses of different Bonding theories regarding complexes.	2-Understanding 4-Analyze
CLO4	To understand different types of Mechanism for reactions Coordination Compounds	2-Understanding 3- Applying
CLO5	To understand different types of Reaction of various complexes.	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										2							1	1
CLO4		1															3	2
CLO5						1											2	2

3:High, 2:Medium, 1:Low

Branch Name:	B.Sc. Chemistry
Program Code:	SC103
Course Title:	Stereochemistry
Course Code:	16-CHM305-3C
Pre-requisite Course:	Basic Chemistry up to S.Y.B.Sc.

Course Objectives:

- Students will learn and understand the fundamentals of stereochemistry
- Students will study nomenclature of optical isomers, recognize the difference between the enantiomers and diastereomers, meso compounds and their properties.
- Students will gain knowledge about general methods for resolution of racemates and also study the conformational analysis of cycloalkanes.

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	Fundamentals of stereochemistry Introduction, Isomerism, stereoisomerism, Representation of three-dimensional molecules (flying-wedge or wedge-dash projection, sawhorse formula, Newman projection and Fischer projection), Interconversions of projection and perspective formulae, Elements of symmetry (plane of symmetry, Centre of symmetry, Alternating axis of symmetry).	15	34%
2	Stereochemistry-I Nomenclature of optical isomers (D/L system, erythro and threo system, C.I.P or R/S Nomenclature), molecular chirality, optical activity (enantiomerism), enantiomers, diastereomers and their properties enantiomeric excess, diastereomeric excess and related examples, Prelog's rule and Cram's rule.	15	33%
3	Stereochemistry-II Racemates (Racemic mixture), General methods for the resolution of racemic mixtures (crystallization, diastereomer formation, chromatographic method and biological or enzymatic method) and conformational analysis of cycloalkanes.	15	33%

Text Books:

1. A textbook of stereochemistry, conformation, analysis and mechanism: By Sushil Chauhan.

Reference Books:

1. Stereochemistry of Organic Compounds: By V.K. Ahluwalia, 2022.
2. Stereochemistry: By R.K. Sharma.
3. Stereochemistry by D.Nasipuri, 2019.
4. Stereochemistry Conformation and Mechanism - P.S. Kalsi

List of Open-Source Software/learning website:

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

List of Experiments:

Sr.No	Practical Exercise
	Green Synthesis (Any 6)
1.	Synthesis of phthalimide from phthalic acid
2.	Synthesis of benzyl alcohol and benzoic acid from benzaldehyde
3.	Synthesis of 2,2'-dihydroxy-1,1'-binaphthyl
4.	Preparation of fluorescein
5.	Preparation of dibenzalacetone using benzaldehyde and acetone
6.	Hantzsch-1,4-dihydropyridine synthesis.
7.	Synthesis of 4-(4'-nitrobenzeneazo)-1-naphthol (Magneson-II)
8.	Synthesis of β -Resacetophenone (2,4-Dihydroxyacetophenone)

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

CLO	Description	Bloom's Taxonomy Level
CLO1	Learn basic concept of stereochemistry.	2 Understanding
CLO2	Understand and learn the nomenclature of optical isomers, recognize the different between the enantiomers and diastereomers, meso compounds and their properties	2 Understand 3 Applying
CLO3	Learn and predicts the stereochemistry of nucleophilic addition to carbonyl compounds with an adjacent chiral center.	2 Understanding 4 Analyze
CLO4	Understand and learn about general methods for the resolution of racemates and conformational analysis of cycloalkanes	2 understanding 3Applying
CLO5	Recognize the applications of stereochemistry in the synthesis of important industrial and pharmaceutical compounds.	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	1
CLO2	1	2				1											2	1
CLO3			1														3	2
CLO4	2	1			1												2	1
CLO5	1	2				2											2	3

3:High, 2:Medium, 1:Low

Branch Name:	B.Sc. Chemistry
Program Code:	SC103
Course Title:	Fundamental Chromatography
Course Code:	16-CHM306-3C
Pre-requisite Course:	-

Course Objectives:

- Separation techniques are the basis of instrumental analysis widely applied in industry, chemistry, biochemistry, environment science.
- These techniques are based on principles of chemistry. Therefore in this module student will study the principles on which these techniques are based and acquire the basic skills necessary to use the techniques.
- Techniques, with the emphasis on the application in chemistry, biochemistry. Understanding the principles of chromatographic

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	Chromatography-1 Introduction of chromatography, principle of separation, classification Theoretical Plates, HETP, Resolution, Capacity Factor, Selectivity Factor, Paper Chromatography (Principles, theory, preparation, purification and identification)	15	34%
2	Chromatography-2 Principles, theory, preparation, identification and Application of Thin Layer Chromatography, High performance Thin Layer Chromatography and Ion exchange Chromatography	15	33%
3	High performance liquid Chromatography HPLC Principle, theory, instrumentation applications and advantages of high performance liquid chromatography (HPLC) ,Types of detectors, types of pump	15	33%

Text Books:

1. A Textbook of Chromatography by Rajbir Singh

Reference Books:

1. Analytical Chemistry by Gurdeep Chatwal(Author),HimalayaPublishingHouse (Contributor), Mahu Arora (Editor), 2019
2. Principles of Instrumental Analysis”byDouglasA.Skoog,2020.
3. 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
1.	Paper chromatography (any 3)
2.	TLC (any 3)

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

CLO	Description	Bloom's Taxonomy Level
CLO1	Students learn about different types of Chromatography and how mixture separate using different chromatography	2.Understanding 3.applying
CLO2	Student describe about fundamental chromatography HETP and various parameters.	1.Remembering 2.Understanding
CLO3	The purpose of chromatography identifies to separate molecules based on differences in size, charge or polarity, And solubility.	4.Analyzing
CLO4	Understanding the HPLC principal and instrumentation and their application.	1.Remembring 3.applying
CLO5	New synthesis material observed and identifies using chromatography.	3. Applying 4.Analyzing

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			1	1
CLO2	2	2			2												2	2
CLO3	2																2	1
CLO4						2				1							2	3
CLO5						3											2	3

3:High, 2:Medium, 1:Low

Branch Name:	B.Sc. Chemistry
Program Code:	SC103
Course Title:	Thermodynamics chemistry
Course Code:	16-CHE303-3C
Pre-requisite Course:	-

Course Objectives:

- To provide basic ideas of chemical and statistical thermodynamics and their related aspects.
- To understand concept and applications of Partial Molar Properties & Fugacity.
- Identifying and formulating power production based on the fundamentals laws of thermodynamics

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	Concepts of laws of thermodynamics Terms used in chemical thermodynamics, Zeroth law of thermodynamics, State: First law of thermodynamics, spontaneous and non-spontaneous process, Reversible and irreversible process, Second law of thermodynamics, Nernst heat theorem, Third law of thermodynamics, Comparison of Nernst heat theorem with third law of thermodynamics, Concept of entropy.	15	34%
2	Partial Molar Properties & Fugacity Partial molar properties, Concept of chemical potential, Expression of dE , dH , dA , and dG for multicomponent open system, Variation of chemical potential with temperature and pressure, Chemical potential of a mixture of ideal gases, Application of chemical potential, Gibbs-Duhem equation, Gibbs Duhem-Margules equation, Concept of fugacity, Determination of fugacity, Fugacity of solids and liquids, Fugacity of a gas in mixture.	15	33%
3	Statistical Thermodynamics Introduction, Probability, Fundamentals of statistical methods, Thermodynamic probability, Sterling's theorem, Partition function: Partition function and thermodynamic functions, Translation partition function, Rotational partition function, Vibrational partition function, Types of statistics: 1) Maxwell-Boltzmann statistics, 2) Bose-Einstein statistics, 3) Fermi-Dirac statistics	15	33%

Text Books:

- 1) A Text Book of Physical Chemistry; A.S. Negi, S.C. Anand; New Age International (P) Limited, New Delhi, 2002

Reference Books:

- 1) Advanced Physical Chemistry, Gurtu-Gurtu, A Pragati Edition
- 2) Advanced Physical Chemistry, D.N. Bajpai, S.Chand.

List of Open-Source Software/learning website:

1. <https://epgp.inflibnet.ac.in/Home/ViewSubject?catid=13G8VouhmrFfuhs6rkiyTA==>
2. https://onlinecourses.nptel.ac.in/noc23_me65/preview
3. <https://www.youtube.com/playlist?list=PL0s3O6GgLL5fsCIx935erCDBWzMtiRAjg>

List of Experiments:

Sr.No	Practical Exercise
1.	To determine the heat of solution of organic acid (benzoic acid) by finding the solubility of the acid at two different temperature procedure.
2.	To determine the heat of solution of organic acid (phthalic acid) by finding the solubility of the acid at two different temperature procedure.
3	To determine the heat of solution of organic acid (cinnamic acid) by finding the solubility of the acid at two different temperature procedure.

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

CLO	Description	Bloom's Taxonomy Level
CLO1	To learn and understand concepts of laws of thermodynamics.	1-Remembering 2- Understanding
CLO2	To understand the concept of chemical potential and its related theories.	2- Understanding
CLO3	To understand the concept of fugacity along with application.	2-Understanding 3- Applying
CLO4	Understand the concept of distribution and thermodynamic probability.	1-Remembering 2- Understanding
CLO5	Evaluate most probable distribution state for all type of statics i.e. for Maxwell Boltzmann, Fermi dirac and Bose–Einstein statistics.	2-Understanding 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																	2	2
CLO2	1	1															2	1
CLO3	1	2			1	2											3	2
CLO4		1			1												1	1
CLO5	1	2				1											2	1

3:High, 2:Medium, 1:Low

Branch Name:	B.Sc. Chemistry
Program Code:	SC103
Course Title:	Dyes and Pigments
Course Code:	16-CHE303-30
Pre-requisite Course:	-

Course Objectives:

- To understand difference between dyes and pigments and their application.
- To learn and analyze different effects of regarding colors.
- To learn how dyes are synthesized.
- The primary goal of this course is to make students aware of how chemical process of making dyes can be designed, developed and employed.

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	Introduction Of Dyes Introduction: Dyes, Chromospheres, Chromogens, Oxochroms, Bathochromic shift, Hypsochromic shift, colour and constitution-Witt's theory, Classification of Dyes: According to constitution & According to method of applications, chemistry of dyeing,	15	34%
2	Synthesis And Uses Methyl orange, malachite green, Rosaniline, Congo Red, Eosin, Alizarin, Crystal violet, Indigo, Phenolphthalein, Methylene Blue, Ereochrom Black-T	15	33%
3	Pigments Definition of pigments, examples, properties of pigments, difference between dyes and pigments Lakes and Toners, classification of pigments(natural & synthetic pigment) , advantage & Disadvantage of pigments	15	33%

Text Books:

1. A Textbook of Synthetic Dyes Book by O. D. Tyagi & M. Yadav

Reference Books:

1. Synthetic Dyes by Venkatramanan
2. Synthetic Dyes by G.R.Chatwal & Anand
3. Synthetic Dyes and Drugs by O.P.Agrawal
4. Chemistry of synthetic dyes by I.G.Vashi
5. Industrial chemistry by B.K.Sharma (sixth edition-2011)

List of Open-Source Software/learning website:

1. <https://swayam.gov.in>
2. <https://nptel.ac.in>
3. <http://onlinelibrary.wiley.com>
4. https://en.wikipedia.org/wiki/Main_Page

List of Experiments:

Sr.No	Practical Exercise
	Preparation dyes (any 3)
1.	Preparation of congo red dye from naphthionic acid via hydrozobenzene.
2.	Preparation of eosin from phthalic acid via phthalic anhydride and fluorescein.
3.	Preparation of malachite green dye.
4.	Preparation of Phenolphthalein.
5.	Preparation of methyl orange.

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

CLO	Description	Bloom's Taxonomy Level
CLO1	To Understand the basic concepts and classification of dyes.	1-Remembering
CLO2	To learn different concepts of colours including chromophores, chromogens, and the Witt's theory of color and constitution.	2- Understanding 4- Analyzing
CLO3	To Learn proficiency in synthesizing key dyes like and comprehend their applications in various industries such as textiles and pharmaceuticals.	2- Understanding 3- Applying
CLO4	To understand differences between dyes and pigments, and analyze the advantages and disadvantages of pigments in various applications.	2- Understanding 3- Applying
CLO5	To learn the pigments and its examples. They will also be able to analyze how these processes contribute to enhancing stability and color intensity in dyed materials.	4- Analyzing

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		2			1												3	1
CLO3	2	1				2											1	3
CLO4						1											2	2
CLO5	1	2															2	2

3:High, 2:Medium, 1:Low

Branch Name:	B.Sc. Chemistry
Program Code:	SC103
Course Name:	Advanced English
Course Code:	16-AEC301-3C
Pre-requisite Course:	Basics English Grammar and Composition up to T.Y. B.Sc.

Course Objectives:

- To inculcate human values among the students through poems and prose.
- To create an interest in literature and to develop language skills.
- The students will become familiar with formal vocabulary that is common in academic texts.

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	
2	--	--	2	25	25	--	--	50

Unit	Contents	Total Hours	Weightage (%)
1	VOCABULARY&GRAMMARLINK Review of Confusing Words, Simple- Compound and Complex Sentences.	9	30
2	SPEAKING Group Discussion Group discussion as a part of selection process, group behavior & leadership Potential, Tips for Effective group discussion. Group Discussion (GD) Topics on Current Affairs The New Education Policy (NEP): Challenges in Implementation, India's Space Missions: From Chandrayaan to Gaganyaan, India's Role in G20 Leadership: Achievements and Challenges	6	20
3	READING&WRITING Writing Portion Essay Writing: Electric Vehicles: The Future of Transportation, The Role of Artificial Intelligence in Shaping the Future, Impact of Western Culture on Indian Youth, How Technology is Transforming Education Unseen Passages/Comprehension Texts from journals, newspapers, research articles, and essays.	6	20
4	TEXT Catalyst-Lesson 6 to 10	9	30

Text Books:

- Catalyst-Text Book,2020
- Easy to learn English grammar by Dr.Jayesh Patel,2021

Reference Books:

- Very Useful Verbs book (Enka Publication)2021
- Contemporary English Grammar Structure & Composition,2020
- Murphy R. Intermediate English Grammar(New Delhi: Cambridge University)2019

List of Open Source Software/learning website:

- englishpage.com

- epaper.timesofindia.com
- epaper.indianexpress.com
- <https://www.youtube.com/watch?v=QdAgnYD4xhY>

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

CLO	Description	Bloom's Taxonomy Level
CLO1	Describe how public speaking can be used to advocate or create change	1 Remembering
CLO2	Explain the goals and benefits of public speaking	2 Understanding
CLO3	Use parallel structures correctly and effectively.	3 Applying
CLO4	Identify strategies for researching and supporting a speech	4 Analyzing
CLO5	Recognize when to use visual aids	3 Applying
CLO6	Describe how public speaking can be used to advocate or create change	6 Creating

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		1		2			1				1			
CLO2			2	3	2	1	2			2	1	2						
CLO3			1	2				2	1						2			
CLO4							1				1							
CLO5					1		1			2		1			1			
CLO6			1															

3:High, 2:Medium, 1:Low