### **DEPARTMENT OF CHEMISTRY**

#### PREAMBLE

**UG**: Programme Profile and the Syllabi of Courses Offered in Semester V Along with I and II Evaluation Components (With Effect from 2022 – 2025 Batch Onwards)

## **PROGRAMME PROFILE B.Sc., (Chemistry)**

**PROGRAMME SPECIFIC OUTCOMES** 

#### **PSO No.** Upon completion of these courses the students will be able to

- **PSO-1** Understand the concepts of theoretical and experimental aspects of chemistry
- **PSO-2** Explain the basic principles, definitions, structures, reactivity, mechanism and
- stereochemistry of the chemical reactions
- **PSO-3** Encourage the capability to synthesize, separate and characterize compounds using
- laboratory and instrumentation techniques
- **PSO-4** Solve problems in different branches of Chemistry
- **PSO-5** Developing employability skills and entrepreneurial skills enable the students to find Jobs in core-chemistry fields.
- **PSO-6** Develop research oriented skills

Make use of the chemistry oriented theoretical and practical knowledge in securing

**PSO-7** a successful career such as chemist, analytical chemist and nanotechnologist and to pursue higher studies

					Pervious	Contact	Credits
Semester	Part	Category	Course code	<b>Course Title</b>	course code	Contact Hrs/ Week 5 5 5 5 4 3 3 3 3	Min/Max
		Languages/AECC-II	UTAL107/	Basic Tamil-I/	UTAL103/		
	т	Tamil/	UTAL108/	Advanced Tamil-I/	UTAL104	5	2/4
	1	Hindi/	UHIL101/	Hindi-I/		5	3/4
		French	UFRL101	French-I			
				English for Communication		5	
	п	English/AECC I	UENL109/	(Stream – I)/			3/4
	11	English/AECC-I	UENL110	English for Communication			
				(Stream – II)			
Ι		Core I/ DSC-I	UCHM109	Inorganic Chemistry-I	-	5	5
		Core II/ DSC-II	UCHM111	Analytical Chemistry	-	4	4
		Core Practical I/	UCUD101	Inongonia Dreatical	-	2	2
			DSC Practical-I	UCHKIUI	morganic Fractical		5
		Allied I/GE	UPHA102	Allied Physics - I	-	3	2
		Allied Practical I/GE		Allied Dhysics Practical I	-	2	C
		Practical-I	UPHKI05	Alled Flysics Flactical-I		5	Z
		Core III/ DSC-III	UPEM101	Professional English I		6	4
	IV	Value Education				2	1
					Tota	36	26/28

	I	Languages/AECC-II Tamil/ Hindi/ French	UTAL207/ UTAL208/ UHIL201/ UFRL201	Basic Tamil-II/ Advanced Tamil-II/ Hindi-II/ French-II	UTAL203/ UTAL204	5	3/4
	П	English/AECC-I	UENL209/ UENL210	English for Communication (Stream – I)/ English for Communication (Stream – II)		5	3/4
		Core IV/ DSC-IV	UCHM203	Organic Chemistry-I		5	5
II		Core V/ DSC-V	UCHM205	Nuclear & Radiation Chemistry	-	3	3
		Core Practical II/ DSC Practical II	UCHR206	Organic Practical	-	3	2
		Allied II/GE	UPHA201	Allied Physics II	-	3	2
		Allied Practical II / GE Practical II	UPHR202	Allied Physics Practical-II	-	3	2
		Core VI/ DSC-VI	UPEM201	Professional English II		6	4
	IV	NME			-	3	2
	V	Extension Programme/ Physical Education/NCC			-	-	1/2
					Total	36	27/30
	Ι	Languages/AECC-II Tamil/Hindi/French	UTAL307/ UTAL308/ UHIL301/ UFRL301	Basic Tamil-III/ Advanced Tamil-III/ Hindi-III/ French-III	UTAL303/ UTAL304	5	3/4
	П	English/AECC-I	UENL309/ UENL310	English for Communication (Stream – I)/ English for Communication (Stream – II)	UENL306	5	3/4
		Core VII/ DSC-VII	UCHM307	Physical Chemistry - I	-	4	4
111	III	Core VIII/ DSC-VIII	UCHM308	Electrochemistry	-	3	2
		Core Practical III / DSC Practical III	UCHR404/ UCHR405	Semi micro Qualitative Inorganic Analysis		3	-
		Allied/GE	UMAA304	Algebra, Differential Calculus and Trigonometry	-	5	4
	IV	Online Course		Online Course (NPTEL/ST)		3	1/2
	IV	Value Education				2	1
		value Education					

		Languages/AECC-II	UTAL407/	Basic Tamil-IV/	UTAL403/		
	т	Tamil/	UTAL408/	Advanced Tamil-IV/	UTAL404	=	2/4
	1	Hindi/	UHIL401/	Hindi-IV/		3	3/4
		French	UFRL401	French-IV			
				English for Communication	-/		
	п	English/AECC I	UENL409/	(Stream – I)/	UENL406	5	3/4
	- 11	Eligiish/AECC-I	UENL410	English for Communication		5	5/4
				(Stream – II)			
		Core IX/DSC-IX	UCHM407	Molecular Spectroscopy &	-	1	4
			001111407	Photochemistry		4	+
		Core X/ DSC-X	UCHM408	Research Methodology	-	3	2
IV	ш	Core Practical III /	UCHR404/	Semi micro Qualitative	-	3	4
		DSC Practical III	UCHR405	Inorganic Analysis		5	+
			UMAA406	Integral Calculus, Laplace	-		
		Allied/GE		Transform & Ordinary		5	4
				Differential Equation			
	IV	NME				3	2
		Soft skill	USKS401			2	1
		Extension Programme/					
	V	Physical				-	-/2
		Education/NCC					
					Total	30	23/27
		Core XI/ DSC-XI	UCHM510	Inorganic Chemistry – II	-	5	5
		Core XII/ DSC-XII	UCHM511	Organic Chemistry – II	-	5	5
		Core XIII/ DSC-XIII	UCHM512	Physical Chemistry –II	-	5	5
			UCHO501	Organometallics and Bio	-		
	III	Major Elective /		inorganic chemistry		5	4
V		DSE-I	UCHO502	Heterocyclic Chemistry		5	4
V			UCHO503	Organic Spectroscopy			
		Core Practical IV /	UCHR501	Gravimetric Analysis	-	3	2
		DSC Practical IV				-	_
		Core Practical V / DSC	UCHR605	Physical Chemistry	-	3	_
		Practical V		Practical			
		Core XIV/ DSC-XIV	UCHP501	Project	-	5	5
	IV	Value education				2	1
					Total	30	27
				La caronia Chamistan III	-	5	5
		Core XV/DSC-XV	UCHM014	Inorganic Chemistry III		5	3
		Core XVI/ DSC-XVI	UCHM615	Organic Chemistry III	-	5	5
		Core XVII/			-	-	-
		DSC-XVII	UCHM616	Physical Chemistry III		5	5
		Core XVIII/		Advanced Material		C	2
		DSC-XVIII	UCHM017	Chemistry		Z	Z
	III	Major Elective/	UCHO602	Polymer Chemistry	-		
VI		DSE-II	UCHO603	Medicinal Chemistry		5	4
, ,			UCHO604	Forensic Chemistry			
		Core Practical V / DSC	UCHR605	Physical Chemistry	-	3	2
		Practical V	0 01110000	Practical		5	
		Core Practical VI /	UCHR606	Organic Analysis and	-	3	2
		DSC Practical VI		Preparation		5	
		Viva –Voce	UCHM605	Comprehensive Viva-Voce	-	-	1
	IV	Soft Skill	USKS601		-	2	1
	V	Extension Programme/			-	-	-/2
		r hysical Education				20	0=100
					Total	30	27/29
				(	Grand Total	192	148/162

Semester	Part	t Category	Course code	Course title	Pervious	Contact hrs per week	Credits
			course cour	course the	course code		Min/M ax
Ι	III	Allied- I/GE	UCHA103	Chemistry for Biochemistry		3	2
IV	III	Allied- I/GE	UCHA402	Chemistry for physics		3	2
Ι	III	Allied Practical-I/ GE Practical-I	UCHR104	Organic Analysis	-	3	2
IV	III	Allied Practical- II/ GE Practical-II	UCHR404	Volumetric Analysis		3	2
V	III	Allied Optional	UCHA502 UCHA504 UCHA505	Industrial Chemistry Dairy Chemistry Agricultural Chemistry	-	5	4
			UCHA506	Environmental Chemistry			

## **COURSES OFFERED TO OTHER DEPARTMENTS**

#### INORGANIC CHEMISTRY – II UCHM510

Semester: VCategory: Core XIClass Major: III-B.Sc. Chemistry

Credit : 5 Hours/Week : 5 Total Hours : 65

**Course Objectives:** 

CO No.	To enable the students
CO-1	Learn organometallic compounds
CO-2	Understand the carbon and metal bond
CO-3	Understand organometallic compounds.
CO-4	Attain the knowledge of trace element uses
CO-5	Acquire the basic concept and theory of co-ordination chemistry and nuclear
	chennsuy

#### UNIT-I BINARY AND ORGANOMETALLIC COMPOUNDS

#### **11 Hours**

**12 Hours** 

Binary compounds - Hydrides, borides and nitrides - Classification, preparation, properties and uses. Organometallic compounds of alkenes like ethylene & butadiene, alkynes like acetylene & diphenyl acetylene and cyclopentadiene.

#### UNIT -II GRAVIMETRIC ANALYSIS

Principles of gravimetric analysis – Gravimetric factor – Calculations involved – conditions for precipitation – Theory of precipitation – Types of precipitants - Organic precipitants & advantages – Purity of precipitates – Co-precipitation and post-precipitation – precipitation from homogeneous solution; crucibles – Types and maintenance – Washing of the precipitates – Drying and ignition of precipitates.

#### **UNIT- III SOLID STATE**

Packing of atoms (Bcc, Ccp and Hcp) - Theories of Bonding - Electron gas, pauling and band theories. Structure of alloys - Interstitial solid solutions - Hume- Rothery rule -Crystal defects in Stoichiometric and non-Stoichiometric compounds. Semi-conductors extrinsic and Intrinsic - N-Type and P-Type - Composition, structure and uses in electronic industry

#### **UNIT- IV NUCLEAR CHEMISTRY**

#### 12 Hours

**15 Hours** 

Introduction - Composition of nucleus and nuclear forces. Nuclear stability - n/p ratio - mass defect, binding energy, packing fraction and magic numbers - Nuclear shell and liquid drop models. Isotopes - Detection and separation - Isotopic constitution of elements - Whole number rule - Isobars, isotones and nuclear isomers.

#### UNIT -V RADIOACTIVITY AND NUCLEAR TRANSFORMATIONS 15 Hours

Radioactivity - Discovery, detection and measurement (Wilson Cloud Chamber) radioactive emission - Disintegration theory - Modes of decay - Rate of disintegration – Half life- Average life - Radioactive series. Nuclear transformations - Use of Projectiles - Nuclear Reactions - Fission and fusion - Nuclear reactor - Applications of radioisotopes - Carbon dating - Radioactive waste disposal.

#### **Reference Books**

- Madan, R.D. (2008). *Modern Inorganic Chemistry*. (2<sup>nd</sup> ed.,). S. Chand and Company Ltd. New Delhi.
- Satyaprakash. Tuli, G.D. Basu,S.K. and Madan, R.D. (2006). *Advanced Inorganic Chemistry* (Vol. I & II). S. Chand. New Delhi.

#### **Text Books**

- Soni, P.L and Mohan Katyal. (2007) *Text Book of Inorganic Chemistry*. (20<sup>th</sup>ed.,). Sultan Chand & Sons. New Delhi.
- Lee, J.D. (1991). *Concise Inorganic Chemistry*. (4<sup>th</sup>ed.,). ELBS.

#### e-Resources

- http://dpuadweb.depauw.edu/harvey\_web/eTextProject/pdfFiles/Chapter8.pdf
- https://www.fys.ku.dk/~jjensen/Book/echap1\_3.pdf
- https://preparatorychemistry.com/Bishop\_Book\_atoms\_16.pdf
- https://www.mcvts.net/cms/lib/NJ01911694/Centricity/Domain/136/chap24.pdf
- https://uomustansiriyah.edu.iq/media/lectures/6/6\_2017\_03\_14!12\_38\_50\_AM.pdf
- https://shodhganga.inflibnet.ac.in/bitstream/10603/24695/2/02\_chapter%201%20w ith %20references.pdf

CO No.	On completion of the course the student will be able to	Bloom's
		Level
CO1	Understand the synthesis and structure of organometallic compounds	K1 & K2
CO2	Understand the classification, preparation, properties and uses of binary and organometallic compounds	K3
CO3	Comprehend the theories, crystal defects and semi- conducting nature of metallic state substances.	K4
CO4	Acquires the basic concepts of nuclear chemistry, radioactivity and nuclear transformations.	K5
CO5	Applying the knowledge of gravimetric and precipitation techniques in the chemical industries.	K6

#### ORGANIC CHEMISTRY – II UCHM511

Semester	: V	Credits: 05
Category	: Core XII	Hours/Week : 05
Class Major	: III-B.Sc. Chemistry	<b>Total Hours : 65</b>

**Course Objectives:** 

CO No.	To enable the students
CO-1	Understand reactions of alcohols and phenols
CO-2	Identify the organic compounds of nitrogen
CO-3	Classify the Carbohydrates
CO-4	Develop the Carbonyl compounds
CO-5	To identify and classify different types of N-based derivatives

#### **UNIT- I REACTION OF ALCOHOLS, PHENOLS & THIOLS**

**15 Hours** 

**Alcohols:** Reactions with sodium - hx (lucas test) – Esterification. Oxidation with PCC - Alkaline.kmno<sub>4</sub> - Acidic dichromate - Con.hno<sub>3</sub>. oxidation of diols - Pinacolpinacolone rearrangement.

**Phenols:** Preparation – Bicumene hydroperoxide method - Diazonium salts. reactions – Electophilic substitution - Nitration, halogenations and sulphonation. Gattermann-Koch reaction, Houben - Hoesch condensation, Schotten Baumann reaction. Acidic character of phenol, Comparative strength of alcohol and phenol.

**Thiols:** Nomenclature - Methods of preparation, properties and uses. Thioethers – Nomenclature - Methods of preparation, properties and uses.

#### **UNIT- II NAME REACTIONS**

Mannich reaction, Birch reduction, Dakin reaction, Simmons - Smith reaction, Kolbeschmitt reaction, Mukaivama reaction, Hundiecker reaction, Chichibabin reaction, Nef reaction, Stephen reaction, Reimer-tiemann reaction, Wurtz reaction, Ullmann reaction, Norrish type cleavage.

#### **UNIT -III ORGANIC COMPOUNDS OF NITROGEN**

Nitro Compounds: Preparation of nitroalkanes and nitroarenes. reduction of nitrobenzene under various conditions, nitro-aci nitro tautomerism.

Amines (aliphatic and aromatic): Cassification, preparation from alkyl halides, gabriel- Phthalimide synthesis, Hofmann bromamide reaction. Hofmann and saytzeff Elimination, Carbylamine test, Hinsberg test, with nano2+hcl, schotten-baumann reaction, Electophilic substitution in aniline: nitration, bromination and sulphonation.

Diazonium salts: preparation from aromatic amines. Conversion to Benzene, Phenol and Azodyes.

#### **UNIT- IV CARBONYL COMPOUNDS**

Aldehydes and Ketones: Structural significance of the carbonyl function and Nomenclature. Formaldehye, acetaldehyde, acetone and benzaldehyde - Preparation from acid chlorides & Nitriles. Reactions with HCN, ROH, NaHSO<sub>3</sub>, Amino derivatives. Iodoform test, Aldol condensation, Cannizzaro's Reaction, Wittig Reaction, Benzoin condensation, Clemmensen reduction, Wolff Kishner reduction and meerwein Pondorff-Verley reduction.

Carboxylic Acids & Their Derivatives: Preparation of formic, Acetic and benzoic acids. Synthetic applications of diethyl malonate & Ethyl acetoacetate. Preparation of acid chlorides, Anhydrides, Esters and amides from acids and their inter-Conversion. Comparative study of the Nucleophilicity of acyl derivatives. Reformatsky reaction, Perkin condensation and hell-Volhardt-Zelinsky reaction.

#### **UNIT -V CARBOHYDRATES**

Carbohydrates - Classification - Aldoses and ketoses, Reducing and non-reducing sugars - Reactions of glucose and fructose - Osazone formation, mutarotation and their mechanism - Structural elucidation of glucose and fructose - Pyranose and furanose forms -Haworth's method. Determination of ring size- Haworth projection formula - Configuration of glucose and fructose - Epimerization - Chain lengthening and chain shortening of aldoses -Inter conversion of aldoses and ketoses – uses of glucose. Disaccharides and polysaccharides - Reactions and structural elucidation of sucrose and maltose - Properties, structure and uses of starch and cellulose.

#### **Reference Books**

- Morrison and Boyd, R.T. (2010). Organic Chemistry (VI ed.,). Prentice Hall of India. New Delhi.
- Ahluwalia, V.K & Rakesh Kumar Parashar. (2015). Organic Reaction Mechanisms. (IV ed.,). Narosa Publishing house.

#### **Text Books**

- Soni, P.L. (2010). Text Book of Organic Chemistry. Sultan Chand.
- Bahl and Arun Bahl. (2014). Advanced Organic Chemistry. S. Chand.
- Peter Sykes. (2013). A Guide Book to Mechanism in Organic Chemistry. (VI ed.,)

# **15 Hours**

**18 Hours** 

15 Hours

#### e-Resources

- http://www.ncert.nic.in/ncerts/l/lech202.pdf •
- https://www.angelo.edu/faculty/kboudrea/index\_2353/Chapter\_03\_2SPP.pdf
- http://www.chtf.stuba.sk/~szolcsanyi/education/files/Organicka%20chemia%20II/Pre dnaska%209\_Sacharidy/Doplnkove%20studijne%20materialy/Carbohydrates\_Boudre aux.pdf
- https://authors.library.caltech.edu/25034/17/BPOCchapter16.pdf •
- http://cms.gcg11.ac.in/attachments/article/105/NITRO%20COMPOUNDS.pdf

#### **Course Outcomes:**

CO No.	On completion of the course the student will be able to	Bloom's Level
CO1	Understands the knowledge of reaction mechanisms of nitro and carbonyl compounds.	K1 & K2
CO2	Acquires the knowledge of preparation, properties and applications of alcohols, phenols, thiols and ethers.	К3
CO3	Analyze the metal and polynuclear carbonyl complex	K4
CO4	Classifies and elucidates the structure, properties and uses of carbohydrates.	K5
CO5	Assemble the reaction mechanism of different heterocyclic compounds	K6

#### PHYSICAL CHEMISTRY-II **UCHM512**

Semester	: V	Credits	: 5
Category	: Core XIII	Hours/Week	: 5
Class Major	: III-B.Sc. Chemistry	Total Hours:	: 65

**Course Objectives:** 

CO No.	To enable the students
CO-1	To improve the ability of mathematical calculations involved in physical
	chemistry
CO-2	To enable the students to understand the concepts of thermodynamics
CO-3	Apply the concepts to more space physical and chemical system
CO-4	To make the students know the concepts of chemical kinetics and
CO-5	To apply the concepts of kinetics to different processes.

#### **UNIT-I PARTIAL MOLAR PROPERTIES**

#### **12 Hours**

Chemical potential – Gibbs Duhem equation – Effect of temperature and pressure on chemical potential – Chemical potential in systems of ideal gases – Duhem margules equation.

Homogeneous catalysis-Definition- Function of a catalyst in terms of gibbs free energy of activation. Heterogeneous catalysis- Application of catalysis.

#### **UNIT-II PHASE RULE**

Concepts of phase, Components and degrees of freedom with examples. Gibb's Phase Rule-Derivation, Classius - Clapeyron equations and their applications to equilibria in Phase Transitions. (Solid– Liquid, Liquid – Vapour, Solid-Vapour)

**One Component System:** Phase diagram-Water and sulphur systems.

**Reduced Phase Rule:** Two component systems - Simple eutectic: Lead-Silver system - Formation of compound with Congruent melting point: FeCl<sub>3</sub>-Water system , Other examples formation of compound with incongruent melting point: Na-K system

#### **UNIT-III ADSORPTION:**

Physisorption & chemisorption- Freundlich adsorption isotherm – Langmuir adsorption isotherm –Bet equation (no derivation) application of adsorption.

**Concept of fugacity & activity: D**etermination of fugacity of a gas- Change of fugacity with temperature. Activity & activity coefficient- Determination of activities – variation of activity of a gas with temperature & pressure- Nernst distribution law – limitations-Thermodynamic derivation – Applications.

#### **UNIT-IV CHEMICAL KINETICS I**

**Order and molecularity of reactions: D**efinition of rate, order rate law, rate constants, molecularity – Simple reactions involving zero, first, second and third order reactions derivations of rate equations for zero, first, second and third order reactions - pseudo first order reactions. Derivation of half life time – Change with examples. Methods to determine order of reactions. Problems based on order, Rate equations and  $T_{1/2}$ .

**Types of reactions:** Reversible or opposing, consecutive and parallel reactions (simple ideas only). Thermal chain reactions (i)  $h_2$  and  $br_2$  reaction (ii) Dissociation of acetaldehyde steps involved only (no kinetics expressions needed)

#### **UNIT-V CHEMICAL KINETICS II**

**Theories of chemical reaction rates:** Factors affecting chemical reactions – Nature of reactants concentration, Catalyst, Solvent polarity and ionic strength (only qualitative ideas), Arrehenius theory of chemical reaction rates collision theory of bimolecular and unimolecular reactions. Lindemann hypothesis, Transition state or absolute reaction rate theory (ARRT)

#### **Text Books:**

- Puri Sharma Pathania.(2009). *Principles of Physical Chemistry*. Shoban Lal Nagin Chand & Co. Jalandhar.
- Soni, P. L. (2006). Text Book of Physical Chemistry. Sultan Chand.

#### **Reference Books:**

- Negi and Anand. (2000). Physical Chemistry. New Age.
- Kundu and Jain. (1999). Physical Chemistry. S. Chand.

#### **13 Hours**

#### **15 Hours**

**10 Hours** 

CO No.	On completion of the course the student will be able to	Bloom's Level
CO1	Understand the concepts of thermodynamics	K1 & K2
CO2	Explain and apply concepts of physical chemistry	K3
CO3	Apply it to more space physical and chemical system	K4
CO4	Know the concepts of chemical kinetics	K5
CO5	Evaluate the concepts of kinetics to different processes	K6

#### GRAVIMETRIC ANALYSIS UCHR501

Semester : V

Credit : 2

Category : Core Practical III

Hours/Week : 3 Total Hours : 39

Class Major : III-B.Sc. Chemistry

#### Course Objectives:

CO No.	To enable the students
CO-1	To give practical exposure to estimations gravimetrically preparation
CO-2	The calculations involved in the preparation of solutions using solid and liquid solutes
CO-3	Acquire quantitative skills to get accurate result
CO-4	Analyze the ions or metals present in the given substance by gravimetric method

#### **Experiments:**

#### **Part I : Gravimetric Estimation**

- 1. Estimation of Sulphate as Barium sulphate.
- 2. Estimation of Barium as Barium sulphate.
- 3. Estimation of Barium as Barium chromate.
- 4. Estimation of Lead as Lead chromate.
- 5. Estimation of Calcium as Calcium oxalate monohydrate.
- 6. Estimation Zinc or Magnesium as oxinate.

#### Part-II

1. Physical constant (melting & boiling point)

#### **Text Books:**

• Venkateswaran, V. Veerasawamy, R. & Kulandaivelu, A. R. (1998) *Basic Principles of Practical Chemistry*. S. Chand & Sons Publications.

#### **Reference Books:**

• Vogel's. (1989). *Text book of Quantitative Chemical Analysis* (5<sup>th</sup> ed.,). ELBS/ Longman. England.

- Thomas, A. O. (1999). Practical Chemistry. Scientific Book Center. Cannanore
- Sundaram, S. and Viswanthan, S. (1998). *Practical Chemistry*. (3 Volumes).

CO No.	On completion of the course the student will be able to	Bloom's Level
CO1	summarize findings in writing in a clear and concise manner	K1 & K2
CO2	Analyze the techniques involved in volumetric chemical analysis with emphasis on solution	K3
CO3	engage in safe laboratory practices handling laboratory glassware, equipment, and chemical reagents	K4
CO4	Understand the basics of gravimetric analysis	K5
CO5	Evaluate data collected to determine the identity, purity, and yield of products.	K6

#### PHYSICAL CHEMISTRY PRACTICAL UCHR605

Semester: V & VI

**Category: Core Practical- IV** 

Credit : 2 Hours/Week: 3 Total Hours: 39

Class Major : III-B.Sc. Chemistry	
<b>COURSE OBJECTIVES</b>	

CO	To enable the students
No.	
CO-1	To understand the phase rule of binary system
CO-2	To know the kinetics of acid hydrolysis of ester
CO-3	To understand the concept of partition co-efficient
CO-4	To understand the basic concepts of conductometric and potentiometric titrations
CO-5	To Interpret the experimental results.

#### 1. Distribution law:

- a) Determination partition coefficient of iodine between carbon tetra chloride and water.
- b) Equilibrium constant of the reaction  $KI + I_2 = KI_3$

#### 2. Kinetics:

Determination of the orders of the following reactions.

- a) Acid catalysed hydrolysis of an ester (Methyl or Ethyl Acetate).
- **3.** Molecular Weight of Solute Rast method using Naphthalene, Meta Dinitrobenzene and Diphenyl as solvents.

#### 4. Heterogeneous Equilibria:

Phenol – water system CST.

5. A) Effect of Impurity – 1 % Nacl or 2% Succinic acid solutions on phenol determination of the concentration of the given solution.

#### **B)** Determination of the Transition Temperature of the Given Salt

Hydrate.Na<sub>2</sub>S<sub>2</sub>O<sub>3</sub>.5H<sub>2</sub>O, CH<sub>3</sub>COONa.H<sub>2</sub>O, SrCl<sub>2</sub>.6H<sub>2</sub>O, MnCl2.4H2O.

#### 6. Electrochemistry: Conductivity

- A) Determination of cell constant.
- B) Conductometric titration of a strong acid against a strong base.

#### 7. Potentiometric Titration

A) Strong acid against a strong base.

- 8. Calorimetric Titration.
- 9. Polarimetric– inversion of sugar.

#### **Text Books**

• Venkateswaran. V, Veerasawamy. R. & Kulandaivelu, A. R. (1998). *Basic Principles of Practical Chemistry*.S. Chand & Sons Publications.

#### **Reference Books**

- Vogel's. (1989). *Text Book of Quantitative Chemical Analysis*. (5<sup>th</sup>ed.,). ELBS/ Longman. England.
- Thomas, O. (2000). *Practical Chemistry*. Scientific Book Center. Cannanore.
- Sundaram, S. (1999). *Practical Chemistry*.(3<sup>rd</sup>Vol).

#### **COURSE OUTCOMES:**

СО	On completion of the course the student will be able to	Bloom's
No.		Level
CO-1	Define the practical knowledge about the chemical kinetics	K1
CO-2	Understand the conductivity experiments	K2
CO-3	Apply potentiometric titrations in identification of acids	K3
CO-4	Analyze the experimental data	K4
CO-5	Develop the partition co-efficient of new compounds in a	K6
	mixture of two immiscible solvents	

#### ORGANOMETALLICS AND BIOINORGANIC CHEMISTRY UCHO501

Semester	:V	Credit	:04
Category	: Major Elective /DSE-1	Hours/Week	:05
Class &Major	: III B.Sc.,Chemistry	<b>Total Hours</b>	:65

#### **Course Objectives:**

CO No.	To enable the students
CO-1	Learn organometallic compounds
CO-2	Understand the carbon and metal bond
CO-3	Predict the Structure of metal carbonyl bond
CO-4	Acquire the knowledge of trace element uses
CO-5	Get the knowledge of oxygen carrier and oxygen transport

#### UNIT-I ORGANOMETTALIC CHEMISTRY

Organometallic Compounds-Synthesis, Structure and bonding. Hapto nomenclature of organometallic compounds. Organometallic compounds with linear pi donor ligands -olefins, acetylenes, dienes and allyl complexes-synthesis, structure and bonding

#### **UNIT-II METALLOCENES**

Synthesis and structure of complexes with cyclic pi donors- metallocenes and cyclic arene complexes. Electronic structure and bonding in ferrocene and dibenzene chromium. Carbene and carbyne complexes - Metallocene-based Ziegler-Natta polymerization of alkenes - application of metallocenes - non-linear optics - medicine - molecular recognition– catalysis.

#### **UNIT-III METAL CARBONYLS**

Metal carbonyls: CO as a  $\pi$ -bonding ligand, synergism, preparation, properties, structure and bonding of simple mono and binuclear metal carbonyls, metal nitrosyls, metal cyanides and dinitrogen complexes. Polynuclear metal carbonyls with and without bridging. Carbonyl clusters-LNCCS and HNCCS, Isoelectronic and isolobal analogy, Wade-Mingos rules, cluster valence electrons. IR spectral studies of bridging and non-bridging CO-ligands.

#### UNIT-IV BIO INORGANIC CHEMISTRY

Classification of elements according to their action in biological system - Toxicity of metals ions (Cd, Hg, Cr and Pb, As) and reasons for toxicity - structure and functions of biological membranes, mechanism of ion transport across membranes, sodium pump, ionophores, valinomycin. Phosphate esters in biology, Redox metalloenzymes, cytochromes-cytochrome P450

#### UNIT-V OXYGEN CARRIERS AND OXYGENTRANSPORT PROTEINS 13 Hours

Oxygen transport - oxygen carriers, oxygen transport proteins, Photosystems, Porphyrins, B-Complex, Cyanocobalamin, - Structure and functions of hemoglobin and myoglobin. Oxygen transport mechanism, cooperativity, Bohr Effect. Structure and functions of hemerythrins, hemocyanin.

#### **Text Books**

- Madan, R. D. (2022). *Modern Inorganic Chemistry*. (3<sup>rd</sup> Ed.). S. Chand and Company Ltd. New Delhi.
- Lee, J.D. (2008). Concise Inorganic Chemistry. (5<sup>th</sup> Ed.). ELBS. London

#### **Reference Books**

- Puri, B.R. Sharma, L.R. and Khalia, K. C. (2020). *Principles of Inorganic chemistry.* (33<sup>rd</sup> Ed.). Vishal Publishing Co.India.
- Tuli, G.D. Satyaprakash. Basu, S.K. and Madan, R.D. (2022). Advanced Inorganic Chemistry (Vol. I & II). S. Chand. NewDelhi.

#### 12 Hours

14 Hours

**11 Hours** 

CO No.	On completion of the course the student will be able to	Bloom's Level
CO1	Understand the synthesis and structure of organometallic compounds	K1 & K2
CO2	Demonstrate the metallocene compound	K3
CO3	Analyze the metal and polynuclear carbonyl complex	K4
CO4	Evaluate and apply knowledge of element use in biological system	K5
CO5	Design the structure and function of haemoglobins and myoglobin	K6

#### HETEROCYCLIC CHEMISTRY UCHO502

Semester	: V
Category	: Major Elective/DSE-I
Class & Majo	r : III B.Sc., Chemistry

Credit: 04 Hours/Week :05 Total Hours :65

#### **Course Objectives:**

CO No.	To enable the students
CO1	To enable the students to Nitrogen containing functional groups and their applications in organic conversions and related mechanisms.
CO2	To learn about structure, synthesis, reactivity of important heterocyclic compounds and polycyclic aromatic hydrocarbons.
CO3	To identify and classify different types of N-based derivatives
CO4	To familiarize students about different classes of N-based naturally occurring important alkaloid and terpenoid compounds, their structures
CO5	Critically examine the synthesis and reaction mechanism of different heterocyclic
	Compounds, as well as natural alkaloid and terpenoid molecules.

#### UNIT- I NITROGEN CONTAINING FUNCTIONAL GROUPS: NITRO COMPOUNDS, NITRILES AND ISONITRILES, AMINES 11 Hours

Structure and Preparation of nitroarenes - Properties and reactions of nitroarenes -Structure, Preparation and properties of nitriles and isonitriles. Preparation of primary amines: Reduction of nitro compounds, Hofmann ammonolysis, Hofmann degradation, Gabriel phthalimide synthesis - Preparation of secondary and tertiary amines: Aminolysis of alkyl halides - Reductive amination of aldehydes and ketones - Ullmann reaction Properties of amines - Basicity - Effect of substituent and solvent on basicity - Important reactions of amines: Alkylation, acylation, Carbylamine reaction - Important reactions of amines: Mannich reaction, Hoffmann's exhaustive methylation, Diels-Alder reaction, Hofmann-elimination reaction - Diazonium Salts: Structure, Preparation and reactions/applications

#### **UNIT- II FIVE MEMBERED HETEROCYCLIC COMPOUNDS CONTAINING ONE HETEROATOM** 12 Hours

Classification, nomenclature and structure of pyrrole, furan and thiophene (5-numbered) and pyridine (6-membered). Molecular orbital pictures and aromaticity in of pyrrole, furan and thiophene and pyridine - Synthesis, reactions and mechanism of substitution reactions of: Furan - Synthesis of Pyrrole: Knorr pyrrole synthesis, Paal-Knorr synthesis, Hantzsch synthesis - Reactions and mechanism of substitution reactions of Pyrrole - Derivatives of furan: Furfural and furoic acid - Synthesis and reactivity of Isothiazole and Isoxazole.

#### **UNIT- III SIX MEMBERED AND CONDENSED HETEROCYCLIC COMPOUNDS** 14 Hours

Structure, synthesis and properties of Pyridine (Hantzsch synthesis), Pyrimidine, Pyrazine - Structure elucidation of indole, Fischer indole synthesis and Madelung synthesis) -Structure elucidation of quinoline and isoquinoline - Skraup synthesis, Friedlander's synthesis

#### **UNIT- IV POLYNUCLEAR HYDROCARBONS**

Preparation and structure elucidation of naphthalene - Reactions of naphthalene -Important derivatives of naphthalene - Preparation, structure elucidation and important derivatives of anthracene. Synthesis and Reactivity of Two or More Heteroatoms - Azoles with Heteroatoms in the 1,2-positions, 1,2- and 1,4- and 1,3- Diazines such as Pyrimidines and Triazines

#### **UNIT- V ALKALOIDS**

Natural occurrence, Isolation and their physiological action - General structural features, experimental determination - Hoffmann's exhaustive methylation, Emde's modification - Structure elucidation and synthesis of Hygrine - Structure elucidation and synthesis of Nicotine. Terpenoids: Occurrence, classification, isoprene rule - Elucidation of structure and synthesis of Citral, Neral

#### **Text Books:**

- A Textbook of Organic Chemistry III, M. K. Jain, S. C. Sharma, Amita, Vishal Publishing Co.
- Kalsi, P. S. (2020) Organic Chemistry and their mechanisms, 5<sup>th</sup> Ed., New Age International (P) Ltd. Pub.
- Morrison, R. T. & Boyd, R. N. (2010). Organic Chemistry, Dorling Kindersley (India) Pvt. Ltd. (Pearson Education), 7<sup>th</sup> Edition.
- Clayden, J. Greeves, N. Warren, S. Wothers, P. (2014). Organic Chemistry, Oxford University Press, 2<sup>nd</sup> Edition

#### **Reference Books:**

- Acheson, R.M. (2008). Introduction to the Chemistry of Heterocyclic compounds, John Welly & Sons, 3<sup>rd</sup> Edition.
- J. A. Joule, K. Mills and G. F. Smith (2010). *Heterocyclic Chemistry*, 1<sup>st</sup> Edition.
- Singh, J. Ali, S.M. & Singh, J.(2010). Natural Product Chemistry, Pragati Parakashan.

#### 15 Hours

CO No.	On completion of the course the student will be able to	Bloom's Level
CO1	Understand the importance, properties, synthesis and applications of various Nitrogen- functional groups	K1 & K2
CO2	Ability to learn and carry out the structure, synthesis, reactivity of important heterocyclic compounds and polycyclic aromatic hydrocarbons.	K3
CO3	Identify and classify different types of N-based derivatives	K4
CO4	Evaluate the different classes of N-based naturally occurring important alkaloid and terpenoid compounds, their structures, synthesis and reactivity	К5
CO5	Assemble the reaction mechanism of different heterocyclic compounds, as well as natural alkaloid and terpenoid molecules	K6

## ORGANIC SPECTROSCOPY UCHO503

Semester : V Category : Major/ Elective DSC-I Class Major : III-B.Sc. Chemistry Course Objectives: Credits : 4

Hours/Week : 5

Total Hours : 65

CO No.	To enable the students
CO-1	Learn various energy level and spectroscopic techniques
CO-2	Identify the electromagnetic spectrum and its components.
CO-3	To identify the organic molecules from characteristic absorption bands
CO-4	To find out the structure of the molecule, principle and instrumentation of NMR- Spectra
CO-5	Learn mass spectroscopic techniques and their instrumentation concept.

#### **UNIT- I INTRODUCTION TO SPECTROSCOPY**

# Interaction of low energy radiation with matter- Electromagnetic spectrum, quantization of energy, Electronic, vibrational, and rotational energy levels, and transitions in atoms and molecules. Absorption and emission spectra-Boltzmann distribution (formula only). Relative population- translational, rotational, vibrational, and electronic energy levels at different temperatures.

#### **UNIT – II ELECTRONIC SPECTOSCOPY**

Absorption laws- calculations involving Beer – Lambert's law, verification, and its limitations. Types of electronic transitions- chromophores and auxochromes, absorption bands

#### 12 Hours

and intensity, factors governing absorption maximum and intensity. Atomic absorption spectroscopy – principles, instrumentation, and applications. Application of electronic spectroscopy and Woodward rules for calculating  $\lambda_{max}$ . of conjugated dienes and  $\alpha$ ,  $\beta$  – unsaturated compounds.

#### UNIT- III VIBRATIONAL SPECTROSCOPY

Principle, types of stretching and bending vibrations- vibrational frequencies, instrumentation- block diagram, source, cell sampling techniques- detector and recorders, identification of organic molecules from characteristic absorption bands. Raman spectroscopy-Raleigh and Raman scattering, stoke's and antistoke's line. Interpretation of spectra- organic compounds like hydrocarbon, aldehyde, ketones, acids and amine with one example to each.

#### **UNIT- IV NMR SPECTROSCOPY**

Principle of nuclear magnetic resonance- basic instrumentation, shielding mechanism, chemical shift, number of signals, spin-spin coupling and coupling constants, splitting of signals, deuterium labelling. Spin-Spin interactions-AX, AX<sub>2</sub> and AB types - Applications of NMR with suitable examples - ethyl bromide, ethanol, acetaldehyde, 1,1,2-tribromo ethane, ethyl acetate, toluene and acetophenone

#### **UNIT- V MASS SPECTROMETRY**

Basic principles of mass spectrum- molecular peak, base peak, isotopic peak, metastable peak and their uses, fragmentation – nitrogen rule, McLafferty rearrangement, Retro-Diels-Alder reaction. Instrumentation- determination of molecular formulae with example, mass spectrum of simple organic compounds, identification – alcohols, aldehydes, aromatic hydrocarbons.

#### **Text Books**

- Skoog, D.A.West, D.M. and Holler, F.J (2021). *Analytical Chemistry: An Introduction, (10<sup>th</sup> Ed.)* Saunders college publishing, Philadelphia.
- Khopkar, S. M. (2023). *Basic concept of Analytical Chemistry*, (5<sup>th</sup> edition), New Age International Publishers. New Delhi.
- Robert M. Silverstein, Francis X. Webster, David J. Kiemle, David L. Bryce, (2014).
- Spectrometric Identification of Organic Compounds, (8<sup>th</sup> Ed), Wiley publishers.
- Pavia Donald, L. (2015). *Introduction to Spectroscopy*, (5<sup>th</sup> edition), Thomson Press (India) Ltd, India

#### **Reference books**

- Chand. S (2013). *Elementary Organic Spectroscopy: Principles and Chemical Applications*, company Ltd. New Delhi, 5<sup>th</sup> Edition.
- Srivastava, V.K. and Srivastava, K.K (1987). *Introduction to Chromatography: Theory and Practice*, S. Chand and company. New Delhi.

## 11 Hours

**12 Hours** 

12 Hours

#### 94

	On completion of the course the student will be able to	<b>Bloom's</b>	
CU NO.	On completion of the course the student will be able to	Level	
CO-1	Explain the concepts of spectroscopy, interaction, matter and various energy level		
CO-2	Learn the absorption and emission law of electromagnetic spectrum and determine the effect of conjugation on a UV/Vis absorption spectrum.	K5	
CO-3	Determine the vibrations for a triatomic molecule and identify whether they are infrared-active and draw the design of a non-dispersive infrared spectrophotometer	K1 & K2	
CO-4	Evaluate and judge the structure of organic structure and its application in various aspects	K6	
CO-5	Explain the concept of mass spectroscopic techniques and explain its various activities	K4	

## III and IV Evaluation Component of CIA

Semester	Course Code	Course Title	Component III	Component IV
V	UCHO501	Organometallics and Bioinorganic chemistry	Assignment	Seminar
	UCHO502	Heterocyclic Chemistry	Assignment	Seminar
	UCHO503	Organic Spectroscopy	Problem Solving	Seminar