Holy Cross College (Autonomous), Nagercoil

Kanyakumari District, Tamil Nadu.

Accredited with A^{++} by NAAC - V Cycle (CGPA 3.53)

Affiliated to

Manonmaniam Sundaranar University, Tirunelveli

Semester I - VI

UG Guidelines & Syllabus

DEPARTMENT OF CHEMISTRY

2023-2026

(With effect from the academic year 2025-2026)

Teaching Plan

Even Semester

2025-2026

Department of Chemistry

Teaching Plan

Department : Chemistry
Class : I B.Sc. Chemistry
Title of the Course : Core Course II – General Chemistry - II
Semester : II
Course Code : CU232CC1

Course Code	L	T	P	S	Credits	Inst. Hours	Total Hours	Marks		
								CIA	External	Total
CU232CC1	5	-	-	-	5	5	75	25	75	100

Learning Objectives:

1. To understand the chemistry of acids, bases and ionic equilibrium
2. To know the chemistry of hydrocarbons, applications of acids and bases

Course Outcomes

On the successful completion of the course, students will be able to:		
1	explain the concept of acids, bases and ionic equilibria; periodic properties of s and pblock elements, preparation and properties of aliphatic and aromatic hydrocarbons	**K1**
2	discuss the periodic properties of s and p- block elements, reactions of aliphatic and aromatic hydrocarbons and strength of acids	**K2**
3	classify hydrocarbons, types of reactions, acids and bases, examine the properties s and p-block elements, reaction mechanisms of aliphatic and aromatic hydrocarbons	**K3**
4	explain theories of acids, bases and indicators, buffer action and important compounds of s-block elements	**K3**
5	assess the application of acids, indicators, buffers, compounds of s and p- block elements and hydrocarbons	**K4**

K1 - Remember; **K2** - Understand; **K3**- Apply; **K4** - Analyse; **K5-** Evaluate

Teaching plan

Total Contact hours: 75 (Including lectures, assignments and tests)

Unit	Module	Topic	Teaching Hours	Assessment Hours	Cognitive level	Pedagogy	Student Centric Method	E-Resources	Assessment / Evaluation Methods
I	**Acids, Bases and Ionic Equilibria**								
	1	Concepts of Acids and Bases - Arrhenius concept, Bronsted-Lowry concept, Lewis concept; Relative strengths of acids, bases and dissociation constant.	3	3	K1(R) & K3 (Ap)	Lecture with Visual Aids such as PPT, Flipped Classroom.	Peer Teaching, Gamified Quiz, Concept Mapping.	Video Lectures, E-Notes.	Formative Quiz using Google Forms Conceptual Questions, CIA I
	2	Ionic product of water, pH scale, pH of solutions; Degree of dissociation, common ion effect, factors affecting degree of dissociation; acid base indicators.	2		K2(U)	Visual Lecture with demonstration on determining p^H of solutions.	Problem-Solving Pairs, experiential learning	Lecture using interactive ppt, Problem Bank.	Short test, CIA I, determining p^H of different solutions.

	3	Theory of acid base indicators – action of phenolphthalein and methyl orange, titration curves - use of acid base indicators.	2		K3(Ap)	Lecture with visualization, Demonstration of acid base titrations.	Collaborative Learning, experiential learning.	Interactive ppt, you- tube videos: Acid – base titrations	Quizzes on choice of indicators, CIA I.
	4	Buffer solutions– types, mechanism of buffer action in acid and basic buffer, Henderson-Hasselbalch equation; Salt hydrolysis.	2		K2 (U), K3(Ap)	Socratic Questioning, lecture with visualization.	Problem-Based Learning, collaborative learning.	Interactive ppt, E-notes.	Oral questions, CIA I.
	5	Salts of weak acids and strong bases, weak bases and strong acids - hydrolysis constant - degree of hydrolysis and relation between hydrolysis constant and degree of hydrolysis.	2		K3(Ap)	Lecture with visualization.	Peer Learning, Real-World applications.	Online Tutorials and Notes:Khan Academy	Problem-Solving Assignments, Open Book Test, CIA I
	6	Solubility product - determination and applications; numerical problems involving the core concepts.	1		K3(Ap)	Simulations, problem solving, Flipped Classroom	Blended learning, group discussion.	Interactive ppt, Determination of solubility product:You-tube videos	Problem solving, quiz using google forms.
II	**Chemistry of s and p- Block Elements**								

	1	Hydrogen: Position of hydrogen in the periodic table. General characteristics of alkali metals and alkaline earth metals- Electronic configuration, oxidation states.	3	3	K1(R) & K3(Ap)	Demonstration-based Learning: Simulations, Concept Mapping, Flipped Classroom	Peer Instruction, Blended Learning.	NPTEL Lectures, YouTube Videos	Poster Presentation , Oral Viva, CIA I
	2	Ionisation energy, reducing property, flame colouration, uses of alkali metals. Comparative study of oxides and hydroxides of alkali metals.	3		K2(U)	Demonstration of flame colours, Collaborative method.	Experiential learning.	Interactive ppt, lecture notes.	Peer discussions and concept maps, CIA I
	3	Diagonal relationship of Li with Mg. Preparation, properties and uses of sodium cyanide, sodamide and potassium cyanide. Extraction of Be and its uses.	2		K2(U)	Analogical Teaching, Visual Demonstration, Application-Based teaching	Project/Activity.	Interactive ppt, NPTEL Video Lectures	Open Book Test, Exam Questions, CIA I
	4	General characteristics of p-	3		K2(U)	Real-world Contextualization,	Peer Teaching,	Interactive ppt, E-notes	Conceptual questions

		Block Elements (Group 13 & 14)- Electronic configuration, oxidation states and metallic character, preparation and structure of diborane and borazine. Chemistry of borax.				Model- based approach.	Think-pair-share		based on periodic table, CIA I
	5	Extraction of Al and its uses. Comparison of carbon with silicon. Carbon-di-sulphide – Preparation, properties, structure and uses.	1		K2(U)	Lecture with visualization.	Group discussion, peer group teaching using periodic table.	Interactive ppt, lecture notes.	Oral viva, short test.
III	**Chemistry of p- Block Elements (Group 15-18)**								
	1	General characteristics of elements of Group 15; chemistry of H_2N-NH_2, NH_2OH and HNO_3. Chemistry of PH_3, PCl_3, PCl_5, $POCl_3$ and P_2O_5	3	3	K2(U) & K3 (Ap)	Concept Mapping	Flipped Classroom, Peer Teaching	Video Lectures	Rubric-Based Assessment, Conceptual MCQs CIA I
	2	Oxy acids of phosphorous (H_3PO_3 and H_3PO_4). General properties of	3		K2(U)	Core Conceptual Approach, Application-Based Teaching.	Socratic Questioning, Analogies	Lectures on oxyacids of phosphorus	Short test, CIA II

		elements of group16 - chemistry of ozone.						interactive ppt, E-notes.	
	3	Classification and properties of oxides - oxides of sulphur and selenium – Oxy acids of sulphur (Caro's and Marshall's acids). Chemistry of Halogens.	3		K2(U)	Concept Building, Application based teaching.	Interactive Simulation	You-tube videos, E-notes.	Slip test, CIA II
	4	General characteristics of halogen with reference to electro-negativity, electron affinity and oxidation states. Peculiarities of fluorine.	2		K3(Ap)	Concept based teaching.	Problem Solving	OpenCourseWare, NPTEL lectures, interactive ppt.	Quick quizzes CIA II
	5	Inter-halogen compounds (ICl, ClF_3, BrF_5 and IF_7),pseudo halogens. Noble gases: Position in the periodic table-uses of noble gases.	1		K2(U)	Core Conceptual Approach	Concept Mapping, Think-pair-share	Interactive ppt, E-notes	Oral/Viva Test CIA II
IV	**Hydrocarbon Chemistry-I**								

	1	Petroproducts: Fractional distillation of petroleum; cracking.Alkenes-Nomenclature, general methods of preparation	2	3	K1(R) & K3 (Ap)	Constructivist method, flipped classroom.	Think-Pair-Share, Simulation-Based Learning	NPTEL - NOC: Petroleum Technology, IIT Kharagpur Prof. Sonali Sengupta, E-notes	Conceptual Quiz, Rubrics-Based Assignment, CIA II
	2	Mechanism of β-elimination reactions – E_1 and E_2 mechanism - orientation – Hofmann and Saytzeff rules. Reactions of alkenes – addition reactions – mechanisms.	1		K2(U)	Inquiry-Based Learning.	Animation-based learning to visualize E1 and E2 Elimination, Think-Pair-Share.	NPTEL Lectures	Open Book Test, CIA II
	3	Markownikoff's rule, Kharasch effect, oxidation reactions – hydroxylation, epoxidation, ozonolysis; polymerization.	3		K3(Ap)	Conceptual Pedagogy.	Application-based examples.	Interactive ppt, E-notes.	Short test, CIA II
	4	Diels–Alder reactions – polymerisation – polybutadiene, polyisoprene (natural rubber), vulcanisation,	3		K3(Ap)	Blended Learning, Flipped classroom.	Think-Pair-Share to explain the different polymerization.	You Tube Videos, E-notes	Short quiz using khahoot, CIA II

		polychloroprene. Alkynes Nomenclature; general methods of preparation (any two) and reactions.							
	5	Acidic nature of terminal alkynes and acetylene. Cycloalkanes: Nomenclature, Relative stability of cycloalkanes, Bayer's strain theory and its limitations.	3		K4(An)	Application-Oriented teaching.	Think-pair-share	NPTEL – Biotechnology – Cell Biology Module 4 Alkenes and Alkynes Lecture no:7 Alkenes	Peer-assessed test, CIA II
V	**Hydrocarbon Chemistry - II**								
	1	Benzene: structure of benzene, stability of benzene ring, aromaticity, Huckel's (4n+2) rule.	1	3	K1(R)	Core Conceptual Approach	Historical Method – Peer group teaching using models.	NPTEL – Biotechnology – Cell Biology Module 7 Benzenes and Substituted Benzenes Lecture no: 17 Benzene and Related Compounds	Conceptual quiz, CIA II
	2	Electrophilic substitution reactions - General mechanism of	1		K2(U)	Visual Pedagogy	Participatory learning, group discussion.	Interactive ppt, E-notes.	MCQ questions, Peer quiz on

		aromatic electrophilic substitution - nitration, sulphonation							electrophilic substitution
	3	Halogenation, Friedel-Craft's alkylation and acylation. Mono substituted and disubstituted benzene	3		K3(Ap)	Lecture with visuvalisation.		You- tube videos, Interactive ppt, E-notes.	Question answering, CIA II
	4	Effect of substituent – orientation and reactivity. Polynuclear Aromatic hydrocarbons: Naphthalene – Haworth synthesis	2	1	K3(Ap)	Collaborative approach	Think-pair-share	You- tube videos	Short test, CIA II
	5	Reactions – electrophilic substitution reaction, nitration, sulphonation, halogenation	2		K3(Ap)	Collaborative approach	Group discussion	Interactive ppt, notes, You – Tube videos	MCQ, CIA II
	6	Friedel – Crafts acylation, alkylation, and oxidation – uses. Anthracene –	2		K3 (Ap)	Lecture with visualization	Peer Teaching, Gamified Quiz,	NPTEL lectures	Assignment, Open Book Test, CIA II

		synthesis by Haworth synthesis; reactions - Diels-Alder reaction -uses.					Concept Mapping.		

Course Focussing on Employability/ Entrepreneurship/ Skill Development: **Employability, Skill Development**

Activities: Group Discussion, Assignment, Exhibition

Assignment: **Due Date: 12-12-2025**

1. Electronic configuration s-block elements.
2. Buffer solutions
3. Benzene and its reactions

Seminar Topic:

1.Markownikoff's rule
2. Karash Effect
3.Chemistry of Naphthalene

Sample questions

Part A

1. Lewis acid is an electron pair ----------. (**K1-R, CO-1)**
2.Ammonium chloride and ammonium hydroxide is an example for basic buffer. Say true or false. (**K1-R, CO-1)**
3.The first element in the periodic table is---------. (**K1-R, CO-1)**
(a) Lithium (b)Hydrogen (c) Helium (d) Sodium
4.The ionisation energy of s block elements ----------along a period. (**K2-U, CO-2)**
5. An example of inter halogen compound is ----------. (**K1-R, CO-1)**

(a) PCl_3 (b) N_2O_5 (c) IF_7 (d)PH_3

6.Marshall's acid is an example of oxyacid of sulphur. Say true or false. (**K1-R, CO-1)**

7.Natural rubber is made up of isoprene units. Say true or false. (**K1-R, CO-1)**

8.Ozonolysis of alkene gives ----------.(**K3-Ap, CO-3)**

(a) aldehydes (b) acid (c) halogens (d) ester

9.Naphthalene is an example for polynuclear hydrocarbon. Say true or false. (**K1-R, CO-1)**

10.Nitrating agent is a mixture of ----------.(**K1-R, CO-1)**

Part B

1. Explain the theory of acid base indicators. (**K2-U, CO-2)**
2. Write notes on(i)Ionic product of water(ii) Buffer action (**K2-U, CO-2)**
3. Give the flame colouration of alkali and alkaline earth metals. (**K2-U, CO-2)**
4. Explain the structure of diborane. (**K2-U, CO-2)**
5. Write notes on Caro's acid and Marshall's acid (**K2-U, CO-2)**
6. What are pseudo halogens? Explain them. (**K2-U, CO-2)**
7. Write notes on Markownikoff's rule and Karash effect. (**K2-U, CO-2)**
8. What do you mean by Hofmann and Saytzeff rule? (**K2-U, CO-2)**
9. Explain the structure of benzene. (**K2-U, CO-2)**
10. Give the mechanism of i) nitration and ii) Friedel crafts alkylation (**K3-Ap, CO-3)**

Part C

1. Derive Henderson Hasselbalch equation. (**K3 - Ap, CO-3)**
2. Mention the applications of solubility product. (**K1-R, CO-1)**
3. How is aluminium extracted from its ore? Mention the uses. (**K2-U, CO-2)**
4. Compare carbon with that of silicon. (**K4-An, CO-4)**
5. List out the peculiarities of fluorine. (**K4-An, CO-4)**
6. Explain the position of noble gases in the periodic table. (**K2-U, CO-2)**
7. Explain Bayer's strain theory on the basis of relative stability of alkanes. (**K3-A, CO-3)**
8. Give any two methods of preparation of alkenes. Explain E_1 and E_2 reactions. (**K2-U, CO-2)**

9. How is naphthalene prepared by Haworth synthesis? Explain the oxidation, alkylation and acylation reactions. (**K3-Ap, CO-3)**
10. Explain electrophilic substitution reactions with examples. (**K2-U, CO-2)**

Course Instructor

Dr. L. Deva Vijila

Head of the Department

Dr. R. Gladis Latha

SEMESTER – II

Department : **Chemistry**
Class : **I B.Sc. Chemistry**
Title of the Course : **Core Lab Course II: Organic Estimation and Preparation of Organic Compounds**
Semester : **II**
Course Code : **CU232CP1**

Course Code	L	T	P	S	Credits	Inst. Hours	Total Hours	Marks		
								CIA	External	Total
CU232CP1	-	-	3		3	3	45	25	75	100

Learning Objectives:

1. To develop skill in estimating organic compounds
2. To prepare organic compounds

Course Outcomes

On the successful completion of the course, student will be able to:		
1.	explain the basic principles involved in organic estimation	**K1**
2.	know the methods of preparing organic compounds.	**K2**
3.	assess the yield of different organic preparations	**K3**
4.	compare the methodologies in preparing various compounds	**K4**

K1 - Remember; **K2** - Understand; **K3** - Apply; **K4**-Analyse

Practical Teaching Plan

Total Contact hours: 45 (Including practical and assessment)

Unit	Topic	Practical Hours	Assessment Hours	Cognitive level	Pedagogy	Student Centric Method	E-Resources	Assessment/ Evaluation Methods
I	**Organic estimation**							
	1. Estimation of Phenol 2. Estimation of Aniline 3. Estimation of Ethyl methyl ketone – course work	26	4	K3(Ap)	Demonstration	Experiential and lab based learning	Simulations and Virtual Labs	Performance, Observation, Reporting, Model examination
II	**Preparation of Organic Compounds**							
	i. Beta naphthyl benzoate from beta naphthol ii. p-bromo acetanilide from acetanilide iii. Benzoic acid from benzaldehyde iv. Benzoic acid from methyl benzoate v. Salicylic acid from methyl salicylate vi. Benzoic acid from benzamide	12	3	K3(Ap)	Demonstration	Experiential and lab based learning	Simulations and Virtual Labs	Performance, Observation, Reporting

Practical-in-Charge: Dr. L. Deva Vijila

Head of the Department: Dr. R. Gladis Latha

Department : Chemistry
Class : Elective Course II: Botany and Zoology Major
Title of the Course : Chemistry for Biological Sciences - II
Semester : II
Course Code : CU232EC1

Course Code	L	T	P	Credits	Inst. Hours	Total Hours	Marks		
							CIA	External	Total
CU232EC1	4	-	-	3	4	60	25	75	100

Learning Objectives

1. To know about amino acids, lipids, essential elements of biosystem and fundamentals of photochemistry.
2. To understand the characteristics and structure of nucleic acids and vitamins.

Course Outcomes

On the successful completion of the course, students will be able to:		
1.	remember the importance of amino acids and learn the basic concepts of Ayurveda	**K1**
2.	understand the importance of nucleic acids and vitamins	**K2**
3.	know the biological functions of lipids, oils and fats	**K1**
4.	understand the function and deficiency of metals in human system	**K2**
5.	outline the various type of photochemical process.	**K3**

K1 - Remember; **K2** - Understand; **K3** - Apply;

Teaching plan

Total Contact hours: 60 (Including lectures, assignments and tests)

Unit	Module	Topic	Teaching Hours	Assessment Hours	Cognitive level	Pedagogy	Student Centric Method	E-Resources	Assessment/ Evaluation Methods
I	**Amino Acids and Essential elements of biosystem**								
	1	Classification - preparation and properties of alanine	2	1	K1(R) & K2(U)	Concept based teaching & Reaction based teaching	Think-Pair-Share	Interactive ppt	Formative Quiz using Quizizz, slip test, CIA I
	2	Preparation of dipeptides using Bergmann method	2		K2(U) & K3(Ap)	Reaction based teaching	Group discussion	Interactive ppt	Class test, CIA I
	3	Proteins- classification – structure	2	1	K2(U)	Concept based teaching with illustrations	Concept mapping	Interactive ppt	Conceptual questions, CIA I
	4	Colour reactions – Biological functions of proteins.	2		K2(U) & K3(Ap)	Conceptual Pedagogy.	Concept mapping	Interactive ppt, notes.	Short test
	5	Basic concepts of Ayurveda, Important test of Ayurveda and Ayurvedic view of the cause of diseases.	2		K2(U)	Interactive lecture	Application-based examples.	Interactive ppt	Quiz, CIA I
II	**Nucleic acids and Vitamins**								
	1	Nucleic acids –nucleosides and nucleotides. Structure of DNA - denaturation and renaturation of DNA - replication of DNA. Hydrogen bonding in DNA.	2	1	K1(R) & K2(U)	Concept based teaching with illustrations	Think-Pair-Share, Concept mapping	Interactive ppt	Formative Quiz using Quizizz, CIA II

	2	Stabilizing forces in protein and DNA - Vander waal's forces, dipole-dipole and dipole-induced dipole interactions.	2		K2(U)& K3(Ap)	Concept based teaching with illustrations	Concept mapping	-	Short test, CIA II
	3	Structure of RNA - Types of RNA. Difference between DNA and RNA.	2	1	K2(U)& K3(Ap)	Conceptual lecture	Think-Pair-Share, Concept mapping	Interactive ppt	Slip test, CIA II
	4	**Vitamins**: Classification, source, biological functions of Vitamin A, B, C, D, E and K.	2		K2(U)	Real-world Contextualization,	Peer Teaching	-	Slip test, CIA II
	5	Diseases caused by the deficiency of Vitamin A, B, C, D, E and K.	2		K2(U)	Real-world Contextualization,	Think-Pair-Share	Interactive ppt	Short test, CIA II
III	**Lipids, oils and fats**								
	1	Lipids - classification - properties - biological functions. Biological functions of phospholipids and glycolipids.	2	1	K1(R) & K2(U)	Concept based teaching with illustrations	Group discussion	Interactive ppt	Formative Quiz using Quizizz, slip test, Quick quiz using Kahoot, CIA II
	2	Oils and fats - definition - characteristics and uses. Common fatty acids in oils and fats.	2		K3(Ap) &	Comparative and thematic teaching	Think-Pair-Share	Interactive ppt	Assignment, CIA II
	3	Extraction and refining of oils. Estimation of fats and oils - acid value, saponification value and Iodine value.	3	1	K3(Ap)	Problem based learning	Group discussion	Interactive ppt	Slip test, CIA II

	4	Distinction between animal and vegetable fats. Hydrogenation and Rancidity.	3		K2(U)	Conceptual lecture	Group discussion	Interactive ppt	, CIA II
IV	**Minerals and water**								
	1	**Minerals:** Introduction – source, function, deficiency and toxicity of calcium.	3	1	K2(U) & K3(Ap)	Interactive lecture	Concept mapping	-	Formative Quiz using Nearpod, slip test, CIA I
	2	Deficiency and toxicity of phosphorous, sodium, potassium, iron and iodine.	2		K2(U) & K3(Ap)	Socratic Questioning & Real world applications	Think-Pair-Share	-	Short test, CIA I
	3	**Water**: Source and distribution of water in the body – functions of water	3	1	K2(U)	Interactive lecture	Think-Pair-Share	Interactive ppt	Slip test, CIA I
	4	Absorption, metabolism and storage of water.	2		K2(U)	Interactive lecture	Think-Pair-Share	Interactive ppt	Short test, CIA I
V	**Photochemistry**								
	1	Importance of photochemistry. Difference between thermal and photochemical reactions. Laws of photochemistry -Beer-Lambert's Law	2	1	K2(U)	Conceptual lecture	Concept mapping	Interactive ppt	Formative Quiz using Nearpod, slip test, Conceptual questions, CIA II

	2	Grother's-Drapers law - Stark-Einstein's law - quantum efficiency.	2		K3(Ap)	Conceptual lecture	Think-Pair-Share	Interactive ppt	Slip test, CIA II
	3	Electronic excitations - singlet and triplet states - Jablonski diagram - internal conversion - intersystem crossing	2		K3(Ap) & K4(An)	Concept based teaching with illustrations	Inquiry based learning	-	Short test, CIA II
	4	Fluorescence - phosphorescence. Difference between fluorescence and phosphorescence.	2	1	K3(Ap) & K4(An)	Derivation based teaching	Concept mapping	Interactive ppt	Conceptual questions, CIA II
	5	Photochemical rate law - kinetics of photochemical combination of H_2 and Cl_2 - decomposition of HI. Photosensitization - photosensitizers - chemiluminescence - bioluminescence.	2		K3(Ap)	Derivation based teaching	Inquiry based learning	-	Short test, CIA II

Course Focusing on Employability/ Entrepreneurship/ Skill Development: Employability
Activity (Em/SD): Mind map on classification of vitamins
Assignment: Compare Oils and fats (Last date to submit: 07-01-2026)

Sample Questions

PART A

1. Recognize the amino acid that contains an imino group instead of a primary amino group. (**K2-U, CO-2)**
   a) Histidine b) Lysine c) Proline d) Valine
2. Nucleic acids are made up of _____. (**K2-U, CO-2)**
   a. RNA b) DNA c) Pentose sugar d) All the above
3. Assertion(A): Fat layer under skin prevents loss of heat from body. (**K3-Ap, CO-5)**
   Reason(R): Fats are poor conductors of heat
   a) Both (A) and (R) are correct
   b) Both (A) and (R) are wrong
   c) (A) is correct but (R) is wrong
   d) (A) is wrong but (R) is correct
4. Pick out the major mineral from the following. (**K2-U, CO-2)**
   Zn b) Na c) Co d) Mo
5. Photochemical reactions are highly selective. State true or false. (**K1-R, CO-1)**

PART B

1. Classify amino acids based on their chemical structure. (**K3-Ap, CO-5)**
2. Compare nucleosides and nucleotides. (**K3-Ap, CO-5)**
3. Explain the biological functions of lipids. (**K2-U, CO-2)**
4. Discuss the function and sources of phosphorous. (**K2-U, CO-2)**
5. Illustrate the mechanism of phosphorescence with a diagram. (**K3-Ap, CO-5)**

PART C

1. Explain the classification of aminoacids and protiens based on their structure. (**K2-U, CO-2)**
2. Differentiate between DNA and RNA. (**K3-Ap, CO-5))**
3. Compare the biological functions of lipids and phospholipids. (**K3-Ap, CO-5)**
4. Write a note on sources, functions, deficiency and toxicity of potassium. (**K2-U, CO-2)**
5. Compare chemiluminescence and bioluminescence. (**K3-Ap, CO-5)**

Course Instructor: Dr. Y. Christabel Shaji **Head of the Department:** Dr. R. Gladis Latha

SEMESTER – II

Department : Chemistry
Class : I B.Sc Botany/Zoology
Title of the Course : ELECTIVE LAB COURSE II: SYSTEMATIC ANALYSIS OF ORGANIC COMPOUNDS
Semester : II
Course Code : CU232EP1

Course Code	L	T	P	S	Credits	Inst. Hours	Total Hours	Marks		
								CIA	External	Total
CU232EP1	-	-	2	-	2	2	30	25	75	100

Learning Objectives

1. To identify of organic functional groups
2. To determine elements in organic compounds.

Course Outcomes

On the successful completion of the course, student will be able to:		
1	learn to test the organic substances	**K1**
2	identify the functional group present in the organic compounds	**K2**
3	detect the elements present	**K3**
4	distinguish between aliphatic, aromatic, saturated and unsaturated compounds	**K3**
5	analyze the given organic substance	**K4**

K1 - Remember; K2 - Understand; K3 - Apply; K4 – Analyze

Practical Teaching Plan

Total Contact hours: 30 (Including practical and assessment)

Unit	Topic	Practical Hours	Assessment Hours	Cognitive level	Pedagogy	Student Centric Method	E-Resources	Assessment/ Evaluation Methods
I	**SYSTEMATIC ANALYSIS OF ORGANIC COMPOUNDS**							
1.	Functional group tests [phenol, mono carboxylic acids, ester, aldehyde, diamide and carbohydrate].	10	5	K3(Ap) & K4(An)	Demonstration	Experimental, Lab based learning	Virtual Labs	Performance, Observation, Reporting, Model examination
2.	To distinguish between aliphatic and aromatic compounds. To distinguish – Saturated and unsaturated compounds.	10		K3(Ap) & K4(An)				
3.	Elements present or absent	5		K3(Ap) & K4(An)				

Course Instructor: Dr. M. Anitha Malbi

Head of the Department: Dr. R. Gladis Latha

Department : Chemistry
Class : Non Major Elective
Title of the Course : Cosmetics and Personal Grooming
Semester : II
Course Code : CU232NM1

Course Code	L	T	P	S	Credits	Inst. Hours	Total Hours	Marks		
								CIA	External	Total
CU232NM1	2				2	2	30	25	75	100

Learning Objectives

1. To provide basic knowledge of the Cosmetics.

2. To know the chemicals, present in hair and skin care products

Course Outcomes

On the successful completion of the course, students will be able to:		
1	remember the composition of various chemicals in cosmetic products	**K1**
2	understand the methods of beauty treatments and their advantages and disadvantage	**K2**
3	apply the functions of various chemicals in cosmetics	**K3**
4	analyze the advantages and hazards of cosmetics	**K4**
5	evaluate the quality of cosmetics on the basis of their chemical composition	**K5**

K1 - Remember; **K2** - Understand; **K3**- Apply; **K4** - Analyse; **K5-** Evaluate

Teaching plan

Total Contact hours: 30 (Including lectures, assignments and tests)

Unit	Module	Topic	Teaching Hours	Assessment Hours	Cognitive level	Pedagogy	Student Centric Method	E-Resources	Assessment/ Evaluation Methods
I	**Skin care**								
	1	Nutrition of the skin, skin care and cleansing of the skin; face powder – ingredients	1	1	K1(R) & K2(U)	Interactive lecture	Think-Pair-Share	E-Notes, You-tube videos	I CIA
	2	Creams and lotions – cleansing, moisturizing all purpose, shaving and sunscreen (formulation only);	1		K2(U)	Concept based learning,	Interactive PPT		Slip test, I CIA
	3	Gels – formulation and advantages; astringent and skin tonics – key ingredients	1	1	K2(U)	Interactive lecture	Collaborative Learning	-	Short test, I CIA
	4	Skin lightness, depilatories. Hazards of skin care products.	1		K3(Ap)	Socratic Questioning, lecture with visualization.	Collaborative learning.	Interactive PPT	Oral test and MCQ, I CIA
II	**Hair care & Dental care**								
	1	Shampoos – types – powder, cream, liquid, gel – ingredients	1	1	K2(U)	Real-world Contextualization,	Think-pair-share	-	Question – answering,, I CIA

	2	Conditioner – types – ingredients – Hair dye. Disadvantages of hair care products	1		K2(U) & K3(Ap)	Group discussion	Collaborative learning.	Interactive ppt, lecture notes.	Quiz on Quizziz, , I CIA
	3	Tooth pastes – ingredients and preparation of tooth paste	1	1	K2(U) & K3(Ap)	Interactive lecture	Application-Based Learning	Interactive videos	I CIA
	4	Ingredients and preparation of mouth wash	1		K2(U)	Real-world Contextualization	Think-pair-share	Interactive PPT, notes	Short summary, I CIA
III	**Make up**								
	1	Base – foundation – types- liquid - powder – stick	1	1	K2(U)	Conceptual lecture	Concept Mapping	Interactive PPT	Assignment, Oral test
	2	Ingredients-lipstick, eyeliner,	1		K2(U) & K3(Ap)	Application-Based Teaching	Real world applications.		Quiz on Quizziz, I CIA
	3	Mascara & eyeshadow	1	1	K2(U)	Interactive lecture	Interactive Simulation	-	Short test, I CIA
	4	Concealers & rouge	1		K2(U)	Interactive lecture .	Group discussion	Interactive videos.	I CIA
IV	**Perfumes**								
	1	Classification - Natural – plant origin – parts of the plant used	1	1	K2(U) & K4(An)	Inquiry-Based Learning	Think-Pair-Share, Simulation-Based Learning	Interactive ppt, notes.	Slip test, II CIA
	2	Isolation of essential oils	1		K2(U)	Inquiry-Based Learning.	Animation-based learning on preparing reconstituted	You tube videos on preparation of	II CIA

							milk, Think-Pair-Share.	reconstituted milk.	
	3	Preparation of odorous substances- methyl anthranilate- citronellol	1		K2(U)& K3(Ap)	Reaction based teaching	Think-Pair-Share	-	Short test, II CIA
	4	Preparation of odorous substances- coumarin-vanillin-diphenyl oxide.	1	1	K2(U)& K3(Ap)	Reaction based teaching	Think-Pair-Share	-.	Question answering, II CIA
V	**Beauty treatments**								
	1	Facials - types – advantages – disadvantages	1	1	K1(R) & K2(U)	Flipped classroom	Inquiry based learning	Interactive videos	Slip test, II CIA
	2	Face masks – types; bleach -types – advantages– disadvantages	1		K2(U) & K3(Ap)	Visual Pedagogy	Think-Pair-Share	Interactive videos.	Short test, II CIA
	3	Shaping the brows; eyelash tinting; Perming types; hair colouring and dyeing	1		K2(U) & K3(Ap)	Interactive lecture .	Group discussion	E-Notes	II CIA
	4	Wax types – waxing; pedicure, manicure - advantages – disadvantages	1	1	K2(U) & K3(Ap)	Interactive lecture .	Think-Pair-Share		II CIA

Course Focusing on Employability/ Entrepreneurship/ Skill Development: Employability

Activities (Em): Group discussion - Shaping the brows

Assignment: Types and ingredients of foundation (Due date : 08-01-2025)

Sample questions

Part- A(2 Marks)

1. Mention any two advantages of gels. (**K2-U, CO-2)**
2. Classify the types of conditioner (**K3-R, CO-3)**
3. What are Concealers? (**K1-R, CO-1)**
4. Give any two examples of natural perfumes. **K1-R, CO-1)**
5. Listout any two advantages of facial. (**K2-U, CO-2)**

Part - B(4 Marks)

1. Explain the steps involved in the cleansing of skin. (**K2-U, CO-2)**
2. Illustrate the preparation and uses of tooth paste. (**K2-U, CO-2)**
3. Write a note on rouge. (**K2-U, CO-2)**
4. What are perfumes? How are they classified? (**K3-Ap, CO-3)**
5. Discuss the disadvantages of hair colouring. (**K2- U, CO-2)**

Part - C(9 Marks)

1. Explain the formulation and advantages of gel. (**K2-U, CO-2)**
2. Compare the advantages and disadvantages of hair care products. (**K3-Ap, CO-3)**
3. Describe the types and ingredients of foundation. (**K2-U, CO-2)**
4. Analyse the preparation of citronellol, coumarin and vanillin. (**K4-An, CO-4)**
5. What is manicure. Give its advantages and disadvantages. (**K2-U, CO-2)**

Course Instructor: Dr. Y. Christabel Shaji

Head of the Department: Dr. R. Gladis Latha

Department : Chemistry
Class : I B.Sc. Chemistry
Title of the Course : Dairy Chemistry
Semester : II
Course Code : CU232SE1

Course Code	L	T	P	S	Credits	Inst. Hours	Total Hours	Marks		
								CIA	External	Total
CU232SE1	1	-	1	-	2	2	30	25	75	100

Learning Objectives

1. To understand the composition and processing of milk.
2. To know the constituents and manufacturing process of milk and milk products.

Course Outcomes

On the successful completion of the course, students will be able to:		
1	remember the composition of milk and its processing	**K1**
2	understand the physio-chemical properties, pasteurization process and manufacture of milk and milk products	**K2**
3	apply the procedure for milk processing and determine the adulterants present in dairy products	**K3**
4	analyse the ingredients, nutritive values and manufacture of special milks and dairy products	**K3**
5	evaluate fat, SNF, specific gravity, acidity, pH, surface tension, viscosity and physio-chemical properties of milk and milk products.	**K4**

K1 - Remember; **K2** - Understand; **K3**- Apply; **K4** - Analyse; **K5-** Evaluate

Teaching plan

Total Contact hours: 30 (Including lectures, assignments and tests)

Unit	Module	Topic	Teaching Hours	Assessment Hours	Cognitive level	Pedagogy	Student Centric Method	E-Resources	Assessment / Evaluation Methods
I									
	1	Milk - definition - general composition of milk. Constituents of milk - lipids, proteins.	1	1	K1(R)	Lecture with Visual Aids such as PPT, Flipped Classroom.	Peer Teaching.	Interactive ppt, notes, You-tube video	Oral test
	2	Carbohydrates, vitamins and minerals.	1		K2(U)	Lecture with visualization	Collaborative Learning, experiential learning.	Interactive ppt, you- tube videos	Short test
	4	Physical properties of milk - colour, odour, acidity	1		K3(Ap)	Socratic Questioning, lecture with visualization.	Collaborative learning.	Interactive ppt, notes.	Oral test and MCQ
	5	Specific gravity, viscosity and conductivity -	1		K4(An)	Lecture with visualization, demonstration	Real-World applications, experiential learning.	Online Tutorials and Notes.	Short test through slido
	6	Factors affecting the composition of milk.	1		K2(U)	Simulations, Flipped Classroom	Blended learning, group discussion.	Interactive ppt, notes.	Quiz on Kahoot.

II	**Processing of Milk**								
	1	Microbiology of milk - destruction of micro - organisms in milk	1	1	K2(U)	Demonstration-based Learning, simulations.	Peer Instruction, Blended Learning.	Interactive ppt, notes	Question - answering
	2	Physico-chemical changes taking place in milk due to processing - boiling	1		K2(U)	Collaborative learning.	Experiential learning.	Interactive ppt, lecture notes.	Quiz on Kahoot.
	3	Pasteurization - types of pasteurization- Bottle, Batch.	1		K2(U)	Analogical Teaching, Visual Demonstration, Application-Based Learning	Visit to milk plant.	Notes.	Question answering.
	4	High Temperature Short Time (HTST) pasteurization, Vacuum pasteurization	1		K2(U)	Real-world Contextualization, Model- based approach.	Peer Teaching, Think-pair-share	Interactive ppt, notes	Short summary.
	5	Ultra High Temperature (UHT) pasteurization	1		K2(U)	Simulations, Flipped Classroom	Peer Instruction, Blended Learning.	NPTEL Lectures	Short Test
III	**Major Milk Products**								
	1	Cream - definition - composition - chemistry of creaming process	1	1	K2(U)	Concept Mapping	Flipped Classroom, Peer Teaching	Interactive ppt, notes.	Oral test
	2	Gravitational and centrifugal methods of separation of cream-	1		K2(U)	Application-Based Teaching	Socratic Questioning, Analogies,	Interactive ppt, notes.	Quiz on Kahoot

		Butter - definition – composition.					Real world applications		
	3	Theory of churning- Desi butter - salted butter.	1		K4(An)	Concept Building, Application based teaching.	Interactive Simulation	NPTEL videos, notes.	Short test and MCQ in google form
	4	Estimation of acidity and moisture content in butter, Ghee - major constituents.	1		K3(Ap)	Concept based learning, demonstration.	Experiential learning, Preparation of butter.	NPTEL lectures, interactive ppt.	Short summary
	5	Common adulterants added to ghee and their detection.	1		K1(K)	Concept Mapping, demonstration.	Experiential learning, Peer Teaching.	You- tube videos on detection of adulterants in milk.	Short Test
IV	**Special Milk**								
	1	Standardised milk - definition - merits	1	1	K1(R)	Inquiry-Based Learning	Think-Pair-Share, Simulation-Based Learning	Interactive ppt, notes.	Slip test
	2	Reconstituted milk - definition - flow diagram of manufacture	1		K2(U)	Inquiry-Based Learning.	Animation-based learning on preparing reconstituted milk, Think-Pair-Share.	You tube videos on preparation of reconstituted milk.	Group discussion
	3	Homogenised milk - flavoured milk - vitaminised milk	1		K3(Ap)	Conceptual Pedagogy.	Application-based examples.	Interactive ppt, notes.	Short test

	4	Toned milk - Imitation milk , Vegetable toned milk - humanized milk	1		K3(Ap)	Blended Learning, Flipped classroom	Think-Pair-Share.	NPTEL lectures on preparation of toned milk and humanised milk.Visual lectures, notes.	Question answering.
	5	Condensed milk - definition, composition and nutritive value.	1		K2(U)	Constructivist Learning, Inquiry-Based Learning.	Think-Pair-Share, Simulation-Based Learning.	NPTEL lectures, notes.	Quizzes
V	**Estimation and Preparation of milk and milk products**								
	1	Estimation of fat, SNF	1	1	K1(R)	Core Conceptual Approach.	Peer group teaching using models.	Interactive ppt, notes.	Slip test
	2	Specific gravity and acidity of milk	1		K2(U)	Visual Pedagogy	Think-Pair-Share, group discussion.	Interactive ppt, You-tube videos.	Short test
	3	Determination of pH, surface tension and viscosity of milk	1		K4(An)	Core Conceptual Approach.	Peer group teaching, experiential learning.	You tube video on determination of surface tension	MCQ through Slido
	4	Preparation of butter - ghee - milk powder and ice cream.	1		K3(Ap)	Visual Pedagogy	Interactive ppt, group discussion.	You -Tube videos, E-notes	Short summary
	5	Preparation of indigenous milk	1		K3(Ap)	Visual Pedagogy	Interactive ppt, chalk and talk.	Interactive ppt,	MCQ

		products - Khoa - chhena - paneer and kulfi						notes.You - Tube videos	

Course Focusing on Employability/ Entrepreneurship/ Skill Development: Employability

Activities (Em): Preparation of Milk Products

Assignment: Due Date: 06-01-2025

1. Constituents of milk - lipids, proteins

2. Estimation of fat, SNF

3. Preparation of indigenous milk products

Seminar:

1. Pasteurization - types of pasteurization

2. Ultra - High Temperature (UHT) pasteurization

3. Gravitational and centrifugal methods of separation of cream.

4. Common adulterants added to ghee and their detection

5. Preparation of indigenous milk products

Sample questions

Part- A(2 Marks)

1. Define milk. **(K1-U, CO-2).**
2. What are the vitamins present in milk? **(K2-U, CO-2)**
3. What do you mean by pausterization? Give its importance. **(K2-U, CO-2)**
4. "Milk is acidic in nature". Justify this statement by giving reasons. **(K4-An, CO-2)**

5. Define butter. (**K2-U, CO-2)**
6. List the adulterants present in ghee. (**K1-R, CO-1)**
7. What are the advantages of homogenization of milk? (**K1-U, CO-2)**
8. Define condensed milk. (**K2-U, CO-2)**
9. Define specific gravity. (**K2-U, CO-2)**
10. What is the purpose of preparing milk powder? (**K4-An, CO-4)**

Part - B(4 Marks)

1.Explain the physical properties of milk. (**K2-U, CO-2)**
11. List out the types of milk. (**K2-U, CO-2)**
12. List out the constituents of milk. (**K2-U, CO-2)**
13. Write notes on pasteurization. (**K2-U, CO-2)**
14. Differentiate HTST and UHT pasteurization techniques. (**K4-An, CO-4)**
15. Compare bottle and batch pasteurization process. (**K4-An, CO-4)**
16. Write notes on rancidity. (**K2-U, CO-2)**
17. Explain the theory of churning for the conversion of cream into butter. (**K2-U, CO-2)**
18. How will you detect the adulterants present in ghee? (**K3-U, CO-2)**
19. Compare gravitational and centrifugal methods for the separation of cream. (**K2-U, CO-2)**
20. Highlight the merits of standardized milk. (**K2-Ap, CO-3)**
21. Differentiate homogenized and flavoured milks. (**K4-An, CO-4)**
22. Compare bulgarious and acidophilous milks (**K4-An, CO-4)**

Part - C(9 Marks)

6. How will you determine the adulterants present in milk? (**K2-U, CO-2)**
7. Analyze the factors which affect the composition of milk. (**K4-An, CO-4)**
8. Describe the physio-chemical changes takes place in milk while processing. (**K2-U, CO-2)**
9. Determine the acidity and moisture content present in butter. (**K2-U, CO-2)**
10. Illustrate the manufacture of reconstituted milk with a flow chart(**K3-Ap, CO-3)**

11. Compare the composition of vitaminised, toned and humanized milks. What is fermentation of milk? Summarize the process involved in the fermentation of milk (**K4-An, CO-4)**
12. Illustrate the procedure for the manufacture of ice cream. Analyze the role of stabilizers and emulsifiers in ice cream. (**K4-An, CO-4)**
13. Illustrate the procedure for the destruction of microorganism present in milk. (**K2-U, CO-2)**
14. Estimate the fat content and total solids present in milk. (**K2-U, CO-2)**

Course Instructor

Dr.Y.Christabel Shaji

Head of the Department

Dr. R. Gladis Latha

Department : Chemistry
Class : II B.Sc Chemistry
Title of the Course : Core Course IV: General Chemistry - IV
Semester : IV
Course Code : CU234CC1

Course Code	L	T	P	S	Credits	Inst. Hours	Total Hours	Marks		
								CIA	External	Total
CU234CC1	5	-	-	-	5	5	75	25	75	100

Learning Objectives:
1. To provide a comprehensive knowledge on thermodynamic concepts and transition elements.
2. To know the chemistry of ethers, aldehydes, ketones and carboxylic acids.

Course Outcomes

On the successful completion of the course, students will be able to:		
1	define the terms in thermodynamics, periodic properties of transition elements and to recognize the properties of aldehydes, ketones and carboxylic acids.	**K1**
2	discuss the fundamentals in the chemistry of ethers and carbonyl compounds and to understand the principles behind thermodynamics.	**K2**
3	apply the laws of thermodynamics and to synthesise various organic compounds.	**K3**
4	classify transition elements into series and to analyse the properties of ethers, acids, and thermodynamical concepts.	**K4**
5	determine the thermodynamic relations and to evaluate the oxidation, reduction and other properties of organic compounds.	**K5**

K1 - Remember; **K2** - Understand; **K3** - Apply; **K4** - Analyse; **K5** - Evaluate

Teaching plan

Total Contact hours: 75 (Including lectures, assignments and tests)

Unit	Module	Topic	Teaching Hours	Assessment Hours	Cognitive level	Pedagogy	Student Centric Method	E-Resources	Assessment/ Evaluation Methods
I	**Thermodynamics I**								
	1	Terminology - Intensive, extensive variables, state, path functions; isolated, closed and open systems; isothermal, adiabatic, isobaric, isochoric, cyclic, reversible and irreversible processes.	2	1	K1(R) & K2(U)	Concept based teaching with demonstration	Think-Pair-Share	Interactive ppt	Formative Quiz using Quizizz, slip test, CIA I
	2	First law of thermodynamics - concept and significance of heat (q), work (w), internal energy (E), enthalpy (H); calculations of q, w, E and H for reversible, irreversible expansion of ideal and real gases under isothermal and adiabatic conditions.	3		K3(Ap) & K4(An)	Lecture with visual aids and Problem solving	Problem based learning, Group discussion, Peer teaching	Video lectures, Interactive ppt	Problem solving, Class test, CIA I
	3	Relation between heat capacities (Cp and Cv); Joule Thomson effect-inversion temperature.	2	2	K2(U) & K3(Ap)	Concept based teaching with illustrations	Concept mapping	Interactive ppt	Conceptual questions, CIA I
	4	Thermochemistry - heats of reactions, standard states; types of heats of	3		K2(U) & K3(Ap)	Conceptual lecture	Think-Pair-Share	Interactive ppt	Group discussion, CIA I

		reactions and their applications.							
	5	Effect of temperature (Kirchhoff's equations) and pressure on enthalpy of reactions; Hess's law and its applications.	2		K4(An)	Concept based teaching with illustrations	Concept mapping	Interactive ppt	Quiz, CIA I
II	**Thermodynamics II**								
	1	Second Law of thermodynamics - Limitations of first law, spontaneity and Randomness. Carnot's cycle; Concept of entropy, entropy change for reversible and irreversible processes, entropy of mixing.	2	1	K1(R) & K2(U)	Concept based teaching with illustrations	Think-Pair-Share, Concept mapping	Interactive ppt	Formative Quiz using Quizizz, CIA I
	2	Calculation of entropy changes of an ideal gas and a van der Waals gas with changes in temperature, volume and pressure, entropy and disorder.	3		K3(Ap) & K4(An)	Problem based teaching	Problem solving	-	Short test, CIA I
	3	Free energy and work functions - Need for free energy functions, Gibbs free energy, Helmholtz free energy - their	3	2	K3(Ap) & K4(An)	Conceptual lecture	Think-Pair-Share, Concept mapping	Interactive ppt	Slip test, CIA II

		variation with temperature, pressure and volume.							
	4	Criteria for spontaneity; Gibbs-Helmholtz equation - derivations and applications. Maxwell relationships.	2		K3(Ap)	Derivation based teaching	Concept mapping	-	Short test, CIA II
	5	Third law of thermodynamics - Nernst heat theorem; Applications of third law - evaluation of absolute entropies from heat capacity measurements, exceptions to third law.	2		K3(Ap) & K5(E)	Conceptual lecture	Think-Pair-Share	Interactive ppt	Short test, CIA II
III	**General Characteristics of d-Block Elements**								
	1	Electronic configuration - General periodic trend variable valency, oxidation states, stability of oxidation states, colour, magnetic properties, catalytic properties and tendency to form complexes.	2	2	K1(R) & K2(U)	Concept based teaching with illustrations	Group discussion	Interactive ppt	Formative Quiz using Quizizz, slip test, Quick quiz using Kahoot, CIA II
	2	Comparative study of transition elements and non-transition elements	2		K3(Ap) & K4(An)	Comparative and thematic teaching	Think-Pair-Share	Interactive ppt	Assignment, CIA II

	3	Comparison of II and III transition series with I transition series.	2		K3(Ap) & K4(An)	Comparative and thematic teaching	Think-Pair-Share	Interactive ppt	Conceptual questions, CIA II
	4	Group study of Titanium, Vanadium, Chromium, Manganese, Iron, Cobalt, Nickel and Zinc groups.	3	1	K4(An)	Comparative and thematic teaching	Group discussion	Interactive ppt	Slip test, CIA II
	5	Extraction and uses of Titanium, Vanadium and Chromium.	3		K3(Ap) & K4(An)	Conceptual lecture	Group discussion	Interactive ppt	Short test, Conceptual questions, CIA II
IV	**Ethers and Thio ethers, Aldehydes and Ketones**								
	1	Ethers - Nomenclature, general methods of preparations, Zeisel's method of estimation of methoxy group. Thioethers - nomenclature, structure, preparation and uses.	3	2	K2(U) & K3(Ap)	Reaction based teaching	Think-Pair-Share	-	Formative Quiz using Nearpod, slip test, CIA I
	2	Aldehydes and Ketones General methods of preparation and physical properties. Nucleophilic addition reactions.	2		K3(Ap) & K4(An)	Reaction based teaching	Think-Pair-Share	-	Short test, CIA I
	3	Base catalysed reactions with mechanism - Aldol, Cannizzaro's reaction, Perkin reaction, Benzoin condensation, Haloform Reaction and Knoevenagel reaction.	3		K3(Ap) & K4(An)	Mechanism based teaching	Group discussion	-	Class test, CIA I

	4	Oxidation of aldehydes. Baeyer-Villiger oxidation of ketones. Clemmensen reduction and Wolf-Kishner reduction.	2	1	K4(An) & K5(E)	Reaction based teaching	Think-Pair-Share	-	Slip test, CIA I
	5	Meerwein-Pondorf Verley reduction, reduction with $LiAlH_4$ and $NaBH_4$. Addition reactions of unsaturated carbonyl compounds: Michael addition.	2		K4(An) & K5(E)	Reaction based teaching	Think-Pair-Share	-	Short test, CIA I
V	**Carboxylic Acids**								
	1	Carboxylic acids: Structure, preparation and acidic nature.	2	2	K2(U)	Conceptual lecture	Inquiry based learning	-	Formative Quiz using Nearpod, slip test, Conceptual questions, CIA II
	2	HVZ reaction, Claisen ester condensation, decarboxylation and Hunsdiecker reaction.	2		K3(Ap)	Reaction based teaching	Think-Pair-Share	-	Slip test, CIA II
	3	Preparations of aliphatic and aromatic acid chlorides, esters, amides and anhydrides.	3		K3(Ap) & K4(An)	Reaction based teaching	Inquiry based learning	-	Short test, CIA II
	4	Schottan- Baumann reaction, Claisen condensation, Dieckmann and Reformatsky	3	1	K3(Ap) & K4(An)	Reaction based teaching	Concept mapping	-	Conceptual questions, CIA II

		reactions, Hofmann bromamide degradation and Curtius rearrangement.							
	5	Alpha, Beta halogenated substituted acids, Preparation and properties.	2		K3(Ap) & K5(E)	Reaction based teaching	Inquiry based learning	-	Short test, CIA II

Course Focusing on Employability/ Entrepreneurship/ Skill Development: Employability
Activity (Em/SD): Mind map on thermodynamic concepts
Assignment: Comparative study of transition elements and non-transition elements (Last date to submit: 06-01-2026)

Sample Questions

PART A(1-Mark)

1. Which of the following is an intensive property? **(K1-R, CO-1)**
   a) Volume b) Mass c) Temperature d) Internal energy
2. Entropy is a measure of _____. **(K2-U, CO-2)**
3. Which of the following ions will show the highest paramagnetism? **(K3-Ap, CO-3)**
   a) Ti^{3+} b) V^{3+} c) Fe^{3+} d) Co^{3+}
4. Which of the following reaction is used to prepare cinnamic acid from benzaldehyde? **(K3-Ap, CO-3)**
   a) Perkin reaction b) Haloform reaction c) Benzoin condensation d) Michael addition reaction
5. β-Halogenated acids undergo nucleophilic substitution more readily than α-halogenated acids. State true or false. **(K2-U, CO-2)**

PART B(4- Marks)

6. State Hess's law. How does it help in determining enthalpy of formation? **(K4-An, CO-4)**
7. Evaluate the concept of entropy using reversible and irreversible processes. **(K5-E, CO-5)**
8. Illustrate the reasons for variable oxidation states in transition elements with examples. **(K3-Ap, CO-3)**
9. Differentiate Clemmensen and Wolf-Kishner reduction reactions with examples. **(K4-An, CO-4)**
10. Discuss any three methods for the preparation of carboxylic acids. **(K2-U, CO-2)**

PART C(9 Marks)

6. Derive expressions for q, w, ΔE, and ΔH for isothermal and adiabatic reversible expansion of an ideal gas. **(K4-An, CO-4)**
7. Discuss the variations of Gibbs and Helmholtz free energy with temperature, pressure, and volume. **(K2-U, CO-2)**
8. Illustrate the methodologies used for the extraction of titanium and vanadium. **(K3-Ap, CO-3)**
9. Compare the mechanisms of aldol, Perkin and Knoevenagel reactions. **(K5-E, CO-5)**
10. Analyze the mechanism of Hofmann bromamide degradation and Curtius rearrangement. **(K4-An, CO4)**

Course Instructor: Dr. Sheeba Daniel

Head of the Department: Dr. R. Gladis Latha

Department : Chemistry
Class : II B.Sc Chemistry
Title of the Course : Core Lab Course IV: Physical Chemistry Practical - I: Conductometric and Potentiometric Titrations
Semester : IV
Course Code : CU234CP1

Course Code	L	T	P	S	Credits	Inst. Hours	Total Hours	Marks		
								Internal	External	Total
CU234CP1	**-**	-	3	-	**3**	**3**	**45**	**25**	**75**	**100**

Learning Objectives:
1. To understand the principle of conductometric and potentiometric titrations.
2. To determine the concentration, conductance and dissociation constant of compounds.

Course Outcomes

On the successful completion of the course, students will be able to:		
1.	remember the theoretical concepts of the experiments.	**K1**
2.	understand the concepts of conductometric and potentiometric titrations.	**K2**
3.	apply the principles of conductometry and potentiometry to determine the strength of unknown solutions.	**K3**
4.	analyze the strength of unknown solution by potentiometric method.	**K4**
5.	evaluate the concentration, conductance and dissociation constant of compounds.	**K5**

K1 - Remember; **K2** - Understand; **K3** - Apply; **K4** - Analyse; **K5** - Evaluate

Practical Teaching Plan

Total Contact hours: 45 (Including practical and assessment)

Unit	Topic	Practical Hours	Assessment Hours	Cognitive level	Pedagogy	Student Centric Method	E-Resources	Assessment/ Evaluation Methods
I	**Conductometric Titrations**							
1.	Comparison of the strengths of given hydrochloric acids using NaOH	4	3	K3(Ap) & K4(An)	Demonstration	Experimental, Lab based learning	Virtual Labs	Performance, Observation, Reporting, Model examination
2.	Estimation of the strength of hydrochloric acid using Std. HCl and NaOH	4		K3(Ap) & K4(An)				
3.	Estimation of strength of weak acid and strong acid using NaOH	4		K3(Ap) & K4(An)				
II	**Potentiometric Titrations**							
1.	Determination of the strength of $FeSO_4$ using Std. Ferrous ammonium sulphate and link - $K_2Cr_2O_7$	5	3	K3(Ap) & K5(E)	Demonstration	Experiential, Lab based learning	Virtual Labs	Performance, Observation, Reporting, Model examination
2.	Determination of the strength of Ferrous ammonium sulphate using Std.$FeSO_4$ and link $KMnO_4$	5		K3(Ap) & K5(E)				
3.	Determination of solubility product of a sparingly soluble substance	5		K3(Ap) & K5(E)				
4.	Determination of heat of solution by solubility method	5		K3(Ap) & K5(E)				
III	**Demonstration**							
1.	Determination of heat of hydration of copper sulphate	3	1	K2(U) & K3(Ap)	Demonstration	Experiential, Lab based learning	Virtual Labs	Performance, Observation

2.	Determination of concentration of copper sulphate solution	3		K2(U) & K3(Ap)				

Practical-in-Charge: Dr. Sheeba Daniel

Head of the Department: Dr. R. Gladis Latha

Department : Chemistry
Class : II B.Sc Physics
Title of the Course : Elective Course IV: Chemistry For Physical Sciences – II
Semester : IV
Course Code : CU234EC1

Course Code	L	T	P	S	Credits	Inst. Hours	Total Hours	Marks		
								CIA	External	Total
CU234EC1	4	-	-	-	3	4	60	25	75	100

Learning Objectives

1. To know co-ordination Chemistry, Water Technology and catalysis
2. To understand Carbohydrates, Amino acids and electrochemistry

Course Outcomes

On the successful completion of the course, student will be able to:		
1.	write the IUPAC name for complex, different theories to explain the bonding in coordination compounds and water technology	**K1**
2.	explain the preparation and property of carbohydrate, amino acids and nucleic acids.	**K2**
3.	apply/demonstrate the electrochemistry principles in corrosion, electroplating and fuel cells.	**K3**
4.	analyze the various types of photochemical process, catalysis, determine the reaction rate and order of chemical reactions	**K4**
5.	evaluate the nature of carbohydrates, reaction rates and electroplating metals	**K5**

K1 - Remember; K2 - Understand; K3 - Apply; K4 – Analyze, K5 - Evaluate

Teaching plan

Total Contact hours: 60 (Including lectures, assignments and tests)

Unit	Module	Topic	Teaching Hours	Assessment Hours	Cognitive level	Pedagogy	Student Centric Method	E-Resources	Assessment/ Evaluation Methods
I	**Co-ordination Chemistry and Water Technology**								
	1	Co-ordination Chemistry: Definition of terms- IUPAC Nomenclature	2	1	K2(U)	Interactive lecture, Demonstration, Problem solving	Problem based learning, Think-Pair-Share, Concept mapping	, Virtual lab simulations	Formative Quiz using Quizizz, Conceptual questions, CIA I
	2	Werner's theory - EAN rule - Pauling's theory – Postulates	2		K3(A)	Lecture with visual aids and models, Demonstration, Flipped classroom	Group discussion.	Interactive videos and ppt	Quiz, CIA I
	3	Applications to [Ni(CO)4], [Ni(CN)4]2-,[Co(CN)6]3- Chelation - Biological role of Haemoglobin and Chlorophyll (elementary idea)	2	1	K3(U)	Visual concept lecture, Structure based learning	Think-Pair-Share, Concept mapping	E- Notes	Conceptual questions, CIA I
	4	Applications in qualitative and quantitative analysis. Water Technology: Hardness of water, determination of hardness of water using EDTA method	2		K3(A)	Model based teaching, Demonstration, Problem solving	Problem based learning, peer teaching.	Ppt	Slip test, CIA I

	5	Zeolite method-Purification techniques- BOD, COD.	2	1	K4(An)	Visual concept lecture, Problem solving	Group discussion	, Virtual lab simulations, Interactive ppt	Slip test, Group discussion, CIA I
II	**Carbohydrates and Amino acids**								
	1	Carbohydrates: Classification, preparation and properties of glucose	2	1	K2(U)	Conceptual lecture, Model based explanation	Think-Pair-Share, Concept mapping	Video lectures and ppt	Slip test, Quick quiz using Kahoot, CIA I
	2	Properties of fructose and sucrose. Discussion of open chain ring structures of glucose and fructose.	2		K2(U)	Mechanism based teaching, mind mapping	Problem based learning, Think-Pair-Share, Concept mapping	Video lectures and ppt	Conceptual questions, CIA I
	3	Glucose–fructose interconversion. Properties of starch and cellulose.	2	1	K3(A)	Interactive lecture, Mechanism based explanation	Group discussion, Concept mapping	Interactive videos and ppt	Quiz, CIA I
	4	Amino acids: Classification - preparation and properties of alanine	2		K3(A)	Application based teaching, Reaction mapping,	Problem based learning, Think-Pair-Share, Concept mapping	Video lectures and ppt	Conceptual questions, CIA I
	5	Preparation of dipeptides using Bergmann method. RNA and DNA (elementary idea only).	2		K4(An)	Interactive lecture, Structure based explanation	Think-Pair-Share, Concept mapping		Short test, CIA I
III	**Electrochemistry**								

	1	Galvanic cells - Standard hydrogen electrode - calomel electrode	2	1	K4(An)	Interactive lecture, Model based explanation	Concept mapping, hands on model making	Lectures using models	Conceptual questions, CIA I
	2	Standard electrode potentials -electrochemical series. Strong and weak electrolytes	2		K3(A)	Mechanism based teaching, Problem solving	Think-Pair-Share	Ppt	Short test, CIA I
	3	Ionic product of water - pH, pKa, pKb. Conductometric titrations - pH determination by colorimetric method	2		K2(U)	Conceptual lecture, Structure property mapping	Concept mapping, Group discussion	E-Notes	Conceptual questions, CIA I
	4	Buffer solutions and its biological applications - electroplating - Nickel and chrome plating	2	1	K3(A)	Mechanism based teaching, Conceptual lecture,	Concept mapping, Think-Pair-Share	Interactive ppt	Slip test, problem based questions, CIA II
	5	Types of cells -fuel cells- corrosion and its prevention.	2		K3(A)	Mechanism based teaching, Conceptual lecture, Structure property mapping	Concept mapping, Group discussion		Short test, Conceptual questions, CIA II
IV	**Kinetics and Catalysis**								
	1	Order and molecularity. Integrated rate expression for I order reaction.	2	1	K2(U)	Interactive lecture, Conceptual lecture, Mechanism based teaching	Think-Pair-Share, Concept mapping	Video lectures and ppt	CIA II
	2	II (2A Products) order reaction and Pseudo first order reaction	2		K3(A)	Mechanism based teaching	Inquiry based learning	Interactive videos and ppt	Short test, CIA II

	3	Methods of determining order of a reaction – Half-life period.	2		K2(U)	Conceptual lecture, Structure property mapping	Concept mapping, problem based learning	Ppt	Conceptual questions, CIA II
	4	Catalysis - homogeneous and heterogeneous, catalyst used in Contact and Haber's processes.	2	1	K3(A)	Mechanism based teaching, Conceptual lecture, Structure property mapping	Concept mapping, Group discussion	Interactive ppt	Slip test, CIA II
	5	Concept of energy of activation and Arrhenius equation.	2		K3(A)	Mechanism based teaching	Concept mapping	Interactive videos and ppt	Short test, CIA II
V	**Photochemistry**								
	1	Grothus-Draper's law and Stark-Einsteins law of photochemical equivalence	2	1	K2(U)	Lecture with visualization, Demonstration, Flipped classroom	Concept mapping	Virtual labs, Interactive ppt	Formative Quiz , CIA II
	2	Photochemical combination of Hydrogen-chloride reaction.	2		K4(An)	Interactive lecture, Demonstration, Problem solving	Problem based learning, Group discussion, , Peer teaching	Interactive ppt	Slip test, Problem solving, CIA II
	3	Phosphorescence, fluorescence and chemiluminescence	2		K3(A)	Lecture with visualization, Demonstration	Inquiry based learning, Hands-on model building	Interactive videos and ppt	Short test, Assignment, CIA II
	4	Photosensitization and photosynthesis (definition with examples).	2	1	K3(A)	Lecture with visualization, Demonstration	Concept mapping	Virtual labs, Interactive ppt	Formative Quiz using Nearpod, slip test, CIA II

	5	Quantum yield	2		K3 (A)	Mechanism based teaching	Think-Pair-Share, Peer teaching	Interactive videos and ppt	Short test, CIA II

Course Focusing on Employability/ Entrepreneurship/ Skill Development: Employability

Activities (Em/SD): Demonstration of conductometric titrations

Assignment: Estimation of Hardness of water, BOD and COD

(Last date to submit: 01-02-2026)

Sample Questions

Part – A (1 mark)

1. The metal atom present in chlorophyll is _____.(K1-R,CO-1)
2. The carbohydrate stored in animals is _____.(K2-U,CO2)
3. Among the following, in solution, which is a weak electrolyte? (K3-A,CO-3)
   a) HCl b) CH_3COONa c) CH_3COOH d) NaCl
4. Energy of activation increases with _____.(K2-U,CO2)
   a) pressure b) temperature c) mass d) volume
5. Photosynthesis takes place in the presence of _____.(K2-U,CO2)

Part – B (6 marks)

1. How is BOD and COD of water is determined? (K1-R,CO-1)
2. Give the preparation and properties of glucose. (K2-U,CO2)
3. Explain corrosion and its prevention. (K2-U,CO2)
4. Deduce the rate constant of second order reaction. (K3-A,CO-3)
5. Explain the photochemical combination of hydrogen and chlorine. (K1-R,CO-1)

Part – C (12 marks)

1. Estimate the total amount of hardness present in water sample using EDTA method. (K1-R,CO-1)
2. How is fructose converted into glucose and glucose into fructose. (K4-An,CO4)
3. Explain the following _____.(K1-R,CO-1)

(i) Standard hydrogen electrode
(ii) Conductometric titrations

4. How will you determine the order of a reaction? (K3-A,CO-3)
5. Write notes on (K2-U,CO2)
   (i) Phosphorescence
   (ii) Fluorescence
   (iii) Chemiluminescence

Course Instructor – Dr. R.Gladis Latha

Head of the Department- Dr.R.Gladis Latha

SEMESTER – IV

Department : Chemistry
Class : II B.Sc Physics
Title of the Course : Elective Lab Course Iv: Chemistry Practical For Physical Sciences: Systematic Analysis Of Organic Compounds
Semester : IV
Course Code : CU234EP1

Course Code	L	T	P	S	Credits	Inst. Hours	Total Hours	Marks		
								CIA	External	Total
CU234EP1			2		2	2	30	25	75	100

Learning Objectives

1. To identify of organic functional groups
2. To determine elements in organic compounds.

Course Outcomes

On the successful completion of the course, student will be able to:		
1	learn to test the organic substances	**K1**
2	identify the functional group present in the organic compounds	**K2**
3	detect the elements present	**K3**
4	distinguish between aliphatic, aromatic, saturated and unsaturated compounds	**K3**
5	analyze the given organic substance	**K4**

K1 - Remember; K2 - Understand; K3 - Apply; K4 – Analyze

Practical Teaching Plan

Total Contact hours: 30 (Including practical and assessment)

Unit	Topic	Practical Hours	Assessment Hours	Cognitive level	Pedagogy	Student Centric Method	E-Resources	Assessment/ Evaluation Methods
I	**SYSTEMATIC ANALYSIS OF ORGANIC COMPOUNDS**							
1.	Functional group tests [phenol, mono carboxylic acids, ester, aldehyde, diamide and carbohydrate].	10	5	K3(Ap) & K4(An)	Demonstration	Experimental, Lab based learning	Virtual Labs	Performance, Observation, Reporting, Model examination
2.	To distinguish between aliphatic and aromatic compounds. To distinguish – Saturated and unsaturated compounds.	10		K3(Ap) & K4(An)				
3.	Elements present or absent	5		K3(Ap) & K4(An)				

Course Instructor: Dr. R. Gladis Latha

Head of the Department: Dr. R.Gladis Latha

Department : Chemistry
Class : III B.Sc Chemistry
Title of the Course : Organic Chemistry - II
Semester : VI
Course Code : CU236CC1

Course Code	L	T	P	S	Credits	Inst. Hours	Total Hours	Marks		
								CIA	External	Total
CU236CC1	6	-	-	-	5	6	90	25	75	100

Learning Objectives:

1. To understand the preparation and properties of alkaloids, terpenes, carbohydrates, organic reagents and mechanism of molecular rearrangement.
2. To apply spectroscopic techniques for the structural elucidation of organic compounds.

Course Outcomes

On the successful completion of the course, student will be able to:		
1	remember the classification and properties of organic compounds	**K1**
2	explain the preparation, properties and basic concepts of natural products, carbohydrates, organic reagents and spectroscopy	**K2**
3	apply the reactions and spectroscopic concepts for the synthesis and characterisation of compounds	**K3**
4	analyse the physical and chemical properties of compounds with synthetic importance	**K4**
5	evaluate the structure and mechanism of natural products, carbohydrates and spectroscopic techniques in organic analyses.	**K5**

K1 - Remember; **K2** - Understand; **K3** - Apply; **K4** - Analyze: **K5** – Evaluate

Teaching plan

Total Contact hours: 90 (Including lectures, assignments and tests)

Unit	Module	Topic	Teaching Hours	Assessment Hours	Cognitive level	Pedagogy	Student Centric Method	E-Resources	Assessment/ Evaluation Methods
I	**Alkaloids**								
	1	**Alkaloids** Classification - isolation - general properties and Hofmann exhaustive methylation.	2	1	K1(R) & K2(U)	Demonstration, Flipped classroom	Problem based learning, Think-Pair-Share, Concept mapping	Interactive ppt	Slip test, Conceptual questions, CIA I
	2	Structure elucidation - coniine - piperine and nicotine.	3		K3(Ap) & K4(An)	Interactive lecture, Demonstration, Problem solving	Group discussion, Peer teaching	Interactive ppt	Quiz, slip test, CIA I
	3	**Terpenes** Classification - Isoprene rule - isolation and structural elucidation of citral -	4	1	K3(Ap) & K4(An)	Visual concept lecture, Structure based learning	Think-Pair-Share, Concept mapping	Interactive videos and ppt	Structural identification, Conceptual questions, CIA I
	4	structural elucidation of alpha terpineol and menthol	3		K3(Ap)	Model based teaching, Demonstration, Problem solving	Molecular structure drawing practice	E-notes	Slip test, Problem solving, Group discussion, CIA I
	5	structural elucidation of geraniol and camphor	3	1	K4(An)	Visual concept lecture, Structure based learning	Group discussion, Problem based learning	Video lectures	Slip test, Problem solving, Formative Quiz using Quizizz, CIA I
II	**Carbohydrates**								
	1	**Carbohydrates** Definition - classification - stereochemistry of carbohydrates - D- and L	2	1	K1(R) & K2(U)	Conceptual lecture, Model based explanation	Think-Pair-Share, Concept mapping	Video lectures and ppt	Formative Quiz using Quizizz, slip test, Conceptual questions, CIA I

		configurations - erythro and threo diastereomers - anomers and epimers.							
	2	**Monosaccharides**: classification of monosaccharides. Glucose - properties - epimerisation - anomers of glucose and mutarotation.	3		K2(U)	Mechanism based teaching, Reaction mapping, Concept mapping	Problem based learning, Think-Pair-Share, Concept mapping	Video lectures and ppt	Short test, Quick quiz using Kahoot, Conceptual questions, Group discussion, CIA I
	3	Conversion of aldose to ketose and ketose to aldose - Formation of osazone and glycosides - Fischer open structure - Haworth projection cyclic structures - pyranose and furanose	3	2	K3(Ap) & K4(An)	Interactive lecture, Mechanism based explanation	Group discussion, Concept mapping	Interactive videos and ppt	Quiz, slip test, Group discussion, CIA I
	4	Fructose and its properties. and evidences for cyclic structures of glucose and fructose - Stepping up - Kiliani- Fischer synthesis and stepping down - Ruff degradation of monosaccharides.	4		K3(Ap) & K4(An)	Mechanism based teaching, Reaction mapping, Concept mapping	Problem based learning, Concept mapping	Video lectures and ppt	Short test, Conceptual questions, Group discussion, CIA I
	5	**Disaccharides**: α- and β-glucosidic linkages - 1,4' and 1,5' linkages - structure and properties of sucrose. **Polysaccharides**: Cellulose and starch - reactions and structure.	3		K1(R) & K2(U)	Conceptual lecture, Interactive lecture, Structure based explanation	Think-Pair-Share, Concept mapping	E-notes	Short test, CIA I

III	**Molecular rearrangements**								
	1	Classification of molecular rearrangements.	2	2	K1(R) & K2(U)	Interactive lecture, Conceptual lecture	Think-Pair-Share, Concept mapping	Video lectures and ppt	Formative Quiz using Quizizz, Conceptual questions, CIA I
	2	Mechanism and applications of Pinacol-pinacolone rearrangements.	3		K3(Ap)	Mechanism based teaching	Think-Pair-Share	Interactive videos and ppt	Short test, CIA I
	3	Mechanism and applications of Wagner-Meerwein - dienone-phenol - benzidine rearrangements.	3		K3(Ap) & K4(An)	Conceptual lecture, Structure property mapping	Concept mapping, Group discussion	Interactive videos and ppt	Quick quiz using Nearpod, Conceptual questions, CIA I
	4	Mechanism and applications of Clasien - Fries - Wolff - Cope rearrangements.	4	1	K3(Ap) & K4(An)	Mechanism based teaching, Conceptual lecture, Structure property mapping	Concept mapping, Think-Pair-Share	Interactive videos and ppt	Formative quiz using Nearpod, slip test, Conceptual questions, CIA II
	5	Mechanism and applications of Baeyer-Villiger and benzil-benzilic acid rearrangements.	3		K3(Ap) & K4(An)	Mechanism based teaching, Conceptual lecture, Structure property mapping	Concept mapping, Group discussion	Interactive videos and ppt	Quiz using Nearpod, short test, Conceptual questions, CIA II
IV	**Special reagents in organic synthesis**								

	1	Preparation and properties of Azobisisobutyronitrile (AIBN) - 9-Borabicyclo[3.3.1]nonane (9-BBN)	2	1	K1(R) & K2(U)	Conceptual lecture, Mechanism based teaching	Think-Pair-Share, Concept mapping	Video lectures and ppt	Formative Quiz using Nearpod, slip test, Quick quiz using Kahoot, Conceptual questions, CIA II
	2	Preparation and properties of (2,2′-bis(diphenylphosphino)-1,1′-binaphthyl) (BINAP) - tert-butyloxycarbonyl (BOC)	3		K1(R) & K2(U)	Mechanism based teaching	Think-Pair-Share	Interactive videos and ppt	Short test, CIA II
	3	Preparation and properties of (1,4-diazabicyclo[2.2.2]octane) (DABCO) - dicyclohexylcarbodiimide (DCC)	3		K1(R) & K2(U)	Conceptual lecture, Structure property mapping	Concept mapping, Group discussion	Interactive videos and ppt	Quick quiz using Socrative, Conceptual questions, CIA II
	4	Preparation and properties of diisobutylaluminium hydride (DIBAL) - 4-Dimethylaminopyridine (DMAP)	3	2	K1(R) & K2(U)	Mechanism based teaching, Structure property mapping	Concept mapping, Group discussion	Interactive videos and ppt	Slip test, CIA II
	5	Preparation and properties of N-bromosuccinimide (NBS) - N-Methyl-2-pyrrolidone (NMP), pyridinium chlorochromate (PCC) and tert-Butyl hydroperoxide (TBHP).	4		K1(R) & K2(U)	Mechanism based teaching	Think-Pair-Share	Interactive videos and ppt	Short test, CIA II
V	**Spectroscopy II**								

	1	**NMR Spectroscopy:** Basic principle of Proton Magnetic Resonance - chemical shift and factors influencing chemical shift.	2	2	K2(U)	Lecture with visualization, Demonstration, Flipped classroom	Concept mapping	Virtual labs, Interactive ppt	Formative Quiz using Nearpod, slip test, Conceptual questions, CIA II
	2	Significance of number of peaks and peak area. Spin-spin coupling and coupling constant.	3		K2(U)	Interactive lecture, Demonstration, Problem solving	Problem based learning, Group discussion, Peer teaching	Interactive ppt	Quiz, slip test, Problem solving, CIA II
	3	Interpretation of NMR spectra of simple compounds - ethyl alcohol - benzene - methyl chloride - benzaldehyde and mesitylene.	4		K3(Ap) & K5(E)	Lecture with visualization, Flipped classroom	Inquiry based learning	Interactive videos and ppt	Short test, Assignment, CIA II
	4	**Mass Spectrometry:** Basic principle **-** molecular ion peak - base peak - meta stable peak and isotopic peaks.	3	1	K2(U)	Lecture with visualization, Demonstration, Flipped classroom	Concept mapping	Virtual labs, Interactive ppt	Formative Quiz using Nearpod, slip test, Conceptual questions, CIA II
	5	McLafferty rearrangement and Retro Diel's Alder reaction	3		K3(Ap) & K4(An)	Mechanism based teaching	Think-Pair-Share	Interactive videos and ppt	Quick Quiz with Kahoot, Short test, CIA II

Course Focussing on Employability/ Entrepreneurship/ Skill Development: Employability and Skill Development
Activities (SD): Group discussion and Problem solving on Molecular rearrangements
Assignment: Due date 07-01-2026
Topic: Evaluate the physiological impact of consuming glucose and fructose. Assess their roles in: Glycemic index, Obesity and Diabetes

Sample questions

PART- A (1 Mark)

1. Nicotine is an example of _____ class of alkaloids. **(K1-R, CO-1)**
2. Which enzyme converts glucose to ethanol? **(K2-U, CO-2)**
   Diesterase (b) Invertase (c) Zymase (d) Both (2) & (3)
3. Pinacol-pinacolone rearrangements is an acid catalysed. Say true or false. **(K3-Ap, CO-3)**
4. Give the importance of AIBN. **(K2-U, CO-2)**
5. Reference solvent used in NMR spectroscopy. **(K2-U, CO-2)**
   a) Silicone (b) TMS (c) Ethanol (d) Water

PART- B(6 Marks)

1. Elucidate the structural elucidation of Citral. **(K5-E, CO-5)**
2. How will you convert an aldohexose into aldoketose? **(K3-Ap, CO-3)**
3. Discuss the mechanism and applications of Wagner-Meerwein – dienone rearrangement. **(K3-Ap, CO-3)**
4. How will you prepare DABCO and NBS. **(K3-Ap, CO-3)**
5. List the factors influencing chemical shift in NMR Spectroscopy. **(K2-U, CO-2)**
6.

PART-C (12 Marks)

1. Elucidate the structure of Nicotine. **(K4-An, CO-4)**
2. Discuss the properties of glucose and fructose. **(K2-U, CO-2)**
3. Compare Fries, Baeyer-Villiger and benzil-benzilic acid rearrangements. (**K4-An, CO-4)**
4. Analyse the importance of AIBN, 9-BBN, TBHP reagents in organic synthesis. **(K4-An, CO-4)**
5. Interpret NMR spectra of ethyl alcohol - benzene - methyl chloride and benzaldehyde. **(K5-E, CO-5)**

Course Instructor: Dr. Sr. K. Francy **Head of the Department:** Dr. R. Gladis Latha

Department : **Chemistry**
Class : **III B.Sc Chemistry**
Title of the Course : **Core VIII: Physical Chemistry -II**
Semester : **VI**
Course Code : **CU236CC2**

Course Code	L	T	P	S	Credits	Inst. Hours	Total Hours	Marks		
								CIA	External	Total
CU236CC2	6	-	-	-	5	6	90	25	75	100

Learning Objectives:

1. To gain a fundamental knowledge on electrochemistry and phase equilibria.
2. To understand the principles and applications of various spectral techniques.

Course Outcomes

On the successful completion of the course, students will be able to:		
1	explain the concepts of conductance, transport number, and factors affecting electrolytic conductance.	**K1**
2	understand the principles of electrochemical cells, electrode potentials and phase diagrams	**K2**
3	apply Woodward-Fieser rules to predict the absorption maxima of conjugated dienes and α, β-unsaturated ketones	**K3**
4	analyze electronic transitions in molecules using UV-Visible spectroscopy and predict spectral properties using Woodward-Fieser rules.	**K4**
5	explain the principles of NMR spectroscopy, including chemical shifts, spin-spin coupling, and structural elucidation of organic compounds	**K5**

K1 - Remember; **K2** - Understand; **K3** - Apply; **K4** - Analyse; **K5** – Evaluate

Teaching plan

Total Contact hours: 90 (Including lectures, assignments and tests)

Unit	Module	Topic	Teaching Hours	Assessment hour	Cognitive level	Pedagogy	Student Centric Methods	E-Resources	Assessment/ Evaluation
I	**Electrochemistry – I**								
	1	Definition of conductance, specific conductance, equivalent conductance and molar conductance and factors affecting conductance of a solution.	2	3	K1(R)	Lecturing	Live demonstration of concepts	Videos and ppt	-
	2	Strong and weak electrolytes , variation of equivalent conductance with dilution. Debye-Huckel theory of strong electrolytes and Debye-Huckel– Onsagar equation.	3		K2(U)	Reflective pedagogical approach	Concept learning	ppt	-
	3	Kohlrausch's law and its applications, Applications of conductance measurements, Determination of λ_∞ of weak acid and weak base-degree of dissociation of weak electrolytes, solubility and solubility products of sparingly soluble salts and conductometric titrations.	3		K3(A)	Problem based learning	Solving complex problems	videos	Short test

	4	Transport number , determination of transport number by Hittorff's method and moving boundary method.	2		K4(An)	Problem based learning	Solving complex problems	Videos and ppt	Slip test and MCQ
	5	Hydrolysis, hydrolysis constant,degree of hydrolysis of salts of weak acids and strong bases, weak bases and strong acids	3		K4(An)	Reflective pedagogical approach	Concept learning	videos	-
	6	Determination of degree of hydrolysis by conduction and distribution methods.	2		K3(A)	Problem based learning	Solving complex problems	Videos and ppt	Slip test
II	**Electrochemistry – II**								
	1	Electrochemical cells , reversible and irreversible cells , EMF of cells , determination , cell representation.	2	3	K1(R)	Lecturing	Live demonstration of concepts	Videos and ppt	Short test
	2	Single electrode potential, types of electrodes , metal-metal ion electrodes, amalgam electrodes, gas electrodes, metal –insoluble metal salt electrodes and oxidation - reduction electrodes . Standard hydrogen electrode (SHE) and calomel electrode.	2		K2(U)	Problem based learning	Solving complex problems	Videos and ppt	-

	3	Nernst equation for electrode potential , Nernst equation for emf of cells , standard electrode potential and its determination.	3		K3(A)	Problem based learning	Solving complex problems	Videos and ppt	Short test and MCQ
	4	Electro chemical series, thermodynamics of galvanic cells ΔG, ΔH, ΔS and equilibrium constant (K).	3		K3(A)	Problem based learning	Solving complex problems	ppt	Short test and quiz
	5	Concentration cells with transference and without transference and liquid junction potential and its elimination.	2		K4(An)	Blended learning	Collaborative learning	Videos and ppt	Slip test
	6	Applications of EMF measurements , determination of transport number, valency of an ion, pH of a solution using hydrogen, quinhydrone and glass electrode.	2		K4(An)	Blended learning	Collaborative learning	Videos and ppt	Short test and MCQ
	7	Potentiometric titrations , acid-base, oxidation reduction and precipitation titrations. Decomposition potential and overvoltage	1		K3(A)	Problem based learning	Solving complex problems	Videos	Short test and quiz
III	**Phase Equilibria**								
	1	Concept of phase – components - degrees of freedom - definitions and examples,	2	3	K1(R)	Lecturing	Live demonstration of concepts	Videos	Oral test

		derivation of Gibb's phase rule.							
	2	Phase diagram for one component system – water and sulphur systems.	2		K4(An)	Blended learning	Collaborative learning	Videos and ppt	Slip test
	3	Two component system – reduced phase rule – simple eutectic system – lead-silver system – Pattinson's process of de-silverisation of lead-freezing mixtures-KI-H_2O system.	3		K4(An)	Concept based discussion	Concept mapping	Lecture with videos	Class test
	4	Formation of compounds with congruent melting point – zinc-magnesium system and $FeCl_3$ -H_2O system.	3		K3(A)	Interactiv e lecture	Think, pair, share	Lecture with videos	Quiz - Kahoot
	5	Formation of compounds with incongruent melting points – Na_2SO_4 -H_2O system.	3		K3(A)	Concept based discussion	Concept mapping	Lecture with ppt	Quiz-Mentimeter and slip test
	6	Solid-gas equilibria – $CuSO_4$ -H_2O system. Efflorescence, deliquescence and hygroscopy.	2		K4(An)	Blended learning	Collaborative learning	Lecture with ppt	-
IV	**Ultra Violet, Visible and Infrared Spectroscopy**								
	1	Electromagnetic radiation, electromagnetic spectrum , general spectroscopic methods , Born-Oppenheimer	3	3	K1(R)	Inquiry based learning	Formulating discussions	Lecture using videos	Slip test

		approximation and types of molecular spectra.							
	2	Microwave spectra, principle, intensity, selection rule and applications and determination of bond distances in diatomic molecules.	3		K2(U)	Heuristic learning	Concept mapping K3(Ap)	Lecture using ppt	Slip test and quiz
	3	Infra Red spectra , principle , harmonic oscillator, unharmonicity, selection rules, intensity, modes of vibrations and types, force constant and its determination	3		K3(A)	Inquiry based learning	Formulating discussions K4(An)	Lecture using videos	Short test
	4	Applications of IR, important functional groups and elucidation of structure, hydrogen bonding, Fermi resonance, overtones and combination bands.	3		K3(A)	Heuristic learning	Concept mapping K4(An)	Lecture using videos	-
	5	Electronic spectra, selection rules, Frank Condon Principle, types of transitions and its applications.	3		K4(An)	Collaborative learning	Group discussion K3(Ap)	Lecture using ppt	CIA
V	**Raman and Nuclear magnetic resonance Spectroscopy**								
	1	NMR, introduction , conditions, principle, types, origin, Larmor procession and signals	3		K1(R)	Heuristic learning	Concept mapping K2(U)	Lecture using ppt	Slip test

	2	Chemical shift, screening constant, spin-spin coupling. Applications of NMR, elucidation of molecular structure, hydrogen bonding, and tautomerism	3	3	K2(U)	Collaborative learning	Group discussion K4(An)	Lecture using video	-
	3	Study of water of crystallization in solids and Nuclear magnetic resonance imaging	3		K4(An)	Inquiry based learning	Formulating discussions K4(An)	Lecture using video	MCQ
	4	ESR spectroscopy, principle, hyperfine structure, application of ESR to hydrogen and methyl radicals. Raman Spectra, introduction - Rayleigh scattering and quantum theory	3		K3(A)	Heuristic learning	Concept mapping K3(Ap)	Lecture using videos	-
	5	Raman effect, Raman scattering , conditions for Raman spectra, selection rule, mutual exclusion principle, Raman spectra of CO_2 and HCN and differences between Raman and IR spectra.	3		K3(A)	Inquiry based learning	Formulating discussions K3(Ap)	Lecture using videos	Short test

Course Focusing on Employability/ Entrepreneurship/ Skill Development: Employability

Activities (Em): Group discussion on IR and ESR spectroscopy

Problem solving on electronic and NMR spectroscopy

Assignment: (Mention Topic and Type)

1. Applications of conductance measurements - Reflective writing (Due date : On or before 6.01.2026)
2. Comparison of types of electrodes - Study assignment (Due date : On or before 03.02.2025)

Sample questions

Part - A

1. The unit of molar conductance is _____ (K1-R, CO1)
   a) 10^{-4} Sm^2 mol^{-1} b)10^{-2} Sm^2 mol^{-1} c) 10^{-3} Sm^2 mol^{-1} d) 10^{-1} Sm^2 mol^{-1}
2. Calomel electrode is represented as _____ (K2-U, CO2)
3. Give Gibb's phase rule. (K2-U, CO2)
4. A vibrational transition occurs on absorption of quantized energy. Say true or false. (K3-A, CO3)
5. Zero point energy of a diatomic SHO is ---------- (K4-An, CO4)
   a) hν b) ½ hν c) ¼ hν d) 0

Part - B

1. State Hittorf's law. How will you determine the transport number of ions by Hittorf's method? (K1-R, CO1)
2. Explain liquid junction potential. How can it be eliminated? (K2-U, CO2)
3. Write a note on the following potentiometric titrations. (K2-U, CO2)
   i) Acid - base ii) Oxidation - reduction
4. Draw and explain the phase diagram of sulphur. (K6-C, CO6)
5. Explain the types of molecular spectra. (K3-A, CO3)

Part- C

1. Discuss the applications of conductance measurements. (K3-A, CO3)
2. i) Derive Nernst equation for electrode potential. (K3-A, CO3)
   ii) Write notes on hydrogen and calomel electrodes.
3. Explain the lead-Silver system with neat phase diagram and desilverisation process. (K6-C, CO6)
4. i) Explain Frank Condon Principle. (K2-U, CO2)
   ii) Write the applications of electronic spectroscopy.
5. Discuss the quantum theory of Raman spectroscopy and show how stokes and anti- stokes lines appear in the Raman spectrum of a molecule? (K3-A, CO3)

Course Instructor: Dr. M. Anitha Malbi **Head of the Department:** Dr. R. Gladis Latha

Department : Chemistry
Class : III B.Sc. Chemistry
Title of the Course : Discipline Specific Elective-Inorganic Chemistry-II
Semester : VI
Course Code : CU236DE1

Course Code	L	T	P	S	Credits	Inst. Hours	Total Hours	Marks		
								CIA	External	Total
CU236DE1	5	–	–	–	3	5	75	25	75	100

Learning Objectives:

1.To know the properties and applications of chemical compounds

2. To analyse the role of elements in biological systems, and the steps in determining errors.

Course Outcomes

On the successful completion of the course, student will be able to:		
1.	identify the role of trace elements, inner transition elements, ionic conductors, silicon compounds and analytical chemistry	**K1**
2.	interpret the properties and uses of trace elements, f block elements, ionic conductors, silicon compounds and analytical chemistry	**K2**
3.	utilize trace elements, f block elements, conducting materials, silicon compounds and error calculations in various fields.	**K3**
4.	analyze the properties of trace elements, f block elements, ionic conductors, silicon compounds and statistical parameters	**K4**
5.	assess the applications and properties of elements in biological system, inner transition elements, nanomaterials, silicon compounds and statistical parameters	**K5**

Teaching plan

Unit	Module	Topic	Teaching Hours	Assessment Hours	Cognitive level	Pedagogy	Student Centric Method	E-Resources	Assessment/Evaluation Methods
I	**Bioinorganic Chemistry**								
	1	Essential and trace elements: Role of sodium, potassium, calcium, magnesium, copper,	2	1	K1(R) & K3 (Ap)	Lecture with ppt	Inquiry-Based Learning, Peer Teaching,	PPT, E-Notes	Formative Quiz slip test, Conceptual questions, CIA I
	2	Role of Iron and Zinc in biological systems. Effect of excess intake (Toxicity) of metal ions-trace elements - As, Cd, Pb, Hg.	3		K2(U)	Visual Lecture,Mini-Lecture Segments	Problem-Solving	Lecture	Quiz, slip test, Problem solving, CIA I
	3	Metallo proteins-types and functions. Biological functions of myoglobin	2	1	K3(Ap)	Lecture with visualization, Concept-based discussion	Collaborative Learning, Concept Mapping	Interactive videos and ppt	Slip test, Conceptual questions, CIA I
	4	Biological functions of haemoglobin-oxygen transport - Bohr effect. Sodium-potassium pump	3	1	K3(Ap)	Lecture with ppt	Participatory learning	Virtual lab simulations, Interactive ppt	Group discussion, CIA I
	5	Metal complexes of copper and platinum as therapeutic agents	2		K4(An)	Lecture with ppt	Peer Learning,	Interactive videos and ppt	Quiz, slip test, Group discussion, CIA I
II	**Inner transition elements**								

	1	Lanthanides and Actinides- Electronic configuration, oxidation states, colour, spectral and magnetic properties.	3	1	K1(R) & K3(Ap)	Demonstration -based Learning: Simulations, Concept Mapping	Peer Instruction, Blended Learning	NPTEL Lectures, Simulations	Formative Quiz, slip test, Conceptual questions, CIA I
	2	Causes and consequences of lanthanide contraction– extraction of lanthanides from monazite sand	2		K2(U)	Interactive lecture, Demonstration , Problem solving	Group discussion, Peer teaching	Interactive videos and ppt	Short test, Conceptual questions, Group discussion, CIA I
	3	Separation of lanthanides by ion-exchange method - uses of lanthanides.	2	1	K3(Ap)	Visual concept lecture, Structure based learning	Think-Pair-Share, Concept mapping	Ppt	Quiz, slip test, Group discussion, CIA I
	4	Comparison between lanthanides and actinides. Extraction, properties and uses of thorium and uranium.	3		K3(Ap)	Model based teaching, Demonstration , Problem solving	Participatory learning	Interactive videos and ppt	Short test, Conceptual questions, Group discussion, CIA I
	5	Compounds of uranium-zinc uranyl acetate and uranium hexa fluoride	2	1	K4(An)	Visual concept lecture, Demonstration , Problem solving	Group discussion, Problem based learning	Video lectures, Virtual lab simulations, Interactive ppt	Short test, CIA I
III	**Material Chemistry**								
	1	Ionic conductors – sodium, β- alumina,	2	1	K1(R) & K3 (Ap)	Interactive lecture, Demonstration	Group discussion, Hands-on	Interactive ppt	Formative Quiz, slip test, Conceptual

		sodium-sulphur battery, Lithium battery.				, Problem solving	model building, Peer teaching		questions, CIA I
	2	Intercalation – layered compounds – graphitic compounds.	2		K2(U)	Visual concept lecture, Structure based learning	Think-Pair-Share, Concept mapping	Interactive videos and ppt	Short test, Conceptual questions, Group discussion, CIA I
	3	Nanophase materials-Introduction - techniques for synthesis of nanophase materials-sol-gel synthesis	3	1	K3(Ap)	Model based teaching, Demonstration , Problem solving	Molecular drawing practice, Problem based learning	Interactive ppt	Quiz, slip test, Group discussion, CIA I
	4	Electro deposition– properties of nanophase materials-optical and electrical properties, applications of nanophase materials.	3		K3(Ap)	Visual concept lecture, Rule based teaching, Demonstration , Problem solving	Hands-on model building, Group discussion, Problem based learning	Virtual lab simulations, Interactive ppt	Short test, Conceptual questions, Group discussion, CIA I
	5	Superconductors-examples of superconducting oxides – applications of superconducting materials.	2	1	K4(An)	Interactive lecture, Demonstration , Problem solving	Group discussion, Hands-on model building, Peer teaching	E-Notes	Short test, CIA I
IV	**Compounds of Silicon**								
	1	General properties of silicates, structure–types	3	2	K1(R) & K3 (Ap)	Conceptual lecture, Model	Think-Pair-Share,	Ppt	Formative Quiz, slip test,

		of silicates–ortho silicates(zircon), pyrosilicates (thortveitite)				based explanation	Concept mapping		Conceptual questions, CIA II
	2	Chain silicates(pyroxenes), ring silicates(beryl), sheet silicates(talc, mica, asbestos)	2		K2(U)	Mechanism based teaching, Reaction mapping, Concept mapping	Problem based learning, Think-Pair-Share, Concept mapping	Interactive ppt	Short test, CIA II
	3	Silicates having three dimensional structure (feldspars, zeolites, ultramarines).	2		K3(Ap)	Interactive lecture, Mechanism based explanation	Group discussion, Concept mapping	E-Notes	Conceptual questions, CIA II
	4	Preparation and uses of silica, silicic acid and silica gel.	2	1	K3(Ap)	Mechanism based teaching, Reaction mapping, Concept mapping	Problem based learning, Think-Pair-Share, Concept mapping	Video lectures and ppt	Slip test, CIA II
	5	Silicones -preparation and uses. Silicon carbide-preparation, properties and uses.	3		K4(An)	Conceptual lecture, Interactive lecture, Structure based explanation	Think-Pair-Share, Concept mapping		Short test, CIA II
V	**Analytical Chemistry**								

	1	Types of errors- determinate and indeterminate errors- minimization of errors. Precision and accuracy in measurements - ways of expressing precision.	3	2	K1(R)	Interactive lecture, Conceptual lecture	Think-Pair-Share, Concept mapping	Video lectures and ppt	Formative Quiz , slip test, Conceptual questions, CIA II
	2	Statistical validation- statistical treatment of finite data -mean, median, Standard deviation- mean deviation – relative mean deviation and coefficient of variance.	3		K2(U)	Mechanism based teaching	Think-Pair-Share	Interactive videos and ppt	Quiz, slip test, Problem solving, CIA II
	3	Accuracy- absolute error- relative error- confidence limit- Rejection of a doubtful value	2		K3(Ap)	Property mapping	Concept mapping, Group discussion	Interactive videos and ppt	Short test, Assignment, CIA II
	4	Q Test-comparison of results-student's t test - F test and related problems.	2	1	K3(Ap)	, Conceptual lecture	Concept mapping, Think-Pair-Share	Interactive videos and ppt	Formative Quiz, slip test, Conceptual questions, CIA II
	5	Significant figures - computation rules, Methods for reporting analytical data.	2		K4(An)	Interactive lecture, Conceptual lecture	Think-Pair-Share, Concept mapping	Video lectures and ppt	Quiz, Short test, CIA I

Course Focussing on Employability/ Entrepreneurship/ Skill Development: Employability

Activities (Em / En /SD): Group discussion and Problem solving

Assignment: Application of Nanomaterials(Last date to submit: 01-02-2026)

Sample questions

Part A (1 mark)

1.Which metal is required for the synthesis of collagen ? . (K3-A,CO3)
a) Copper b) Zinc c) Sodium d) Potassium
2. Monazite is the ore of lanthanide. Say true or false. (K4-An,CO4)
3. The electrical conductivity of nano particles increases with---------- in size. (K1-R,CO1)
4. Talc is an example for chain silicate. Say true or false. (K4-An,CO4)
5. Accuracy is expressed interms of ----------. (K2-U,CO2)
a) relative mean error b) deviation c) mean deviation d) standard deviation

Part B (6 marks)

1. What is the role of sodium and calcium in the biological system? (K1-R,CO-1)
2. Account for lanthanide contraction. (K2-U,CO2)
3. Give the special applications of solid state materials. (K3-A,CO-3)
4. Give the preparation and properties of silicones. (K3-A, CO-3)
5. How will you reject a doubtful value among a series of experimental values? (K5-E, CO-5)

Part C (12 marks)

1. Explain sodium potassium pump. How this is useful in studying the concentration of cellular fluids? (K3-A,CO-3)
2. How is thorium extracted from its ore? Mention the properties and uses. (K2-U,CO2)
3. List out the applications of nano materials in medicine and industry. (K3-A,CO-3)
4. Discuss the general properties of silicates. Explain pyro silicates. (K1-R,CO1)

5. What are the different types of experimental errors. How will you eliminate them? (K5-E, CO-5)

Course Instructor: Dr. R. Gladis Latha

Head of the Department: Dr.R.Gladis Latha

Department : Chemistry
Class : III B.Sc Chemistry
Title of the Course : Discipline Specific Elective II: a) Nano chemistry
Semester : VI
Course Code : CU236DE4

Course Code	L	T	P	S	Credits	Inst. Hours	Total Hours	Marks		
								CIA	External	Total
CU236DE4	5	-	-	-	3	5	75	25	75	100

Learning Objectives

1. To understand the basic concepts, properties and characterization of nanomaterials
2. To know the preparation and applications of various nanomaterials

Course Outcomes

On the successful completion of the course, student will be able to:		
1	recall the fundamental concepts, properties, and types of nanomaterials	**K1**
2	explain the synthesis, characterization techniques, and properties of nanomaterials.	**K2**
3	apply the nano chemical principles to synthesize, modify, and characterize various nanomaterials.	**K3**
4	analyse the structural, optical, electronic, and magnetic properties of different nanomaterials.	**K4**
5	evaluate the synthesis, characterization techniques and applications of nanomaterials in biomedical, electronics, agricultural and industrial fields.	**K5**

K1 - Remember; **K2** - Understand; **K3** - Apply; **K4** – Analyse; **K5**- Evaluate

Teaching plan
Total Contact hours: 75 (Including lectures, assignments and tests)

Unit	Module	Topic	Teaching Hours	Assessment Hours	Cognitive level	Pedagogy	Student Centric Method	E-Resources	Assessment/ Evaluation
I	**Introduction to Nanochemistry**								
	1	Nanoscience, nanoparticles, clusters, quantum dots, nanostructures and nanocomposites. Electron behaviour in free space, bulk material and nanomaterials.	3	1	K1(R) & K2(U)	**Lecture with Visual Aids** such as PPT, **Demonstration, Flipped Classroom**	Inquiry-Based Learning, Quiz, Concept Mapping.	*Video Lectures,* Slides	Formative Quiz using Google Forms, Assignment,
	2	Synthesis and stabilization of nanomaterials. Top-down approach (physical methods), mechanical dispersion, ball milling and ion sputtering	3	1	K2(U) & K3(A)	Visual Lecture Demonstration with visual aids, Questioning	Guided Inquiry Worksheets, Problem Solving	Video Lecture, Interactive Notes	Formative Worksheet, Visualization Task
	3	Spray pyrolysis, aerosol synthesis and nanolithography. Bottom-up approach (chemical methods) and solvothermal synthesis	3	-	K4(An)	Lecture with visualization, Concept-based discussion	Concept Mapping	Interactive videos and ppt	Quizzes
	4	Photochemical method, gamma radiolysis, Sono chemical synthesis, electro deposition and sol-gel method.	3	1	K2(U) & K3(A)	Model based teaching, Demonstration,	Group discussion, Problem based learning	Video lectures, Interactive ppt	Slip test, Group discussion
	Properties of Nanomaterials								

II	1	Optical properties, surface plasmon resonance (SPR), surface enhanced Raman spectra (SERS) and quantum confinement effect	3	1	K1(R) & K2(U)	Lecture with models	Think-Pair-Share, Inquiry-Based Learning	*Video Lectures*	Formative Quiz using Nearpod, Oral Presentation
	2	Tuning of optical spectrum. Chemical properties, chemical process on the surface of nanoparticles and catalysis.	3	-	K2(U) & K3(A)	Lecture with visual aids, Problem solving	Problem-Solving, Guided Inquiry	Video Lecture, Interactive Notes.	Formative Worksheet, Conceptual Quiz
	3	Magnetic properties and supra magnetic properties.	3	1	K3(A)	Concept-based discussion, Demonstration.	Think-Pair-Share, ncept mapping, Group discussion	Interactive videos and ppt	Quizzes, Concept check polls during class using Slido,
	4	Electronic and mechanical properties	3	1	K2(U) & K3(A)	Lecture with Visual Aids such as PPT	Problem based learning, Think- Pair-Share, Concept mapping	Interactive videos and ppt	Group discussion
III	**Characterization of nanomaterials**								
	1	Spectroscopy, UV-Visible, photoelectron spectroscopy, Electron microscopy.	3	1	K1(R) & K3(A)	Lecture with Visual Aids such as PPT, Conceptual Demonstration	Think-Pair-Share, Inquiry-Based Learning,	*Interactive Video Lectures*	Assignment, Oral Presentation.

	2	Scanning electron microscopy (SEM), transmission electron microscopy (TEM) and scanning probe microscopy (SPM) -	3	1	K3(A)	Visual Lecture with videos	Problem-Solving Method, Guided Inquiry	Video Lecture, Interactive Notes	Formative Worksheet, Visualization Task
	3	Atomic force microscopy (AFM), scanning tunneling microscopy (STM)	3	1	K3(A)	Lecture with visualization, Concept-based discussion	Collaborative Learning, Concept Mapping	Interactive Notes	Quizzes, Concept check polls during class using Slido,
	4	Optical microscopy, confocal microscopy and X-ray diffraction (XRD).	3	-	K3(A)	Conceptual lecture, Model based Explanation	Think-Pair-Share, Concept mapping	Video lectures and ppt	Formative Quiz using slip test, Conceptual questions, CIA I
IV	**Special Nanomaterials**								
	1	Carbon nanotubes, introduction, types, zigzag, armchair and Helical.	3	-	K1(R) & K2(U)	Lecture with Visual Aids such as PPT	Inquiry-Based Learning, Peer Teaching,	*Video Lectures,* Simulations, Notes/Slides	Assignment, Oral Presentation.
	2	Synthesis by CVD and Functionalization of Carbon Nanotubes	2	-	K2(U) & K4(An)	Lecture with PPT	Inquiry Worksheets	Video Lecture, Interactive Notes	Formative Worksheet, Group Presentation

	3	Reactivity of Carbon Nanotubes, Field emission, Fuel Cells, Display devices.	3	1	K3(A)	Conceptual lecture, Interactive lecture	Think-Pair Share, Concept mapping	*Video Lectures,* Simulations, Notes/Slides	Quick quiz using Kahoot, Written Assignment
	4	Semiconductor nanoparticles, quantum dots, synthesis and properties.	2	1	K2(U) & K4(An)	Interactive lecture, Mechanism based teaching	Think-Pair Share, Concept mapping	Video Lecture, Interactive Notes	Formative Worksheet, Group Presentation
	5	Self-assembled nanomaterials, self-assembled monolayers (SAMS), inorganic and organic molecules.	3	-	K3(A)	Lecture with Visual Aids such as PPT	Think-Pair-Share, Inquiry-Based Learning, Peer Teaching,	*Video Lectures,* Interactive Notes	Written Assignment, Oral Presentation
V	**Application of Nanomaterials**								
	1	Biomedical applications, drug delivery, biolabeling, artificial implants, cancer treatment.	2	1	K1(R) & K2(U)	Lecture with PPT, Conceptual Demonstration**,** Flipped Classroom**.**	Think-Pair-Share, Inquiry-Based Learning	*Interactive Video Lectures,* Simulations, Notes/Slides	Formative Quiz using Nearpod / Oral Presentation, Conceptual Questions, CIA I
	2	Therapeutic applications of Ayurvedic	3	-	K3(A)	Lecture with visualization, Demonstration,	Problem based learning, Group discussion,	Interactive videos and ppt	Conceptual Quiz, Group Presentation

		nanoparticles, Swarna Bhasma (gold nanoparticles), Rajata Bhasma (silver nanoparticles)				Flipped classroom	Hands-on model building, Peer teaching		
	3	Tamra Bhasma (copper nanoparticles), Lauha Bhasma (iron oxide nanoparticles) and Yashada Bhasma (zinc nanoparticles).	2	-	K3(A)	Lecture with visualization, Concept-based discussion	Collaborative Learning, Inquiry based learning	Interactive videos and PPT	Formative Quiz using Nearpod, slip test, Conceptual questions
	4	Sensors, natural nanoscale sensors, chemical sensors, biosensors and electronic noses. Optics and electronics applications, nanomaterials in the next generation computer technology, high-definition TV and flat panel displays	3	1	K3(A)	Lecture with PPT, Demonstration, Flipped classroom	Think-Pair-Share, Inquiry-Based Learning	Interactive videos and PPT	Conceptual Quiz, Group Presentation
	5	Agricultural applications, Fertilizer and pesticides nanomaterials for water purification. Industrial applications - nanomaterials in food and packaging materials and fabric industry.	3	1	K3(A)	Lecture with PPT, Demonstration, Flipped classroom	Think-Pair-Share, Inquiry-Based Learning	Interactive videos and PPT	Conceptual Quiz, Group Presentation

Course Focusing on Employability/ Entrepreneurship/ Skill Development: Employability and Skill Development

Activities (Em/SD): Think-Pair-Share, Group discussion and Problem solving
Assignment: Nanomaterials in food and packaging materials (Last date to submit: 25-01-2026)

Seminar: Nanomaterials in the next generation computer technology

Sample questions

Part A (1 mark)

One-Word Answer Questions (10)

1.What term refers to nanoparticles that show quantum mechanical effects? (K2-U,CO2)
a) Quantum dots b) Nanotubes c) Nanorods d) Nanoparticles

2. Which physical method involves grinding or crushing materials to create nanoparticles? (K3-A,CO3)
a) Laser ablation b) Ball milling c) Electrochemical deposition d) Solvothermal synthesis

3. What is the key characteristic of carbon nanotubes' structure? (K1-R,CO1)
a) Spherical b) Cylindrical c) Cubic d) Conical

4. Which spectroscopy technique is commonly used to study the absorption of ultraviolet and visible light by nanomaterials? (K3-A,CO3)
a) Infrared spectroscopy b) UV-Visible spectroscopy c) X-ray photoelectron spectroscopy d) Raman spectroscopy

5. What method involves the use of a laser to break down materials into nanoparticles? (K3-A,CO3)
a) Laser ablation b) Ball milling c) Aerosol synthesis d) Spray pyrolysis

6.What is a well-known magnetic nanomaterial used in MRI and medical applications? (K3-A,CO3)
a) Copper oxide b) Iron oxide c) Gold nanoparticles d) Zinc oxide

Part B (6 marks)

1. What is the difference between the top-down and bottom-up approaches in nanomaterial synthesis? (K4-An,CO4)

2. What are the main types of carbon nanotubes? (K2-U,CO2)
3. How does the quantum confinement effect influence the optical properties of nanomaterials? (K4-An,CO4)
4. Name two applications of quantum dots in technology. (K3-A,CO3)
5. Why are nanoparticles more reactive than bulk materials? (K4-An,CO4)
6. Write the principle of Atomic Force Microscopy? (K1-R,CO1)

Part C (12 marks)

1. Explain the features and importance of nanoparticles and nano clusters. (K1-R,CO1)
2. Compare electron behaviour in free space, bulk materials, and nanomaterials. (K4-An,CO4)
3. Explain any three top-down methods of nanomaterial synthesis. (K2-U,CO2)
4. Explain any three bottom-up chemical methods for synthesizing nanomaterials. (K2-U,CO2)
5. Explain the types, synthesis and applications of carbon nanotubes. (K2-U,CO2)
6. Write notes on self-assembled monolayers (SAMs) and their applications. (K3-A,CO3)

Course Instructor: Dr.S.Ajith Sinthuja

Head of the Department: Dr. R.Gladis Latha

Department : Chemistry
Class : III B.Sc Chemistry
Title of the Course : Professional Competency Skill II: Analytical and Computational Chemistry
Semester : VI
Course Code : CU236PS1

Course Code	L	T	P	S	Credits	Inst. Hours	Total Hours	Marks		
								CIA	External	Total
CU236PS1	2	-	-	-	2	2	30	25	75	100

Learning Objectives:
1. To enable students to understand and apply analytical techniques including chromatography and spectroscopy for chemical analysis.
2. To equip students with skills to use chemistry-related software, cheminformatics and sources for research.

Course Outcomes

On the successful completion of the course, students will be able to:		
1.	list the definitions and classifications of chromatography, spectroscopy sampling techniques, cheminformatics notations and research types.	**K1**
2.	infer the chromatographic principles, sample preparation techniques, research methodologies and software functions.	**K2**
3.	use the chromatography techniques, sample preparation protocols and chemistry software tools in lab and documentation work.	**K3**
4.	analyze and compare analytical techniques, identify ethical issues and differentiate between molecular representations.	**K4**
5.	evaluate tools and methods in spectroscopy, cheminformatics, and research practices for scientific reliability and accuracy.	**K5**

K1 - Remember; **K2** - Understand; **K3** - Apply; **K4** - Analyse; **K5** - Evaluate

Teaching plan

Total Contact hours: 30 (Including lectures, assignments and tests)

Unit	Module	Topic	Teaching Hours	Assessment Hours	Cognitive level	Pedagogy	Student Centric Method	E-Resources	Assessment/ Evaluation Methods
I	**Chromatography**								
	1	Chromatography: Definition - classification.	1	1	K1(R) & K2(U)	Lecture with visual aids	Think-Pair-Share	Virtual lab	Oral questions, Discussion
	2	Plate and rate theories.	1		K2(U)	Interactive lecture	Group discussion	Interactive ppt	Group discussion
	3	Paper chromatography: Principle - types and applications.	1		K3(Ap) & K4(An)	Concept mapping	Blended learning	Interactive videos and ppt	Conceptual questions
	4	Column chromatography: Principle - experimental technique and applications.	1		K3(Ap) & K4(An)	Demonstration based teaching	Experimental learning	Virtual lab	Group discussion
	5	Thin layer chromatography: Principle - experimental technique and applications.	1		K3(Ap) & K4(An)	Demonstration based teaching	Experimental learning	Virtual lab	Group discussion
II	**Sampling Techniques in Spectroscopy**								
	1	UV-Visible spectroscopy: Solution preparation - concentration - dilution and solvent selection.	1	1	K1(R) & K2(U)	Conceptual lecture	Concept mapping	Interactive ppt	Conceptual questions
	2	IR spectroscopy: Solid samples - KBr pellet method	1		K2(U) & K3(Ap)	Demonstration based teaching	Experimental learning	Virtual lab	Group discussion
	3	Nujol mull technique. Liquid samples: neat liquids and liquid cells.	1		K2(U)	Interactive lecture	Group discussion	Interactive ppt	Oral questions

	4	Gas samples: Gas cells.	1		K2(U)	Interactive lecture	Think-Pair-Share	Interactive ppt	Oral questions
	5	NMR spectroscopy: Sample purity - solvent selection - concentration and volume.	1		K4(An) & K5(E)	Conceptual lecture	Concept mapping	Interactive ppt	Conceptual questions
III	**Research Methodology and Ethics**								
	1	Source of chemical information - primary - secondary and tertiary sources.	1	1	K1(R) & K2(U)	Interactive lecture	Think-Pair-Share	Interactive ppt	Group discussion
	2	Types of research - fundamental vs applied.	1		K2(U)	Conceptual lecture	Think-Pair-Share	Interactive ppt	Oral questions
	3	Data collection and analysis - basic statistics for chemistry.	1		K2(U) & K3(Ap)	Interactive lecture	Group discussion	Interactive ppt	Oral questions
	4	Scientific misconduct - plagiarism and falsification.	1		K2(U)	Interactive lecture	Think-Pair-Share	Interactive ppt	Group discussion
	5	Ethical considerations in chemistry research and publication.	1		K2(U)	Conceptual lecture	Group discussion	Interactive ppt	Conceptual questions
IV	**Chemistry Software**								
	1	ChemDraw: Writing chemical equations and schemes	1	1	K2(U) & K3(Ap)	Demonstration based teaching	Collaborative learning	ChemDraw software	Practical assignment
	2	Structure to IUPAC name conversion and vice versa.	1		K3(Ap)	Task based teaching	Problem based learning	ChemDraw software	Practical assignment
	3	Transporting picture to word and image document.	1		K3(Ap) & K4(An)	Demonstration based teaching	Collaborative learning	ChemDraw software	Oral questions

	4	Origin: Importing and exporting data - scientific graphing	1		K3(Ap) & K4(An)	Task based teaching	Problem based learning	Origin software	Practical assignment
	5	Data analysis - transporting graph to tag image file format.	1		K3(Ap) & K4(An)	Demonstration based teaching	Problem based learning	Origin software	Oral questions
V	**Cheminformatics**								
	1	Cheminformatics: Definition and applications in drug discovery - materials science and chemical databases.	1	1	K2(U)	Flipped classroom	Inquiry based learning	Interactive ppt	Assignment
	2	Representing molecules: line notation - InChI.	1		K2(U)	Interactive lecture	Group discussion	Interactive ppt	Oral questions
	3	SMILES and WLN.	1		K4(An)	Flipped classroom	Inquiry based learning	Interactive ppt	Group discussion
	4	Query languages - SMARTS.	1		K4(An)	Conceptual lecture	Group discussion	Interactive ppt	Conceptual questions
	5	Connection tables and line notation versus connection tables.	1		K5(E)	Interactive lecture	Group discussion	Interactive ppt	Oral questions

Course Focussing on Employability/ Entrepreneurship/ Skill Development: Employability and Skill Development
Activity (SD): Basic chemical structure drawing using Chemdraw software.
Assignment: Applications of cheminformatics (Last date to submit: 07-01-2026)

Sample questions

PART A

7. List out the classifications of chromatography. **(K1-R, CO-1)**
8. Mention any two characteristics of an ideal UV-Visible solvent. **(K2-U, CO-2)**
9. Differentiate secondary and tertiary sources of information with examples. **(K4-An, CO-4)**
10. What is the purpose of importing data into Origin software? **(K2-U, CO-2)**

11. Discuss any two applications of cheminformatics. **(K2-U, CO-2)**

PART B

1. Discuss the plate and rate theories of chromatography. **(K2-U, CO-2)**
2. Explain the importance of sample purity and concentration in NMR spectroscopy. **(K2-U, CO-2)**
3. Compare fundamental and applied research with examples from chemical sciences. **(K4-An, CO-4)**
4. Mention the steps involved in creating a reaction scheme in ChemDraw. **(K3-Ap, CO-3)**
5. Illustrate SMARTS query language with examples. **(K3-Ap, CO-3)**

PART C

1. Compare and contrast paper chromatography and TLC in terms of principle, technique and applications. **(K5-E, CO-5)**
2. Differentiate the various sample preparation techniques used in IR spectroscopy. **(K4-An, CO-4)**
3. Evaluate the ethical considerations involved in chemical research and publication. **(K5-E, CO-5)**
4. Explain the significance of exporting graphs in TIF file format for journals. **(K2-U, CO-2)**
5. Differentiate line notation and connection table with examples. **(K4-An, CO-4)**

Course Instructor: Dr. Sheeba Daniel **Head of the Department:** Dr. R. Gladis Latha

Department : **Chemistry**
Class : **III B.Sc Chemistry**
Title of the Course : **CORE LAB COURSE V: GRAVIMETRIC ESTIMATION AND SEMI MICRO INORGANIC MIXTURE ANALYSIS**
Semester : **VI**
Course Code : **CU236CP1**

Course Code	L	T	P	S	Credits	Inst. Hours	Total Hours	Marks		
								CIA	External	Total
CU236CP1	-	-	6	-	4	6	90	25	75	100

Learning Objectives

1. To understand the principle and basic concepts of gravimetric estimation and semi micro analysis.
2. To analyse the cations and anions present in the chemical compounds.

Course Outcomes

On the successful completion of the course, student will be able to:		
1	recall the principles of precipitation, filtration and weighing techniques used in gravimetric analysis.	**K1**
2	explain the theoretical concepts behind gravimetric estimation and qualitative inorganic analysis.	**K2**
3	apply gravimetric analysis on different substances and quantify the metal ions using standard procedures.	**K3**
4	analyze the cations and anions in unknown inorganic mixtures through systematic semi micro analysis.	**K4**
5	evaluate the accuracy and reliability of gravimetric estimations and qualitative inorganic mixture analysis.	**K5**

K1 - Remember; K2 - Understand; K3 - Apply; K4 – Analyze, K5 - Evaluate

Practical Teaching Plan

Total Contact hours: 90(Including practical and assessment)

Unit	Topic	Practical Hours	Assessment Hours	Cognitive level	Pedagogy	Student Centric Method	E-Resources	Assessment/ Evaluation Methods
I								
	Gravimetric Analysis **1.** Estimation of Lead as Lead Chromate 2. Estimation of Barium as Barium Chromate 3. Estimation of Calcium as Calcium oxalate monohydrate 4. Estimation of Copper as Cuprous thiocyanate - course work 5. Estimation of Nickel as Nickel Dimethyl Glyoximate - course work	25	5	K3(Ap) & K4(An)	Demonstration	Experiential and lab based learning	Simulations and Virtual Labs	Performance, Observation, Reporting, Model examination
II	**Analysis of an Inorganic mixture containing two anions and two cations.** **Anions** 1. Carbonate 2. Sulphate 3.Nitrate 4. Chloride	50	10	K3(Ap) & K4(An)	Demonstration	Experiential and lab based learning	Virtual Labs	Observation, Reporting, Model examination

	5. Oxalate 6. Borate 7.Fluoride 8. Phosphate **Cations** 1. Lead 2. Copper 3.Bismuth 4. Cadmium 5. Manganese 6. Nickel 7. Cobalt 8.Zinc 9. Barium 10. Strontium 11. Calcium 12. Magnesium 13. Ammonium							

Practical-in-Charge: Dr. S.Ajith Sinthuja

Head of the Department: Dr. R. Gladis Latha