

**Department** : Chemistry  
**Class** : I B.Sc Chemistry  
**Title of the Course** : 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

CO	Upon completion of this course, the students will be able to:	PSO addressed	Cognitive level
CO - 1	explain the concept of acids, bases and ionic equilibria; periodic properties of s and p block elements, preparation and properties of aliphatic and aromatic hydrocarbons	PSO-1	<b>K1</b>
CO - 2	discuss the periodic properties of s and p- block elements, reactions of aliphatic and aromatic hydrocarbons and strength of acids	PSO-2	<b>K2</b>
CO - 3	classify hydrocarbons, types of reactions, acids and bases, examine the properties s and p-block elements, reaction mechanisms of aliphatic and aromatic hydrocarbons	PSO-3	<b>K3</b>
CO - 4	explain theories of acids, bases and indicators, buffer action and important compounds of s-block elements	PSO-4	<b>K3</b>
CO - 5	assess the application of acids, indicators, buffers, compounds of s and p- block elements and hydrocarbons	PSO-4	<b>K4</b>

## Teaching plan

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

Unit	Module	Topic	Teaching Hours	Cognitive level	Pedagogy	Assessment/Evaluation
<b>I</b>	<b>Acids, bases and Ionic equilibria</b>					
	1	Concepts of Acids and Bases - Arrhenius concept, Bronsted-Lowry concept, Lewis concept; Relative strengths of acids, bases and dissociation constant	3	K2(U)	Lecture using models, chalk and talk	Slip test and concept explanations
	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	K3(A)	Group discussion and problem solving	Problem solving
	3	Theory of acid base indicators – action of phenolphthalein and methyl orange, titration curves - use of acid base indicators;	3	K1(R)	Lecture using chalk and talk	Short test
	4	Buffer solutions– types, mechanism of buffer action in acid and basic buffer, Henderson-Hasselbalch equation; Salt hydrolysis	3	K2(U)	Lecture using chalk and talk	Slip test and MCQ
	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	3	K3(A)	Lecture using chalk and talk, group discussion and problem solving	Group discussion and problem solving
	6	Solubility product - determination and applications; numerical problems involving the core concepts.	2	K3(A)	Lecture using models, chalk and talk	Concept explanations and slip test
<b>II</b>	<b>Chemistry of s and p- Block Elements</b>					
	1	Hydrogen: Position of hydrogen in the periodic table. General characteristics of alkali metals and alkaline earth metals-Electronic configuration, oxidation states,	3	K2(U)	Lecture using chalk and talk	Short test
	2	Ionisation energy, reducing property, flame colouration, uses of alkali metals. Comparative	3	K4(An)	Lecture using chalk and talk	Mentimeter

		study of oxides and hydroxides of alkali metals.				
	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)	Lecture using chalk and talk	Short test and MCQ
	4	General characteristics of p-Block Elements (Group 13 & 14)-Electronic configuration, oxidation states and metallic character, preparation and structure of diborane and borazine. Chemistry of borax	4	K2(U)	Lecture using chalk and talk	Short test and quiz
	5	Extraction of Al and its uses. Comparison of carbon with silicon. Carbon-di-sulphide – Preparation, properties, structure and uses.	3	K4(An)	Lecture using chalk and talk	Slip test
<b>III</b>	<b>Chemistry of p- Block Elements (Group 15-18)</b>					
	1	General characteristics of elements of Group 15; chemistry of $\text{H}_2\text{N}-\text{NH}_2$ , $\text{NH}_2\text{OH}$ and $\text{HNO}_3$ . Chemistry of $\text{PH}_3$ , $\text{PCl}_3$ , $\text{PCl}_5$ , $\text{POCl}_3$ and $\text{P}_2\text{O}_5$	3	K1(R)	Lecture using chalk and talk	Concept explanation
	2	Oxy acids of phosphorous ( $\text{H}_3\text{PO}_3$ and $\text{H}_3\text{PO}_4$ ). General properties of elements of group 16 - chemistry of ozone	3	K2(U)	Lecture using chalk and talk, Group discussion	Slip test
	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	K3(A)	Lecture using powerpoint	Short test
	4	General characteristics of halogen with reference to electronegativity, electron affinity and oxidation states. Peculiarities of fluorine.	3	K1(R)	Lecture using chalk and talk, Seminar	Slip test and quiz- google forms
	5	Inter-halogen compounds ( $\text{ICl}$ , $\text{ClF}_3$ , $\text{BrF}_5$ and $\text{IF}_7$ ), pseudo halogens. Noble gases: Position in the periodic table-uses of noble gases.	3	K2(U)	Lecture using chalk and talk	Concept explanation

IV	Hydrocarbon Chemistry-I					
	1	Petroproducts: Fractional distillation of petroleum; cracking, Alkenes-Nomenclature, general methods of preparation –	3	K2(U)	Lecture using power point	Slip test
	2	Mechanism of $\beta$ - elimination reactions – $E_1$ and $E_2$ mechanism - orientation – Hofmann and Saytzeff rules. Reactions of alkenes – addition reactions – mechanisms	4	K1(R)	Lecture using chalk and talk	Slip test and quiz
	3	Markownikoff's rule, Kharasch effect, oxidation reactions – hydroxylation, epoxidation, ozonolysis; polymerization.	3	K3(A)	Lecture using chalk and talk	Short test
	4	Diels–Alder reactions – polymerisation – polybutadiene, polyisoprene (natural rubber), vulcanisation, polychloroprene. Alkynes Nomenclature; general methods of preparation (any two) and reactions;	2	K2(U)	Lecture using chalk and talk	Group discussion , slido
	5	Acidic nature of terminal alkynes and acetylene. Cycloalkanes: Nomenclature, Relative stability of cycloalkanes, Bayer's strain theory and its limitations.	3	K3(A)	Lecture using chalk and talk, Seminar	Short test
V	Hydrocarbon Chemistry - II					
	1	Benzene: structure of benzene, stability of benzene ring, aromaticity, Huckel's (4n+2) rule.	2	K2(U)	Lecture using chalk and talk	Slip test
	2	Electrophilic substitution reactions - General mechanism of aromatic electrophilic substitution - nitration, sulphonation,	2	K2(U)	Lecture using powerpoint, Seminar	Concept explanation
	3	Halogenation, Friedel-Craft's alkylation and acylation. Mono substituted and disubstituted benzene	3	K2(U)	Lecture using chalk and talk, Group discussion	MCQ- Google forms
	4	Effect of substituent – orientation and reactivity. Polynuclear Aromatic hydrocarbons: Naphthalene –Haworth synthesis;	4	K3(A)	Lecture using chalk and talk	Short test
	5	Reactions – electrophilic substitution reaction, nitration, sulphonation, halogenation,	2	K3(A)	Lecture using chalk and talk	Short test

	6	Friedel – Crafts acylation, alkylation, and oxidation – uses. Anthracene – synthesis by Haworth synthesis; reactions - Diels-Alder reaction -uses.	2	K2(U)	Power point	Long answer test
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### Course Focussing on Employability/ Entrepreneurship/ Skill Development :

Employability

**Activities:** Group Discussion, Assignment, Seminar

#### Assignment :

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 -----.
2. Ammonium chloride and ammonium hydroxide is an example for basic buffer. Say true or false.
3. The first element in the periodic table is-----.  
(a) Lithium (b) Hydrogen (c) Helium (d) Sodium
4. The ionisation energy of s block elements -----along a period.
5. An example of inter halogen compound is -----.  
(a)  $\text{PCl}_3$  (b)  $\text{N}_2\text{O}_5$  (c)  $\text{IF}_7$  (d)  $\text{PH}_3$
6. Marshall's acid is an example of oxyacid of sulphur. Say true or false.
7. Natural rubber is made up of isoprene units. Say true or false.
8. Ozonolysis of alkene gives -----.  
(a) aldehydes (b) acid (c) halogens (d) ester
9. Naphthalene is an example for polynuclear hydrocarbon. Say true or false.
10. Nitrating agent is a mixture of -----.

#### Part B

1. Explain the theory of acid base indicators.
2. Write notes on (i) Ionic product of water (ii) Buffer action
3. Give the flame colouration of alkali and alkaline earth metals.
4. Explain the structure of diborane.
5. Write notes on Caro's acid and Marshall's acid
6. What are pseudo halogens? Explain them.

7. Write notes on Markownikoff's rule and Karash effect.
8. What do you mean by Hofmann and Saytzeff rule?
9. Explain the structure of benzene.
10. Give the mechanism of            i) nitration        and    ii) Friedel crafts alkylation

### **Part C**

1. Derive Henderson Hasselbalch equation.
2. Mention the applications of solubility product.
3. How is aluminium extracted from its ore? Mention the uses.
4. Compare carbon with that of silicon.
5. List out the peculiarities of fluorine.
6. Explain the position of noble gases in the periodic table.
7. Explain Bayer's strain theory on the basis of relative stability of alkanes.
8. Give any two methods of preparation of alkenes. Explain E1 and E2 reactions.
9. How is naphthalene prepared by Haworth synthesis? Explain the oxidation, alkylation and acylation reactions.
10. Explain electrophilic substitution reactions with examples.

**Head of the Department**

Dr. M. Anitha Malbi

**Course Instructor**

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

### 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

CO	Upon completion of this course, the students will be able to:	PSO Addressed	Cognitive level
CO - 1	Remember the composition of milk and its processing	PSO - 1	K1
CO - 2	Understand the physio-chemical properties, pasteurization process and manufacture of milk and milk products	PSO - 3	K2
CO - 3	Apply the procedure for milk processing and determine the adulterants present in dairy products	PSO - 4	K1
CO - 4	Analyse the ingredients, nutritive values and manufacture of special milks and dairy products	PSO - 5	K2
CO - 5	Evaluate fat, SNF, specific gravity, acidity, pH, surface tension, viscosity and physio-chemical properties of milk and milk products.	PSO - 2	K3

### Teaching plan

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

Unit	Module	Topic	Teaching Hours	Cognitive level	Pedagogy	Assessment/ Evaluation
<b>I</b>	<b>Composition of Milk</b>					
	1	Milk - definition - general composition of milk	1	K1(R)	Lecture with ppt	Oral test
	2	constituents of milk - lipids, proteins	1	K2(U)	Lecture using chalk and talk	Slip test

	3	carbohydrates, vitamins and minerals	1	K2(U)	Seminar	Short test
	4	physical properties of milk - colour, odour, acidity	1	K3(Ap)	Demonstration	Oral test and MCQ
	5	specific gravity, viscosity and conductivity -	1	K4(An)	Lecture using chalk and talk	Short test through slido
	6	Factors affecting the composition of milk.	1	K3(Ap)	Lecture using chalk and talk	Short test
<b>II</b>	<b>Processing of Milk</b>					
	1	Microbiology of milk - destruction of micro - organisms in milk	1	K2(U)	Lecture using chalk and talk	Oral test
	2	physico-chemical changes taking place in milk due to processing - boiling	1	K4(An)	Lecture using ppt	Quiz on Kahoot
	3	pasteurization - types of pasteurization	1	K4(An)	Seminar	Short test and MCQ in google form
	4	Bottle, Batch and High Temperature Short Time (HTST)	1	K3(Ap)	Exhibition of vitamin sources	Short summary
	5	Vacuum pasteurization	1	K3(Ap)	Lecture using videos	Short test and quiz through nearpod
	6	Ultra High Temperature (UHT) pasteurization	1	K1(K)	Seminar	Short Test
<b>III</b>	<b>Major Milk Products</b>					
	1	Cream - definition - composition - chemistry of creaming process	1	K1(R)	Lecture using videos	Short test
	2	Gravitational and centrifugal methods of separation of cream.	1	K2(U)	Seminar	Oral test
	3	Butter - definition - composition - theory of churning	1	K3(Ap)	Demonstration on estimation of oil	Short test
	4	Desi butter - salted butter, estimation of acidity and moisture content in butter	1	K3(Ap)	Lecture using ppt	Quiz through Quizzes



	5	Ghee - major constituents	1	K2(U)	Lecture using chalk and talk	Group discussion
	6	common adulterants added to ghee and their detection.	1	K1(R)	Seminar	Class test
<b>IV</b>	<b>Special Milk</b>					
	1	Standardised milk - definition - merits	1	K1(R)	Lecture using chalk and talk	Slip test
	2	Reconstituted milk - definition - flow diagram of manufacture	1	K4(An)	Seminar	Group discussion
	3	Homogenised milk - flavoured milk - vitaminised milk	1	K4(An)	Lecture using videos	Short test
	4	Toned milk - Incitation milk	1	K3(Ap)	Lecture using ppt	Oral test
	5	Vegetable toned milk - humanized milk	1	K1(R)	Seminar	Slip test
	6	Condensed milk - definition, composition and nutritive value.	1	K3(Ap)	Lecture using chalk and talk	Quizzes
<b>V</b>	<b>Estimation and Preparation of milk and milk products</b>					
	1	Estimation of fat, SNF	1	K1(R)	Lecture using ppt	Slip test
	2	specific gravity and acidity of milk	1	K2(U)	Lecture using chalk and talk	Short test
	3	Determination of pH, surface tension and viscosity of milk	1	K4(An)	Lecture using videos	MCQ through Slido
	4	Preparation of butter - ghee - milk powder and ice cream.	1	K2(U)	Group Discussion	Short summary
	5	Preparation of indigenous milk products	1	K3(Ap)	Problem solving	Slip test
	6	khoa - chhena - paneer and kulfi	1	K3(Ap)	Seminar	MCQ

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

**Activities (Em):** Group discussion and Seminar

**Assignment:**

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**

1. Pasteurization is done to improve the \_\_\_\_\_ quality of milk.
2. Pasteurized milk should give positive phosphatase test. Say true or false.
3. In batch pasteurization, milk is heated to 63 °C for  
a) 15 min                      b) 15 sec                      c) 30 min                      d) 30 sec
4. The cooling temperature of milk is \_\_\_\_\_
5. In HTST method of pasteurization this is used for diverting unpasteurized milk.  
a) FTBC                      b) FDV                      c) FDP                      d) FCP
6. Double toned milk should contain \_\_\_\_\_ % of fat.  
a) 3%                      b) 1.5%                      c) 9%                      d) 8.5%
7. The term condensed milk refers to full cream \_\_\_\_\_  
a) unsweetened condensed milk                      b) unsweetened skim milk  
c) Sweetened condensed milk                      d) sweetened skim milk
8. Deficiency of pyridoxine causes \_\_\_\_\_  
a) pellagra                      b) cheilosis                      c) anaemia                      d) depression
9. Vitamin B12 is otherwise known as \_\_\_\_\_  
a) pyridoxime                      b) Niacin                      c) cyanocobalamine                      d) Thiamine
10. Sweetened condensed skim milk is the produce of \_\_\_\_\_  
a) cow skimmed milk                      b) goat condensed milk  
c) cow condensed milk                      d) goat skimmed milk

**Part - B**

1. Explain the physical properties of milk.
2. List out the types of milk.
3. List out the constituents of milk.

4. Define pasteurization.
5. Differentiate HTST and UHT pasteurization techniques.
6. Compare bottle and batch pasteurization process.
7. Define rancidity.
8. Explain the theory of churning for the conversion of cream into butter.
9. How will you detect the adulterants present in ghee?
10. Compare gravitational and centrifugal methods for the separation of cream.
11. Highlight the merits of standardized milk.
12. Differentiate homogenized and flavoured milks.
13. 13. Compare bulgarian and acidophilous milks

### **Part - C**

1. How will you determine the adulterants present in milk?
2. Analyze the factors which affect the composition of milk.
3. Describe the physio-chemical changes takes place in milk while processing.
4. Determine the acidity and moisture content present in butter.
5. Illustrate the manufacture of reconstituted milk with a flow chart
6. Compare the composition of vitaminised, toned and humanized milks. What is fermentation of milk? Summarize the process involved in the fermentation of milk
7. Illustrate the procedure for the manufacture of ice cream. Analyze the role of stabilizers and emulsifiers in ice cream.
8. Illustrate the procedure for the destruction of microorganism present in milk.
9. Estimate the fat content and total solids present in milk.

**Head of the Department:** Dr. M. Anitha Malbi

**Course Instructor:** Dr. L. Deva Vijila

**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

### Objectives

1. amino acids and essential elements of biosystem
2. understand the characteristics and structure of nucleic acids and vitamins
3. understand the biological functions of lipids
4. provide fundamentals of photochemistry

CO	Upon completion of this course, the students will be able to:	PSO Addressed	Cognitive level
CO - 1	remember the importance of amino acids and learn the basic concepts of Ayurveda	PSO - 1	K1
CO - 2	understand the importance of nucleic acids and vitamins	PSO - 3	K2
CO - 3	know the biological functions of lipids, oils and fats	PSO - 1	K1
CO - 4	understand the function and deficiency of metals in human system	PSO - 6	K2
CO - 5	outline the various type of photochemical process.	PSO - 2	K3

### Teaching plan

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

Unit	Module	Topic	Teaching Hours	Cognitive level	Pedagogy	Assessment/Evaluation
<b>I</b>	<b>Amino Acids and Essential elements of biosystem</b>					
	1	Classification - preparation and properties of alanine	3	K1(R)	Lecture with ppt	Oral test
	2	preparation of dipeptides using Bergmann method	2	K2(U)	Lecture using chalk and talk	Slip test
	3	Proteins- classification – structure	2	K2(U)	Seminar	Short test

	4	Colour reactions – Biological functions of proteins.	2	K3(Ap)	Demonstration	Oral test and MCQ
	5	Basic concepts of Ayurveda, Important test of Ayurveda and Ayurvedic view of the cause of diseases.	3	K4(An)	Lecture using chalk and talk	Short test through slido
<b>II</b>	<b>Nucleic acids and Vitamins</b>					
	1	Nucleic acids –nucleosides and nucleotides. Structure of DNA - denaturation and renaturation of DNA - replication of DNA. Hydrogen bonding in DNA.	3	K2(U)	Lecture using chalk and talk	Oral test
	2	Stabilizing forces in protein and DNA - Vander waal's forces, dipole-dipole and dipole-induced dipole interactions.	3	K4(An)	Lecture using ppt	Quiz on Kahoot
	3	Structure of RNA - Types of RNA. Difference between DNA and RNA.	3	K4(An)	Seminar	Short test and MCQ in google form
	4	<b>Vitamins:</b> Classification, source, biological functions of Vitamin A, B, C, D, E and K.	2	K3(Ap)	Exhibition of vitamin sources	Short summary
	5	Diseases caused by the deficiency of Vitamin A, B, C, D, E and K.	1	K3(Ap)	Lecture using videos	Short test and quiz through nearpod
<b>III</b>	<b>Lipids, oils and fats</b>					
	1	Lipids - classification - properties - biological functions. Biological functions of phospholipids and glycolipids.	3	K1(R)	Lecture using videos	Short test
	2	Oils and fats - definition - characteristics and uses. Common fatty acids in oils and fats.	3	K2(U)	Seminar	Oral test
	3	Extraction and refining of oils. Estimation of fats and oils - acid value, saponification value and Iodine value.	3	K3(Ap)	Demonstration on estimation of oil	Short test
	4	Distinction between animal and vegetable fats. Hydrogenation and Rancidity.	3	K3(Ap)	Lecture using ppt	Quiz through Quizzes
<b>IV</b>	<b>Minerals and water</b>					
	1	<b>Minerals:</b> Introduction – source, function, deficiency and toxicity of calcium.	3	K1(R)	Lecture using chalk and talk	Slip test
	2	deficiency and toxicity of phosphorous, sodium, potassium, iron and iodine.	3	K4(An)	Seminar	Group discussion

	3	<b>Water:</b> Source and distribution of water in the body – functions of water	3	K4(An)	Lecture using videos	Short test
	4	absorption, metabolism and storage of water.	3	K3(Ap)	Lecture using ppt	Oral test
<b>V</b>	<b>Photochemistry</b>					
	1	Importance of photochemistry. Difference between thermal and photochemical reactions. Laws of photochemistry -Beer-Lambert's Law	2	K1(R)	Lecture using ppt	Slip test
	2	Grother's-Drapers law -Stark-Einstein's law - quantum efficiency.	2	K2(U)	Lecture using chalk and talk	Short test
	3	Electronic excitations - singlet and triplet states - Jablonski diagram - internal conversion - intersystem crossing	2	K4(An)	Lecture using videos	MCQ through Slido
	4	fluorescence - phosphorescence. Difference between fluorescence and phosphorescence.	2	K2(U)	Group Discussion	Short summary
	5	Photochemical rate law - kinetics of photochemical combination of H <sub>2</sub> and Cl <sub>2</sub> - decomposition of HI.	2	K3(Ap)	Problem solving	Slip test
	6	Photosensitization - photosensitizers - chemiluminescence - bioluminescence.	2	K3(Ap)	Seminar	MCQ

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

**Activities (Em):** Group discussion and Seminar

**Assignment:**

1. Estimation of fats and oils - acid value, saponification value and Iodine value - Practical Assignments
2. Classification, source, biological functions of Vitamin A, B, C, D, E and K. – Analysis of food samples

**Seminar**

1. Proteins- classification – structure
2. Oils and fats - definition - characteristics and uses. Common fatty acids in oils and fats.
3. Structure of RNA - Types of RNA. Difference between DNA and RNA.
4. deficiency and toxicity of phosphorous, sodium, potassium, iron and iodine.
5. Photosensitization - photosensitizers - chemiluminescence - bioluminescence

## Sample questions

### Part A

1. These are polyamides formed by the condensation of  $\text{-NH}_2$  group of one amino acid with the  $\text{-COOH}$  group of the other.  
a) Proteins                      b) Peptides                      c) Carbohydrates                      d) Fats
2. Proteins are complex organic nitrogenous substances found in animal and plant tissues. Say true or false.
3. Nucleosides containing \_\_\_\_\_ sugar are called ribonucleotides.  
a) Glucose                      b) Ribose                      c) Arabinose                      d) Maltose
4. DNA is a polymer of \_\_\_\_\_.
5. Oxidation of unsaturated fatty acids yield \_\_\_\_\_.  
(a) Peroxides                      (b) Carboxylic acid                      (c) Lipids                      (d) Phenol
6. Suitability of an oil for soap making is defined by \_\_\_\_\_.  
(a) Iodine value                      (b) Saponification value  
(c) Acid Value                      (d) Reichert – Meissel value
7. The reason for the greenish yellow glowing of yellow phosphorous.  
a) Reduction of phosphorous                      (b) oxidation of phosphorous  
(c) Addition of phosphorous                      (d) removal of phosphorous
8. What is the quantum yield for the photochemical decomposition of hydrogen iodide?  
a) 1                      (b) 2                      (c) 3                      (d) 4

### 9. Match the following

Fluorescence	-	blue light
Secondary process	-	has unit quantum efficiency
Fluorspar	-	instantaneous process
Primary process	-	thermal radiation
Incandescence	-	temperature dependent

10. Primary process of photochemical reaction is independent of temperature. Say true or false

### Part B

1. Define the following:  
i. Acid value      ii. Saponification value                      iii. Iodine value
2. What is rancidity? Explain
3. Write notes on nucleosides.
4. List the important characteristics of fluorescence.
5. Define photosensitization with few examples

### Part C

1. Give any three methods of synthesis of amino acids (i) glycine (ii) alanine and (iii) phenylalanine.
2. Write in detail the function, metabolism and storage of water in the body.
3. How will you extract oil from their sources?
4. Explain the structure of DNA using Watson and Crick model.
5. Give the mechanism of photochemical combination of  $\text{H}_2$  and  $\text{Cl}_2$ .

Head of the Department: Dr. M. Anitha Malbi

Course Instructor: Dr. K. Francy

**Department** : Chemistry  
**Title of the Course** : NME - 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 cosmetics.
2. To know the chemicals present in hair and skin care products

### Course Outcomes

COs	<i>Upon completion of this course, the students will be able to:</i>	PSO addressed	Cognitive level
CO - 1	Remember the composition of various chemicals in cosmetic products	PSO -2	K1(R)
CO - 2	Understand the methods of beauty treatments and their advantages and disadvantages	PSO -1	K2(U)
CO - 3	Apply the functions of various chemicals in cosmetics	PSO -4	K3(A)
CO - 4	Analyze the advantages and disadvantages of cosmetics	PSO -2	K4(An)
CO - 5	Evaluate the quality of cosmetics on the basis of their chemical composition	PSO -2	K5(E)

### Teaching plan

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

Unit	Module	Topic	Teaching Hours	Cognitive level	Pedagogy	Assessment/ Evaluation
<b>I</b>	<b>Skin care</b>					
	1	Nutrition of the skin, skin care and cleansing of the skin; face powder – ingredients; creams and lotions – cleansing, moisturizing all purpose,	2	K2(U)	lecture using chalk and talk	Slip test and concept explanations
	2	shaving and sunscreen (formulation only); Gels – formulation and advantages; astringent and skin tonics – key ingredients,	2	K3(A)	Seminar	class test



	3	skin lightness, depilatories. Hazards of skin care products.	2	K4(An)	lecture using chalk and talk	Short test
<b>II</b>	<b>Hair care</b>					
	1	Shampoos – types – powder, cream, liquid, gel – ingredients; conditioner – types – ingredients – Hair dye.	3	K2(U)	Lecture using videos and ppt	Quiz - Quizizz and slip test
	2	Disadvantages of hair care products.	1	K2(U)	Lecture using chalk and talk	Slip test and class test
	3	<b>Dental care</b> Tooth pastes – ingredients and preparation of tooth paste – mouth wash	2	K3(A)	Group discussion	Quiz and slip test
<b>III</b>	<b>Make up</b>					
	1	Base – foundation – types- liquid - powder – stick.	3	K2(U)	Lecture using ppt	Concept explanations
	2	Ingredients, lipstick, eyeliner, mascara, eye shadow, concealers, rouge.	3	K4(An)	Seminar	Slip test
<b>IV</b>	<b>Perfumes</b>					
	1	Classification - Natural – plant origin – parts of the plant used – isolation of essential oils	4	K2(U)	Lecture using videos and ppt	Concept explanations and short summary
	2	Preparation of odorous substances – methyl anthranilate-citronello- coumarin-vanillin-diphenyl oxide.	2	K4(An)	Lecture using chalk and talk	Slip test and quiz
<b>V</b>	<b>Beauty treatments</b>					
	1	Facials - types – advantages – disadvantages; face masks – types	2	K3(A)	Group discussion	slip test
	2	Bleach -types – advantages– disadvantages; shaping the brows; eyelash tinting; perming types;	2	K2(U)	Lecture using chalk and talk	Short test

	3	Hair colouring and dyeing ; permanent waving – hair straightening; wax types – waxing; pedicure, manicure - advantages – disadvantages	2	K6(C)	Group discussion, and Peer tutoring	Quiz - Slido
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**Course Focusing on Employability/ Entrepreneurship/ Skill Development:** Employability

**Activities (Em/SD):** Think-Pair-Share and Seminar

**Assignment: (Mention Topic and Type)**

Disadvantages of hair care products

**Seminar: (Mention Topic)**

Unit :I

Gels – formulation and advantages; astringent and skin tonics – key ingredients

Unit :IV

Ingredients, lipstick, eyeliner, mascara, eye shadow, concealers, rouge – therapeutic uses

**Sample questions**

#### **Part - A**

1. The absorbent used for the talcum powder is -----  
a) Magnesium carbonate      b) Sodamine      c) Lavender oil d) Zinc oxide
2. The lotion used to protect against sun burn is -----  
a)Sun screen lotion b) Shaving cream c) Face cream d) Body lotion
3. A chemical substance used to lighten the skin is skin bleaching agents. State true or false.
4. The pigment present in black and brown mascaras are ----- .  
a) Iron oxide 50      b) Silver oxide      c) Paraffin 30 d) Lead acetate
5. Abrasives are used to polish the surface of teeth. State true or false.

#### **Part - B**

1. Explain the ingredients present in talcum powder.
2. Illustrate the preparation and uses of Skin bleaching agents.
3. Discuss the preparation and uses of hair dye.
4. List out types of shampoos.
5. Explain the advantages of skin care products.
6. Write a note on Astringents.

#### **Part - C**

1. Explain the disadvantages of hair products.
2. Discuss the ingredients present tooth paste.
3. Compare the advantages and disadvantages of beauty products.
4. Explain the preparation of methyl anthranilate and citronellol.
5. Explain ingredients present in lipstick, eyeliner, mascara and eye shadow.

**Head of the Department:** Dr. M. Anitha Malbi **Course Instructor:** Dr.Y.Christabel Shaji

**Department** : Chemistry  
**Class** : II B.Sc Chemistry  
**Title of the Course** : Core IV: General Chemistry - IV  
**Semester** : IV  
**Course Code** : CC2041

Course Code	L	T	P	Credits	Inst. Hours	Total Hours	Marks		
							CIA	External	Total
CC2041	4	-	-	4	4	60	30	70	100

### Objectives

- To study the preparation and chemical reactions of alkyl and aryl halides with mechanism and to apply the knowledge in the synthesis of compounds.
- To study the preparation and properties of alcohols, phenols, ethers and epoxides with mechanisms and to apply the knowledge in the synthesis of their derivatives.
- To know the detailed chemistry about halogens and noble gases.
- To understand the basics of first and second law of thermodynamics and related relationship.

### Course outcomes

COs	Upon completion of this course, the students will be able to:	PSO addressed	Cognitive level
CO - 1	know the mechanism of important name reactions	PSO - 1	K2(U)
CO - 2	apply the reaction mechanisms in the synthesis of components used in industrial and medicinal fields	PSO - 2	K3(Ap)
CO - 3	evaluate the characteristics halogens and noble gases	PSO - 3	K4(An)
CO - 4	classify the non-aqueous solvents and know the theories of acids and bases	PSO - 3	K5(E)
CO - 5	list out the applications of first and second law of thermodynamics	PSO - 3	K1(R)

### Teaching plan

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

Unit	Module	Topic	Teaching Hours	Cognitive level	Pedagogy	Assessment/Evaluation
<b>I</b>	<b>Haloalkanes and Haloarenes</b>					
	1	Classification of alkyl halides - methods of formation from alcohols, alkanes, alkenes – allylic/benzylic bromination and chlorination – Hundiecker reaction, Finkelstein reaction and Swart's reaction	3	K2(U)	Lecture with videos and ppt	Quiz - Slido

	2	Nucleophilic substitution reactions - mechanisms of nucleophilic substitution reactions - $S_N2$ and $S_N1$ reactions with energy profile diagrams- difference.	3	K4(An)	Group discussion	Oral test
	3	Dehydrohalogenation with mechanism - Saytzeff's rule - reaction with metals -Wurtz reaction and formation of Grignard reagent.	2	K2(U)	Lecture with videos and ppt	Quiz - Mentimeter
	4	Methods of formation of aryl halides - nucleophilic substitution reactions of aryl halides - addition-elimination and the elimination-addition mechanisms - electrophilic substitution	2	K3(Ap)	Lecture with chalk and talk	Slip test
	5	Ullmann reaction – Wurtz-Fittig reaction - Relative reactivities of alkyl, allyl, vinyl and aryl halides - Synthesis and uses of DDT and BHC	2	K3(Ap)	Blended learning	Class test
<b>II</b>	<b>Alcohols, Phenols and Ethers</b>					
	1	Preparation of alcohols through reduction, hydroboration, hydration, oxymercuration and Grignard reaction.	3	K2(U)	Flipped classroom	Concept explanations and group discussion
	2	Reactions of alcohol - with metals, esterification with mechanism, oxidation, dehydration, conversion to alkyl halides	2	K2(U)	Lecture with illustrations	Slip test
	3	Preparation of phenols - acidity of phenol vs alcohols - relative acid strength of substituted phenols - reactions of phenols - esterification, oxidation	3	K3(Ap)	Lecture	Class test
	4	Kolbe's, Reimer-Tiemann, Gattermann, electrophilic substitution reactions.	2	K4(An)	Lecture with illustrations	Quiz- Nearpod
	5	Ethers – preparations, reactions - epoxide - Synthesis of aspirin, 3 and 4-nitro phenol, t-butylmethyl ether and 1-methyl-1-cyclohexanol	2	K5(E)	Lecture with illustrations	Quiz and slip test
<b>III</b>	<b>Halogen family and Noble gases</b>					
	1	General characteristics of halogen with reference of electro negativity, electron affinity	3	K2(U)	Blended learning	Concept explanations
	2	Oxidation states, and oxidizing power – peculiarities of fluorine, Hydrides, oxides and oxo acids of halogens	2	K3(Ap)	Lecture with illustrations	Slip test

	3	Interhalogen compounds – polyhalide ions – pseudohalogens – preparation, properties and structure of interhalogen compounds	2	K2(U)	Flipped classroom	Group discussion
	4	Inert gases – position in the periodic table – isolation from atmosphere – General characteristics Structure and shape of xenon compounds – $\text{XeF}_2$ , $\text{XeF}_4$ , $\text{XeF}_6$ , $\text{XeOF}_2$ , $\text{XeOF}_4$ – uses of noble gases	2	K4(An)	Lecture with illustrations	Short test and quiz - Slido
	5	Non-aqueous solvents: Classification of solvents – General properties of ionizing solvents-chemical reactions. Liquid ammonia and liquid $\text{SO}_2$ as solvents. Acid Base Chemistry: Theories of acids and bases – Arrhenius, Bronsted-Lowry theory proton donor - acceptor system.	3	K2(U)	Lecture with ppt and videos	Quiz - Quizizz and slip test
<b>IV</b>	<b>First Law of Thermodynamics and its Applications</b>					
	1	Chemical thermodynamics – importance of thermodynamics– basic terms – system, boundary and surroundings. Types of systems – open, closed and isolated. Types of processes - isothermal, adiabatic, isobaric and isochoric, reversible and irreversible process. Difference between reversible and irreversible process.	3	K2(U)	Lecture with illustrations	Oral test
	2	First law of thermodynamics- mathematical form- Heat capacity of a system – heat capacity at constant volume ( $C_v$ ) and heat capacity at constant pressure ( $C_p$ ) – relationship between $C_p$ and $C_v$ .	3	K3(Ap)	Lecture with illustrations	Slip test and quiz
	3	Calculations of $w$ , $q$ , $dE$ and $dH$ for the reversible expansion of ideal gases under isothermal and adiabatic conditions. Joule- Thomson effect- derivation of Joule- Thomson coefficient for ideal gases and real gases, inversion temperatures.	3	K4(An)	Lecture with illustrations	Quiz - Kahoot and slip test
	4	Variation of enthalpy change of reaction with temperature (Kirchoff's equation). Second law of thermodynamics – Need for second law – statements of Second law – Carnot theorem, Carnot cycle – Efficiency of heat engine	3	K3(Ap)	Lecture and Group discussion	Group discussion and Assignment

V	Thermodynamics – II					
	1	Third law of thermodynamics - concept of entropy – State function – entropy change in isothermal expansion of ideal gas - entropy change in reversible and irreversible process – entropy change accompanying by change of phase.	3	K1(R)	Flipped classroom	MCQ - Slido
	2	Calculation of entropy change of an ideal gas with changes in pressure, volume and temperature – Entropy of mixing – Physical significance of entropy	2	K3(Ap)	Problem solving and group discussion	Quiz - Kahoot and slip test
	3	Gibbs free energy – Work function – Variation of free energy change with temperature and pressure – Criteria for spontaneity – Gibbs Helmholtz equation – Partial molar properties – Clapeyron Clausius equation and its applications	3	K2(U)	Lecture with ppt and videos	MCQ- Google clasroom
	4	Van't Hoff reaction isotherm and its significance. Van't Hoff isochore and significance. Fugacity – concept – determination of fugacity of real gases – variation of fugacity with temperature and pressure	2	K3(Ap)	Lecture with ppt	Short test
	5	Physical significance of fugacity. Activity – activity coefficient. Nernst Heat theorem and its applications. Zeroth law of thermodynamics	2	K5(E)	Lecture with ppt and videos	Quiz and slip test

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

**Activities (Em):**

Synthetic terminology - Group discussion.

Interhalogen compounds - Group discussion.

Need for second law - Group discussion.

**Assignment: (Mention Topic and Type)**

- Calculation of entropy change of an ideal gas with changes in pressure, volume and temperature - Assignment
- Variation of enthalpy change of reaction with temperature – Assignment.

**Sample questions**

**Part A**

- SN<sup>2</sup> reaction means substitution Nucleophilic \_\_\_\_\_ order.
- Wurtz reaction leads to
  - Alkanes
  - Alkenes
  - Alkynes
  - Arenes

3. The oxidation product of any primary alcohol is  
a) Acid                      b) Ester                      c) Aldehyde                      d) Ketone
4. Cresols are more acidic than phenol.                      - Say true or false
5. The most electro negative element is  
a) Oxygen b) fluorine                      c) chlorine                      d) bromine
6. The geometry of  $\text{XeF}_6$  is -----
7. Joule Thomson expansion of an ideal gas is  
a) isothermal process                      b) isochoric process  
c) isoenthalpic process                      d) isoentropic process
8.  $C_p - C_v = S$ . Say true or false.
9. Inversion temperature is equal to -----  
a)  $2a/R$                       b)  $2a/RT$                       c)  $a/Rb$                       d)  $2a/Rb$
10. Van't Hoff reaction isotherm is  
a)  $\Delta G = - RT \ln K_p$                       b)  $\Delta G = RT \ln K_p$                       c)  $\Delta G = - RT \ln K_c$                       d)  $\Delta G = RT \ln K_c$

### Part B

1. List the differences between  $S_N^2$  and  $S_N^1$  mechanism.
2. Explain Hunsdiecker and Finkelstein's reactions with examples.
3. Explain Kolbe acid Reimer Tiemer reaction.
4. How will you synthesise (i) Aspirin                      (ii) t – butyl ether
5. List the peculiar properties of Fluorine
6. Discuss the structure of  $\text{XeF}_6$
7. Derive the thermodynamic relationship between  $C_p$  and  $C_v$ .
8. Differentiate reversible and irreversible processes.
9. Derive expression for  $\Delta E$ ,  $W$ ,  $\Delta H$  and  $q$  in reversible expansion of a real gas.

### Part C

1. Explain  $S_N^2$  mechanism. What are the factors that affect  $S_N^2$  mechanism?
2. How will you convert ethyl bromide to  
(a)  $\text{C}_2\text{H}_5\text{OH}$                       (b)  $\text{C}_4\text{H}_{10}$                       (c)  $(\text{C}_2\text{H}_5)_2\text{O}$                       (d)  $\text{C}_2\text{H}_5\text{COOH}$
3. How are the following conversions effected?  
i. Phenol to picric acid                      ii. Catechol to Alizarin  
iii. Phenol to picramide                      iv. Phenol to phenolphthalein
4. Give the preparation of  
i. Styphnic acid                      ii. Resorcinol  
iii. Quinol                      iv. Phloroglucinol
5. What are inter halogen compounds. How are they prepared?
6. Discuss the structure of the oxy fluorides of xenon
7. Derive an expression for the efficiency of Carnot's cycle.

**Head of the Department:** Dr. M. Anitha Malbi

**Course Instructor:** Dr. Y.Christabel Shaji

**Department** : **Chemistry**  
**Class** : **II B.Sc Chemistry**  
**Title of the Course** : **Green Chemistry**  
**Semester** : **IV**  
**Course Code** : **CC2042**

Course Code	L	T	P	S	Credits	Inst. Hours	Total Hours	Marks		
								CIA	External	Total
CC2042	4	-	-	-	3	4	60	25	75	100

### Learning Objectives

- To know the principles of green chemistry.
- To study the important techniques and green synthesis of compounds.
- To study the concept of atom economy in chemical synthesis.

CO	Upon completion of this course, the students will be able to:	PSO Addressed	Cognitive level
CO - 1	know the principles of green chemistry	PSO - 1	K1
CO - 2	design green synthesis	PSO - 3	K2
CO - 3	interpret green method for organic synthesis	PSO - 1	K1
CO - 4	synthesize various compounds by microwave and ultrasound assisted methods	PSO - 6	K2
CO - 5	analyze the important techniques and directions in practicing green chemistry	PSO - 2	K3
CO-6	identify the importance of Green chemistry in day to day life	PSO - 3	K4



## Teaching plan

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

Unit	Module	Topic	Teaching Hours	Cognitive level	Pedagogy	Assessment/ Evaluation
<b>I</b>	<b>Introduction to green chemistry</b>					
	1	Definition – need for green chemistry – scope of green chemistry	2	CO - 1	Lecture using chalk and talk	Slido
	2	Concept of atom economy – yield – mass intensity and atom economy	2	CO - 1	Seminar	Quiizzes
	3	Calculation of atom economy, mass intensity, mass productivity and carbon efficiency.	2	CO - 2	Lecture using videos	Oral test
	4	Different types of reactions and atom economy – addition, substitution, elimination and rearrangements	2	CO - 4	Lecture using ppt	Quiz on Kahoot
	5	Concept of selectivity – enantioselectivity, chemoselectivity	2	CO - 5	Lecture using chalk and talk	Short test through slido
	6	Regioselectivity and diastereoselectivity.	2	CO-6	Seminar	Oral test
<b>II</b>	<b>Green solvent</b>					
	1	Twelve principles of green chemistry	2	CO - 1	Lecture using chalk and talk	Oral test
	2	Choice of starting materials – biomimetic, multifunctional reagents, materials reagents	2	CO - 3	Lecture using ppt	Quiz on Kahoot
	3	Combinatorial green chemistry – Green Chemistry in sustainable developments	2	CO - 4	Seminar	Short test and MCQ in google form
	4	Importance of Green chemistry in day to day life	2	CO - 1	Exhibition of vitamin sources	Short summary
	5	versatile bleaching agents	2	CO-4	Lecture using videos	Short test and quiz through nearpod

	6	Analgesic drugs.	2	CO - 1	Lecture using chalk and talk	Oral test
<b>III</b>	<b>Green catalyst</b>					
	1	Super critical fluids- Introduction – extraction of super critical fluids	2	CO - 1	Lecture using videos	Short test
	2	Solvents of super critical fluid – advantages and applications	2	CO - 4	Lecture using ppt	Slido
	3	Carbondioxide as a super critical fluid – features of technique for using super critical carbondioxide – advantages and application	2	CO - 5	Demonstration on estimation of oil	Short test
	4	Chemical reaction in supercritical water and near critical water region. Extraction of natural products, dry cleaning	2	CO-6	Lecture using ppt	Quiz through Quizzes
		Supercritical polymerization, hydrogenation and hydroformylation. Ionic liquid as green solvent: Introduction	2	CO - 1	Lecture using chalk and talk	Short Test
		Synthesis of ionic liquids– acidic ionic liquid and neutral ionic liquids – applications in organic synthesis.	2	CO - 2	Seminar	Slip test
<b>IV</b>	<b>Green synthesis</b>					
	1	Catalysis over view: acid catalyst – basic catalyst- oxidation catalyst	2	CO - 4	Lecture using chalk and talk	Slip test
	2	Polymer supported catalyst – photosensitized super acid catalyst	2	CO - 5	Seminar	Group discussion
	3	Tetra AmidoMacrocyclic Ligand (TAML) catalyst. Biocatalyst: microbial oxidation, microbial reduction	2	CO-6	Lecture using videos	Short test
	4	Enzyme catalyzed hydrolytic process, per fluorinated catalyst and modified biocatalyst.	2	CO - 1	Lecture using ppt	Oral test
	5	Development of mesoporous supports by liquid crystal templating	2	CO - 2	Lecture using chalk and talk	MCQ through Slido

	6	Neutral templating methods – heterogeneous catalyst – solid supported catalyst.	2	CO - 3	Seminar	Short summary
<b>V</b>	<b>Green reactions involving basic principle of green chemistry</b>					
	1	Green synthesis of the following compounds – Adipic acid, Catechol, Benzoyl bromide, Acetaldehyde, Citral	2	CO - 1	Lecture using ppt	Slip test
	2	Green synthesis of Ibuprofen and Paracetamol. Microwave assisted reactions in water	2	CO-6	Lecture using chalk and talk	Short test
	3	Hoffmann Elimination, hydrolysis of benzyl chloride and methyl benzoate	2	CO - 1	Lecture using videos	MCQ through Slido
	4	Oxidation of toluene and alcohols. Microwave assisted reactions in organic solvents – esterification	2	CO - 2	Group Discussion	Short summary
	5	Fries rearrangement, Claisen Rearrangement Diels - Alder Reaction and decarboxylation.	2	CO - 3	Problem solving	Slip test
	6	Ultra sound assisted reactions – esterification, saponification, alkylation, oxidation, reduction, coupling reactions and Cannizzaro reactions.	2	CO - 4	Seminar	MCQ

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

**Activities (Em):** Group discussion and Seminar

**Assignment:**

1. Principles of Green Chemistry
2. Green synthesis of citral and ibuprofen
3. Ultra sound assisted reactions
4. Super critical fluids

**Seminar:**

1. Concept of atom economy
2. Twelve principles of green chemistry
3. Chemical reaction in supercritical water
4. Polymer supported catalyst
5. Oxidation of toluene and alcohols

## Sample questions

### Part - A

- The reaction of m-nitrobenzaldehyde with  $\text{NaBH}_4$  is
  - chemoselective
  - regioselective
  - enantioselective
  - diastereoselective
- Division of the total mass of a chemical reaction by the mass of product gives
  - Carbon efficiency
  - yield
  - mass productivity
  - yield
- Example of green Chemistry
  - carpet
  - bioplastics
  - sublimation
  - rubber
- Hydrolysis of benzyl chloride gives
  - benzyl alcohol
  - benzal alcohol
  - butyl alcohol
  - phenol
- Which one of the following is a preferred green solvent?
  - water
  - toluene
  - $\text{ZnCl}_2$
  - $\text{H}_2\text{SO}_4$
- Benzene is a ----- substance used as solvent in many industries.
  - Flammable
  - Non-flammable
  - Biodegradable
  - Carcinogenic
- The catalyst used to remove pesticides in water is -----
  - hydrotalcite
  - amberlyst-21-CuI
  - Clayzic
  - TAML
- Match the following

	Catalyst		Example
(i)	Acid	-	KOH
(ii)	Basic	-	$\text{HClO}_4$
(iii)	Oxidation	-	$\text{BF}_3$
(iv)	Super acid	-	$\text{K}_2\text{Cr}_2\text{O}_7$

- Assertion (A)** : Non-polar solvents cannot be used in micro-wave oven  
**Reason (R)** : Non-polar solvents are inert to microwave.
  - Both (A) and (R) are wrong
  - Both (A) and (R) are correct
  - (A) is correct but (R) is wrong
  - (A) is correct but (R) is not the correct explanation of (A)

- Match the following

	Synthesis	Catalyst/reagent
i)	Adipic acid	- NBS
ii)	Benzyl bromide	- <i>E.coli</i>
iii)	Acetaldehyde	- Water/ $\text{CHCl}_3$
iv)	Hoffmann elimination	- Ag

### Part - B

- Explain enantioselectivity with examples.
- Explain the terms mass intensity and mass productivity.
- Write notes on combinatorial green chemistry.
- Explain the term biomimetic in green chemistry
- Discuss the advantages of using SCF as solvent.
- Discuss supercritical polymerization with example.
- Apply Tetra Amido Macrocyclic Ligand catalyst for the synthesis of cysteic acid and formic acid.
- Apply microbial oxidation catalyst for the synthesis of adipic acid and 3,4-dihydroxyphenyl alanine.
- Write the green synthesis of adipic acid. Mention its uses.
- Write the green synthesis of catechol.

### **Part - C**

1. Explain the terms atom economy and carbon efficiency using an example each.
2. Calculate the atom economy in the following types of reaction using an example each.
  - i) Addition and substitution reactions
  - ii) Elimination and rearrangement reactions
3. Explain the important role of green chemistry in day to day life.
4. Discuss the choice of starting materials used in green synthesis with suitable examples.
5. Explain the various applications of supercritical fluid extraction
6. Write notes on
  - i) hydrogenation and
  - ii) hydroformylation.
7. Describe microbial oxidation and reduction reactions
8. Discuss the role of the following green catalysts
  - a) Acid catalyst
  - b) Basic catalyst
  - c) Oxidation catalyst
9. Write notes on the following green synthesis
  - i) benzyl bromide
  - ii) acetaldehyde
  - iii) citral
  - iv) paracetamol
10. Write notes on microwave assisted reactions in water

**Head of the Department :** Dr. M. Anitha Malbi

**Course Instructor:** Dr. L. Deva Vijila

**Department** : Chemistry  
**Class** : II B.Sc Physics  
**Title of the Course** : Allied : Physical Chemistry  
**Semester** : IV  
**Course Code** : CA2041

Course Code	L	T	P	Credits	Inst. Hours	Total Hours	Marks		
							CIA	External	Total
CA2041	4	-	-	3	4	60	30	70	100

### Objectives

1. To understand the basic concepts of thermodynamics and nano chemistry
2. To enable them to apply concepts related to chemistry in their careers
3. To know the basic principles of kinetics and photochemistry

### Course Outcome

CO	Upon completion of this course, the students will be able to:	PSO addressed	Cognitive level
CO-1	remember the theories and the factors influencing rate of reaction	PSO-1	K1(R)
CO-2	understand the laws and theories that govern photochemistry	PSO-1	K2(U)
CO-3	apply the principles of physical properties for structural determination	PSO-6	K3(Ap)
CO-4	understand the different laws of thermodynamics	PSO-1	K2(U)
CO-5	analyse the importance of nano chemistry in various fields	PSO-2	K3(Ap)

### Teaching Plan

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

Unit	Module	Topics	Teaching hours	Cognitive level	Pedagogy	Assessment/Evaluation
<b>I Thermodynamics</b>						
	1	Thermodynamics - importance - basic terms - system, boundary and surroundings - types of systems - open - closed - isolated - homogeneous and heterogeneous	2	K1(R)	Lecture, Group discussion	Short test
	2	Types of processes - isothermal, adiabatic, isobaric, isochoric, reversible and irreversible process- difference between reversible and irreversible process - state and path functions.	2	K2(U)	PowerPoint presentation	Quiz - Slido

	3	First law of thermodynamics - different statements - mathematical derivation - heat capacity of a system - heat capacity at constant volume ( $C_v$ ) - heat capacity at constant pressure ( $C_p$ ) - thermodynamic relationship between $C_p$ and $C_v$ .	2	K2(U)	Lecture with illustrations	Assignment on heat capacities
	4	Variation of enthalpy of a reaction with temperature - Kirchoff's equation, Joule Thomson effect .	2	K3(Ap)	Lecture, Problem solving	Short test
	5	Expression for Joule Thomson coefficient for an ideal gas and vanderwaal's gas - derivation - inversion temperature – significance.	2	K3(Ap)	Problem solving and group discussion	MCQ – Google Forms
	6	Second law of thermodynamics - need for second law of thermodynamics - different statements - Carnot's cycle	2	K4(An)	Lecture with Videos	Short Test
<b>II Chemical kinetics</b>						
	1	Rate of reaction - expression of rate - factors influencing rate of reaction - order and molecularity of a reaction - definition and examples	2	K3(Ap)	Cognitive Learning	Multiple choice questions – Google Forms
	2	Difference between order and molecularity - zero, first and second order reactions - examples derivation of rate constant and half life period	2	K3(Ap)	Problem solving	Short test
	3	Methods of determining order of reaction - use of differential - integral - half-life method and Ostwald's methods.	2	K4(An)	Lecture with ppt, Group discussion	Formative assessment – I
	4	Arrhenius theory -concept of activation energy - effect of catalyst - calculation of energy of activation. Theories of reaction rates - collision theory of	2	K4(An)	Comparative learning, mind map	Quiz – Quizizz

		bimolecular reactions - gaseous activated complex theory.				
<b>III Physical properties and structure determination</b>						
	1	Dipole moment - definition and expression for dipole moment - applications - molecular geometry - cis-trans isomerism and disubstituted benzene derivatives	2	K3(Ap)	Seminar, PowerPoint Presentation	Short test
	2	Dia, para and ferro magnetism - magnetic susceptibility and magnetic moment - measurement using Guoy balance - application of magnetic properties.	2	K1(R)	Lecture, ppt	Assignment
	3	Thermogravimetric analysis - principles - applications. Chromatography - classification.	2	K2(U)	Group discussion	Quiz – Nearpod
	4	Column chromatography - principle - experimental techniques - factors affecting column efficiency and applications.	2	K3(Ap)	Mind map	Slip test
	5	TLC principle - experimental techniques - advantages - limitations - applications. GC - principle - experimental techniques - applications.	2	K3(Ap)	Illustration, Seminar	Multiple choice questions
	6	HPLC - principle and experimental techniques.	1	K3(Ap)	Lecture , PowerPoint Presentation	Class Test
<b>IV Photochemistry</b>						
	1	Importance of photochemistry - difference between thermal and photochemical reactions - laws of photo chemistry - Beer-Lambert's Law - Grother's - Drapers law - Stark-Einstein's law –	1	K2(U)	ppt, videos	Multiple choice questions
	2	Quantum efficiency - electronic excitations - singlet and triplet states - Jablonski diagram -	2	K1(R)	Lecture with illustration	Quiz - Slido



		internal conversion - intersystem crossing				
	3	Fluorescence - phosphorescence - difference between fluorescence and phosphorescence .	2	K2(U)	Lecture with PowerPoint Presentation	Slip test
	4	Types of photo chemical reactions based on quantum efficiency ( $\phi = 1$ , $\phi < 1$ and $\phi > 1$ ) - primary and secondary process of photo chemical reaction - photo chemical rate law	2	K3(Ap)	Problem solving	Short test
	5	Kinetics of photo chemical reactions - combination of $H_2$ and $Cl_2$ - decomposition of HI- photosensitization - photosensitizers - Chemiluminescence – bioluminescence. Lasers - principle - uses	2	K3(Ap)	Problem solving	Slip test
<b>V Chemistry of Nanomaterials</b>						
	1	Nanotechnology - introduction, fundamental principles - nano particles - size - nano particles of metals - semi conductors and oxides.	2	K1(R)	Lecture with ppt	Short test
	2	Synthesis of nano sized compounds - reduction methods by sodium citrate and borohydride - Sol-gel method and chemical vapour deposition method - properties - optical and electrical.	2	K2(U)	Lecture with videos	Formative assessment – II
	3	Sol-gel method and chemical vapour deposition method - optical and electrical properties.	2	K2(U)	Seminar	Seminar
	4	Nano clusters - carbon nano tubes - single walled nano tubes and multi-walled nanotubes	1	K3(Ap).	Mind map	Assignment

	5	Properties of carbon nanotubes – applications - Application of nano chemistry in various fields.	2	K1(R)	Lecture with videos	Class test
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**Course Focusing on Employability/ Entrepreneurship/ Skill Development:** Employability

**Activities (Em):**

Expression for Joule Thomson coefficient for an ideal gas and vanderwaal's gas - derivation - inversion temperature – significance – Problem Solving

Methods of determining order of reaction - use of differential - integral - half-life method and Ostwald's methods - Group discussion.

Thermogravimetric analysis - principles - applications. Chromatography - classification - Group discussion

**Assignment: (Mention Topic and Type)**

5. Dia, para and ferro magnetism - magnetic susceptibility and magnetic moment - measurement using Guoy balance - application of magnetic properties – Assignment - I.
6. Nano clusters - carbon nano tubes - single walled nano tubes and multi-walled nanotubes – Assignment - II

**Sample questions**

**Part – A**

1. A system which can exchange energy as well as matter with its surroundings is called a ----  
----- system.  
a) isolated                      b) open                      c) closed                      d) isobaric
2. The temperature at which Joule –Thomson Coefficient changes its sign is \_\_\_\_\_.
3. Rate of a reaction depends upon the concentration of the reactant. Say True or False.
4. A substance which increases the rate of a reaction without itself undergoing any permanent chemical change is called -----  
a) inhibitor                      b) oxidizing agent                      c) reducing agent                      d) catalyst
5. The ratio of intensity of magnetization and magnetic field strength is \_\_\_\_\_
6. Which of the following do not affect column efficiency?  
a) Column length                      b) Volume                      c) Solvents                      d) Temperature
7. Match the following :  
i) Fluorescence - Firefly  
ii) Phosphorescence - Yellow Phosphorus  
iii) Chemiluminescence - Aspirin  
iv) Bioluminescence - Mercury Vapour
8. Plant synthesising starch is an example for \_\_\_\_\_  
a) Bioluminescence                      b) Fluorescence                      c) Photosensitisation  
d) Phosphorescence
9. A particle that exhibits size of 1 to 10nm in 1D network is called \_\_\_\_\_
10. MgO nano oxides are used as insulators. Say True or False?

**Part – B**

1. Give the importance of thermodynamics.
2. Differentiate reversible and irreversible process.
3. Derive Arrhenius equation and give its significance.
4. Write notes on activation energy and its significances.

5. Write notes on thermogravimetric analysis.
6. What are the factors that affect the efficiency of column?
7. Discuss Grothuss – Draper's law and Stark – Einstein law.
8. Define chemiluminescence with suitable examples.
9. List the fundamental principles of nanotechnology.
10. What are the significant properties of CNT's and give its applications.

### **Part – C**

1. Derive Kirchoff's equation and give its applications.
2. Derive the expression for the efficiency of carnot's cycle.
3. Explain the methods of determination of order of a reaction .
4. Derive absolute reaction rate theory (ARRT) and give its significances.
5. How will you determine the magnetic susceptibility using Gouy's balance? What are the applications of magnetic properties?
6. Discuss Thin layer chromatography.
7. What is quantum yield? Explain the validity of Einstein's law of quantum yield.
8. Discuss the kinetics of photochemical reaction.
9. How will you synthesise nano sized compounds by reduction method and CVD method?
10. What are the various applications of nanochemistry?

Course Instructor

Dr .M. Anitha Malbi

HOD

Dr. M. Anitha Malbi

**Department** : Chemistry  
**Class** : III B.Sc Chemistry  
**Title of the Course** : Core VIII: Organic Chemistry - II  
**Semester** : VI  
**Course Code** : CC2061

Course Code	L	T	P	Credits	Inst. Hours	Total Hours	Marks		
							CIA	External	Total
CC2061	6	-	-	5	6	90	30	70	100

### Objectives:

- To know the synthesis and structure of carbohydrates, alkaloids, terpenoids and dyes
- To understand the rearrangements, synthetic strategies and terminologies involved in organic synthesis and the role of reagents in organic synthesis.
- To study the basic principles of UV, IR and NMR spectroscopy and instrumentation.

### Course Outcomes (COs)

CO	Upon completion of this course, the students will be able to:	PSO Addressed	Cognitive level
CO - 1	understand the synthetic methodology, reagents and rearrangements in organic chemistry	PSO - 1	K2(U)
CO - 2	elucidate the structure of carbohydrates, alkaloids and terpenoids	PSO - 6	K6(C)
CO - 3	synthesize dyes and compounds of synthetic importance	PSO - 4	K3(Ap)
CO - 4	analyse the strategies and terminologies involved in organic synthesis leading to new products	PSO - 5	K4(An)
CO - 5	apply the spectral techniques in structural determination	PSO - 6	K3(Ap)

### Teaching plan

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

Unit	Module	Topic	Teaching Hours	Cognitive level	Pedagogy	Assessment/Evaluation
<b>I</b>	<b>Carbohydrates</b>					
	1	Carbohydrates: Definition - classification with suitable examples - classification of sugars as reducing and non-reducing sugars - stereochemistry of carbohydrates: D- and L-configurations - erythro and	3	K2(U)	Lecture with videos and ppt	Slip test and quiz

		threodiastereomers - anomers and epimers with suitable examples				
	2	Monosaccharides: Classification of monosaccharides with suitable examples – glucose - properties of glucose - epimerisation of glucose - anomers of glucose and mutarotation - fructose and its properties	3	K4(An)	Group discussion	Oral test
	3	Conversion of aldose to ketose and ketose to aldose - formation of osazone and glycosides - Fischer open structure and evidences for open structure - Haworth projection cyclic structures - pyranose and furanose and evidences for cyclic structures of glucose and fructose	3	K2(U)	Lecture with videos and ppt	Quiz and group discussion
	4	Stepping up - Kiliani- Fischer synthesis and stepping down - Ruff degradation of monosaccharides	3	K3(Ap)	Lecture with chalk and talk	Slip test
	5	Disaccharides: $\alpha$ - and $\beta$ - glucosidic linkages with suitable examples - 1,4' and 1,5' linkages with suitable examples - Structure and properties of sucrose	3	K3(Ap)	Blended learning	Group discussion
	6	Polysaccharides: Cellulose and starch - reactions and structure	3	K4(An)	Lecture with videos and ppt	Class test
<b>II</b>	<b>Synthetic Methodology and Reagents</b>					
	1	Synthetic terminology - Disconnection, synthon, synthetic equivalent (SE), functional group interconversion (FGI), target molecule (TM)	3	K2(U)	Flipped classroom	Concept explanations and group discussion
	2	Retro synthetic analysis - Linear, convergent and combinatorial syntheses	2	K2(U)	Lecture with illustrations	Slip test
	3	Retrosynthesis of 4-methyl acetophenone, methylcyclohex-3-enecarboxylate, phenylethylbromide, 2-methylcyclopentene and 2-allyl phenol	3	K3(Ap)	Lecture with illustrations	Class test
	4	Role of reagents in organic synthesis: DIBAL, NBS, DCC, trimethylsilyl chloride and methyl lithium - List of nucleophilic reagents and electrophilic reagents	5	K4(An)	Lecture with illustrations	Quiz and surprise test
	5	Malonic ester and acetoacetic ester in the synthesis of monocarboxylic acids - dicarboxylic acids - $\alpha,\beta$ -unsaturated carboxylic acids and heterocyclic compounds	5	K4(An)	Lecture with illustrations	Quiz and slip test

<b>III</b>	<b>Natural Products and Dyes</b>					
	1	Alkaloids: Definition - classification with suitable examples for each class - properties - structural determination - Hoffman exhaustive methylation	3	K2(U)	Blended learning	Concept explanations
	2	Sources, isolation, physiological activities and structural elucidation of conine, piperine and nicotine.	4	K4(An)	Lecture with illustrations	Slip test
	3	Terpenoids: Definition, classification, isoprene and special isoprene rule	2	K2(U)	Flipped classroom	Group discussion
	4	Sources, isolation, structural elucidation and uses of citral, geraniol and limonene	3	K4(An)	Lecture with illustrations	Short test and quiz
	5	Dyes: Theory of color and constitution - chromophore, auxochrome, classification according to application and structure.	3	K2(U)	Lecture with ppt and videos	Concept explanations and group discussion
	6	Preparation and uses of methyl orange, congo red, malachite green, phenolphthalein, fluorescein, indigotin and alizarin.	3	K3(Ap)	Lecture with illustrations	Class test
<b>IV</b>	<b>Rearrangements</b>					
	1	Rearrangement to electron-deficient carbon - 1,2 shift - Wagner-Meerwein, pinacol-pinacolone, dienone-phenol, Wolff and benzil-benzilic acid rearrangements	5	K3(Ap)	Lecture with illustrations	Oral test
	2	Rearrangements from oxygen to ring carbon - Fries, Claisen and benzidine rearrangements	3	K3(Ap)	Lecture with illustrations	Slip test and quiz
	3	Rearrangement to electron-deficient nitrogen - Beckmann, Schmidt, Hofmann, Lossen and Curtius rearrangements.	5	K4(An)	Lecture with illustrations	Short test
	4	Rearrangement to electron-deficient oxygen: Baeyer-Villiger oxidation, Dakin reaction, cumenehydroperoxide-phenol rearrangements.	5	K4(An)	Lecture with illustrations	Quiz and slip test
<b>V</b>	<b>Spectroscopy</b>					
	1	UV Spectroscopy: Electromagnetic spectrum - Types of electronic transitions - $\lambda_{\text{max}}$ , chromophores and auxochromes. Bathochromic and hypsochromic shifts. Intensity of absorption - hyper chromic and hypo chromic shifts	3	K2(U)	Flipped classroom	Concept explanations and group discussion

2	Application of Woodward-Fieser rules for calculation of $\lambda_{\max}$ for $\alpha$ , $\beta$ unsaturated aldehydes, ketones, carboxylic acids and esters. Conjugated dienes - acyclic, homoannular and heteroannular, extended conjugated systems-aldehydes, ketones and dienes	4	K3(Ap)	Problem solving and group discussion	Group discussion and Assignment
3	IR Spectroscopy: Molecular vibrations and origin of IR spectra, IR absorptions- fingerprint region and its significance. H-bonding-inter and intramolecular hydrogen bonding	3	K2(U)	Lecture with ppt and videos	MCQ
4	Application in functional group analysis. IR spectrum of alkane, alkene, alkyne, alkyl halide, alcohols and carbonyl compounds	2	K3(Ap)	Lecture with ppt	Short test
5	NMR Spectroscopy: Basic principles of Proton Magnetic Resonance, chemical shift and factors influencing it. Significance of number of peaks and peak area. Spin-spin coupling and coupling constant	3	K2(U)	Lecture with ppt and videos	Quiz and slip test
6	Interpretation of NMR spectra of simple compounds- ethyl alcohol, benzene, methyl chloride, benzaldehyde and mesitylene	3	K4(An)	Problem solving and group discussion	Group discussion

**Course Focusing on Employability/ Entrepreneurship/ Skill Development: Employability Activities (Em):**

Synthetic terminology - Group discussion.

Calculation of  $\lambda_{\max}$  of organic compounds using Woodward-Fieser rule - Group discussion.

Interpretation of NMR spectra of simple compounds - Group discussion.

**Assignment: (Mention Topic and Type)**

1. Theory of colour and constitution - Assignment
2. Interpretation of  $\lambda_{\max}$  of organic compounds using Woodward-Fieser rule simple compounds – Assignment.

**Sample questions**

**Part A**

1. Pick out the reducing sugars from the following.  
(a) D-glucose (b) D-Fructose (c) Sucrose (d) Cellulose
2. D-Glucose and D-Galactose are epimers. Say True or False.
3. Assertion: Synthons are idealized fragments resulting from a disconnection.  
Reason: Synthons are derived from synthetic equivalents.  
(a) Both A and R are false (b) Both A and R are true  
(c) A is true but R is false (d) R is true but A is false
4. Identify the reagent used for the conversion of cyclohexene to 3-bromocyclohexene.  
(a) DCC (b) Methyl lithium (c) NBS (d) DIBAL
5. Coniine on oxidation with zinc dust gives \_\_\_\_\_.

6. Draw the structure of fluorescein.

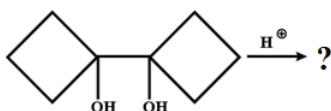
7. Match the following:

**Rearrangement**

**Product**

- |                                   |                      |
|-----------------------------------|----------------------|
| (a) Wolff rearrangement           | (i) Ester            |
| (b) Fries rearrangement           | (ii) Amine           |
| (c) Hofmann rearrangement         | (iii) Ketene         |
| (d) Baeyer-Villiger rearrangement | (iv) Hydroxy ketones |

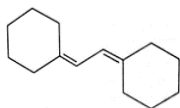
8. Propose the product of the following rearrangement:



9. Which of the following do not affect chemical shift?

- (a) Inductive effect (b) Tautomerism (c) Resonance effect (d) Hydrogen bonding

10. Predict the  $\lambda_{\max}$  value of the following compound:



- (a) 237 nm (b) 245 nm (c) 247 nm (d) 240 nm

**Part B**

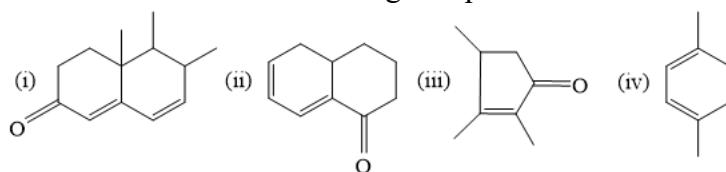
1. Define epimers and anomers with suitable examples.
2. Discuss any two chemical properties of glucose.
3. Describe the following retrosynthesis terminologies with examples:  
(i) Target molecule (ii) Synthons  
(iii) Synthetic equivalents (iv) Target molecule
4. Analyze the role of DIBAL and DCC reagents in organic synthesis.
5. Elucidate the structure of limonene.
6. Illustrate Hoffman exhaustive methylation with an example.
7. Predict the mechanism of cumenehydroperoxide-phenol rearrangement.
8. Mention any two applications of Wolff and Wagner-Meerwein rearrangements.
9. Draw the NMR spectrum of ethyl alcohol and methyl chloride
10. Describe the following terms with examples:  
(i) Chromophore (ii) Auxochrome  
(iii) Bathochromic Shift (iv) Hypsochromic Shift

**Part C**

1. How will you convert aldose to ketose and ketose to aldose?
2. Discuss the Ruff degradation.
3. Predict the retrosynthesis of 4-methyl acetophenone and 2-allyl phenol.
4. Analyze the synthetic applications of malonic ester and acetoacetic ester for the synthesis of mono and di carboxylic acids.
5. Elucidate the structure of nicotine.
6. Deduce the preparation and uses of malachite green and phenolphthalein.
7. Compare the mechanism of Schmidt and Curtius rearrangements.
8. Predict the mechanism of the following rearrangements:



- (i) Acetamide to methyl amine                      (ii) Hydrazobenzene to benzidine
9. Calculate the  $\lambda_{\text{max}}$  for the following compounds:



10. Analyze the factors which affect the chemical shift in NMR spectroscopy.

**Head of the Department:** Dr. M. Anitha Malbi

**Course Instructor:** Dr. Sr. K. Francy

**Department** : Chemistry  
**Class** : III B.Sc Chemistry  
**Title of the Course** : Inorganic Chemistry  
**Semester** : VI  
**Course Code** : CC2062

Course Code	L	T	P	Credits	Inst. Hours	Total Hours	Marks		
							CIA	External	Total
CC2062	4	1	-	5	5	75	30	70	100

### Objectives

- To understand the concepts and applications of nuclear reactions.
- To know the characteristics of solids and its applications.
- To gain knowledge about the development and uses of bioinorganic compounds.

### Course Outcome

CO - No.	Upon completion of the course students will be able to	PSO	CL
CO - 1	understand the types of nuclear reactions and their applications	PSO – 1	U
CO - 2	differentiate natural and artificial radioactivity	PSO – 2	An
CO – 3	classify crystal systems and their structures	PSO – 1	An
CO – 4	predict the role of bioinorganic compounds in biological systems	PSO – 2	A
CO – 5	use the solid materials for specific purposes	PSO – 6	A

### Teaching plan

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

Unit	Module	Topic	Teaching Hours	Cognitive level	Pedagogy	Assessment/E valuation
<b>I</b>	<b>Nuclear Chemistry I</b>					
	1	Introduction – composition of nucleus and nuclear forces – nuclear stability – mass defect – binding energy – packing fraction – N/P ratio	3	K2(U)	Lecture using models, chalk and talk	Slip test and concept explanations
	2	Magic numbers – nuclear models – liquid drop – Shell and collective model. Isotopes – detection and separation	3	K3(A)	Group discussion and problem solving	Problem solving

	3	Deviation of atomic weights from whole numbers – isobars, isotones and isomers	3	K3(A)	Lecture using chalk and talk, group discussion	Short test
	4	Radioactive decay and equilibrium – nuclear isomerism – internal conversion.	3	K2(U)	Lecture using chalk and talk	Slido and MCQ-Google forms
	5	Nuclear Q-value – threshold energy – cross sections, types of reactions Fission and fusion – modes of radioactive decay.	3	K3(A)	Lecture using chalk and talk, and problem solving	Group discussion and problem solving
<b>II</b>	<b>Nuclear Chemistry II</b>					
	1	Natural and induced radioactivity – radioactive decay – half-life period – radioactive displacement law– Average life period.	3	K2(U)	Lecture using chalk and talk	Short test
	2	Radioactive series – Radioactive techniques – Geiger Muller and ionization counters. Natural radioactivity Detection and measurement of radioactivity	3	K3(A)	Lecture using chalk and talk	Slip test
	3	Radioactive series including neptunium series – group displacement law – Rate of disintegration and half-life period- Artificial radioactivity – induced radioactivity	2	K2(U)	Lecture using chalk and talk	Short test and MCQ-Google forms
	4	Transmutation of elements- hazards of radiations – nuclear energy – nuclear reactors –fission products and fission yields – spallation Photonuclear and thermo nuclear reactions	4	K3(A)	Lecture using chalk and talk	Short test and quiz
	5	Energy source of the sun and stars – carbon dating – rock dating. Radioactive waste disposal – applications of nuclear science in agriculture, biology and medicine – Atomic power projects in India.	4	K3(A)	Lecture using chalk and talk	Test-Mentor menti
<b>III</b>	<b>Solid State Chemistry</b>					
	1	Amorphous and crystalline solids - Laws of crystallography – Elements of symmetry – Weiss and Miller indices – Crystal systems and Bravais lattices - derivation of Bragg's equation -	3	K2(U)	Lecture using chalk and talk	Concept explanations

	2	Ionic bonding – lattice energy – Born equation and its derivation, radius ratio rules – structures of some ionic crystals – Structure of solids – comparison of X-ray and Neutron diffraction –.	3	K2(U)	Lecture using chalk and talk, Group discussion	Slip test
	3	Crystal structure of NaCl – powder method - Electrical, Magnetic and optical properties of solids – band theory semiconductors – superconductors.	3	K3(A)	Lecture using powerpoint	Test-Nearpod
	4	Solid state electrolytes – Types of magnetic behavior, dia, para, ferro, antiferro and ferrimagnetism – Hysterisis	3	K4(An)	Lecture using chalk and talk , Seminar	Slip test and quiz
	5	Solid state lasers – inorganic phosphors – ferrites – crystal defects- Schotkydefect –Frenkel defect – metal excess defect – metal deficiency defect – f center	3	K2(U)	Lecture using chalk and talk	Concept explanations
<b>IV</b>	<b>Bioinorganic Chemistry</b>					
	1	Metal ions in biology- role of sodium - potassium- calcium – magnesium – copper - molybdenum and their vital role in the active site	4	K2(U)	Lecture using powerpoint	Slip test
	2	Metallo proteins – types and functions – metalloenzymes - structure and characteristic features of Vitamin B <sub>12</sub>	4	K2(U)	Lecture using chalk and talk	Slip test and quiz
	3	Biological functions of haemoglobin and myoglobin, – sodium potassium pump- cytochromes and ferredoxins,	3	K3(A)	Lecture using chalk and talk	Short test
	4	Metal complexes of copper and platinum as therapeutic agents - Biological nitrogen fixation, Photosynthesis: Photosystem-I	4	K2(U)	Lecture using chalk and talk	Group discussion
<b>V</b>	<b>Material Chemistry</b>					
	1	Ionic conductors – sodium, $\beta$ - alumina, sodium-sulphur battery. Intercalation – layered compounds –	3	K2(U)	Lecture using chalk and talk	Slip test

	2	Graphitic compounds. Special applications of solid state materials. High energy battery, lithium cells.	3	K4(An)	Lecture using powerpoint, Seminar	Concept explanations
	3	Introduction – techniques for synthesis of nanophase materials – sol-gel synthesis- electro deposition	3	K1(U)	Lecture using chalk and talk, Group discussion	MCQ-Google forms
	4	Inert gas condensation-mechanical alloying –properties of nanophase materials	2	K2(U)	Lecture using chalk and talk	Slido-evaluation
	5	Applications of nanophase materials, composite materials.	2	K3(A)	Lecture using chalk and talk	Short test
	6	Superconductivity – introduction – examples of superconducting oxides – applications of superconducting materials.	2	K2(U)	Power point	Long answer test

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

**Activities (Em):** Assignment, Endowment Lecture, Group discussion and Seminar

**Assignment :**

1. Nuclear fission
2. Nuclear fusion
3. Artificial transmutation
4. Applications of Nano Chemistry
5. Super conductors

**Seminar Topic:**

1. Radioactive series
2. Semi conductors
3. Lithium batteries

**Sample questions**

### Part A

1. Which nucleus among the following is most stable?  
a)  $^{26}\text{Fe}$       b)  $^{235}\text{U}$       c)  $^{230}\text{Th}$       d)  $^{231}\text{Pu}$
2. The mass of a nucleus is less than the sum total of the individual masses of the protons and neutrons. Say true or false.
3. The reaction that takes place in sun and stars is -----  
a) Nuclear fusion      b) Nuclear fission  
c) thermal reaction      d) photochemical reaction
4. The radioactivity of a substance can be detected by using -----  
a) Spectrophotometer      b) lactometer  
c) barometer      d) Geiger- Muller Counter

5. The number of atoms contained within a face-centred cubic unit cell is -----.  
a) 2                      b) 3                      c) 4                      d) 1
6. The Miller indices of crystal planes which cut through the crystal axes at (2a, 3b, c) are -----  
a) (236)                  b) (326)                  c) (122)                  d) (221)
7. For the synthesis of collagen the metal required is -----.  
a) Copper                  b) Zinc                      c) Sodium                  d) Potassium
8. Hemoglobin transports ----- from lungs to tissues.
9. Nano materials exhibit increased quantum size effect than the bulk form. Say true or false.
10. For tissue welding these are used as solders  
a) nano composites      b) nano shells              c) nano dots              d) nano films.

### **Part - B**

1. Compare shell model and liquid drop model of nucleus.
2. Differentiate between nuclear fission and nuclear fusion.
3. Radioactive isotopes follow different decay series. Prove this concept using examples.
4. Write notes on transmutation of elements.
5. Derive Bragg's equation.
6. Write notes on Weiss and Miller indices.
7. What is the role of sodium and calcium in the biological system?
8. What are metallo proteins? Explain the different types.
9. Write the principles of nanotechnology.
10. Write notes on super conductors.

### **Part - C**

1. Packing fraction helps in predicting nuclear stability. Prove this statement by giving evidences.
2. Radioactive isotopes follow different decay series. Prove this concept using examples.
3. List out the applications of nuclear science in the field of agriculture, biology and medicine.
4. Write notes on radioactive waste disposal.
5. Derive Born – Lande equation for lattice energy of an ionic crystal.
6. i) Explain rock salt structure of NaCl.  
ii) Differentiate between extrinsic and intrinsic semiconductors.
7. Explain sodium potassium pump
8. List out the biological role of hemoglobin.
9. Explain the sol-gel method of preparing nano particles.
10. Give the applications of nanotechnology in medical and industrial field.

**Head of the Department**

Dr. M. Anitha Malbi

**Course Instructor**

Dr. R. Gladis Latha

**Department** : Chemistry  
**Class** : III B.Sc Chemistry  
**Title of the Course** : Core XI: Physical Chemistry  
**Semester** : VI  
**Course Code** : CC2063

Course Code	L	T	P	Credits	Inst. Hours	Total Hours	Marks		
							CIA	External	Total
CC2063	5	-	-	5	5	90	30	70	100

#### Objectives:

- To understand the theories of reaction rate, adsorption and catalysis
- To learn phase rule and phase equilibria
- To know the concepts of symmetry elements, symmetry operations and point groups.

#### Course Outcomes (COs)

CO	Upon completion of this course, the students will be able to:	PSO Addressed	Cognitive level
CO - 1	understand the theories of reaction rate, adsorption and catalysis	PSO - 1	K2(U)
CO - 2	construct phase diagrams for one and two component systems	PSO - 3	K6(C)
CO - 3	recall colligative properties and their applications	PSO - 2	K1(R)
CO - 4	predict the point groups of molecules	PSO - 3	K5(E)
CO - 5	construct group multiplication table for simple molecules	PSO - 7	K6(C)

#### Teaching plan

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

Unit	Module	Topic	Teaching Hours	Cognitive level	Pedagogy	Assessment/Evaluation
<b>I</b>	<b>Chemical kinetics</b>					
	1	Rate of reaction – expression of rate – factors influencing rate of reaction – order and molecularity - definition and examples – differences between order and molecularity–zero, first and second order reaction – definition- examples.	3	K1(R)	Lecture with videos and ppt	Slip test and quiz - Slido
	2	Derivation of rate constant and half life period. Methods of determining order of reaction –differential, integral, half-life and Ostwald's isolation methods.	3	K2(U)	Group discussion	Quiz - Nearpod

	3	Temperature dependence of reaction rates (Arrhenius equation) – significance – temperature coefficient – energy of activation – effect of catalyst	3	K2(U)	Lecture with videos and ppt	Quiz – Slido and group discussion
	4	Calculation of energy of activation– theories of reaction rates – collision theory of bimolecular gaseous reactions, activated complex theory	3	K3(Ap)	Lecture with chalk and talk	Slip test
	5	Comparison of collision theory and activated complex theory. Lindeman’s theory of unimolecular reactions	3	K3(Ap)	Blended learning - Mentimeter	Group discussion and quiz - Mentimeter
<b>II</b>	<b>Phase Equilibria</b>					
	1	Concept of phase – components - degrees of freedom - definitions and examples, derivation of Gibb’s phase rule.	3	K1(R)	Flipped classroom - Nearpod	Oral test and group discussion - Nearpod
	2	Phase diagram for one component system – water and sulphur systems.	2	K2(U)	Lecture with chalk and talk	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 <sub>2</sub> O system.	3	K2(U)	Lecture with illustrations	Class test
	4	Formation of compounds with congruent melting point – zinc-magnesium system and FeCl <sub>3</sub> -H <sub>2</sub> O system.	2	K6(C)	Lecture with videos and ppt	Quiz - Kahoot
	5	Formation of compounds with incongruent melting points – Na <sub>2</sub> SO <sub>4</sub> - H <sub>2</sub> O system.	2	K2(U)	Lecture with chalk and talk	Quiz- Mentimeter and slip test
	6	Solid-gas equilibria – CuSO <sub>4</sub> -H <sub>2</sub> O system. Efflorescence, deliquescence and hygroscopy.	3	K5(E)	Lecture with videos and ppt	Quiz - Kahoot
<b>III</b>	<b>Catalysis and Adsorption</b>					
	1	Catalysis- characteristics- different types - homogeneous, heterogeneous, acid-base catalysis and auto catalysis	3	K1(R)	Blended learning - Mentimeter	Group discussion
	2	Catalysis-theories of catalysis- intermediate compound formation theory and adsorption theory	3	K1(R)	Lecture with illustrations	Slip test



	3	Kinetics of enzyme catalysis – Michaelis-Menten equation - derivation – applications of catalysis.	2	K2(U)	Flipped classroom - Nearpod	Group discussion
	4	Adsorption – definition-physisorption and chemisorption – differences - factors influencing adsorption of gases on solids	2	K5(E)	Lecture with chalk and talk	Short test and quiz - Mentimeter
	5	Adsorption isotherms –types - Freundlich and Langmuir monolayer adsorption isotherms,	2	K2(U)	Lecture with ppt and videos	Concept explanation and assignment - Google classroom
	6	Gibbs adsorption isotherm - BET theory of multilayer adsorption – applications of adsorption . Adsorption indicators.	3	K2(U)	Lecture with chalk and talk	Class test
<b>IV</b>	<b>Solutions and Colligative Properties</b>					
	1	Solutions of non-electrolytes – solutions of liquids in liquids – vapour pressure of non-ideal solutions - type I, type II and type III.	3	K1(R)	Lecture with chalk and talk	Oral test
	2	Vapour pressure - composition and boiling point - composition curves of completely miscible binary solutions - type I, type II and type III.	3	K2(U)	Lecture with illustrations	Slip test and quiz - Nearpod
	3	Theory of fractional, azeotropic and steam distillations. Solubility of partially miscible liquids - phenol-water system, triethylamine – water system and nicotine water system.	3	K6(C)	Lecture with ppt and videos	Short test
	4	Colligative properties – definition and examples. Osmotic pressure, Laws of osmotic pressure – van't Hoff theory of dilute solutions - isotonic solution.	2	K2(U)	Lecture with chalk and talk	Quiz – Mentimeter and slip test
	5	Elevation of boiling point - molal boiling point elevation constant or ebullioscopic constant - determination of molar mass from elevation of boiling point.	2	K1(R)	Lecture with ppt and videos	Quiz - Quizizz and slip test
	6	Depression of freezing point - molal freezing point depression constant or cryoscopic constant - determination of molar mass by depression	2	K6(C)	Lecture with chalk and talk	Quiz - Quizizz and slip test

		of freezing point. Abnormal results and van't Hoff factor.				
<b>V</b>	<b>Group theory</b>					
	1	Symmetry elements and symmetry operations – definition of identity (E), proper rotational axis (n) – mirror plane ( $\sigma$ ) – inversion centre (i) and rotation reflection axis ( $S_n$ ).	3	K1(R)	Flipped classroom - Nearpod	Group discussion
	2	Symmetry operations generated by symmetry elements- $H_2O$ , $NH_3$ , $BF_3$ , $[PtCl_4]^{2-}$ , $H_2O_2$ (cis and trans) and $CH_4$ as examples.	4	K2(U)	Problem solving and group discussion	Group discussion and assignment - Google classroom
	3	Matrix representation of symmetry operations. Comparison of molecular and crystallographic symmetry.	3	K2(U)	Lecture with ppt and videos	MCQ - Mentimeter
	4	Group postulates – abelian and cyclic groups – group multiplication table	2	K6(C)	Lecture with ppt	Short test
	5	Molecular point groups – Point group assignment to simple molecules like $H_2$ , $HCl$ , $CO$ , $H_2O$ , $NH_3$ and $CO_2$ . Determination of point groups.	3	K6(C)	Lecture with ppt and videos	Quiz - Kahoot and slip test

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

#### Activities (Em):

Temperature coefficient and energy of activation - Group discussion.

Catalysis and its characteristics - Group discussion.

Symmetry elements and symmetry operations - Group discussion.

#### Assignment: (Mention Topic and Type)

1. Formation of compounds with congruent melting point - Assignment
2. Depression of freezing point - molal freezing point depression constant or cryoscopic constant – Assignment.

#### Sample questions

##### Part A

1. The rate constant of zero-order reactions has the unit -----
  - a)  $s^{-1}$
  - b)  $mol\ L^{-1}\ s^{-1}$
  - c)  $L^2\ mol^{-2}\ s^{-1}$
  - d)  $L\ mol^{-1}\ s^{-1}$
2. When the rate of the reaction is equal to the rate constant, the order of the reaction is
  - a) zero order

- b) first order
  - c) second order
  - d) third order
3. Which of the following is the non-homogeneous system?
- (a). Salt solution
  - (b). Sugar solution
  - (c). Saturated solution of NaCl
  - (d). Glucose in water
4. The Gibb's phase rule states \_\_\_\_\_
- (a).  $P+F=C+2$
  - (b).  $P+F=C+1$
  - (c).  $P+F=C-2$
  - (d).  $P+F=C-1$
5. Which one of the following is an example of adsorption?
- (a) ammonia in contact with water
  - (b) anhydrous  $\text{CaCl}_2$  with water
  - © silica gel in contact with water vapours
  - (d) all of these
6. Which of the following colloids are solvent hating?
- a) lyophilic
  - b) lyophobic
  - c) hydrophilic
  - d) none of these
7. With evaporation, the boiling point of a solution
- (a) Decreases
  - (b) Increases
  - (c) Becomes half
  - (d) Remains the same
8. Which of the following is not a colligative property?
- (a) Surface tension
  - (b) Osmotic pressure
  - (c) Vapour pressure depression
  - (d) Boiling point elevation
9. Matrix multiplication is a/an \_\_\_\_\_ property.
- a) Commutative
  - b) Associative
  - c) Additive
  - d) Disjunctive
10. In any group, the number of improper subgroups is 2 . Say True or False.

#### **Part B**

1. Write the differences between order and molecularity of a reaction.
2. Discuss the factors influencing the rate of the reaction.
3. Derive Gibb's phase rule .
4. Illustrate efflorescence and deliquescence.
5. Discuss the characteristics of catalysis.
6. Differentiate between physisorption and chemisorption.
7. Define osmotic pressure. Write the laws of osmotic pressure.
8. How will you determine the molar mass from elevation of boiling point?
9. Define identity and proper rotational axis.
10. Compare molecular and crystallographic symmetry.

### Part C

1. Explain the methods of determining order of reaction.
2. Derive Arrhenius equation and write its significances.
3. Illustrate the phase diagram for water system.
4. Explain the lead-silver system with a neat phase diagram.
5. Derive Michaelis-Menten equation .
6. Discuss intermediate compound formation theory and adsorption theory.
7. Explain the solubility of partially miscible phenol-water system.
8. What is depression of freezing point? How will you determine the molar mass by depression of freezing point?
9. List the properties of group postulates. ii) Write notes on group multiplication table
10. Explain the symmetry elements of
  - a)  $\text{CH}_4$
  - b)  $\text{H}_2\text{O}$
  - c)  $\text{BF}_3$

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