

P. Santhiya priya
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J.S. College of arts and Science
Dudulekottai

LESSON PLAN NOTE

Even Semester - 2021

PAPER :

1. Allied chemistry - III
2. Allied chemistry - III
3. Chemistry in every day life.

	1	2	3	4	5
D ₁			SBE-1		
D ₂	All				All
D ₃		SBE-1			All
D ₄		All		All	
D ₅	All		All		All
D ₆				All	All

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SUBJECT TITLE : CORE COURSE / BIOMOLECULES

ALLIED CHEMISTRY

UNIT : I

CARBOHYDRATES

Introduction:

Natural occurrence and physiological importance, classification - aldoses and ketoses, mono, oligo and polysaccharide. Reactions of carbohydrates due to glycosidic OH, alcoholic OH and functional (aldehyde and ketone) groups.

Disaccharides : Occurrences, structure and physiological importance of maltose, sucrose, lactose, cellobiose, trehalose and raffinose.

Polysaccharides : Occurrence, structure and physiological importance of starch, glycogen, cellulose, ^{Seminar} hemicellulose, dextrin, chitin, inulin, Pectin. Glycosaminoglycans occurrence, structure and physiological importance of hyaluronic acid, heparin and chondroitin sulfates. Sugar derivatives of biological importance - cell-wall polysaccharides, blood group polysaccharides

11/5/22
Dy

Φ^H Electrical Conductance.

Electrical Conductance is a function of temp type & Conc of various ion.

Distilled Water - 0.5

Pure Water - 0.055

0.1 N KCl

↓
50 ml distilled Water

↓
0.7456 g KCl.

↓
0.1 N KCl.

↓
Conductivity meter.



11/5/22



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LESSON PLAN NOTE
EVEN SEMESTER - 2022

PAPERS

* ANALYTICAL CHEMISTRY

* PHYSICAL METHODS IN CHEMISTRY - I

DAY	1	2	3	4	5
DAY 1	III A		III B		
D2	III A		III A	III B	
D3	III A	II PU	III B		III B
D4		III A	III B	II PU	III A
D5	III A	II PU	III B	II PU	III B
D6			III B	II PU	

of Chemistry
Pudukkottai

Y

ks : 100

ks : 25

ks : 75

chemical analysis
inking
of chemistry
graphy
of Titrations and
kniques

(10 Hrs)

poisonous
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Significant
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2 Hrs)

atography:
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t used, R_f
of amino

ions. Gas

MAJOR BASED ELECTIVE COURSE-I: ANALYTICAL CHEMISTRY

Course Code:

Hours/Week : 5

Credit : 4

Max. Marks : 100

Internal Marks : 25

External Marks : 75

To help students learn

Objectives:

- ❖ To develop the habit of accurate manipulation and an attitude of critical thinking
 - ❖ To learn the basic analytical methods and have a sound knowledge of chemistry involved in analysis
 - ❖ To know about the handling methods of chemicals
 - ❖ To understand the chromatographic and titrimetric methods of analyses
 - ❖ To understand the spectroanalytical and electroanalytical techniques
- Handwritten notes:*
Methods of handling chemicals and * techniques of chemical analysis
the basic concepts of chromatography
the procedures of Titrations and
spectro analytical techniques
* electro analytical Techniques

Unit-I: Handling of Chemicals and Analysis

(10 Hrs)

- 1.1. Storage and handling of chemicals-handling of acids, ethers, toxic and poisonous chemicals, antidotes, threshold vapour concentration and first aid procedure. Heating methods, stirring methods filtration techniques.
- 1.2. Error in chemical analysis: Accuracy, precision, types of error-absolute and relative error, methods of eliminating or minimizing errors.
- 1.3. Methods of expressing precision: mean, median, deviation, average deviation. Significant figures and its application with respect to the glassware used. Normal error curve and its importance.

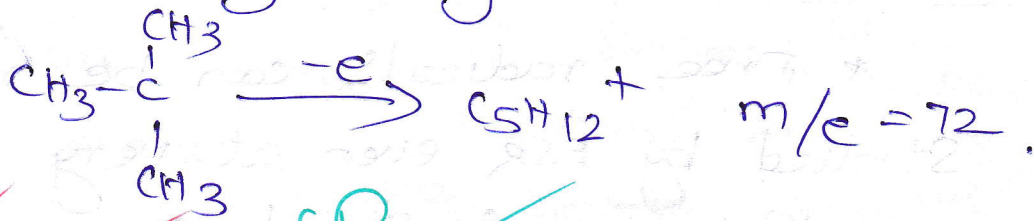
Unit -II: Chromatography Techniques

(12 Hrs)

- 2.1. Principle of adsorption and partition chromatography-Column chromatography: adsorbents, classification of adsorbents, solvents, preparation of column, adsorption and applications.
- 2.2. Thin Layer Chromatography-choice of adsorbent, choice of solvent, preparation of chromatogram, sample, R_f value and its applications. Paper chromatography, solvent used, R_f value, factors which affect R_f value. Applications. paper electrophoresis -separation of amino acids.
- 2.3. Ion exchange chromatography- resins used, experimental techniques, applications. Gas Chromatography, principle, detector (FID, TCD, ECD).

the molecular mass, of the compound, and its elemental composition.

Molecules are bombarded with a beam of energetic electrons. The molecules are ionised and broken up into many fragments.



19/5/22

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Lesson Plan Note December 2021

DAY /HY	I	II	III	IV	V
D1	← IIIU	Ahy. chem. Practical			→
D2	IIIU (A)	IIU	IIIU B		
D3	IIIU A	IIIU A		IIIU	IIIU B
D4		IIIU B	I PA	I U	
D5	I PA			I U	IIIU A
D6	I U		I PA		IIIU B

General chemistry - II (U2R1 etcc3)
 organic chemistry - II (U6R1 etcc12)

Department of Chemistry
J.J. College of Arts and Science (Autonomous), Pudukkottai

SEMESTER-II: CORE COURSE-II: GENERAL CHEMISTRY-II

Course Code : U2R1CHCC3
Hours/Week : 6
Credit : 5

Max. Marks : 100
Internal Marks : 25
External Marks : 75

Objectives:

help students

- ❖ To understand the acid, base and Titrimeric analyses
- ❖ To learn the chemistry of s-block elements
- ❖ To study the preparations and reactions of alkenes, alkynes and dienes
- ❖ To understand the chemistry of benzene and non-benzenoid compounds
- ❖ To understand the basic idea of gases

Unit -I: Acid-Base Theory and Titrimeretry (Analysis Oriented) (13 Hrs)

1.1. Acids and Bases: Arrhenius, Protonic and Lewis Theories of Acids and Bases – Usanovich's generalized definition – Relative strengths of Acids and Bases – Dissociation constant of Acids and Bases – Levelling effect of water, Hard and soft acids and bases (HSAB).

1.2. Titrimeretry: Definitions of Molality, Normality, Molarity and mole fraction – Primary and Secondary standards – Types of titrimeric reactions – acid-base, redox, precipitation and complexometric titrations – Indicators – Effect of change in pH – Neutralization, redox, adsorption and metal ion indicators.

Unit -II: Chemistry of s-Block Elements (12 Hrs)

2.1. General characteristics of s-Block elements: Hydrogen in the Periodic Table, atomic hydrogen, nascent hydrogen, occluded hydrogen, uses of hydrogen.

2.2. General characteristics of Group IA – diagonal relationship between Li and Mg – Extraction of Lithium, Sodium, Potassium – Physical and Chemical properties – Uses – Preparation of NaOH, Na₂CO₃ (Laboratory), Properties – Uses .

2.3. General characteristics of Group IIA – diagonal relationship between Be and Al – Extraction of Beryllium, Magnesium, Calcium – Physical and Chemical properties, Uses.

Unit -III: Chemistry of Alkenes, Alkynes and Dienes (15 Hrs)

3.1. Alkene-Petroleum source of alkenes and aromatics – General methods of preparation of alkenes – Chemical properties – Elimination mechanisms (E1, E2, E1cB) Electrophilic, Free radical additions – Ziegler-Natta catalytic polymerization of ethylene.

3.2. Alkyne-General methods of preparation of alkynes – physical and chemical properties.

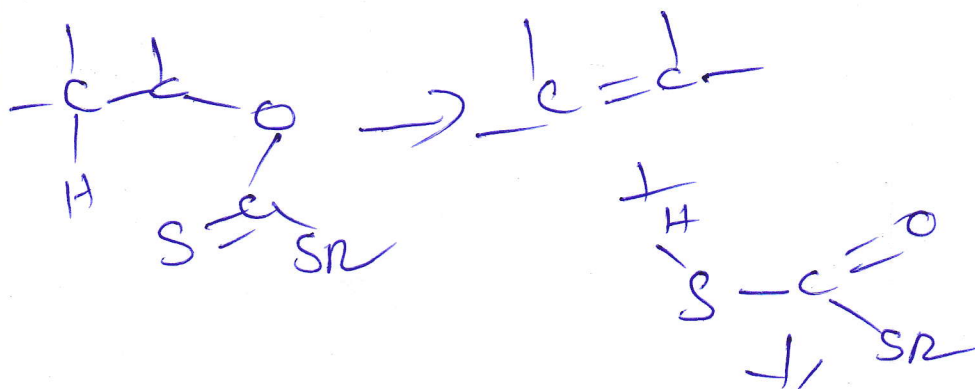
3.3. Diene-Types of alkadienes, general methods of preparation of dienes – physical and chemical properties, mechanisms of electrophilic and free radical addition reactions.

Class: I msc. chem

Date: - 12.5.22

Topic: Chugaev reaction

alkyl xanthates prepared by rxn of alcohols with NaOH & CS₂ to give RO-CS-SNa



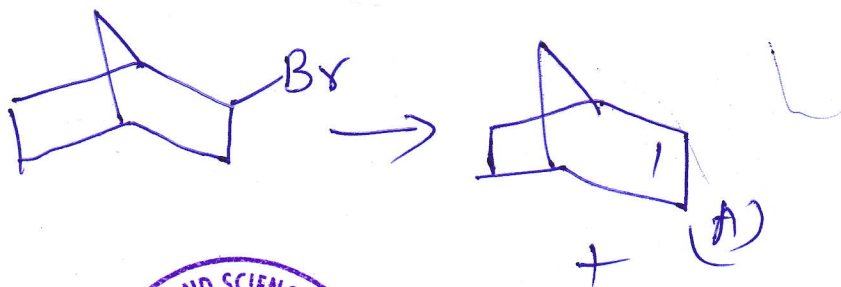
RSA + COS

class: I msc. chem

Date: 13.5.22

Topic: Bredt's Rule.

In elimination reaction newly forming double bonds does not go to bridgehead carbon unless ring sizes are large enough



S. Kalairani

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Lesson plan work

Feb 2022 - May 2022.

Papers:

III year - Physical chemistry - II.

I. M. Sc - Industrial chemistry.

II M. Sc - Instrumental methods
for analysis

Day	I	II	III	IV	V
D1	III A	III B		III A	
D2			III B		III A
D3	III A	III A	III A		III A
D4	III B	III A		III A	III A
D5	III A	III B	III A	III A	III A
D6			III A	III A	III A

SEMESTER-VI: CORE COURSE-XIII:PHYSICAL CHEMISTRY-II

Course Code: ~~UGRCHCC13~~ UGRCHCC13

Max. Marks : 100

Hours/Week : 5

Internal Marks : 25

Credit : 5

External Marks : 75

Objectives:

To expose learners to

- ❖ To understand the photochemistry and group theory
- ❖ To learn the properties of solutions
- ❖ To understand the electrochemical and electromotive forces
- ❖ To learn about Gibbs free energy and third law of thermodynamics ^{concept of}
- ❖ To study the phase rule and its applications

Unit -I: Photo Chemistry and Group Theory

(10 Hrs)

- 1.1. Laws of photo chemistry - Lambert – Beer, Grothus - Draper and Stark – Einstein, quantum efficiency, Photo sensitization and quenching. Cosequences of light absorption- Jablonski diagram-radioactive and non radioactive transition.
- 1.2. Photo chemical reactions - rate law - kinetics of H_2-Br_2 reaction. Comparison between thermal and photochemical-Flourescence, Phosphorescence, chemiluminescence. Laser and its uses.
- 1.3. Group theory-symmetry elements and symmetry operation-Point groups of like $HCl, H_2, CO_2, H_2O, NH_3, BCl_3$.

Unit-II : Solutions

(12 Hrs)

- 2.1. Ideal and non-ideal solutions-normality, molarity, molality, mole fraction. concept of activity and activity coefficients - completely miscible liquid systems - benzene and toluene. Raoult's law and Henry's law. deviation from Raoult's law and Henry's law. Duhem - Margules equation, theory of fractional distillation.
- 2.2. Azeotropes - HCl - water and ethanol - water systems - partially miscible liquid systems - phenol - water, triethanolamine - water and nicotine - water systems. Lower and upper CSTs - effect of impurities on CST - completely immiscible liquids - principle and applications of steam distillation.
- 2.3. Nernst distribution law – derivation. Applications –determination of formula of a complex ($KI+I_2 = KI_3$) solvent extraction-principle and derivation of a general formula of the amount unextracted.

Date: 11.5

Day: DS

no: 5

Date: 13.5.22

Esters

(i) Anthranilates: Walbaum in 1899 reported the occurrence of methyl anthranilate in oil of Neri.

Methyl anthranilate is used in soaps & in floral blending viz orange, flavours, gardenia, Jasmine.

(ii) Salicylates. Among the salicylates, Amyl salicylate is the most important ester. It is used in many types of fragrances. Benzyl salicylate is used as a solvent & fixative for artificial flowers.

(Handwritten signature and date: 19/5/22)



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LESSON PLAN NOTE
ODD SEMESTER - 2021

PAPERS :

1. Allied chemistry - I
2. General chemistry - IV

	1	2	3	4	5
D ₁				Gr.C-IV	
D ₂				A.C	Gr.C-IV
D ₃		Gr.C-IV			
D ₄	Gr.C-IV	A.C			
D ₅					A.C
D ₆	Gr.C-IV			A.C	

GENERAL CHEMISTRY - IV

Semester - III

Course code U3RICHCC5

UNIT - I

Chemistry of Nitrogen Group

1.1 General characteristics of elements of Group - the unique features of nitrogen from the rest of the family preparation of nitro physical and chemical properties - a few industrial preparation of ammonia physical and chemical properties.

1.2 Chemistry of some compounds of group hydrazine Hydroxylamine nitric acid nitrogen cycle artificial fixation of nitrogen preparation of phosphorous compounds physical and chemical properties.

1.3 Chemistry of some compounds of phosphorus PH_3 , PCl_5 , P_2O_5 and oxides of phosphorus.

UNIT - II

Chemistry of Oxygen Group

2.1 Anomalous behaviour of oxygen Paramagnetic nature of oxygen, preparation, properties structure and uses of oxides SO_2 , SO_3 .

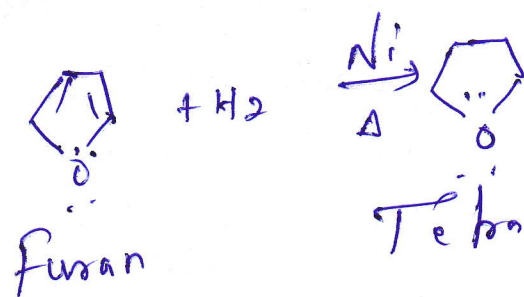
2.2 Oxyacids of sulphuric acid, peroxoacid. Seri classification of oxides based

side

Properties

Uses.

Reduction:



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G.P.

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 CH

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LESSON PLAN NOTE

PAPERS : ODD SEMESTER - 2021

- * ORGANIC CHEMISTRY - I
- * PHYSICAL METHODS IN CHEMISTRY - II
- * VALUE EDUCATION

DAY	1	2	3	4	5
D1	III U A		II U		III U A
D2	II PG		III U A	III U B	
D3	II PG	III U A	II PG		III U A
D4	III U B	II U			III U B
D5	III U B				III U B
D6		II PG			II PG

SEMESTER-V: CORE COURSE-VIII: ORGANIC CHEMISTRY-I

Course Code : U5R1CHCC8

Max. Marks : 100

Hours/Week : 5

Internal Marks : 25

Credit : 5

External Marks : 75

Objectives:

To make students understand

❖ *To understand the chemistry of carbonyl compounds and their derivatives*

❖ *To understand the nitrogen containing compounds*

❖ *To study the chemistry of proteins and vitamins*

❖ *To know the alkaloids and terpenoids*

carboxylic acids and their functional derivatives

Unit- I: Aldehydes and Ketones

(12 Hrs)

1.1.Nomenclature and classification-Preparation of aldehydes and ketones. Reactivity of carbonyl groups, acidity of alpha hydrogen. Reactions: Mechanism of enolization reactions, nucleophilic addition, addition reactions with Grignard reagents, cyanide, and bisulphate, preparation of derivatives of ammonia and alcohols.

1.2.Mechanism of aldol, cannizaro, Perkin, Knoevenagel reactions, Benzoin condensation, Claisen, Wittig, Reformatsky reactions. Mechanism of reduction with NaBH_4 , LiAlH_4 . Wolf-kishner Clamension and MPV reduction. Mechanism of haloform and Michael addition

Unit- II: Carboxylic Acids and their Functional Derivatives

(10 Hrs)

2.1. Nomenclature and classification of aliphatic and aromatic carboxylic acids. Preparation and reactions. Acidity (effect of substituents on acidity) and salt formation Reactions: Mechanism of reduction, substitution in alkyl or aryl group.

2.2. Preparation and properties of dicarboxylic acids such as oxalic, malonic, succinic, adipic acids and unsaturated carboxylic acids such as acrylic, crotonic and cinnamic acids.

2.3. Preparation and reactions of acid chlorides, acid anhydrides, amides and esters. Acid and alkaline hydrolysis of esters, trans-esterification.

Unit- III: Nitrogen Containing Compounds

(12 Hrs)

3.1. Nomenclature and classification of Nitrocompounds: aliphatic and aromatic nitro Compounds, classification, general properties, Preparation by nitration. Reactions: reduction by chemical and electrolytic methods.

3.2. di- and tri-substitution of aromatic nitro compounds: synthesis of *o*-, *m*-, *p*-dinitrobenzenes and trinitrobenzene. Amines: Preparation of primary, secondary and tertiary aliphatic amines, basicity of aliphatic amines, effect of substituents on basicity of aromatic amines.

1.11.21

D6-II, IV

Tanabe-Sugano diagrams

Interpretation of the spectra using Orgel diagram is only qualitative. It suffers from two important limitations.

* They treat only the weak field or high spin case.

* They are only useful for spin allowed transitions when the number of observed peaks are greater than or equal to the number of empirical parameters. It is used to interpret the spectra of complexes of both low spin and high spin.

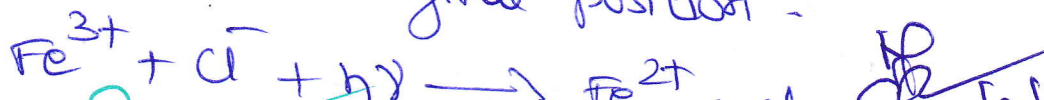
2.11.21

D6-V, IV

charge transfer spectra

The spectra of inorganic complexes generally deal with the d-d transitions. The visible spectrum of the complexes may also be due to the charge transfer transitions.

Charge transfer transition may also occur with the free radical mechanism. The electron displaced often returns to the original position.



Lesson Plan Note

General Chemistry - IV (U3RICHCC5)
 II B.Sc Chemistry

Physical Chemistry - I (U5RICHCC10)
 III B.Sc Chemistry

Days	1	2	3	4	5
Q ₁	III B	III A			
Q ₂		IIU7	III A	III B	
Q ₃	IIU7	III A	IIU7	III B	II U7
Q ₄				III (A)	
Q ₅				III (B)	III A
Q ₆	IIU7	III B	IIU7	III U7 (B)	IIU7.

P-Cellular
 3/10/21

SEMESTER-V: CORE COURSE-X: PHYSICAL CHEMISTRY-I

Course Code : U5R1CHCC10

Hours/Week : 5

Credit : 5

Max. Marks : 100

Internal Marks : 40

External Marks : 60

Objectives:

To help students learn

- ❖ To study the basic concept of chemical kinetics and
- ❖ To understand the terminology involving in thermodynamics
- ❖ To learn the second law of thermodynamics and its importance
- ❖ To understand the applications of electrolytic conductance
- ❖ To understand the UV-Visible, IR, Raman and spectroscopy

Unit- I: Chemical Kinetics

(12 Hrs)

1.1. Rate of reaction- average and instantaneous rates, rate equation, order of reaction. Laws: rate constants – derivation of rate constants and characteristics for zero, first, second and third order (equal initial concentration) – derivation of time for half change examples.

1.2. Methods of determination of order of reactions – experimental determination of rate constant of a reaction – volumetry, polarimetry. Effect of temperature on rate.

1.3. Concept of activation energy- energy barrier Arrhenius equation, collision theory derivation of rate constant of bimolecular gases reaction – failure of collision theory Lindemann's theory of unimolecular reaction. Theory of absolute reaction rate derivation of rate for a bimolecular reaction.

Unit- II: Thermodynamics - I

(12 Hrs)

2.1. System and surrounding – isolated, closed and open systems - state of the system Intensive and extensive variables. Thermodynamic processes - reversible and irreversible isothermal and adiabatic processes - state and path functions - exact and inexact differentials Work of expansion at constant pressure and free expansion.

2.2. First law of thermodynamics - statement - definition of internal energy (E), enthalpy and heat capacity. Relation between C_p and C_v . calculation of w , q , dE and dH for expansion of ideal and real gases under isothermal and adiabatic conditions of reversible and irreversible processes.

2.3. Definition of Joule - Thomson coefficient (μ_{JJ}), calculation of (μ_{JJ}) for ideal and real gases - Inversion temperature.

Date : 25-10-21

Day order : Q3

Topic : Resolution

The separation of racemic mixture into a enantiomers is known as Resolution.
Mechanical Separation.

Optically active, form well-defined crystals showing hemihedral faces, they can be separated by simple hand picking powder separated in mirror crystals.

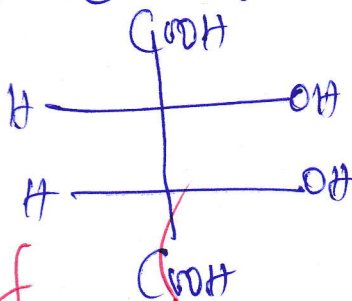
Date : 25-10-21

Day order Q3

Topic : Racemization

Racemization is the process of converting an optically active compound into the racemic mixture.

Racemic modifications are also called racemic mixture



20/10/21

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Lesson plan note June 2021

Day/HR	I	II	III	IV	V
D1		Phy chem	IPh		
D2		IPh	Inorg. practical		
D3	IPh			IV	IV
D4		IV B	IV A	IV A	
D5	IPh			IV A	IV A
D6			IPh		IV B

General chemistry - II (USRICHC04)

Inorganic chemistry (USRICHC09)

Physical chemistry practical (USRICHC11P)

SEMESTER-V: CORE COURSE-IX: INORGANIC CHEMISTRY

Course Code :U5R1CHCC9

Hours/Week : 5

Credit : 5

Max. Marks : 100

Internal Marks : 25

External Marks : 75

Objectives:

To Enable students to learn

- ❖ To understand the chemistry of lanthanides and actinides
- ❖ To study the nomenclature and theory of Coordination compounds
- ❖ To understand the stability and effect of Coordination compounds
- ❖ To know the biological importance and applications of Coordination compounds
- ❖ To learn about the nature of silicates and silicone

Unit - I: Lanthanides and Actinides

(12 Hrs)

1.1.Lanthanides: lanthanide series, occurrence, abundance and natural isotopes, similarity in properties, occurrence, oxidation states, chemical properties of Lanthanide(III) ions, magnetic properties,lanthanide contraction. Separation of lanthanides: solvent extraction, ion exchange method.

1.2.Actinides:actinide series, abundance and natural isotopes, occurrence, preparation of actinides, oxidation states, general properties, the later actinide elements. Uranium-occurrence, metallurgy, chemical properties of hydrides, oxides, and halides.

Unit- II: Coordination Chemistry- I

(10 Hrs)

2.1.Types of ligands - IUPAC nomenclature - Isomerisms

2.2.Theories of coordination compounds – Werner, Sidgwick, valence bond, crystal field theory of octahedral complexes.

Unit- III: Coordination Chemistry- II

(11 Hrs)

3.1.Stability of complexes - factors affecting the stability of complexes

3.2. unimolecular and bimolecular nucleophilic substitution reactions in octahedral and square planar complexes - trans effect - magnetic properties of transition metal complexes.

Unit -IV: Application of Coordination Compounds (Analysis Oriented)

(12 Hrs)

4.1.Estimation of nickel using DMG and aluminium-using oxine - estimation of hardness of water using EDTA - biologically important coordination compounds:chlorophyll, haemoglobin-their structure and application.

Class: II BSc

Date & Hr: 19.12.21

Topic: Properties of CO

Combustion

Reducing properties

Reaction with chlorine

Reaction with metals

Reaction with Dihydrogen

Uses reducing agent

water gas

refining

Preparation of methanol

Producer gas

Class: II BSc

Date & Hr: 19.12.21

Topic: Preparation of CO₂

from carbonates

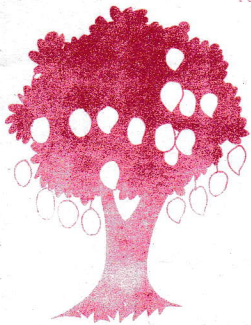
Lab method

Alcoholic fermentation

Complete combustion of carbon

from fuel gas





INDEX

Name : ~~S. Kalaiivan~~ S. Kalaiivan

Subject : Lesson plan Date .

Std : Sec : Roll No.

School :

S.No.	Date	Title	Marks	Signature
		II M.Sc.		
		Natural product chemistry		
		III B.Sc.		
		Agriculture chemistry		So

hr	I	II	III	IV	V
D1	I pg.			II pg.	II pg.
D2		II pg.		II pg.	III pg.
D3		II pg.	II pg.		
D4	III pg.	II pg.	II pg.		
D5		III pg.			
D6	part Phy-I				

SEMESTER-III: ELECTIVE COURSE-VI: NATURAL PRODUCTS CHEMISTRY

Course Code :

Hours/Week : 5

Credit : 3

Max. Marks : 100

Internal Marks : 25

External Marks : 75

To enable students to understand

Objectives

- ❖ ~~To understand~~ the some important natural pigments and their isolation
- ❖ ~~To know~~ the separation and structural elucidation of alkaloids
- ❖ ~~To learn~~ about synthesis and structural elucidation of terpenoids
- ❖ ~~To understand~~ the biosynthesis of natural products and steroids
- ❖ ~~To know~~ the constitution and functions of steroids and hormones

UNIT-1: Natural pigments

(12 Hrs)

1.1. **Carotenoids and Anthocyanins** -Introduction-Classification-Isolation and Separation of carotenoids-Characteristics-function-elucidation of constitution-synthesis.

1.2. **Flavones and Xanthenes**- Introduction-properties -Isolation-Separation and purification-Elucidation of structure-synthesis.

UNIT-II: Alkaloids

(11 Hrs)

2.1. **Definition**-Occurrence, extraction of alkaloids from plants, general properties, determination of the chemical constitution of the alkaloids, functional group analysis, estimation of groups, degradation and synthesis.

2.2. **Structural elucidation:** Coniine, Piperine, nicotine and ephedrine.

UNIT-III: Terpenoids

(12 Hrs)

Introduction-Nomenclature-properties-Isolation-Isoprene rule-Gem-dialkyl rule-Determination of structures of terpenoids. **Myrcene**-Introduction-Elucidation of constitution-Synthesis. **Citral**-Introduction-Isolation-Elucidation of constitution-Synthesis.**Menthone**-Introduction-Elucidation of constitution-Synthesis.**Irones**- Introduction-Elucidation of constitution-Synthesis.**Carone**-Introduction-Elucidation of constitution-Synthesis.

UNIT-IV: Bio Synthesis of Some Natural Products

(11 Hrs)

Introduction, Bio synthesis of Terpenoids, Steroids, Oestrogens, Gestrogens, Corticoids, Alkaloids.

UNIT-V: Steroids and Hormones

(11 Hrs)

Cholesterol-Introduction-Elucidation of constitution. **Stigmasterol** -Introduction-Elucidation of constitution. **Ergosterol**-Introduction-Elucidation of constitution. Sexhormones-Introduction-

Date: 17.9.21 Day: D1 Sec: A hrs: 11
 Date: 18.9.21 Day: D2 Sec: B hrs: 12

Iron Fertilizer.

Ferrous Sulphate is the most commonly used fertiliser.

When it is applied to soil, it is oxidised to ferric sulphate which is not readily available to plants.

To overcome this problem, iron chelates are used both for soil & foliar application.

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Ferrous sulphate - 10%, ferric sulphate - 23%,
 ferrous oxide - 77%, ferric oxide - 69%.

G. Paul

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12/9/21

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