	<b>P.R. GOVERNMENT COLLEGE(A), KAKINADA</b>	<b>Program &amp; Semester</b> <b>II B.Sc.</b> <b>ORGANIC CHEMISTRY(H)</b> <b>(SEMESTER – IV)</b>			
Course Code 09	TITLE OF THE COURSE Course -09: <b>SPECTROSCOPY</b> 2024-25 AB				
Teaching	Hours Allocated: 45 ( <b>Theory</b> ) (3 hrs. / Wk.)	L	T	P	C
Pre-requisites:	Basic knowledge about spectrum and its classification	3	-	1	3

### Course Objectives:

- To inculcate basic knowledge on basic concepts like Beer-Lambert's law
- To understand the concept of Spectroscopy
- To illustrate the classification of spectroscopies
- To provide knowledge and applications on various spectroscopies

### Course Outcomes:

On Completion of the course, the students will be able to-		Cognitive Domain
CO1	Understand the basic governing law of spectroscopy – Beer lamberts law and interaction of electromagnetic radiation with matter	Knowledge
CO2	Learn Principles of Electronic, IR and NMR spectroscopies	Understand
CO3	Understand Applications of Electronic, IR and NMR spectroscopies	Application
CO4	Applying principles of various spectroscopies to various organic compounds	Application
Skill Development		Employability
		Entrepreneurship

### Syllabus:

#### UNIT-I

#### GENERAL FEATURES OF ABSORPTION

- Beer-Lambert's law and its limitations, transmittance, Absorbance, and molar absorptivity. Single and double beam spectrophotometers. Application of Beer-Lambert law for quantitative analysis of 1. Chromium in  $K_2Cr_2O_7$  2. Manganese in Manganous sulphate

#### UNIT-II

#### ELECTRONIC SPECTROSCOPY:

Interaction of electromagnetic radiation with molecules and types of molecular spectra. Energy levels of molecular orbitals ( $\sigma$ ,  $\pi$ ,  $n$ ). Selection rules for electronic spectra. Types of electronic

transitions in molecules effect of conjugation. Concept of chromophore and auxochrome.

### UNIT-III

#### INFRA RED SPECTROSCOPY:

Different Regions in Infrared radiations. Modes of vibrations in diatomic and polyatomic molecules. Characteristic absorption bands of various functional groups. Interpretation of spectra-Alkanes, Aromatic, Alcohols carbonyls, and amines with one example to each.

Functional group and finger print Region.

### UNIT-IV

#### PROTON MAGNETIC RESONANCE SPECTROSCOPY (1H-NMR)

Principles of nuclear magnetic resonance, equivalent and non-equivalent protons, position of signals. Chemical shift, NMR splitting of signals - spin-spin coupling, coupling constants.

### UNIT-V

#### APPLICATIONS

Applications of NMR with suitable examples - ethyl bromide, ethanol, acetaldehyde, 1,1,2-tribromo ethane, ethyl acetate, toluene and acetophenone.

Applications of UV-Visible and IR-Spectroscopy

#### List of Reference Books:

- Spectroscopy by William Kemp
- Spectroscopy by Pavia
- Organic Spectroscopy by J. R. Dyer
- Elementary organic spectroscopy by Y.R. Sharma
- Spectroscopy by P.S. Kalsi
- Organic spectroscopy by Jagmohan

#### CLO-PLO Mapping:

(1: Slight [Low]; 2: Moderate [Medium]; 3: Substantial [High], '-': No Correlation)

	CL O\P LO	PL O1	PL O2	PL O3	PL O4	PL O5	PL O6	PL O7	PL O8	PLO 9	PLO1 0	CLO \PLO	PLO1
CLO1	3	2	3	2	2	2	3	3	2	2	3	3	3
CLO2	2	3	3	3	3	2	1	2	2	3	2	2	3
CLO3	3	3	3	2	2	1	1	2	3	1	2	3	3
CLO4	2	1	2	1	3	2	3	1	2	3	2	3	2
CLO5	2.5	2.25	2.75	2.0	2.5	1.75	2.0	2.0	2.25	2.25	2.25	2.75	2.75

**WEIGHTAGE TO CONTENT**

S No	Course Content	Essay (10M)	Short (5M)	Total marks	Question Relates as per Bloom's Taxonomy
1.	UNIT-I	1	1	15	Remembering, understanding
2.	UNIT-II	1	2	20	Analyzing, Remembering
3.	UNIT-III	1	2	20	Analyzing, Remembering
4.	UNIT-IV	2	1	25	Analyzing, Evaluating
5.	UNIT-V	1	1	15	Evaluating
	Total	6	7	95	

**PITHAPUR RAJAH'S GOVERNMENT COLLEGE (A), KAKINADA**

**ILB.Sc. ANALYTICAL CHEMISTRY. SEMESTER-IV**

**COURSE-09: SPECTROSCOPY**

**MODEL QUESTION PAPER**

**TIME: 2 hrs.**

**MAX. MARKS: 50**

---

**SECTION-A**

**Answer any THREE questions choosing at least ONE question from each section Each carries 10 Marks**

*3x10=30M*

1. One question is to be set from unit-I
2. One question is to be set from unit-II
3. One question is to be set from unit-III

**SECTION-B**

4. One question is to be set from unit-IV
5. One question is to be set from unit-IV
6. One question is to be set from unit-V

**SECTION-C**

**Answer any FOUR questions each carries FIVE marks.**

**4x5=20M**

7. One question is to be set from unit-I
8. One question is to be set from unit-II
9. One question is to be set from unit-II
10. One question is to be set from unit-III
11. One question is to be set from unit-III
12. One question is to be set from unit-IV
13. One question is to be set from unit-V

**P.R. GOVERNMENT COLLEGE(A), KAKINADA**

**II B.Sc. ORGANIC CHEMISTRY, SEMESTER-IV 2024-25**

**CHEMISTRY COURSE-09: SPECTROSCOPY**

**QUESTION BANK**

**UNIT-I**

**GENERAL FEATURES OF ABSORPTION**

1. What is Beer-Lambert's law. What are its limitations.
2. Describe Single beam and double beam spectrophotometer.
3. Explain the determination of Chromium in  $K_2Cr_2O_7$  using spectrophotometer.
4. Explain the determination of Manganese in  $MnSO_4$  using spectrophotometer.
5. Define the following terms.
  - a) Transmittance
  - b) Absorbance
  - c) Molar absorptivity
6. Write the working principle of Spectrophotometer.

**UNIT-II**

**ELECTRONIC SPECTROSCOPY**

7. Explain different types of electronic transitions occur in a molecule.
8. Write about Chromophore and Auxochrome with examples.
9. What is electromagnetic spectrum.
10. Write the selection rules for electronic spectra.
11. Explain the impact of conjugation on electronic transitions in a molecule.
12. Write about different types of molecular spectra.
13. Explain energy levels of molecular orbitals.

**UNIT-III**

**INFRA RED SPECTROSCOPY**

14. Explain the characteristic absorption bands of various functional groups in IR spectroscopy.
15. Write about the different regions of Infrared radiations.
16. What are the modes of vibrations in diatomic and poly atomic molecules.
17. What are the applications of IR spectroscopy.
18. Explain about Finger print region in IR spectrum.

## **UNIT-IV**


### **NMR SPECTROSCOPY**

19. Explain the Principle involved in NMR spectroscopy.
20. Explain the following
  - a) Equivalent and Non-Equivalent protons
  - b) Spin – Spin coupling
21. Write a note on Chemical shift.
22. Explain about the position of signals and splitting of signals in NMR spectroscopy.

## **UNIT-V**

### **APPLICATIONS NMR SPECTROSCOPY**

23. Explain the Applications of NMR spectra of
  - a) Ethyl bromide
  - b) Ethyl alcohol
  - c) Acetaldehyde
  - d) 1,1,2-Tribromoethane
  - e) Ethyl Acetate
  - f) Acetophenone.
24. Applications of UV-Visible and IR spectroscopy.

	<b>P.R. GOVERNMENT COLLEGE(A), KAKINADA</b>		Program & Semester II B.Sc. (SEMESTER – IV) <b>ORGANIC CHEMISTRY</b>			
	Course Code C09I	TITLE OF THE COURSE <b>Course 09: SPECTROSCOPY</b>				
Teaching	Hours Allocated: 30 ( <b>Practical</b> )		L	T	P	C
Pre-requisites	Preparation of standard solutions and handling of laboratory apparatus and instruments		-	-	2	1

### Course Objectives:

- To demonstrate basic knowledge about the handling of laboratory apparatus
- To illustrate knowledge about the preparation of standard solutions
- To provide hands-on training for the determination of different organic compounds

### Course Outcomes:

On Completion of the course, the students will be able to	
CO1	Learn to Handle and calibrate the common laboratory glass apparatus and instruments
CO2	Get practical skill to the preparation of different standard solutions used for quantitative analysis
CO3	Identify and confirm the structure of a given organic compounds
CO4	Principles and applications of different molecular spectra

### Course with focus on employability / entrepreneurship / Skill Development modules

<b>Skill Development</b>		<b>Employability</b>		<b>Entrepreneurship</b>	-
------------------------------	--	----------------------	--	-------------------------	---

IR spectral analysis of the following functional groups with examples

- Hydroxyl Groups
- Carbonyl Groups
- Amino Groups
- Aromatic Groups

**CLO-PLO Mapping:**

**1: Slight [Low]; 2: Moderate [Medium]; 3: Substantial [High], 4: (No Correlation)**

	CL OP LO	PLO 1	PLO 2	PLO 3	PLO 4	PLO 5	PLO 6	PLO 7	PLO 8	PLO 9	PLO1 0	CLO\ PLO	PLO1
CLO1	3	3	3	2	3	2	2	2	3	2	2	3	3
CLO2	3	3	3	2	3	2	2	3	2	3	3	3	3
CLO3	3	2	3	2	3	1	2	2	2	2	2	3	2
CLO4	3	3	2	1	3	2	2	1	2	3	3	3	3
CLO5	3	2.75	2.75	2	3	2	2	2	2.25	2.5	2.5	3	2.75

	<b>Pithapur Rajah's Government College (Autonomous) kakinada</b>	<b>Program &amp; Semester</b> II B.Sc. Honors in Organic Chemistry Semester-IV			
Course Code CHE-10	TITLE OF THE COURSE Course -10: <b>PHYSICAL CHEMISTRY</b>				
Teaching	Hours Allocated: 45 ( <b>Theory</b> ) (3 hrs. / Wk.)	L	T	P	C
Pre-requisites:	Basic knowledge about Dilute solutions, Electrochemistry, photochemical reactions and phase rule	45		30	3+1

### Course Objectives:

1. To provide basic knowledge on Colligative Properties
2. To provide basic awareness on concepts of electrochemistry
3. To understand the basic concepts of Electrodes significance and their usage
4. To provide knowledge and understand ability on phase systems
5. To Provide the knowledge on photochemistry

### Course Outcomes:

On Completion of the course, the students will be able to-		Cognitive Domain
CO1	Understand the concept of Colligative Properties.	Knowledge and Application
CO2	Understand the basic concepts of electrochemistry	Knowledge
CO3	Understand the basic concepts of Electrodes and their usage	Understand and application
CO4	To understand basic concepts of phase rule	Application
CO5	Understand the laws of photochemistry and learn how to calculate the quantum yields of different photo physical processes	Knowledge

### Course with focus on employability / entrepreneurship / Skill Development modules

Skill Development		Employability		Entrepreneurship	
-------------------	--	---------------	--	------------------	--

## Course outcome & Program outcome mapping

On Completion of the course, the students will be able to	
CO1	In depth understanding of theory and principles in Physical chemistry
CO2	Understand and explain various Redox reactions by using Nernst Equation for
CO3	Understand the importance of Phase rule and its applications applications in respect of Nitrogen based organic compounds
CO4	Comprehend the concepts and applications of Photo Chemistry and Quantum Yield

## SYLLABUS

### UNIT-I DILUTE SOLUTIONS

Colligative properties. Raoult's law, relative lowering of vapour pressure, its relation to molecular weight of non-volatile solute. Elevation of boiling point and depression of freezing point. Derivation of relation between molecular weight and elevation in boiling point and depression in freezing point. osmotic pressure, experimental determination. Theory of dilute solutions. Determination of molecular weight of non-volatile solute from osmotic pressure. Abnormal Colligative properties- Van't Hoff factor.

### UNIT-II ELECTROCHEMISTRY-I

Specific conductance, equivalent conductance. Variation of equivalent conductance with dilution. Migration of ions, Kohlrausch's law. Arrhenius theory of electrolyte dissociation and its limitations. Ostwald's dilution law. Debye-Huckel-Onsager's equation for strong electrolytes (elementary treatment only). Definition of transport number, determination by Hittorfs method. Application of conductivity measurements- conductometric titrations.

### UNIT-III ELECTROCHEMISTRY-II

Single electrode potential, sign convention, Reversible and irreversible cells Nernst Equation- Reference electrode, Standard Hydrogen electrode, calomel electrode, Indicator electrode, metal – metal ion electrode, Inert electrode, Determination of EMF of cell, Applications of EMF measurements- Potentiometric titrations.

### UNIT - IV IONIC EQUILIBRIUM AND HSAB

Ionic product, common ion effect, solubility and solubility product Definition of acids and bases with examples

Pearson concept, HSAB Principle & its importance definition of buffer solution. Henderson- Hassel batch Equation.

### UNIT-V PHOTOCHEMISTRY

Difference between thermal and photochemical processes. Laws of photochemistry- Grothus- Draper's law and Stark-Einstein's law of photochemical equivalence. Quantum yield-Photochemical reaction mechanism- hydrogen- chlorine, hydrogen- bromine reaction. Qualitative description of fluorescence, phosphorescence, Photosensitized

### LIST OF REFERENCE BOOKS

1. Modern Electrochemistry by J.O. M. Bockris and A.K.N.Reddy
2. Advanced Physical Chemistry by Atkins
3. Introduction to Electrochemistry by S. Glasstone

### CO-PO Mapping:

CO	PO1	PO 2	PO3	PO 4	PO 5	PO6	PO 7	PSO1	PSO2	PSO 3
CO 1	3	2	2	2	1	2	1	3	2	2
CO 2	3	1	2	2	1	1	1	3	1	2
CO 3	3	2	2	3	2	2	2	3	2	2
CO 4	3	1	1	1	1	1	1	2	1	1

### PROGRAMME OUTCOMES (PO's)

At the completion of the B.Sc. Chemistry program, the students of our Department will be able to:

**(PO1) Knowledge:** Attain in depth knowledge about the fundamental principles, essential facts, conclusions and applications of chemical and scientific theories in various domains of chemistry.

**(PO2) Critical Thinking:** Carry out experiments in the area of organic analysis, estimation, derivative process, inorganic semi micro analysis, preparation, Kinetic, experiments and spectral analysis applying the domain of critical thinking.

**(PO3) Problem Solving:** Define the background of reaction mechanisms, complex chemical structures, instrumental method of chemical analysis, and separation

techniques and apply appropriate techniques for analyzing specific problems both qualitatively and quantitatively in laboratories and in industries.

**(PO4): Usage of modern tools:** Create data using modern chemical tools and ICT for modeling and analyze the data obtained from sophisticated instruments (like UV - Vis, FTIR, NMR, GCMS, Fluorescence, SEM, TEM and XRD) for chemical analysis

**(PO5): Communication:** Develop Skills to evaluate, analyze and interpret the chemical information and data and to communicate effectively within the chemical community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

**(PO6): Life-long Learning:** Demonstrate scholarly attitude to pursue a career in the field of chemical education and research and have the zeal and vision to engage in independent and life-long learning in the broadest context of technological and social change.

**(PO7) Ethical Practices and Social Responsibility:** Generate ideas and solutions for green and sustainable chemistry and approach towards planning and execution of research in frontier areas of chemical sciences

#### **PROGRAM SPECIFIC OUTCOMES (PSO's)**

At the time of graduation, our under graduates would be able to:

**PSO 1-** Evaluate, analyze, interpret and effectively apply the basic laws, principles, phenomena, processes and mechanisms involved in the domain of organic, inorganic, physical and analytical Chemistry

**PSO2 -** Demonstrate the knowledge of Chemistry in the domain of research, education and perspective entrepreneurship.

**PSO3 -** Evaluate distinct problems in the field of chemical data analysis, scientific interpretation and reaction mechanisms with an understanding on basic tools to be employed.

**Pithapur Rajah's Government College (Autonomous), kakinada**

**II B.Sc. ORGANIC CHEMISTRY  
SEMESTER – IV**

**PHYSICAL CHEMISTRY-II WEIGHTAGE TO CONTENT  
& BLUE PRINT**

<b>S.NO.</b>	<b>COURSE CONTENT</b>	<b>LONG ANSWER QUESTIONS</b>	<b>SHORT ANSWER QUESTIONS</b>	<b>TOTAL MARKS</b>	<b>AS PER BLOOMS TAXONOMY</b>
<b>1.</b>	UNIT - I	1	1	15	Understanding, Application
<b>2.</b>	UNIT – II	1	2	20	Remembering, Understanding
<b>3.</b>	UNIT – III	2	1	25	Analyzing, Creation
<b>4.</b>	UNIT – IV	1	2	20	Evaluation, Understanding
<b>5.</b>	UNIT - V	1	1	15	Understanding, Application
	<b>TOTAL</b>	<b>6</b>	<b>7</b>	<b>95</b>	

# Pithapur Rajah's Government College (Autonomous), Kakinada

## II B.Sc. ORGANIC CHEMISTRY

### SEMESTER-IV

### MODEL PAPER

### Course - 10: PHYSICAL CHEMISTRY

Time: 2 hrs.

Maximum Marks:50

---

#### Section – 1

Answer any THREE questions choosing at least one from each part.

Each question carries TEN marks.

3 X 10 = 30 Marks

#### PART-A

- 1) What is elevation in boiling point and derive the relation between molecular weight of solute and elevation in boiling point? BT2 CO1 PO1
- 2) Define the transport number and determine the transport number by Hittorf's method
- 3) Describe the following electrodes (a) Calomel electrode (b) Indicator electrode BT2 CO3 PO3

#### PART-B

- 4) Write a brief note on Pearson concept of HSAB principle
- 5) Derive the quantum yield of Hydrogen chlorine photochemical reaction through mechanism
- 6) Elaborate Potentiometric titrations with example. [BT3, CO4]

#### Section-II

Answer any four of the following questions.

Each question carries FIVE marks.

4 x 5=20 Marks

- 7) . Explain arhenious theory of dissociation and its limitations BT2 CO2 PO2
- 8) Derive the Nernst equation BT2 CO3 PO3
- 9) Define osmotic pressure and explain their experimental determination? BT2 CO1 PO1
- 10) Discuss the common ion effect and its applications in qualitative an
- 11) Define fluorescence and phosphorescence? BT1 CO5 PO5
- 12) Explain how HSAB principal apply to the toxicity of heavy metal
- 13) Explain the Kohlrausch law BT2 CO2 PO2

**PITHAPUR RAJAH'S GOVERNMENT COLLEGE (A) : KAKINADA**

**BOARD OF STUDIES 2024-25**

**DEPARTMENT OF CHEMISTRY**

**II B.Sc., Honors in Organic Chemistry**

**SEMESTER- IV**

**Paper: II - Physical Chemistry (Course 10)**

**Question Bank**

**UNIT-I**

**DILUTE SOLUTIONS**

**ESSAY QUESTIONS**

1. What is Elevation of the Boiling point. Derive its relationship with molar mass of Non-volatile solute and write its determination by Cottrell's method.
2. What is Depression of Freezing point. Derive the relationship with molar mass of Non-Volatile solute and write its determination by Rast's Camphor method.
3. Define Osmotic pressure. Explain Berkley and Hartley's method to determine the molecular mass of non-volatile solute.

**SHORT ANSWERS**

4. How do you determine relative lowering of vapour pressure by Ostwald – Walker method.
5. Write about Van't Hoff factor.

**UNIT-II**

**ELECTROCHEMISTRY-I**

**ESSAY QUESTIONS**

1. State Kohlrausch law. And explain its applications.
2. Explain Debye-Huckel -Onsagar equation for strong electrolytes.
3. Define transport number. Describe the determination of transport number by Hittorf's method.
4. Discuss Conductometric titrations with examples.

**SHORT ANSWERS**

5. Define equivalent conductance and conductance.
6. Define strong and weak electrolytes with examples.

## UNIT-III ELECTROCHEMISTRY-II

### ESSAY QUESTIONS

1. Explain different types of electrodes with examples.
2. Explain the determination of EMF of a cell.
3. Write about Potentiometric titrations.

### SHORT ANSWERS

4. Write about galvanic cell and electrolytic cell.
5. Write about Nernst equation

## UNIT-IV

### Essay questions

- 1) Derive the Henderson - Hasselbalch equation and calculate the pH of a buffer solution containing 0.1 M acetic acid and 0.1 M sodium acetate
- 2) Write a brief note on Pearson concept of HSAB principle
- 3) Define solubility product constant K<sub>SP</sub> and explain its significance in predicting the solubility of sparingly soluble salts
- 4) i) The solubility product constant K<sub>SP</sub> for AgCl is  $1.8 \times 10^{-10}$  calculate the solubility of AgCl in water.  
ii) Solubility of PbSO<sub>4</sub> is  $4.5 \times 10^{-3}$  calculate its K<sub>SP</sub> value

### Short questions :

- 1) What is common ion effect give examples
- 2) Define buffer solution and its classification
- 3) Define solubility product constant and calculate the K<sub>SP</sub> of MgCl<sub>2</sub> having solubility  $2 \times 10^{-4}$  g/L
- 4) Discuss the common ion effect and its applications in qualitative analysis
- 5) Predict the stability of the following complexes using HSAB principle (CoF<sub>6</sub>)<sup>3-</sup> and (CoI<sub>6</sub>)<sup>3-</sup>
- 6) Explain how HSAB principle applies to the toxicity of heavy metal ions

## UNIT-V PHOTOCHEMISTRY

### ESSAY QUESTIONS

1. State and Explain Laws of Photo chemistry.
2. Give photo chemical reaction mechanism of H<sub>2</sub>-Cl<sub>2</sub> and H<sub>2</sub>-Br<sub>2</sub>
3. Explain Jablonski's Diagram.

### SHORT ANSWERS

4. Write about a) Fluorescence b) Phosphorescence c) Chemiluminescence
5. Write about Photosensitization.
6. Distinguish between thermal and photochemical process.

	<b>PITHAPUR RAJAH'S GOVERNMENT COLLEGE KAKINADA</b>	<b>Program &amp; Semester</b>			
Course Code <b>CHE-11</b>	<b>TITLE OF THE COURSE</b> <b>COURSE 11 : ORGANIC CHEMISTRY</b> 2024-25 AB	II B.Sc.HONORS (IV Semester)			
Teaching	Hours Allocated: 45 ( <b>Theory</b> )	L	T	P	C
Pre - requisites	Fundamental Knowledge in functional Groups of organic compounds and their general formulas	45	10	30	3+1

### Course Outcomes:

At the end of the course , the students will be able to

- 1.Understand the basic concepts of Amines,Nitrocompounds
- 2.Understand the concept of Carbohydrates,Amino Acids.

<b>On Completion of the course, the students will be able to</b>	
<b>CO1</b>	Handle indepth of various named reactions with mechanism
<b>CO2</b>	Understand the basic concepts of Amines,Nitrocompounds
<b>CO3</b>	Learn and identify Amines, Nitrocompounds, Carbohydrates, Amino Acids.
<b>CO4</b>	Understand the reactivity and structure of different functional groups of compounds

### Course with focus on employability/entrepreneurship/SkillDevelopment modules

Skill Development		Employability		Entrepreneurship	
-------------------	--	---------------	--	------------------	--

# Syllabus

## UNIT- I

### NITRO HYDROCARBONS

Nomenclature and classification-nitro hydrocarbons, structure -Tautomerism of nitroalkanes leading to aci and keto form, Preparation of Nitroalkanes, reactivity -halogenation, reaction with HONO (Nitrous acid), Nef reaction and Mannich reaction leading to Micheal addition and reduction.

## UNIT - II

### NITROGEN COMPOUNDS

#### ALIPHATIC AMINES:

Nomenclature, Classification into 1°, 2°, 3° Amines and Quarternary ammonium compounds. Preparative methods - 1. Ammonolysis of alkyl halides 2. Gabriel synthesis 3. Hoffman's bromamide reaction (mechanism). Reduction of Amides and Schmidt reaction. Physical properties and basic character - Comparative basic strength of Ammonia, methyl amine, dimethyl amine, trimethyl amine

## UNIT-III

### AROMATIC AMINES

Introduction comparative basic strength of aniline, N-methylaniline and N,N-dimethyl aniline (in aqueous and non-aqueous medium), steric effects and substituent effects. Chemical properties: a) Alkylation b) Acylation c) Carbylamine reaction d) Hinsberg separation e) Reaction with Nitrous acid of 1°, 2°, 3° (Aliphatic and aromatic amines). Electrophilic substitution of Aromatic amines - Bromination and Nitration. Oxidation of aryl and Tertiary amines, Diazotization.

## UNIT-IV

### CARBOHYDRATES

Monosaccharides: (+) Glucose (aldo hexose) - Evidence for cyclic structure of glucose (some negative aldehydes tests and mutarotation) - Proof for the ring size (methylation, hydrolysis and oxidation reactions) - Pyranose structure (Haworth formula and chair conformational formula). (-) Fructose (ketohexose) - Evidence of 2 - ketohexose structure (formation of penta acetate, formation of cyanohydrin its hydrolysis and reduction by HI). Cyclic structure for fructose (Furanose structure and Haworth formula) - osazone formation from glucose and fructose - Definition of anomers with examples.

Interconversion of Monosaccharides: Aldopentose to Aldohexose (Arabinose to D- Glucose, D- Mannose) (Kiliani - Fischer method). Epimers, Epimerisation - Lobry de bruyn van Ekenstein rearrangement. Aldohexose to Aldopentose (D-Glucose to D- Arabinose) by Ruff degradation. Aldohexose to Ketohexose [(+) Glucose to (-) Fructose] and Ketohexose to Aldohexose (Fructose to Glucose)

## **UNIT- V**

### **AMINO ACIDS**

Introduction: Definition of Amino acids, classification of Amino acids into alpha, beta, and gamma amino acids. Natural and essential amino acids - definition and examples, classification of alpha amino acids into acidic, basic and neutral amino acids with examples.

Methods of synthesis: General methods of synthesis of alpha amino acids (specific examples - Glycine, Alanine, valine and leucine) by following methods: a) from halogenated carboxylic acid b) Malonic ester synthesis c) strecker's synthesis.

Physical properties: Zwitter ion structure - salt like character - solubility, melting points, amphoteric character, definition of isoelectric point.

Chemical properties: General reactions due to amino and carboxyl groups - lactams from gamma and delta amino acids by heating peptide bond (amide linkage)

### **List of Reference Books**

1. Organic Chemistry by G.Mare loudan, Purdue Univ
2. A Text Book of Organic Chemistry by Bahl and Arun bahl
3. A Text Book of Organic chemistry by I L Finar Vol IOrganic Chemistry by G.Mareloudan, Purdue Univ
4. A Text Book of Organic Chemistry by Bahl and Arunbahl
5. A Text Book of Organic chemistry by I L FinarVol I
6. A Text Book of Organic chemistry by I L FinarVol II

## Course outcome & Program outcome mapping

On Completion of the course, the students will be able to	
CO1	In depth understanding of Structural theory in Organic chemistry
CO2	Understand and explain preparations and properties of Amines, Nitrocompounds, Carbohydrates, Amino Acid Compounds
CO3	Understand the importance of structure, preparation and chemical applications in respect of Nitrogen based organic compounds
CO4	Comprehend the concepts and applications of Carbohydrates & Amino acids

### CO-PO Mapping:

CO	PO1	PO 2	PO3	PO 4	PO 5	PO6	PO 7	PSO1	PSO2	PSO 3
CO 1	3	2	2	2	1	2	1	3	2	2
CO 2	3	1	2	2	1	1	1	3	1	2
CO 3	3	2	2	3	2	2	2	3	2	2
CO 4	3	1	1	1	1	1	1	2	1	1

### PROGRAMME OUTCOMES (PO's)

At the completion of the B.Sc. Chemistry program, the students of our Department will be able to:

**(PO1) Knowledge:** Attain in depth knowledge about the fundamental principles, essential facts, conclusions and applications of chemical and scientific theories in various domains of chemistry.

**(PO2) Critical Thinking:** Carry out experiments in the area of organic analysis, estimation, derivative process, inorganic semi micro analysis, preparation, Kinetic, conductometric and potentiometric experiments and spectral analysis applying the domain of critical thinking.

**(PO3) Problem Solving:** Define the background of reaction mechanisms, complex chemical structures, instrumental method of chemical analysis, and separation techniques and apply appropriate techniques for analyzing specific

problems both qualitatively and quantitatively in laboratories and in industries.

**(PO4): Usage of modern tools:** Create data using modern chemical tools and ICT for modeling and analyze the data obtained from sophisticated instruments (like UV - Vis, FTIR, NMR, GCMS, Fluorescence, SEM, TEM and XRD) for chemical analysis

**(PO5): Communication:** Develop Skills to evaluate, analyze and interpret the chemical information and data and to communicate effectively within the chemical community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

**(PO6): Life-long Learning:** Demonstrate scholarly attitude to pursue a career in the field of chemical education and research and have the zeal and vision to engage in independent and life-long learning in the broadest context of technological and social change.

**(PO7) Ethical Practices and Social Responsibility:** Generate ideas and solutions for green and sustainable chemistry and approach towards planning and execution of research in frontier areas of chemical sciences

### **PROGRAM SPECIFIC OUTCOMES (PSO's)**

At the time of graduation, our under graduates would be able to:

**PSO 1-** Evaluate, analyze, interpret and effectively apply the basic laws, principles, phenomena, processes and mechanisms involved in the domain of organic, inorganic, physical and analytical Chemistry

**PSO2 -** Demonstrate the knowledge of Chemistry in the domain of research, education and perspective entrepreneurship.

**PSO3 -** Evaluate distinct problems in the field of chemical data analysis, scientific interpretation and reaction mechanisms with an understanding on basic tools to be employed.

## Weightage to content

S.No.	Course Content	Long Answer Questions	Short Answer Questions	Total Marks	As per Blooms Taxonomy
1	Nitro hydrocarbons	1	1	15	Understanding, Application
2	Nitrogen compounds Aliphatic amines	1	1	20	Remembering, Understanding
3	Nitrogen compounds Aromatic amines:	1	1	15	Analyzing & Creation
4	Carbohydrates	2	2	30	Evaluation, Understanding
5.	Amino acids	1	2	15	Understanding, Application
	<b>TOTAL</b>	<b>6</b>	<b>7</b>	<b>95</b>	

**PITHAPUR RAJAH'S GOVERNMENT COLLEGE (A) :: KAKINADA**

**II YEAR B.Sc (Examination at the end of IV semester)**

**COURSE - 11 :: ORGANIC  
CHEMISTRY  
MODEL PAPER**

**Duration: 2hr**

**Max.Marks: 50M**

**Section - 1**

Answer any THREE questions choosing at least one from each part.

Each question carries TEN marks.

3 X 10 = 30 Marks

**PART-A**

1. Explain two Preparations of Nitro alkanes and the reaction of Nitroalkanes with  $\text{HNO}_2$ ? [BT1, CO1]
2. Support the open chain structure of Glucose with relevant chemical reactions [BT1, CO2]
3. How will you inter convert Glucose to Fructose and Fructose to Glucose [BT2, CO2]

**PART-B**

4. Give the synthesis of Glycine and Alanine by Gabriel -Pthalimide and Strecker synthesis.[BT3, CO3]
5. Discuss the separation of mixture of Amines by using Hinsberg reagent. [BT2 CO3]
6. Elaborate Gabriel synthesis and Hoffman's bromamide reaction (mechanism). [BT3, CO4]

**Section-II**

Answer any four of the following questions.

Each question carries FIVE marks.

4x5=20 Marks

7. Brief Tautomerism of nitroalkanes leading to aci and keto form[BT3, CO1]
8. Brief the mechanism of Hoffmann bromide reaction [BT3, CO1]
9. Define Epimers and Anomers and give an example for each [BT1, CO2]
10. Write a note on Zwitterion and Isoelectric point [BT3, CO3]
11. Brief Mutarotation.[BT3, CO1]
12. Give the mechanism of Diazotisation reaction. [BT2, CO3]
13. Write the classification of amino acids[BT1, CO1]

**PITHAPUR RAJAH'S GOVERNMENT COLLEGE (A) : KAKINADA**

**BOARD OF STUDIES 2024-25**

**DEPARTMENT OF CHEMISTRY**

**II B.Sc., Honors in Organic Chemistry**

**SEMESTER- IV**

**Paper: III - Organic Chemistry (Course 11/Major 9)**

**Question Bank**

**UNIT- I**

**NITRO HYDROCARBONS**

**Essay Questions**

1. How is nitrobenzene prepared. Give its reducing properties
2. Write on a) Mannich Reaction b) Michael addition c) Michael Reduction
3. Write the two Preparation of Nitro alkanes and discuss the reactivity of Nitroalkanes with HNO<sub>2</sub>
4. Explain reactivity of nitroalkanes -halogenation, reaction with HONO (Nitrous acid), Nef reaction

**Short Answer Questions**

5. Discuss the Nomenclature of nitro hydrocarbons
6. Explain classification-nitro hydrocarbons
7. Write about the structure and Tautomerism of nitroalkanes

**UNIT - II**

**NITROGEN COMPOUNDS**

**ALIPHATIC AMINES:**

**Essay Questions**

1. Give the general methods of Preparation of aliphatic amines
2. Discuss about Physical properties of aliphatic amines
3. Write about the basic character of aliphatic amines

**Short Answer Questions**

4. Discuss the Nomenclature of aliphatic amines
5. Write about the Classification of aliphatic amines

## UNIT-III

### AROMATIC AMINES

#### Essay Questions

1. Give the general methods of Preparation of aliphatic amines
2. Explain the following Chemical properties of aromatic amines
  - a) Alkylation
  - b) Acylation
  - c) Carbylamine reaction
  - d) Hinsberg separation
3. Write the reaction with Nitrous acid of 1°, 2°, 3° (Aliphatic and aromatic amines).
4. Discuss the following Electrophilic substitution of Aromatic amines –
  - a) Bromination
  - and
  - b) Nitration.
5. Explain the oxidation reactions of aromatic amines,

#### Short Answer Questions

6. Write about comparative basic strength of aniline, N-methylaniline and N,N-dimethylaniline (in aqueous and non-aqueous medium)
7. Explain steric effects and substituent effects on the basic strength of aromatic amines
8. Discuss the nomenclature and classification of aromatic amines
9. Explain the significance of Diazotization.

## UNIT-IV

### CARBOHYDRATES

#### Essay Questions

1. Explain open and cyclic structure of glucose with evidences
2. Explain the following
  - a) Killiani fisher synthesis
  - b) Ruff degradation
3. Explain Inter-conversion of
  - a) aldohexose to ketohexose.
  - b) Ketohexose to aldohexose.
4. Determine the ring size of Glucose and write pyranose structure of  $\alpha$  and  $\beta$  anomers of Glucose?
5. Explain open and cyclic structure of fructose with evidences

### Short Answer Questions

1. Define Epimers and Anomers and give one example each.
2. Write about the classification of carbohydrates
3. Discuss the phenomenon of mutarotation in carbohydrates by taking glucose or fructose as an example
4. Explain how to determine the ring structure of glucose with relevant equations
5. Write about osazone formation and explain why it reacts only three molecules of phenyl hydrazine
6. Explain Lobry de Bruyn van Ekenstein rearrangement

## UNIT- V

### AMINO ACIDS

#### Essay Questions

1. Explain the Synthesis of Glycine and Alanine using Gabriel Phthalimide synthesis and Strecker's Method
2. Explain general reactions due to amino and carboxyl groups of amino acids
3. Define Amino acids and explain the classification of Amino acids

#### Short Answer Questions

1. What are Essential and Non Essential amino acids give examples?
2. Write about Zwitter ion?
3. Summarize the importance of isoelectric point.
4. Explain the solubility of amino acids and their melting points

**SEMESTER-IV**  
**COURSE 11 : ORGANIC CHEMISTRY**  
Credits: 1

Practical

2 hrs/week

---

**(At the end of Semester)**

(A) Give a brief introduction on

(1) Re-crystallisation

(2) sublimation

(3) distillation

(4) M.P & B.P

(B) Single step preparations

1. Preparation of P-Nitro acetanilide

2. Preparation of Aspirin

**Scheme of Valuation for Practical**

Physical State - 1M

Odour - 1M

Colour - 1M

MP - 1M

Report -1M

Procedure in first 10 mts - 15M

Principle in Re-crystallisation - 5M

Calculation - 5M

% of Yield - 5M

Viva-voce - 5M

Record - 10M

