	<b>Pithapur Rajah's Government College (Autonomous) Kakinada</b>	<b>Program &amp; Semester</b> II B.Sc. B. SC ANALYTICAL CHEMISTRY MAJOR & Semester-III (Course-5)			
Course Code AC-5	<b>COURSE-5: QUANTITATIVE METHODS OF ANALYSIS</b>				
Teaching	<b>Hours Allocated: 60</b> (Theory)	L	T	P	C
Pre-requisites:	Basic understanding of stoichiometry, chemical equations, concept of concentration and solutions, basic principles of centrifugation, electrochemistry fundamentals	45	10	30	3+1

### Course Objectives:

To gain knowledge on production, purification, properties of natural gases.

### Course Outcomes:

On Completion of the course, the students will be able to-	
CO1	Understand Various methods in Gravimetric Analysis and its applications.
CO2	To Gain Knowledge on Basic Principles of Volumetric analysis
CO3	To Learn about the Principle and Types of Centrifugation methods and Environmental Analysis.
CO4	To Know the Applications of electroanalytical methods.

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

Skill Development		Employability		Entrepreneurship	
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### Syllabus:

#### UNIT-I

09 hrs

#### GRAVIMETRIC ANALYSIS:

- Gravimetric methods introduction and types of gravimetric methods.
- Volatilization methods - Principle, Applications of Volatilization methods -Determination of the sodium hydrogen carbonate content of antacid tablets
- Precipitation methods - Principle, Various steps involved in Precipitation gravimetry. Properties of precipitates and precipitating reagents: Particle size, Filterability of

Precipitates - Factors that determine particle size & formation of Precipitates. (Mechanism of Precipitate and Relative super saturation).

- D. Colloidal Precipitates - coagulation of colloids, peptization of colloids, Treatment of colloidal precipitates.
- E. Crystalline Precipitates (particle size and Filterability).
- F. Co-precipitation & Types of Co -precipitation (surface adsorption, mixed-crystal formation, occlusion, and Mechanical entrapment) and co precipitation errors.
- G. Precipitation from Homogeneous Solution (The use of the technique of Homogeneous solutions to effect precipitation).
- H. Drying and Ignition of precipitates

#### **UNIT-II**

**09 hrs**

#### **VOLUMETRIC ANALYSIS**

Volumetric titrimetry introduction-Definitions of the terms - Titrant, Titrand, The equivalence point, the endpoint and the indicator. Classification of volumetric methods- Acid-base titrations, Redox titrations, Complexometric titrations, Precipitation titrations, Indicator, Theories of indicators and Buffer solutions, Sigmoidal Titration Curves, Henderson -Hassel Balch equation for acids and bases.

#### **UNIT-III**

**09 hrs**

#### **CENTRIFUGATION METHODS:**

- A. Introduction to Centrifugation methods
- B. Types of centrifugation techniques
- C. Sedimentation and relative centrifugal force
- D. Different types of rotors.
- E. Density gradient

#### **UNIT-IV**

**09 hrs**

#### **INTRODUCTION TO ENVIRONMENTAL ANALYSIS:**

- A. Sampling methods.
- B. Environmental pollution from industrial effluents and radiochemical waste.
- C. Introduction to water and waste analysis.

#### **UNIT-V**

**09 hrs**

#### **POLAROGRAPHY**

- A. Basic principles of Polarography, residual current, migration current, diffusion current, half wave potential, the Ilkovic equation.

B. Instrumentation of Polarography technique -Dropping Mercury Electrode (DME) - Advantages and Disadvantages. Applications. Qualitative and quantitative analysis of inorganic ions: Determination of Copper and Zinc in Brass.

Unit No	Additions	Deletions	Expected levels of learning as per Blooms taxonomy assessment of CO	Percentage added/deleted
I	--	--	K <sub>3</sub> , K <sub>4</sub>	
II	--	--	K <sub>1</sub> , K <sub>2</sub>	
III	--	--	K <sub>2</sub> , K <sub>3</sub>	
IV	--	--	K <sub>5</sub> , K <sub>6</sub>	
V	--	--	K <sub>3</sub> , K <sub>4</sub>	

K<sub>1</sub>= Remembering, K<sub>2</sub>= Understanding, K<sub>3</sub>= Applying, K<sub>4</sub>= Analysing, K<sub>5</sub>= Evaluating, K<sub>6</sub>=Create.

### Textbooks & Reference Books

S. No	Author	Title	Publisher
1	R.V.Dilts	Analytical Chemistry- Methods of Separation	---
2	O. Mikes, R.A. Chalmers	Laboratory Handbook of Chromatographic Methods	---
3	F.W. Fifield and D. Kealy	Analytical Chemistry	---
4	GH Jeffery, J. Bassett, J. Mendham, R.C Denny.	Vogel's textbook of quantitative chemical analysis, 6 <sup>th</sup> edition.	Longman Scientific & Technical
5	Skoog & West	Fundamentals of Analytical Chemistry	---

## CO-PO Mapping

### On Completion of the course, the students will be able to-

CO1	Understand Various methods in Gravimetric Analysis and its applications.
CO2	To Gain Knowledge on Basic Principles of Volumetric analysis
CO3	To Learn about the Principle and Types of Centrifugation methods and Environmental Analysis.
CO4	To Know the Applications of electroanalytical methods.

## CO-PO Mapping

1: Low=1; 2: Moderate=2; 3: High=3; 4: No Correlation=0

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3
CO1	3	3	1	1	1	1	1	0	1	0	1	3	0
CO2	3	3	1	1	2	1	1	1	2	2	1	0	2
CO3	3	3	1	3	1	1	0	1	1	0	0	1	3
CO4	3	1	0	1	3	3	1	0	1	1	3	2	1

### Programme Outcomes (PO):

**PO-1 Foundational Knowledge:** Graduates will demonstrate a comprehensive understanding of the fundamental principles and theories of analytical chemistry.

**PO-2 Laboratory Skills:** Graduates will possess practical laboratory skills, including proficiency in using a wide range of analytical instruments and techniques.

**PO-3 Data Analysis and Interpretation:** Graduates will be able to collect, analyze, and interpret experimental data using statistical methods and computational tools.

**PO-4 Quality Assurance:** Graduates will understand and apply quality assurance principles to ensure the accuracy and reliability of analytical results.

**PO-5 Problem-Solving Abilities:** Graduates will develop critical thinking and problem-solving skills to address challenges encountered in analytical chemistry research and practice.

**PO-6 Communication Skills:** Graduates will effectively communicate scientific concepts and research findings through written reports, oral presentations, and visual aids.

**PO-7 Ethical Conduct:** Graduates will adhere to ethical principles and professional standards in conducting research and interacting with colleagues and stakeholders.

**PO-8 Continuous Learning:** Graduates will recognize the importance of lifelong learning and professional development to stay updated with advancements in the field of analytical chemistry.

**PO-9 Interdisciplinary Collaboration:** Graduates will collaborate effectively with professionals from other disciplines to address complex scientific problems requiring multidisciplinary approaches.

**PO-10: Career Readiness:** Graduates will be prepared for various career pathways in analytical chemistry, including roles in academia, industry, government, and research institutions.

**Programme-Specific Outcomes (PSO):**

**PSO-1 Instrumentation Proficiency:** Graduates will demonstrate advanced proficiency in operating and troubleshooting analytical instruments specific to analytical chemistry, such as spectrophotometers, chromatographs, and mass spectrometers.

**PSO-2 Method Development and Optimization:** Graduates will have the ability to develop and optimize analytical methods tailored to specific sample matrices and analytical targets.

**PSO-3 Specialization in Separation Techniques:** Graduates will specialize in separation techniques, including chromatography and electrophoresis, for the analysis of complex mixtures and compounds.

**PSO-4 Applications in Industry and Research:** Graduates will apply analytical chemistry principles and techniques to address industry-specific challenges in fields such as pharmaceuticals, environmental science, food and beverages, and materials science.

**WEIGHTAGE TO CONTENT  
SEMESTER -III  
COURSE-5: QUANTITATIVE METHODS OF ANALYSIS**

S. No	Course Content	Long Answer	Short Answer	Total marks	As per Blooms Taxonomy
1	GRAVIMETRIC ANALYSIS	2	1	25	Evaluating, Analysis
2	VOLUMETRIC ANALYSIS	1	2	20	Remembering, Understanding, Analysis
3	CENTRIFUGATION METHODS	1	1	15	Understanding, Applying
4	INTRODUCTION TO ENVIRONMENTAL ANALYSIS	1	1	15	Understanding, Applying
5	POLAROGRAPHY	1	2	20	Create, Applying, Understanding
	<b>TOTAL</b>	<b>6</b>	<b>7</b>	<b>95</b>	

**PITHAPUR RAJAH'S GOVERNMENT COLLEGE(A), KAKINADA.**  
**B.SC.-ANALYTICAL CHEMISTRY**  
**MODEL QUESTIONPAPER**  
**COURSE-5 : QUANTITATIVE METHODS OF ANALYSIS**

**Time: 2 Hrs.**

**Max. Marks 50**

**PART-I**

**Answer any THREE questions by attempting at least ONE question from each section.**

**Each Question carries TEN marks.**

**3X10=30M**

**SECTION - A**

1. Examine the concept of Precipitation methods in analytical chemistry? Elucidate the various steps involved in precipitation gravimetry. **BT2, CO1, PO2**
2. Evaluate the properties of precipitates and precipitating reagents. **BT3, CO1, PO4**
3. What is an Indicator? List out the various theories of Indicators. **BT1, CO2, PO1**

**SECTION - B**

4. By using the concept of centrifugation, Explain different types of centrifugation techniques. **BT2, CO3, PO3**
5. How would you demonstrate Environmental pollution from industrial effluents and radiochemical waste. **BT2, CO3, PO9.**
6. Demonstrate the principle and instrumentation of Polarography technique. **BT2, CO4, PO2.**

**PART-II**

**Answer any FOUR Questions from the following.**

**Each Question carries FIVE marks.**

**4 x 5 =20M**

7. Evaluate the concept involved in Crystalline precipitates. **BT3, CO1, PO2.**
8. What is Buffer? Explain briefly about Buffer solutions. **BT1, CO2, PO1.**
9. Explain briefly about Complexometric and Redox titrations with examples. **BT1, CO2, PO1.**
10. Write about sedimentation. **BT1, CO3, PO1.**
11. Write briefly about Sampling methods **BT1, CO3, PO1.**
12. Explain about Diffusion current and half wave potentials **BT1, CO4, PO1.**
13. Explain about residual current and migration current **BT1, CO4, PO1.**

**PITHAPUR RAJAH'S GOVERNMENT COLLEGE(A), KAKINADA.**  
**B.SC.-ANALYTICAL CHEMISTRY**  
**QUESTION BANK**  
**COURSE-5: QUANTITATIVE METHODS OF ANALYSIS**

**UNIT-I**

**Essay Questions:**

1. Specify the principles of Volatilization methods. How do you determine the Sodium Bicarbonate ( $\text{NaHCO}_3$ ) content of Antacid tablets by using volatilization method? **BT2, CO1, PO3**
2. Examine the concept of Precipitation methods in analytical chemistry? Elucidate the various steps involved in precipitation gravimetry. **BT2, CO1, PO2**
3. Evaluate the properties of precipitates and precipitating reagents. **BT3, CO1, PO4**
4. Analyse Co-precipitation? Elucidate the different types of Co-precipitation methods. **BT2, CO1, PO3**

**Short Answer Questions:**

1. Analyse the Gravimetric methods and explain briefly? **BT2, CO1, PO3**
2. Evaluate the concept involved in Colloidal precipitates. **BT3, CO1, PO2**
3. Evaluate the concept involved in Crystalline precipitates. **BT3, CO1, PO2**
4. Analyse Co-precipitation? By using the knowledge of Co-precipitation, explain Co-precipitation errors. **BT2, CO1, PO3**
5. Compare and Contrast Drying and ignition of precipitates. **BT2, CO1, PO2**

**UNIT-II**

**Essay Questions:**

1. What is an Indicator? List out the various theories of Indicators. **BT1, CO2, PO1**
2. Derive Henderson - Hassel Balch equation for acids and bases. **BT2, CO2, PO5**
3. Write about the classification of volumetric methods with examples. **BT1, CO2, PO2**
4. Explain about the four types of titrations involved in volumetric analysis. **BT1, CO2, PO2**
5. Explain about the sigmoidal titration curves. **BT1, CO2, PO5**

**Short Answer Questions:**

1. Explain the terms equivalence point, end point and the Indicator. **BT1, CO2, PO1**
2. What is Indicator? Write the examples of indicators for various types of titrations. **BT1, CO2, PO1**
3. What is Buffer? Explain briefly about Buffer solutions. **BT1, CO2, PO1**
4. Explain briefly about Complexometric and Redox titrations with examples. **BT1, CO2, PO1**

### UNIT-III

#### Essay Questions:

1. ssBy using the concept of centrifugation, Explain different types of centrifugation techniques. **BT2, CO3, PO3**

#### Short Answer Questions:

1. Explain briefly about centrifugation methods. **BT1, CO3, PO1**
2. Write about sedimentation. **BT1, CO3, PO1**

### UNIT-IV

#### Essay Questions:

1. How would you demonstrate Environmental pollution from industrial effluents and radiochemical waste. **BT2, CO3, PO9**
2. Explain about different types of rotors. **BT1, CO3, PO1**

#### Short Answer Questions:

1. Write briefly about Sampling methods **BT1, CO3, PO1**
2. Explain briefly about Water analysis. **BT1, CO3, PO1**

### UNIT-V

#### Essay Questions:

1. Demonstrate the principle and instrumentation of Polarography technique. **BT2, CO4, PO2**
2. Elucidate the following. **BT4, CO4, PO3**
  - i). Ilkovic equation
  - ii). Dropping mercury electrode (DME).
3. Develop the process to determination of Cu and Zn in brass by using Polarography technique. **BT4, CO4, PO5**

#### Short Answer Questions:

1. Explain about Diffusion current and half wave potentials **BT1, CO4, PO1**
2. Explain about residual current and migration current **BT1, CO4, PO1**
3. Write the advantages and disadvantages of DME **BT1, CO4, PO1**
4. State and explain the Ilkovic equation **BT1, CO4, PO1**
5. How do you explain the principle and applications of Polarography technique. **BT2, CO4, PO4**

**PITHAPUR RAJAH'S GOVERNMENT COLLEGE(A), KAKINADA.  
B.SC.-ANALYTICAL CHEMISTRY**

**COURSE-5: QUANTITATIVE METHODS OF ANALYSIS**

**LABORATORY COURSE - 5**

**30 hrs. (2 h /w) Max.Marks: 50M**

1. Determination of HCl with Standard NaOH solution by using pH meter
2. Determination of Acetic acid with Standard NaOH by using pH meter
3. Determination of the strength of the given magnesium sulphate solution using EDTA and Eriochrome black -T as the indicator by Complexometric titration method.
4. Determination of the Nickel as its Dimethyl glyoxime by Precipitation Gravimetric method.
5. Analysis of soil:
  - i) Determination of pH of soil.
  - ii) Determination of total soluble salts.
  - iii) Determination of carbonate and bicarbonate.

**SCHEME OF VALUATION**

**Max. Marks: 50**

1. Procedure to be written in the first 15 minutes	....	10 Marks
2. Recording of data and reporting the value	Up to 2% error...	25 Marks
3. Error up to 5%	.....	10 Marks
Error greater than 5%	.....	5 Marks
4. Viva - Voice	.....	05 Marks
5. Record	.....	10 Marks

**Co-Curricular Activities:**

Mandatory:(Lab/field training of students by teacher:(lab:10+field:05):

**For Teacher:** Training of students by teacher in laboratory and field for not less than 15 hours on the field techniques/skills of Volumetric Analysis and their applications.

**For Student:** Student shall visit a related industry/chemistry laboratory in universities/research organizations/private sector facility and observe the techniques used for Chemical Analysis and their applications. Write their observations and submit a handwritten fieldwork/project work report not exceeding 10 pages in the given format to the teacher.


Max marks for Fieldwork/project work Report:05.

Suggested Format for Fieldwork/project work: Title page, student details, index page, details of place visited, observations, findings, and acknowledgements.

Unit tests (IE).

a) Suggested Co-Curricular Activities

1. Training of students by related industrial experts.
2. Assignments, Seminars and Quiz (on related topics), collection of videos and other material.
3. Visits of facilities, firms, research organizations etc.
4. Invited lectures and presentations on related topics by field/industrial experts.

	<b>Pithapur Rajah's Government College (Autonomous) Kakinada</b>	<b>Program &amp; Semester</b> <b>II B.Sc. B. SC</b> <b>ANALYTICAL</b> <b>CHEMISTRY MAJOR</b> <b>&amp; Semester-III</b> <b>(Course-6)</b>			
Course Code AC - 6	<b>COURSE- 6 : SEPARATION METHODS</b>				
Teaching	<b>Hours Allocated: 45</b> <b>(Theory)</b>	L	T	P	C
Pre-requisites:		45	10	30	3+1

### Course Objectives:

To gain knowledge on Separation, purification, properties of Various Chemicals and Mixtures.

### Course Outcomes:

On Completion of the course, the students will be able to-	
CO1	Understand Principles and Techniques of Solvent Extraction.
CO2	To Gain Knowledge on Principles and Classification of Chromatographic Techniques.
CO3	To Learn about the Principle and Types of Paper, Thin Layer, Column Chromatography.
CO4	To Know the Applications of Normal Phase and Reverse Phase Chromatography.

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

Skill Development		Employability		Entrepreneurship	
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### Syllabus:

#### UNIT-I

09 hrs

#### SOLVENT EXTRACTION:

Introduction, principle, techniques, factors affecting solvent extraction. Different types of Solvent extraction techniques- Batch extraction, continuous extraction and counter current extraction.

Application - Determination of Iron (III)

#### UNIT-II

09 hrs

#### CHROMATOGRAPHY:

A. Classification of chromatographic methods: Principle of differential migration, description of the chromatographic process, distribution coefficients.

B. Chromatography – theory and practice: Introduction, the chromatograph (elution time and volume), capacity factor, column efficiency and resolution.

**UNIT-III**

**09 hrs**

A. Techniques of paper chromatography: Experimental modifications, various modes of development, nature of the paper, detection of spots, retardation factors, factors that affect the reproducibility of R<sub>f</sub> values (due to paper, solvent system, sample, development procedure), selection of solvent, quantitative analysis. Applications.

B. Thin layer chromatography: stationary phase, adsorbents, liquid phase supports, plate preparation, mobile phase, sample application, development, saturation of chamber, detection of spot, R<sub>f</sub> values (effect of adsorbent, solvent, solute, development process).

**UNIT-IV**

**09 hrs**

**COLUMN CHROMATOGRAPHY.**

A. General: columns, matrix materials, stationary phase, column packing, application of sample, column development and sample elution, detectors and fraction collectors, applications.

B. High performance liquid chromatography: Principle, column, matrices and stationary phases, column packing, mobile phase and pumps, application of sample, detectors, applications.

**UNIT-V**

**09 hrs**

A. Partition chromatography: Principle of liquid – liquid partition chromatography, Normal phase chromatography, Reversed phase liquid chromatography, applications.

B. Adsorption chromatography: Principle, adsorbents, solvents, nature of solute, operating parameters, retention volumes and times, applications.

Unit No	Additions	Deletions	Expected levels of learning as per Blooms taxonomy assessment of CO	Percentage added/deleted
I	--	--	K <sub>3</sub> , K <sub>4</sub>	
II	--	--	K <sub>1</sub> , K <sub>2</sub>	
III	--	--	K <sub>2</sub> , K <sub>3</sub>	
IV	--	--	K <sub>5</sub> , K <sub>6</sub>	
V	--	--	K <sub>3</sub> , K <sub>4</sub>	

K<sub>1</sub>= Remembering, K<sub>2</sub>= Understanding, K<sub>3</sub>= Applying,  
K<sub>4</sub>= Analysing, K<sub>5</sub>= Evaluating, K<sub>6</sub>=Create.

## Text books & Reference Books

S. No	Author	Title	Publisher
1	R.V.Dilts	Analytical Chemistry- Methods of Separation	---
2	O. Mikes, R.A. Chalmers	Laboratory Handbook of Chromatographic Methods	---
3	F.W. Fifield and D. Kealy	Analytical Chemistry	---
4	GH Jeffery, J. Bassett, J. Mendham,R.C Denny.	Vogel's textbook of quantitative chemical analysis, 6 <sup>th</sup> edition.	Longman Scientific & Technical
5	Skoog & West	Fundamentals of Analytical Chemistry	---

### CO-PO Mapping

On Completion of the course, the students will be able to-	
CO1	Understand Principles and Techniques of Solvent Extraction.
CO2	To Gain Knowledge on Principles and Classification of Chromatographic Techniques.
CO3	To Learn about the Principle and Types of Paper, Thin Layer, Column Chromatography.
CO4	To Know the Applications of Normal Phase and Reverse Phase Chromatography.

### CO-PO Mapping

1: Low=1; 2: Moderate=2; 3: High=3; 4: No Correlation=0

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3
CO1	3	3	1	1	1	1	1	0	1	0	1	3	0
CO2	3	3	1	1	2	1	1	1	2	2	1	0	2
CO3	3	3	1	3	1	1	0	1	1	0	0	1	3
CO4	3	1	0	1	3	3	1	0	1	1	3	2	1

### Programme Outcomes (PO):

**PO-1 Foundational Knowledge:** Graduates will demonstrate a comprehensive understanding of the fundamental principles and theories of analytical chemistry.

**PO-2 Laboratory Skills:** Graduates will possess practical laboratory skills, including proficiency in using a wide range of analytical instruments and techniques.

**PO-3 Data Analysis and Interpretation:** Graduates will be able to collect, analyze, and interpret experimental data using statistical methods and computational tools.

**PO-4 Quality Assurance:** Graduates will understand and apply quality assurance principles to ensure the accuracy and reliability of analytical results.

**PO-5 Problem-Solving Abilities:** Graduates will develop critical thinking and problem-solving skills to address challenges encountered in analytical chemistry research and practice.

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**PO-9 Interdisciplinary Collaboration:** Graduates will collaborate effectively with professionals from other disciplines to address complex scientific problems requiring multidisciplinary approaches.

**PO-10: Career Readiness:** Graduates will be prepared for various career pathways in analytical chemistry, including roles in academia, industry, government, and research institutions.

#### **Programme-Specific Outcomes (PSO):**

**PSO-1 Instrumentation Proficiency:** Graduates will demonstrate advanced proficiency in operating and troubleshooting analytical instruments specific to analytical chemistry, such as spectrophotometers, chromatographs, and mass spectrometers.

**PSO-2 Method Development and Optimization:** Graduates will have the ability to develop and optimize analytical methods tailored to specific sample matrices and analytical targets.

**PSO-3 Specialization in Separation Techniques:** Graduates will specialize in separation techniques, including chromatography and electrophoresis, for the analysis of complex mixtures and compounds.

**PSO-4 Applications in Industry and Research:** Graduates will apply analytical chemistry principles and techniques to address industry-specific challenges in fields such as pharmaceuticals, environmental science, food and beverages, and materials science.

**WEIGHTAGE TO CONTENT**  
**SEMESTER -III**  
**COURSE- 6 : SEPARATION METHODS**

S. No	Course Content	Long Answer	Short Answer	Total marks	As per Blooms Taxonomy
1	Solvent Extraction	1	2	20	Applying, Understanding
2	Chromatography	1	1	15	Remembering, Understanding
3	Paper, Thin layer Chromatography	2	1	25	Understanding, Applying
4	Column Chromatography	1	2	15	Understanding, Create
5	Partition & Adsorption Chromatography	1	1	15	Applying, Analysis
	<b>TOTAL</b>	<b>6</b>	<b>7</b>	<b>95</b>	

**PITHAPUR RAJAH'S GOVERNMENT COLLEGE(A), KAKINADA.**  
**B.SC - ANALYTICAL CHEMISTRY**  
**MODEL QUESTION PAPER**  
**COURSE- 6 : SEPARATION METHODS**

Time: 2 Hrs.

Max. Marks 50

**PART-I**

**Answer any THREE questions by attempting at least ONE question from each section.**

**Each Question carries TEN marks.**

**3X10=30M**

**SECTION - A**

1. Illustrate the principles and applications of Solvent extraction. **BT2, CO1, PO3.**
2. Explain about the Principle and classification of Chromatographic methods **BT1, CO2, PO2.**
3. Write about various modes of developments in Paper chromatographic technique. **BT1, CO3, PO2.**

**SECTION - B**

4. Explain the principle and Design the Experimental set up and applications of HPLC **BT4, CO3, PO3**
5. Analyse the Principle, Adsorbents, Solvents used in Adsorption Chromatography. **BT2, CO4, PO4.**
6. Demonstrate the principle, experimental set up and applications of TLC. **BT2, CO3, PO2.**

**PART-II**

**Answer any FOUR Questions from the following.**

**Each Question carries FIVE marks.**

**4 x 5 =20M**

7. How do you determine Fe(III) by using solvent extraction technique? **BT2, CO1, PO4.**
8. Explain briefly about efficiency of a chromatographic column. **BT1, CO2, PO4.**
9. Write about nature of paper, detection of spots in paper chromatography Write about nature of paper, detection of spots in paper chromatography. **BT1, CO3, PO1.**
10. Explain about Column development and sample elution in Column chromatography. **BT1, CO3, PO2.**
11. Analyse the principle and applications of Adsorption chromatography. **BT2, CO4, PO4.**
12. Explain factors affecting solvent extraction. **BT1, CO1, PO1.**
13. Explain about various Detectors used in HPLC. **BT1, CO3, PO1.**

**PITHAPUR RAJAH'S GOVERNMENT COLLEGE(A), KAKINADA.**  
**B.SC - ANALYTICAL CHEMISTRY**  
**QUESTION BANK**  
**COURSE- 6 : SEPARATION METHODS**

**LABORATORY COURSE -VI**

**30 hrs. (2 h /w) Max.Marks: 50M**

1. Determination of Rf value of amino acids using paper chromatography.
2. Separation and identification of monosaccharide present in a given mixture by paper chromatography.
3. Determination of Fe (III) by Solvent Extraction
4. Separation of organic mixtures through acid/base solvent extraction
5. Analysis of soil
  - i. Determination of pH of soil.
  - ii. Determination of total soluble salts.
  - iii. Determination of carbonate and bicarbonate.
  - iv. Determination of calcium, magnesium, and iron.
6. Determination of adulterant in some common food items:
7. Chicory in coffee powder,
8. Foreign resin in asafoetida
9. Chilli powder
10. Turmeric powder
11. Pulses

**SCHEME OF VALUATION**

**Max. Marks: 50**

1.Procedure to be written in the first 15 minutes	....	10 Marks
2.Recording of data and reporting the value up to 2% error.....		25 Marks
Error up to 5%	.....	15 Marks
Error greater than 5%	.....	5 Marks
4.Viva - Voice	.....	05 Marks
5. Record	.....	10 Marks

**Co-Curricular Activities:**

Mandatory:(Lab/ field training of students by teacher:(lab:10+field:05):

**For Teacher:** Training of students by teacher in laboratory and field for not less than 15 hours on the field techniques/skills of Volumetric Analysis and their applications.

**For Student:** Student shall visit a related industry/chemistry laboratory in universities/research organizations/private sector facility and observe the techniques used for Chemical Analysis and their applications. Write their observations and submit a handwritten fieldwork/project work report not exceeding 10 pages in the given format to the teacher.

Max marks for Fieldwork/project work Report:05.

Suggested Format for Fieldwork/project work: Title page, student details, index page, details of place visited, observations, findings, and acknowledgements.

Unit tests (IE).

a) Suggested Co-Curricular Activities

1. Training of students by related industrial experts.
2. Assignments, Seminars and Quiz (on related topics), collection of videos and other material.
3. Visits of facilities, firms, research organizations etc.
4. Invited lectures and presentations on related topics by field/industrial experts.

	<b>PITHAPUR RAJAH'S GOVERNMENT COLLEGE(A) KAKINADA DEPARTMENT OF CHEMISTRY</b>	<b>Program &amp; Semester</b> Ana Chemistry II B.Sc. (III Semester)			
Course Code AC -7	TITLE OF THE COURSE <b>COURSE 7: PHYSICAL CHEMISTRY-I 2024-25 AB</b>				
Teaching	Hours Allocated:45 (Theory)	L	T	P	C
Pre-requisites	Gas laws, Laws of symmetry, Intermolecular interactions	45	10	30	3+1

### Course Outcomes:

On Completion of the course, the students will be able to	
CO1	Understand and analyze the behavior of ideal and real gases using kinetic theory, van der Waal's equation, and critical phenomena.
CO2	Apply knowledge of liquid properties and liquid crystals to determine physical behavior and explain their technological applications.
CO3	Interpret crystal structures and symmetry using X-ray diffraction and classify defects in crystalline solids.
CO4	Apply Gibbs phase rule and construct phase diagrams for one- and two-component systems to explain phase equilibria.
CO5	Understand colloidal properties, types of adsorption, and evaluate adsorption isotherms in surface chemical processes.

### Course with focus on Skill Development/Employability/Entrepreneurship modules

Skill Development		Employability		Entrepreneurship	
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### Syllabus:

#### Unit I - Gaseous state (9 h )

Postulates of Kinetic theory of Gases (exclude derivation) – deduction of gas laws from kinetic gas equation-Vander Waal's equation of state. Andrew's isotherms of carbon dioxide, continuity of state. Critical phenomena. Relationship between critical constants and vander Waal's constants. Law of corresponding states. Joule- Thomson effect. Inversion temperature.

## **Unit II: Liquid State ( 9 h )**

Physical properties of liquids; vapour pressure, surface tension and coefficient of viscosity, and their determination. Effect of addition of various solutes on surface tension and viscosity. Temperature variation of viscosity of liquids and comparison with that of gases. Qualitative discussion of the structure of water.

Liquid crystals, mesomorphic state. Differences between liquid crystal and solid/liquid. Classification of liquid crystals into Smectic and Nematic. Application of liquid crystals as LCD devices

## **UNIT-III - Solid state ( 9h )**

Symmetry in crystals. Law of constancy of interfacial angles. The law of rationality of indices. Miller indices, Definition of lattice point, space lattice, unit cell. Bravais lattices and crystal systems. X-ray diffraction and crystal structure. Bragg's law and its derivation. Powder method. Defects in crystals. Stoichiometric and non-stoichiometric defects.

## **Unit IV - Phase Rule ( 9 h )**

The Concept of phase, components, degrees of freedom. Gibbs phase rule. Phase diagram of one component system - water system, Study of Phase diagrams of Simple eutectic systems

i) Pb-Ag system, desilverisation of lead ii) NaCl-Water system, Congruent and incongruent melting point- Definition and examples for systems having congruent and incongruent melting point, freezing mixtures.

## **Unit V - Surface Chemistry ( 9 h )**

Definition and classification of Colloids- Coagulation of colloids- Hardy-Schulze rule. Stability of colloids, Protection of Colloids, Gold number.

Adsorption - Physical and chemical adsorption, Freundlich and Langmuir adsorption isotherm, applications of adsorption.

**Textbooks:**

S.N O	AUTHOR	TITLE	PUBLISHER
1	K L Kapoor Vol.1	Text book of physical chemistry	JPNP publications
2	Puri, Sharma and Pathania	Principles of physical chemistry	S.Chand publications

**Reference books**

S.N O	AUTHOR	TITLE	PUBLISHER
1	Anthony R. West	Solid State Chemistry and its applications	
2	S Glasstone	Text book of physical chemistry	Oxford University Press
3	Bahl and Tuli	Advanced physical chemistry	Oxford University Press

**WebLinks:**

- [https://r.search.yahoo.com/\\_ylt=AwrX\\_2xJRzhntwIAF1K7HAX.;\\_ylu=Y29sbwNzZzMEcG9zAzEEdnRpZAMEc2VjA3Ny/RV=2/RE=1732951113/RO=10/RU=https%3a%2f%2fncert.nic.in%2fncerts%2f%2fkech105.pdf/RK=2/RS=Vm9QfnIDc3bV3suL2OFEa2QmVNU-](https://r.search.yahoo.com/_ylt=AwrX_2xJRzhntwIAF1K7HAX.;_ylu=Y29sbwNzZzMEcG9zAzEEdnRpZAMEc2VjA3Ny/RV=2/RE=1732951113/RO=10/RU=https%3a%2f%2fncert.nic.in%2fncerts%2f%2fkech105.pdf/RK=2/RS=Vm9QfnIDc3bV3suL2OFEa2QmVNU-)
- <https://ncert.nic.in/ncerts/1/kech105.pdf>
- <https://ncert.nic.in/ncerts/1/lech101.pdf>
- [https://in.video.search.yahoo.com/search/video;\\_ylt=Awr1QGxgSDhn6gEAOiO7HAX.;\\_ylu=Y29sbwNzZzMEcG9zAzEEdnRpZAMEc2VjA3Nj?type=E210IN885G0&p=Phase+rule+ncert+pdf&fr=mcafee&turl=https%3A%2F%2Ftse4.mm.bing.net%2Fth%3Fid%3DOVP.JxFcEpp5NbDamMSQrb4TBgHgFo%26pi%26w%3D296%26h%3D156%26c%3D7%26p%3D0&rurl=https%3A%2F%2Fwww.youtube.com%2Fwatch%3Fv%3DlkyOIL0yuCo&tit=PHASE+RULE+%28+Phase%2C+components+and+degree+of+freedom+in+a+single+shot+with+examples%29&pos=11&vid=81f4608b48f4687d75f45904baeaac3e&sigr=N6uflKlnj6Q5&sig=hJJod0UFuWJ9&sigi=7h78CUEbal4Y](https://in.video.search.yahoo.com/search/video;_ylt=Awr1QGxgSDhn6gEAOiO7HAX.;_ylu=Y29sbwNzZzMEcG9zAzEEdnRpZAMEc2VjA3Nj?type=E210IN885G0&p=Phase+rule+ncert+pdf&fr=mcafee&turl=https%3A%2F%2Ftse4.mm.bing.net%2Fth%3Fid%3DOVP.JxFcEpp5NbDamMSQrb4TBgHgFo%26pi%26w%3D296%26h%3D156%26c%3D7%26p%3D0&rurl=https%3A%2F%2Fwww.youtube.com%2Fwatch%3Fv%3DlkyOIL0yuCo&tit=PHASE+RULE+%28+Phase%2C+components+and+degree+of+freedom+in+a+single+shot+with+examples%29&pos=11&vid=81f4608b48f4687d75f45904baeaac3e&sigr=N6uflKlnj6Q5&sig=hJJod0UFuWJ9&sigi=7h78CUEbal4Y)
- <https://epgp.inflibnet.ac.in/Home/ViewSubject?catid=13G8VouhmrFfuhs6rkiyTA==>

## Course outcome & Program outcome mapping

On completion of the course, the students will be able to	
CO1	Understand and analyze the behavior of ideal and real gases using kinetic theory, van der Waal's equation, and critical phenomena.
CO2	Apply knowledge of liquid properties and liquid crystals to determine physical behavior and explain their technological applications.
CO3	Interpret crystal structures and symmetry using X-ray diffraction and classify defects in crystalline solids.
CO4	Apply Gibbs phase rule and construct phase diagrams for one- and two-component systems to explain phase equilibria.
CO5	Understand colloidal properties, types of adsorption, and evaluate adsorption isotherms in surface chemical processes.

### CO-PO Mapping:

1: Low =1 ;2: Moderate = 2 ; 3: High = 3 ; 4: No Correlation = 0

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3
CO1	3	2	2	2	1	2	1	3	2	2
CO2	3	1	2	2	1	1	1	3	1	2
CO3	3	2	2	3	2	2	2	3	2	2
CO4	3	1	1	1	1	1	1	2	1	1
CO5	3	2	2	3	1	2	2	3	1	2

## PROGRAMME OUTCOMES

At the completion of the B.Sc. Chemistry program, the students 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

Semester -III

Course - 7

S.No	Course Content	Long Answer	Short Answer	Total marks	As per Blooms Taxonomy
1	Gaseous state	2	1	25	Understanding, Application
2	Liquid State	1	1	20	Remembering, Understanding
3	Solid state	1	2	20	Analyzing, Creation
4	Phase Rule	1	1	15	Evaluation, Understanding
5	Surface Chemistry	1	2	20	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 Analytical Chemistry Hons (2024-25 AB)**  
**(Examination at the end of III semester)**  
**Course-7 :: Physical Chemistry-I**  
**MODEL PAPER**

**Duration: 2hrs**

**Max. Marks: 50**

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**PART- A**

Answer any **THREE** of the following questions by choosing at least **ONE** from each section.  
Each carries **TEN** marks 3 X 10 = 30 M

SECTION -A

1. Unit - I
2. Unit - II
3. Unit - V

SECTION -B

4. Unit - III
5. Unit - IV
6. Unit - I

**PART- B**

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

**4 X 5 = 20 Marks**

7. Unit - I
8. Unit - II
9. Unit - III
10. Unit - III
11. Unit - IV
12. Unit - V
13. Unit - V

**PITHAPUR RAJAH'S GOVERNMENT COLLEGE (A) :: KAKINADA**  
**II Year B.Sc Organic Chemistry Hons (2024-25 AB)**  
**(Examination at the end of III semester)**  
**Course-7 :: Physical Chemistry-I**

**Question Bank**

**Unit-1:**

**Essay Questions:**

1. Derive the following laws from kinetic theory of gases?  
a) Boyle's law    b) Avogadro's law    d) Dalton's Law
2. Elaborate Vander Waal equation of state?
3. Derive the mathematical relation between Vander Waal constants and critical constants?

**Short answer Questions:**

1. Write the postulates of kinetic theory of gases?
2. Discuss the Anderw's Isotherm of carbon dioxide?
3. Explain the reduced equation of state and law of corresponding states?
4. What is Joule-Thomson effect and explain inversion temperature?

**Unit-2:**

**Essay Questions:**

1. What are liquid crystals and explain their classification?
2. Define surface tension & explain its determination by using drop count method?
3. What is the coefficient of viscosity & explain its determination by using viscometer.

**Short answer Questions:**

1. Write the applications of liquid crystals?
2. Explain the differences between liquid crystal and solid/liquids
3. Elaborate on the Qualitative discussion of the structure of water.

**Unit-3:**

**Essay Questions:**

1. Explain the law of symmetry in crystals?
2. Derive Bragg's equation for the determination of crystal structure?
3. Explain the stoichiometric and non-stoichiometric defects in crystals?

**Short answer Questions:**

1. Explain the law of constancy of interfacial angles?
2. Define space lattice, lattice point & unit cell?
3. Write about the different crystal systems with examples?
4. what is law of rational indices?

**Unit-4:**

**Essay Questions:**

1. Explain the phase diagram of the Water system?
2. Elaborate the phase diagram of the NaCl- Water system?
3. Discuss the phase diagram of the Ag-Pb system

**Short answer Questions:**

1. Define phase rule and explain the terms involved in it.
2. Discuss the Pattinson's process for the desilverisation of lead?
3. Define congruent and incongruent melting points give examples?
4. Write a short note on freezing mixtures.

**Unit-5:****Essay Questions:**

1. Define is Langmuir adsorption isotherm and explain?
2. What is physisorption and Chemisorption and write their differences?
3. Explain the various factors that effecting adsorption of gases on solids?
4. Explain the following
  - a) Hardy-Schulze rule.
  - b) Gold number
  - c) Coagulation

**Short answer Questions:**

1. Define colloids and their classification?
2. Write a short note on Freundlich adsorption isotherm.
3. Write the applications of adsorption?

**PITHAPUR RAJAH'S GOVERNMENT COLLEGE(A) KAKINADA**  
**II BSc HONORS ANALYTICAL CHEMISTRY**  
**III - SEMESTER**

**Course Code 7: Physical Chemistry - 1**

**Credits: 01**

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**Course outcomes:**

At the end of the course, the student will be able to:

- 1) Use glassware, equipment and chemicals and follow experimental procedures in the laboratory
- 2) Apply concepts of surface chemistry in experiments.
- 3) Be familiar with the concepts & practical applications of Surface tension and viscosity of liquids.

**Physical Chemistry Practical Syllabus:**

1. Determination of surface tension of liquid by drop count method
2. Determination of surface tension of liquid by drop weight method
3. Determination of coefficient of viscosity of an organic liquid.

**Co-curricular activities and Assessment Methods:**

- 1) Continuous Evaluation: Monitoring the progress of student's learning
- 2) Class Tests, Worksheets and Quizzes
- 3) Presentations, Projects and Assignments and Group Discussions: Enhances critical thinking skills and personality
- 4) SEMESTER -End Examination: critical indicator of student's learning and teaching methods adopted by teachers throughout the SEMESTER.

**List of reference books:**

- 1) A Text Book of Quantitative Inorganic Analysis(3<sup>rd</sup>Edition) -A.I.Vogel
- 2) Web related references suggested by teacher.

	<b>PITHAPUR RAJAH'S GOVERNMENT COLEGE(A) Kakinada DEPARTMENT OF CHEMISTRY</b>	<b>Program &amp; Semester II B.Sc. (III Semester)</b>			
Course Code AC-8	TITLE OF THE COURSE <b>GENERAL AND INORGANIC CHEMISTRY</b>				
Teaching	Hours Allocated: 45 ( <b>Theory</b> )	L	T	P	C
Pre-requisites	Atomic models and chemical bonding	45	10	30	3+1

### Course Objectives:

1. Atomic Structure and Periodic table
2. Ionic bond
3. The Covalent Bond
4. Metallic and Weak Bonds
5. Acids and Bases.

### Course Outcomes:

<b>On Completion of the course, the students will be able to</b>	
CO1	Understand the structure of atom and the arrangement of elements in the periodic table
CO2	Understand the properties of Ionic bond.
CO3	Identify the structure of a given inorganic compound.
CO4	Explain the existence of special types of compounds through weak chemical forces.
CO5	Define acids and bases and predict the nature of salts

### Course with focus on Skill Development/Employability/Entrepreneurship modules

#### Syllabus:

#### UNIT-I: Atomic Structure and Periodic table

**9 h**

Electronic configuration: Bohr theory, dual nature of electrons, Heisenberg uncertainty principle, the Schrodinger equation, significance of wave functions, normalization of wave function, radial and angular wave functions, Pauli's exclusion principle, Hund's rule, sequence of energy levels (Aufbau principle).

Periodicity: periodic law and arrangement of elements in the periodic table, IUPAC nomenclature and group number, horizontal, vertical, and diagonal relationships in the periodic table. General

properties of atoms: size of atoms and ions-atomic radii, ionic radii, covalent radii; trend in ionic radii, ionization potential, electron affinity; electronegativity - Pauling, Mulliken-Jaffe, Allred-Rochow definitions; oxidation states and variable valency; isoelectronic relationship; inert-pair effect

### **UNIT-II: Ionic bond**

**9h**

Properties of ionic compounds, factors favouring the formation of ionic compounds- ionization potential, electron affinity, and electronegativity. Lattice energy: definition, factors affecting lattice energy, Born-Haber cycle-enthalpy of formation of ionic compound and stability. Stability of ionic compounds in terms of  $\Delta H_f$  and  $U_o$ . Solubility and thermal stability of ionic compounds. Covalent character in ionic compounds-polarization and Fajan's rules; effects of polarization-solubility, melting points, and thermal stability of typical ionic compounds.

### **UNIT-III: The Covalent Bond**

**12 h**

Valence Bond theory-arrangement of electrons in molecules, hybridization of atomic orbitals and geometry of molecules- $\text{BeCl}_2$ ,  $\text{BF}_3$ ,  $\text{CH}_4$ ,  $\text{PCl}_5$ ,  $\text{SF}_6$ - VSEPR model-effect of bonding and nonbonding electrons on the structure of molecules, effect of electronegativity, isoelectronic principle, illustration of structures by VSEPR model- $\text{NH}_3$ ,  $\text{H}_2\text{O}$ ,  $\text{SF}_4$ ,  $\text{XeF}_4$ ,  $\text{XeF}_6$

Molecular orbital theory -LCAO method, construction of M.O. diagrams for homo-nuclear and hetero-nuclear diatomic molecules ( $\text{N}_2$ ,  $\text{O}_2$ ,  $\text{CO}$  and  $\text{NO}$ )

### **Unit-IV: Metallic and Weak Bonds**

**9h**

The Metallic bond: metallic properties, free electron theory, Valence Bond Theory, band theory of metals. Explanation of conductors, semiconductors and insulators.

Weak bonds: hydrogen bonding-intra- and intermolecular hydrogen bonding, influence on the physical properties of molecules, comparison of hydrogen bond strength and properties of hydrogen bonded N, O and F compounds; associated molecules-ethanol and acetic acid; Vander Waals forces, ion dipole-dipole interactions.

### **Unit-5: Acid Bases**

**9h**

Theories of acids and bases: Arrhenius theory, Bronsted-Lowry theory, Lewis theory, the solvent system, Non-aqueous solvents: classification-protonic and aprotic solvents, liquid ammonia as solvent-solutions of alkali and alkaline earth metals in ammonia.

Types of chemical reactions: acid-base, oxidation-reduction, calculation of oxidation

number. Definition of pH,  $pK_a$ ,  $pK_b$ . Types of salts, Salt hydrolysis. Pearson's concept, HSAB principle & its importance, bonding in Hard-Hard and Soft-Soft combinations.

### Reference books

S.NO	AUTHOR	TITLE	PUBLISHER
1	J. D. Lee	Concise Inorganic Chemistry	Blackwell Science
2	B. R. Puri, L. R. Sharma, K. C. Kalia,	Principles of Inorganic Chemistry	Shoban Lal Nagin Chand and Co
3	D. F. Shriver and P. W. Atkins,	Inorganic Chemistry	W. H. Freeman and Co

### WebLinks:

### Course outcome & Program outcome mapping

On Completion of the course, the students will be able to	
CO1	Understand the structure of atom and the arrangement of elements in the periodic table
CO2	Understand the structure of atom and the arrangement of elements in the periodic table
CO3	Identify the structure of a given inorganic compound.
CO4	Explain the existence of special types of compounds through weak chemical forces.
CO5	Define acids and bases and predict the nature of salts

**CO-PO Mapping:** 1: Low =1 ; 2: Moderate = 2 ; 3: High = 3 ; 4: No Correlation = 0

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3
CO1	3	1	2	2	1	1	1	3	1	1
CO2	3	2	1	1	1	1	1	2	1	1
CO3	3	3	2	2	1	1	1	3	2	1
CO4	3	2	2	1	2	2	1	3	2	1
CO5	3	1	2	1	1	1	2	2	2	2

### PROGRAMME OUTCOMES

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 employe

**Weightage to content****Semester -III****Course - VIII**

<b>S.No</b>	<b>CourseContent</b>	<b>Long Answer</b>	<b>ShortAnswer</b>	<b>Totalmarks</b>	<b>As per Blooms Taxonomy</b>
1	Atomic Structure and Periodic table	2	2	30	Understanding, Application
2	Ionic bond	1	1	15	Remembering, Understanding
3	Covalent bond	1	1	15	Analysizing & Creation
4	Metallic and Weak bonds	1	1	15	Evaluation, Understanding
5.	ACIDS & BASES	1	2	20	Understanding, Application
	<b>TOTAL</b>	<b>6</b>	<b>7</b>	<b>95</b>	

**II YEAR B.Sc (Examination at the end of II semester)**  
**(COURSE - VIII - Inorganic and General Chemistry)**

**MODEL PAPER**

**Duration: 2hr**

**Max.Marks:50M**

**Section -I**

Answer any three of the following questions. Must attempt atleast one question from each part.Each question carries 10 Marks.

3 X 10 = 30M

**Part – A**

1. Write a short note on a) Significance of wave function  
a) Electronic configuration rules.
2. Define lattice enthalpy. Determine lattice enthalpy by using born Haber cycle take an example.
3. Write about ionization energy and atomic size. What is the relation between them and justify your answer with an example.

Part - B

4. Why  $O_2$  is paramagnetic and  $N_2$  is diamagnetic? Explain with the help of molecular orbital diagrams.
5. Describe the properties of metals by using free electron theory and band theory.
6. Write a brief note on Pearson concept of HSAB principle.

**Section II**

Answer any four of the following questions. Each question carries 5 marks. 4 X 5 = 20M

7. Predict the relation between Pauling and Mulliken scale to explain electron negativity.
8. Explain Heisenberg uncertainty principle.
9. Write the factors favourable for the formation of ionic compounds. Explain with examples.
10. Illustrate the structure of ammonia and  $XeF_4$  by VSEPR model.
11. Compare strength of hydrogen bonding strength in o-Nitrophenol and p-Nitrophenol.
12. Describe the nature of salts  $NH_4Cl$ ,  $CuSO_4$  and  $KNO_3$ .
13. Explain solvent effect of ammonia on alkali metals and alkaline earth metals.

**SEMESTER-III**

**COURSE VIII: GENERAL AND INORGANIC CHEMISTRY**

**Practical**

**Credits: 1**

**2 hrs/week**

**Practical- I Qualitative Analysis of SIMPLE SALT**

Qualitative inorganic analysis (Minimum of Six simple salts should be analysed) 50 M

**I.** Course outcomes:

At the end of the course, the student will be able to;

1. Understand the basic concepts of qualitative analysis of inorganic simple salt.
2. Use glassware, equipment and chemicals and follow experimental procedures in the laboratory
3. Apply the concepts of common ion effect, solubility product and concepts related to qualitative analysis

Laboratory course syllabus: Analysis of SIMPLE SALT

50 M

**I.**

Analysis of simple salt containing ONE anion and ONE cation from the following:

Anions: Carbonate, Sulphate, Chloride, Bromide, Acetate, Nitrate, Borate, Phosphate.

Cations: Lead, Copper, Iron, Aluminium, Zinc, Nickel, Manganese, Calcium, Strontium,

Barium, Magnesium and Ammonium.

Co-curricular activities and Assessment Methods

1. Continuous Evaluation: Monitoring the progress of student's learning.
2. Class Tests, Work sheets and Quizzes
3. Presentations, Projects and Assignments and Group Discussions:  
Enhances critical thinking skills and personality
4. SEMESTER -End Examination: critical indicator of student's learning and teaching methods adopted by teachers throughout the SEMESTER

### SCHEME OF VALUATION

a. Preliminary Tests	05 M
b. Identification of anion	08 M
c. Conformation tests for anion	10 M
d. Identification cation(Group separation table)	10 M
e. Conformation of Cation	05 M
f. Report	02 M
g. Viva voce	05 M
h. Record	05 M
<b>TOTAL</b>	<b>50 marks</b>