B.SC
ANALYTICAL CHEMISTRY
SYLLABUS

	Government College (Autonomous) Rajahmundry	Program & Semester I B.Sc. Analytical Chemistry (H) I Semester			
Course Code	TITLE OF THE COURSE **Course – 1: Essentials of Mathematics, Physics, chemistry & Computer Science**				
Teaching	Hours Allocated: 60 (**Theory and Activities**) (5 Hrs./wk.	L	A	P	C
Pre-requisites	Basic knowledge about Mathematics, physics, Chemistry and Computer science	4	1	-	4

Course Objectives:

1. To provide students with a comprehensive understanding of the essential concepts and applications of mathematical, physical, and chemical sciences.
2. To develop students' critical thinking, problem-solving, and analytical skills in these areas, enabling them to apply scientific principles to real-world situations.

Course Outcomes:

On Completion of the course, the students will be able to		Cognitive Domain
CO1	Apply critical thinking skills to solve complex problems involving complex numbers, trigonometric ratios, vectors, and statistical measures.	Critical Thinking
CO2	To Explain the basic principles and concepts underlying a broad range of fundamental areas of physics and to Connect their knowledge of physics to everyday situations	Application
CO3	To Explain the basic principles and concepts underlying a broadrange of fundamental areas of chemistry and to Connect their knowledge of chemistry to daily life.	Application
CO4	ore the history and evolution of the Internet and to gain an nding of network security concepts, including threats, vulnerabilities, ntermeasures.	Application

Course with focus on employability / entrepreneurship / Skill Development modules

Skill Development		Employability		Entrepreneurship	

Syllabus:

UNIT I: ESSENTIALS OF MATHEMATICS: **9hrs.**

Complex Numbers: Introduction of the new symbol i General form of a complex number Modulus-Amplitude form and conversions

Trigonometric Ratios: Trigonometric Ratios and their relations Problems on calculation of angles

Vectors: Definition of vector addition Cartesian form Scalar and vector product and problems

Statistical Measures: Mean, Median, Mode of a data and problems

UNIT II: ESSENTIALS OF PHYSICS: 9hrs.

Definition and Scope of Physics- Measurements and Units - Motion of objects: Newtonian Mechanics and relativistic mechanics perspective - Laws of Thermodynamics and Significance- Acoustic waves and electromagnetic waves- Electric and Magnetic fields and their interactions- Behaviour of atomic and nuclear particles- Wave-particle duality, the uncertainty principle- Theories and understanding of universe

UNIT III: ESSENTIALS OF CHEMISTRY:: 9 hrs.

Definition and Scope of Chemistry- Importance of Chemistry in daily life -Branches of chemistry and significance- Periodic Table- Electronic Configuration, chemical changes, classification of matter, Biomolecules- carbohydrates, proteins, fats and vitamins.

UNIT IV: APPLICATIONS OF MATHEMATICS, PHYSICS & CHEMISTRY: 9 hrs

Applications of Mathematics: Calculus, Differential Equations & Complex Analysis

Application of Physics in Industry and Technology: Electronics and Semiconductor Industry, Robotics and Automation, Automotive and Aerospace Industries, Quality Control and Instrumentation, Environmental Monitoring and Sustainable Technologies.

Application of Chemistry in Industry and Technology: Chemical Manufacturing, Pharmaceuticals and Drug Discovery, Materials Science, Food and Beverage Industry.

UNIT V: ESSENTIALS OF COMPUTER SCIENCE: 9 hrs.

Milestones of computer evolution - Internet, history, Internet Service Providers, Types of Networks, IP, Domain Name Services, applications. Ethical and social implications: Network and security concepts- Information Assurance Fundamentals, Cryptography-Symmetric and Asymmetric, Malware, Firewalls, Fraud Techniques-Privacy and Data Protection

Reference Books:

Functions of one complex variable by John.B.Conway, Springer- Verlag.

Elementary Trigonometry by H.S.Hall and S.R.Knight

Vector Algebra by A.R.Vasishtha, Krishna Prakashan Media(P)Ltd.

Basic Statistics by B.L.Agarwal, New age international Publishers

University Physics with Modern Physics by Hugh D. Young and Roger A. Freedman

Fundamentals of Physics by David Halliday, Robert Resnick, and Jearl Walker

Chemsitry in daily life by Kirpal Singh

Chemistry of bio molecules by S. P. Bhutan

Fundamentals of Computers by V. Raja Raman

CO-PO Mapping:

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

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3
CO1	2	3	2	3	3	3	1	2	2	3	3	3	3
CO2	3	2	3	3	2	3	3	1	3	3	3	2	3
CO3	3	3	3	3	2	2	2	2	2	3	3	2	2
CO4	3	2	2	2	2	2	3	3	1	1	2	2	2
Avg.	2.75	2.5	2.5	2.75	2.25	2.5	2.25	2	2	2.5	2.75	2.25	2.5

Student Activities (15 hrs)

Unit – I: Mathematics **3 hrs.**

1: Complex Number Exploration Provide students with a set of complex numbers in both rectangular and polar forms.

2: Trigonometric Ratios Problem Solving Give students a set of problems that require the calculation of trigonometric ratios and their relations.

3: Vector Operations and Applications Provide students with a set of vectors in Cartesian form. Students will perform vector addition and subtraction operations to find the resultant vectors.

4: Statistical Measures and Data Analysis give students a dataset containing numerical values. Students will calculate the mean, median, and mode of the data, as well as other statistical measures if appropriate (e.g., range, standard deviation).

Unit – II: Physics **3 hrs.**

Laboratory Experiment: Select a laboratory experiment related to one of the topics, such as motion of objects or electric and magnetic fields. Provide the necessary materials, instructions, and safety guidelines for conducting the experiment. Students will work in small groups to carry out the experiment, collect data, and analyze the results.

Unit – III: Chemistry **3 hrs.**

1: Chemistry in Daily Life Presentation Divide students into groups and assign each group a specific aspect of daily life where chemistry plays a significant role, such as food and nutrition, household products, medicine, or environmental issues.

2: Periodic Table Exploration Provide students with a copy of the periodic table. Students will explore the periodic table and its significance in organizing elements based on their properties. 3: Chemical Changes and Classification of Matter Provide students with various substances and chemical reactions, such as mixing acids and bases or observing a combustion reaction.

4: Biomolecules Investigation Assign each student or group a specific biomolecule category, such as carbohydrates, proteins, fats, or vitamins. Students will research and gather information about their assigned biomolecule category, including its structure, functions, sources, and importance in the human body.

Unit – IV: Applications of Mathematics, Physics and Chemistry **3 hrs.**

1: Laboratory Experiments assign students laboratory experiments that demonstrate the practical applications of mathematics, physics, and chemistry. Examples include investigating the relationship between concentration and reaction rate, analyzing the behavior of electrical circuits, or measuring the properties of materials.

2: Mathematical Modeling Present students with real-world problems that require mathematical modeling and analysis

UNIT V: ESSENTIALS OF COMPUTER SCIENCE: 3 hrs.

1. Identifying the attributes of network (Topology, service provider, IP address and bandwidth
2. Your college network) and prepare a report covering network architecture.
3. Identify the types of malwares and required firewalls to provide security.
4. Latest Fraud techniques used by hackers.

GOVERNMENT COLLEGE (A), RAJAMAHENDRAVARAM I B.Sc.
CHEMISTRY (H)

SEMESTER - I QUESTION
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Course -1: ESSENTIALS OF MATHEMATICS, PHYSICS, CHEMISTRY & COMPUTER SCIENCE

TIME: $2^1/_2$ hrs. **Max. MARKS: 50**

PART-A

Answer **ALL** the Questions **5x7 = 35 M**

1. **UNIT-I 2 Questions (Answer Q. No. 1 or 2)**
2. **UNIT- II 2 Questions (Answer Q. No. 3 or 4)**
3. **UNIT- III 2 Questions (Answer Q. No. 5 or 6)**
4. **UNIT- IV 2 Questions (Answer Q. No. 7 or 8)**
5. **UNIT- V 2 Questions (Answer Q. No. 9 or 10)**

PART – B

Answer any **FIVE** Questions **5x3 = 15 M**

6. **2 Question from UNIT- I (Q. No. 11 & 12)**
7. **2 Questions from UNIT- II (Q. No. 13 & 14)**
8. **2 Question from UNIT- III (Q. No. 15 & 16)**
9. **1 Questions from UNIT- IV (Q. No. 17)**
10. **1 Questions from UNIT- V (Q. No. 18)**

	Government College (Autonomous) Rajahmundry	Program & Semester			
Course Code	TITLE OF THE COURSE **Course – 2: Advances of Mathematics, Physics, chemistry & Computer Science**	I B.Sc. Analytical Chemistry (H) I Semester			
Teaching	Hours Allocated: 60 (**Theory and Activity**) (5 hrs. / wk.)	L	A	P	C
Pre-requisites	Basic knowledge about Mathematics, Physics, chemistry and Computer science	4	1	-	4

Course Objectives:

1. To provide students with an in-depth understanding of the recent advances and cutting- edge research in mathematical, physical, and chemical sciences.
2. To broaden students' knowledge beyond the foundational concepts and expose them to the latest developments in these disciplines, fostering critical thinking, research skills, and the ability to contribute to scientific advancements.

Course Outcomes:

On Completion of the course, the students will be able to		Cognitive Domain
CO1	Explore the applications of mathematics in various fields of physics and chemistry, to understand how mathematical concepts are used to model and solve real-world problems.	Application
CO2	To Explain the basic principles and concepts underlying a broad range of fundamental areas of physics and to Connect their knowledge of physics to everyday situations.	Application
CO3	Understand the different sources of renewable energy and their generation processes and advances in nanomaterial's and their properties.	Application
CO4	Understand and convert between different number systems, such as binary, cimal, and hexadecimal. Differentiate between analog and digital signals erstand their characteristics.	Application

Course with focus on employability / entrepreneurship / Skill Development modules

Skill Development		Employability		Entrepreneurship	

Syllabus:

UNIT I: ADVANCESIN BASICS MATHEMATICS 9 hrs.

Straight Lines: Different forms Reduction of general equation into various forms Point of intersection of two straight lines Limits and Differentiation: Standard limits Derivative of a function Problems on product rule and quotient rule Integration: Integration as a reverse process of differentiation Basic methods of integration Matrices: Types of matrices Scalar multiple of a matrix Multiplication of matrices Transpose of a matrix and determinants

UNIT II: ADVANCES IN PHYSICS: 9 hrs.

Renewable energy: Generation, energy storage, and energy-efficient materials and devices. Recent advances in the field of nanotechnology: Quantum dots, Quantum Communication- recent advances in biophysics- recent advances in medical physics- Shape Memory Materials.

UNIT III: ADVANCES IN CHEMISTRY: 9 hrs.

Computer aided drug design and delivery, Nano sensors, Chemical Biology, impact of chemical pollutants on ecosystems and human health, Dye removal- Catalysis method

UNIT IV: ADVANCED APPLICATIONS OF MATHEMATICS, PHYSICS & CHEMISTRY 9hrs.

Mathematical Modeling applications in physics and chemistry Application of Renewable energy: Grid Integration and Smart Grids, Application of nanotechnology: Nano medicine, Application of biophysics: Biophysical Imaging, Biomechanics, Neurophysics, Application of medical physics: Radiation Therapy, Nuclear medicine Solid waste management, Environmental remediation- Green Technology, Water treatment.

UNIT V: Advanced Applications of computer Science 9 hrs.

Number System-Binary, Octal, decimal, and Hexadecimal, Signals-Analog, Digital, Modem, Codec, Multiplexing, Transmission media, error detection and correction- Parity check andCRC, Networking devices- Repeater, hub, bridge, switch, router, gateway.

Reference Books:

1. Coordinate Geometry by S.L.Lony, Arihant Publications
2. Calculus by Thomas and Finny, Pearson Publications
3. Matrices by A.R.Vasishtha and A.K.Vasishtha, Krishna PrakashanMedia(P)Ltd.
4. "Renewable Energy: Power for a Sustainable Future" by Godfrey Boyle
5. "Energy Storage: A Nontechnical Guide" by Richard Baxter
6. "Biophysics: An Introduction" by Rodney Cotterill
7. "Medical Physics: Imaging" by James G. Webster
8. "Shape Memory Alloys: Properties and Applications" by Dimitris C. Lagoudas
9. Nano materials and applications by M.N.Borah
10. Environmental Chemistry by Anil.K.D.E.
11. Digital Logic Design by Morris Mano
12. Data Communication & Networking by Bahrouz Forouzan.

CO-PO Mapping:

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

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3
CO1	2	3	2	3	3	3	1	2	2	3	3	3	3
CO2	3	2	3	3	2	3	3	1	3	3	3	2	3
CO3	3	3	3	3	2	2	2	2	2	3	3	2	2
CO4	3	2	2	2	2	2	3	3	1	1	2	2	2
Avg.	2.75	2.5	2.5	2.75	2.25	2.5	2.25	2	2	2.5	2.75	2.25	2.5

Student Activities (15 hrs.)

UNIT I: ADVANCESIN BASIC MATHEMATICS **3 hrs.**

1: Straight Lines Exploration Provide students with a set of equations representing straight lines in different forms, such as slope intercept form, point-slope form, or general form.

2: Limits and Differentiation Problem Solving Students will apply the concept of limits to solve various problems using standard limits.

3: Integration Exploration Students will explore the concept of integration as a reverse process of differentiation and apply basic methods of integration, such as the product rule, substitution method, or integration by parts.

4: Matrices Manipulation Students will perform operations on matrices, including scalar multiplication, matrix multiplication, and matrix transpose.

UNIT II: ADVANCES IN PHYSICS: **3 hrs.**

1: Experimental Design Assign students to design and conduct experiments related to one of the topics: renewable energy, nanotechnology, biophysics, medical physics,

2: Group Discussion and Debate Organize a group discussion or debate session where students will discuss the ethical, social, and environmental implications of the recent advances in renewable energy, nanotechnology, biophysics, medical physics.

UNIT III: ADVANCES IN CHEMISTRY: **3 hrs.**

1. Experimental Design and Simulation In small groups, students will design experiments or simulations related to the assigned topic. For example, in the context of computer-aided drug design, students could design a virtual screening experiment to identify potential drug candidates for a specific disease target.

2. Case Studies and Discussion Provide students with real-world case studies related to the impact

of chemical pollutants on ecosystems and human health. Students will analyze the case studies, identify the sources and effects of chemical pollutants, and propose mitigation strategies to minimize their impact.

3. 3: Group Project

Assign students to work in groups to develop a project related to one of the topics.

The project could involve designing a computer-aided drug delivery system, developing a nano sensor for a specific application, or proposing strategies to mitigate the impact of chemical pollutants on ecosystems.

UNIT IV: ADVANCED APPLICATIONS OF MATHEMATICS, PHYSICS & CHEMISTRY 3 hrs.

1: Mathematical Modeling Experiment Provide students with a mathematical modeling experiment related to one of the topics. For example, in the context of renewable energy, studentscan develop a mathematical model to optimize the placement and configuration of solar panels ina solar farm..
2: Case Studies and Group Discussions Assign students to analyze case studies related to the applications of mathematical modeling in nanotechnology, biophysics, and medical physics,solid waste management, environmental remediation, or water treatment.

4. Group Project

Assign students to work in groups to develop a group project that integrates mathematicalmodeling with one of the application areas: renewable energy, nanotechnology, biophysics,medical physics, solid waste management, environmental remediation, or water treatment.

UNIT V: Advanced Applications of computer Science 3 hrs.

1. Students must be able to convert numbers from other number system to binary number systems
2. Identify the networking media used for your college network
3. Identify all the networking devices used in your college premises

GOVERNMENT COLLEGE (A), RAJAMAHENDRAVARAM I B.Sc.

CHEMISTRY (H)

SEMESTER - I QUESTION

PAPER BLUE PRINT

Course -2: ADVANCES OF MATHEMATICS, PHYSICS, CHEMISTRY & COMPUTER SCIENCE

TIME: $2^1/_2$ hrs. **Max. MARKS: 50**

PART-A

Answer **ALL** the Questions **5x7 = 35 M**

1. **UNIT-I 2 Questions (Answer Q. No. 1 or 2)**
2. **UNIT- II 2 Questions (Answer Q. No.3 or 4)**
3. **UNIT- III 2 Questions (Answer Q. No. 5 or 6)**
4. **UNIT- IV 2 Questions (Answer Q. No. 7 or 8)**
5. **UNIT- V 2 Questions (Answer Q. No. 9 or 10)**

PART – B

Answer any **FIVE** Questions **5x3 = 15 M**

6. **2 Questions from UNIT- I (Q. No 11 & 12)**
7. **2 Questions from UNIT- II (Q. No 13 & 14)**
8. **2 Questions from UNIT- III (Q. No 15 & 16)**
9. **1 Question from UNIT- IV (Q. No 17)**
10. **1 Question from UNIT- V (Q. No 18)**

	Government College(Autonomous) Rajamahendravaram	Program & Semester			
Course Code C3	**TITLE OF THE COURSE** **Course -3: INORGANIC CHEMISTRY**	I B.Sc.Analytical Chemistry (H) (Semester - II)			
Teaching	Hours Allocated: 45 (**Theory**)	L	T	P	C
Pre-requisites	Basics in Inorganic Chemistry and Periodic Table	3		-	3

Course Objectives:

4. To learn the preparation and structure of Diborane and Borazole.
5. To provide the knowledge about different types of Interhalogen compounds.
6. To provide the basic knowledge on d-block elements and f-block elements.
7. To learn the synthetic applications of Grignard reagents.

Course Outcomes:

On Completion of the course, the students will be able to	
CO1	Acquire knowledge on preparation and structure of Diborane and Borazole.
CO2	Identify the importance of Interhalogen compounds and Pseudo halogens.
CO3	Comprehend the characteristic properties of d-block elements and f-block elements.
CO4	Identify the importance of Organo metallic compounds in Organic synthesis.

Course with focus on Employability / Entrepreneurship / Skill Development modules

Skill Development		Employability		Entrepreneurship	

Syllabus

UNIT –I Chemistry of p-block elements – I **9 h**

Group 13: Preparation & Structure of Diborane, Borazine.

Group14: Preparation, classification and uses of Silicones and Silanes.

Group 15: Preparation & Structure of Phosphonitrilic Chloride $P_3N_3Cl_6$.

Unit II Chemistry of p-block elements – II **9 h**

Group 16: Classification of Oxides, Structures of Oxides and Oxoacids of Sulphur.

Group 17: Preparation and Structures of Interhalogen compounds, Pseudo halogens.

UNIT-III Chemistry of d-block elements: **9 h**

Characteristics of d-block elements with special reference to electronic configuration, variable valence, magnetic properties, catalytic properties and ability to form complexes. Stability of various oxidation states of 3d series-Latimer diagrams.

UNIT-IV Chemistry of f-block elements: **9 h**

Chemistry of lanthanides - electronic configuration, oxidation states, lanthanide contraction, consequences of lanthanide contraction, color, magnetic properties. Separation of lanthanides by ion exchange method. Chemistry of actinides - electronic configuration, oxidation states, actinide contraction, comparison of lanthanides and actinides.

UNIT-V: ORGANOMETALLIC CHEMISTRY **9 h**

Definition - classification of Organometallic compounds - nomenclature, preparation, properties and synthetic applications of

Organometallic compounds of Li and Mg.

List of Reference Books:

1. Inorganic Chemistry by J.E.Huheey
2. Basic Inorganic Chemistry by Cotton and Wilkinson.
3. A textbook of qualitative inorganic analysis by A.I. Vogel 4. Concise Inorganic Chemistry by J.D.Lee.

CO-PO Mapping:

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

	PO 1	PO2	PO 3	PO4	PO5	PO 6	PO7	PO 8	PO9	PO1 0	PSO1	PSO2	PSO3
CO1	3	2	3	2	2	2	3	3	2	2	3	3	3
CO2	2	3	3	3	3	2	1	2	2	3	2	2	3
CO3	3	3	3	2	2	1	1	2	3	1	2	3	3
CO4	2	1	2	1	3	2	3	1	2	3	2	3	2
Avg.	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

GOVERNMENT COLLEGE (A), RAJAMAHENDRAVARAM

I B.Sc. CHEMISTRY (H)

SEMESTER – II

QUESTION PAPER BLUE PRINT

Course -3: INORGANIC CHEMISTRY

TIME: $2^1/_2$ Hrs. **MARKS: 50 M**

PART-A

Answer ALL the Questions **5 x 7 = 35 M**

1. 2 Questions from UNIT- I
2. 2 Questions from UNIT- II
3. 2 Questions from UNIT-III
4. 2 Questions from UNIT IV
5. 2 Questions from UNIT-V

PART-B

Answer any FIVE Questions **5 x 3 = 15 M**

6. 2 Question from UNIT- I
7. 2 Questions from UNIT- II
8. 2 Question from UNIT- III
9. 1 Questions from UNIT- IV
8. 1 Questions from UNIT- V

GOVERNMENT COLLEGE (A), RAJAHMUNDRY
I B.Sc. CHEMISTRY Hons. (SEMESTER-II)
MODEL PAPER
Course - 3: INORGANIC CHEMISTRY

Time: $2^1/_2$ Hrs. **Maximum Marks: 50**

PART- A

Answer ALL the questions. Each question carries SEVEN marks. 5 x 7M = 35 M

1.Explain the preparation and structure of Diborane. [BT2,CO1]

(OR)

2. What are Silicones? Explain the classification, preparation and applications of Silicones. [BT3,CO1]
3. What are Oxides? Explain the classification of Oxides based on Oxygen content. [BT2,CO2]

(OR)

4. Explain the preparation and structures of AX_3 and AX_5 type Inter halogen compounds. [BT2,CO2]
5. Why d- block elements exhibit variable oxidation states? Explain the variable oxidation states exhibited by d- block elements. [BT4,CO3]

(OR)

6. Explain the following characteristic properties of d-block elements. [BT2,CO3]

   (a) Complex forming ability (b) Magnetic properties.

7. What is Lanthanide contraction ? Explain the consequences of Lanthanide contraction. [BT2,CO3]

(OR)

8. How can you separate the Lanthanides by ion exchange method? [BT4,CO3]
9. What are Grignard reagents? Write the preparation and synthetic applications of Grignard reagents. [BT3,CO4]

(OR)

10. What are Organometallic compounds? Explain the classification of Organometallic compounds based on Carbon-Metal (C-M) bond. [BT3,CO4]

PART- B

Answer any FIVE of the following questions. Each question carries THREE marks
5 x 3M = 15M

11. Why Borazole is called as Inorganic Benzene? Explain in detail. [BT4,CO1]
12. Illustrate the structure of $P_3N_3Cl_6$. [BT2,CO1]
13 **.**Write a short note on pseudo halogens. [BT1,CO2]
14. Describe the classification of oxides based on chemical behavior. [BT2,CO2]
15. Why Cr and Cu exhibit abnormal electronic configurations? [BT4,CO3]
16. Why particularly d- block elements act as catalysts? Explain with suitable examples. [BT4,CO3]
17. Write the differences between Lanthanides and Actinides. [BT1,CO3]
18. Describe the classification of organometallic compounds. [BT2,CO4]

	Government College (Autonomous) Rajamahendravaram	Program & Semester			
Course Code	TITLE OF THE COURSE **Course -3: ANALYSIS OF SIMPLE SALT**	I B.Sc. Analytical CHEMISTRY(H) (Semester - II)			
Teaching	Hours Allocated: 30 (**Practical**)	L	T	P	C
Pre-requisites	Basic principles of inorganic qualitative analysis	-	-	2	1

Course Objectives:

1. To learn the systematic procedure for identification of simple inorganic anions.
2. To learn the systematic procedure for identification of simple inorganic cations.
3. To learn the laboratory techniques involved in the inorganic qualitative analysis.
4. To understand the chemical reactions involved in the identification of acidic and basic radicals.

Course Outcomes:

On Completion of the course, the students will be able to	
CO1	Understand the basic concepts of qualitative analysis of inorganic salts
CO2	Learn the usage of glassware, equipment and chemicals involved in salt analysis
CO3	Apply the concepts of common ion effect, solubility product and concepts related to qualitative analysis
CO4	Acquire knowledge of micro scale salt analysis procedure.

Course with focus on employability / entrepreneurship / Skill Development modules

Skill Development		Employability		Entrepreneurship	-

Syllabus

Analysis of inorganic simple salt: **50 M**

Analysis of simple salt containing one anion and one cation from the following.

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

Cations: Lead, Copper, Iron, Aluminium, Zinc, Nickel, Manganese, Calcium, Strontium, Barium, Magnesium and Ammonium.

References:

1. A Text Book of Quantitative Inorganic Analysis - Vogel, A. I.
2. A Textbook of Elementary Qualitative Analysis. Third edition (Engelder,Carl J.)
3. Systematic Qualitative Analysis. K L Kapoor.

Web Links:

1. https://youtu.be/adA8doZhqWs

CO-PO Mapping:

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

	PO1	PO 2	PO 3	PO 4	PO 5	PO 6	PO7	PO8	PO9	PO1 0	PSO1	PSO2	PSO3
CO1	3	3	3	2	3	2	2	2	3	2	2	3	3
CO2	3	3	3	2	3	2	2	3	2	3	3	3	3
CO3	3	2	3	2	3	1	2	2	2	2	2	3	2
CO4	3	3	2	1	3	2	2	1	3	3	3	3	3
Avg.	3	2.75	2.75	2	3	2	2	2	2.5	2.5	2.5	3	2.75

	Government College (Autonomous) Rajahmundry	Program & Semester I B.Sc. ANALYTICAL CHEMISTRY (SEMESTER – II)			
Course Code C4	TITLE OF THE COURSE Course -4: **BASIC PRINCIPLES IN ANALYTICAL CHEMISTRY**				
Teaching	Hours Allocated: 45 (**Theory**) (3 hrs. / Wk.)	L	T	P	C
Pre-requisites:	Basic knowledge about material and energy balances	3	-	-	3

Course Objectives:

1. To provide basic knowledge about Chemical concentrations and standard solutions
2. To provide basic awareness on Chemical analysis
3. To understand and proper handling of common laboratory glass apparatus
4. To provide knowledge and applications of errors in chemical analysis

Course Outcomes:

On Completion of the course, the students will be able to-		Cognitive Domain
CO1	Understand chemical concentrations and get skill to prepare different standard solutions	Skill
CO2	Understand about chemical analysis and identify suitable chemical methods to analyze different samples.	Application
CO3	Handle different types of common laboratory glass apparatus used in chemical analysis	Understand
CO4	Get awareness on errors in chemical analysis and get capability to calculate them	Application

Course with focus on employability / entrepreneurship / Skill Development modules

Skill Development		Employability		Entrepreneurship	

Syllabus:

UNIT-I: **9 Hrs.**

1. SI Units:

1. Definitions of the Seven Base Units: Mass, Length, Time, Temperature, Amount Of substance, Electrical current and luminous intensity
2. Derived units and Conversion between units.

2. CHEMICAL CONCENTRATIONS:

1. Mole, molar mass; Calculations in grams and moles;
2. Solutions and their concentrations:
    1. Molar concentrations;
    2. Analytical Molarity;
    3. Equilibrium molarity of a particular species;
    4. Percent concentration;
    5. Parts per million/ billion (ppm, ppb);
    6. Volume ratios for dilution procedures;
    7. p-functions;
3. **Preparation of standard Solutions and Experimental procedure:**

    Standard solutions, Primary standard solutions and Secondary Standard solutions

UNIT-II: **9 Hrs.**

INTRODUCTION TO ANALYTICAL CHEMISTRY AND ANALYTICAL METHODS – I:

1. Introduction to Chemical analysis
2. General steps involved in chemical analysis
3. Quantitative Chemical analysis
4. Types of Quantitative Chemical Analysis: Classical methods of analysis and Instrumental methods of analysis with examples
5. Methods of detecting analytes based on,
    1. Physical properties,
    2. Electromagnetic radiations
    3. Electric charge

UNIT-III: **9 Hrs.**

INTRODUCTION TO ANALYTICAL CHEMISTRY AND ANALYTICAL METHODS – II:

4. Description, use and calibration of common laboratory apparatus: Volumetric flask, Burettes and Pipettes

5. Description and use of common laboratory apparatus

   Conical Flask, Weighing bottles, Funnels, Desiccators, Drying ovens

6. pH meter - components, use, maintenance, applications

7. Single pan analytical balance - operation and construction, Errors in weighing and care of an analytical balance.

UNIT-IV: **9 Hrs.**

ERRORS IN CHEMICAL ANALYSIS:

a. Errors and Types of Errors

b. Accuracy and Precision

c. Propagation of uncertainty: Gaussian distribution

d. Mean and Standard deviation;

e. Statistical tests of data: F-test, t-test, Q-test for bad data

f. .Calibration curve;

7. Significant figures and their computation rules

11. Laboratory note book

12. Safety with chemicals and Wastes.

UNIT – V:

VOLUMETRICANALYSIS: **9Hours**

a. Titrimetric analysis: Volumetric titrimetry introduction

b. Different terms involved in titrimetric analysis: Titrant, Titrand, The equivalence point, the end point and Indicator.

c. Classification and principles of volumetric methods with examples:

d. Acid-Base titrations,

e. Redox Titrations

f. Complexometric Titrations

g. Precipitation Titrations.

h. Indicator; Definition, theories of indicators, different types of indicators

i. Buffer Solutions

Text Books:

Douglas A. Skoog and Donald M.West: Fundamentals of Analytical Chemistry.

Quantitative chemical analysis by Vogel's 6th and 7th editions

List of Reference Books:

i. **Seamus P.J. Higson: Analytical Chemistry.**

ii. Douglas A. Skoog and Donald M.West: Fundamentals of Analytical Chemistry.

iii. Adion A. Gordus: Schaum's Outline of Analytical Chemistry, Tata McGraw-Hill.

iv. GaryD.Christian: Analytical Chemistry.

v. Freifelder and Kealy: Analytical Chemistry.

vi. Daniel C Harris: Exploring Chemical Analysis.

vii. Daniel C Harris: Quantitative Chemical Analysis.

viii. Quantitative chemical analysis by Vogel's 6^{th} and 7^{th} editions

CO-PO Mapping:

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

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

GOVERNMENT COLLEGE (A), RAJAMAHENDRAVARAM I B.Sc.

ANALYTICAL CHEMISTRY

SEMESTER – II

Course -4: BASIC PRINCIPLES IN ANALYTICAL CHEMISTRY WEIGHTAGE TO CONTENT & BLUE PRINT

S.NO.	COURSE CONTENT	LONG ANSWER QUESTIONS	SHORT ANSWER QUESTIONS	TOTAL MARKS	AS PER BLOOMS TAXONOMY
1.	UNIT - I	2	1	17	Understanding, Application
2.	UNIT – II	2	2	20	Remembering, Understanding
3.	UNIT – III	2	2	20	Analyzing, Creation
4.	UNIT – IV	2	2	20	Evaluation, Understanding
5.	UNIT - V	2	1	17	Understanding, Application
	TOTAL	**10**	**8**	**94**	

GOVERNMENT COLLEGE (A), RAJAHMUNDRY I B.Sc.

ANALYTICAL CHEMISTRY

SEMESTER-II MODEL

PAPER (From 2024-25)

Course - 4: BASIC PRINCIPLES IN ANALYTICAL CHEMISTRY

Time: $2^1/_2$ hrs. **Maximum Marks: 50**

PART- A

Answer ALL the questions. Each carries SEVEN marks **5 x 7 = 35 M**

1. What are Primary standard solutions? Explain the experimental procedure for the preparation of a primary standard solution. BT2 CO1 PO1

(OR)

2. What are secondary standard solutions? Explain the experimental procedure for the preparation of a secondary standard solution. BT2 CO1 PO1
3. Explain the methods of detecting analytes based on Electic charge and electromagnetic radiation BT2 CO2 PO2

(OR)

4. Explain about the Instrumental methods of analysis with suitable examples BT1 CO2 PO2
5. Explain in detail about pH meter BT2 CO3 PO3

(OR)

6. Write in detail about the single pan analytical balance BT2 CO3 PO3

8. What are Errors? Write about the classification of errors BT1 CO4 PO4

(OR)

9. What are significant figures? Write the computation rules of significant figures BT3 CO4 PO4
10. Explain different theories of Indicators BT2 CO5 PO5

(OR)

11. Explain the acid – base titrations with examples BT3 CO5 PO5

PART- B

Answer any FIVE of the following questions. Each carries THREE marks 5 x 3 = 15 M

11. Define mole and molar concentration BT1 CO1 PO1
12. Write briefly about chemical analysis BT2 CO2 PO2
13. Write a short note on Qualitative analysis BT2 CO2 PO2
14. How do you calibrate a volumetric flask? BT3 CO3 PO3
15. Write the uses of commonly used laboratory glass apparatus BT1 CO3 PO3
16. Define mean and standard deviation BT3 CO4 PO4
17. Explain briefly about accuracy BT2 CO4 PO5
18. What are Buffer solutions? BT1 CO5 PO5

	Government College (Autonomous) Rajahmundry	Program & Semester			
Course Code C4P	TITLE OF THE COURSE **Course -4: VOLUMETRIC ANALYSIS**	I B.Sc. ANALYTICAL CHEMISTRY (II Semester)			
Teaching	Hours Allocated: 30 (**Practical**)	L	T	P	C
Pre-requisites	Preparation of standard solutions and handling of laboratory apparatus	-	-	2	1

Course Objectives:

1. To provide basic knowledge about the handling of laboratory apparatus
2. To provide knowledge about the preparation of standard solutions
3. To provide hands on training for the determination of different components

Course Outcomes:

On Completion of the course, the students will be able to	
CO1	Handle and calibrate the common laboratory glass apparatus
CO2	Get practical skill to the preparation of different standard solutions used for quantitative analysis
CO3	Determine different unknown components present in the given solutions
CO4	Acquire knowledge on buffer solutions

Course with focus on employability / entrepreneurship / Skill Development modules

Skill Development		Employability		Entrepreneurship	-

Practical Syllabus: **50 M**

1. Use and calibration of common volumetric apparatus : Burette, Pipette and Volumetric flask
2. Preparation of standard solutions: Primary and secondary standard solutions
3. Determination of Sodium carbonate by using standard HCl solution
4. Determination of zinc by using EDTA solution
5. Preparation of Buffer solutions

CO-PO Mapping:

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

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3
CO1	3	3	3	2	3	2	2	2	3	2	2	3	3
CO2	3	3	3	2	3	2	2	3	2	3	3	3	3
CO3	3	2	3	2	3	1	2	2	2	2	2	3	2
CO4	3	3	2	1	3	2	2	1	2	3	3	3	3
Avg.	3	2.75	2.75	2	3	2	2	2	2.25	2.5	2.5	3	2.75

	Government College (Autonomous) Rajahmundry	Program & Semester II B.Sc. ANALYTICAL CHEMISTRY (SEMESTER – III)			
Course Code C5	TITLE OF THE COURSE Course -5: **ORGANIC CHEMISTRY**				
Teaching	Hours Allocated: 45 (**Theory**) (3 hrs. / Wk.)	L	T	P	C
Pre-requisites:	Basic knowledge organic chemistry	3	-	-	3

Course Objectives:

13. To provide basic knowledge about structural theory in organic chemistry
14. To provide knowledge on alkenes, alkynes and its applications
15. Gain knowledge on benzene and its derivatives in synthetic organic chemistry

Course Outcomes:

On Completion of the course, the students will be able to-		Cognitive Domain
CLO1	Know the concepts of inductive effect, mesomeric effect and hyper conjugation	Knowledge
CLO2	Understand the basic concepts in Organic chemistry	Understanding
CLO3	Apply the knowledge of structural theories of organic compounds	Applying
CLO4	Synthesis of Alkenes, Alkynes, Cycloalkanes and Benzene	Evaluating
CLO5	Properties of Alkene, Alkynes, Cycloalkanes, Benzenes and its mechanisms	Analysing

Course with focus on employability / entrepreneurship / Skill Development modules

Skill Development		Employability		Entrepreneurship	

Syllabus:

UNIT-I: **9 Hrs.**

STRUCTURAL THEORY IN ORGANIC CHEMISTRY

Types of bond fission and organic reagents (Electrophilic, Nucleophilic, and free radical reagents including neutral molecules like H2O, NH3& AlCl3).

Inductive effect. Application of inductive effect (a) Basicity of amines (b) Acidity of carboxylic acids (c) Stability of carbonium ions. Resonance or Mesomeric effect, application

to (a) acidity of phenol, and (b) acidity of carboxylic acids. Hyper conjugation and its application to stability of carbonium ions, Free radicals and alkenes, carbanions..

Types of Organic reactions : Addition - electrophilic, nucleophilic and free radical. Substitution - electrophilic, nucleophilic and free radical. Elimination- Examples.

UNIT-II: **9 Hrs.**

ACYCLIC HYDROCARBONS

Alkenes - Preparation of alkenes. Properties: Addition of hydrogen - heat of hydrogenation and stability of alkenes. Addition of halogen and its mechanism. Addition of HX, Markonikov's rule, addition of H2O, HOX, H2SO4 with mechanism and addition of HBr in the presence of peroxide (anti - Markonikov's addition).

Dienes - Types of dienes, reactions of conjugated dienes - 1,2 and 1,4 addition of HBr to 1,3 - butadiene and Diel's - Alder reaction

UNIT-III: **9 Hrs.**

Alkynes - Preparation by dehydrohalogenation of dihalides, dehalogenation of tetrahalides, Properties; Acidity of acetylenic hydrogen (formation of Metal acetylides).

Preparation of higher acetylenes, Metal ammonia reductions, Physical properties. Chemical reactivity - electrophilic addition of X2, HX, H2O (Tautomerism), Oxidation with KMnO4, OsO4, reduction and Polymerisation reaction of acetylene.

UNIT-IV: **9 Hrs.**

ALICYCLIC HYDROCARBONS (CYCLOALKANES)

Nomenclature, Preparation by Freunds method, Wislicenus method. Properties - reactivity of cyclopropane and cyclobutane by comparing with alkanes,

Stability of cycloalkanes - Baeyer's strain theory, Sachse and Mohr predictions and Pitzer's strain theory. Conformational structures of cyclobutane, cyclopentane, cyclohexane.

UNIT – V:

BENZENE AND ITS REACTIVITY

Concept of aromaticity - aromaticity (definition), Huckel's rule - application to Benzenoid (Benzene, Naphthalene) and Non - Benzenoid compounds (cyclopropenyl cation, cyclopentadienyl anion and tropylium cation)

Reactions - General mechanism of electrophilic substitution, mechanism of nitration, Friedel Craft's alkylation and acylation.

Orientation of aromatic substitution - Definition of ortho, para and meta directing groups. Ring activating and deactivating groups with examples (Electronic interpretation of various groups like NO2 and Phenolic). Orientation of (i) Amino, methoxy and methyl groups (ii) Carboxy, nitro, nitrile, (iii) Halogens

List of Reference Books

a. NCERT +1 and +2

b. Unified chemistry textbook, O.P.Agarwal

CLO-PLO Mapping:

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

	CLO\ PLO	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7	PLO8	PLO9	PLO10
Inorganic Chemistry	CLO1	3	2	2	1	1	0	0	0	3	0
	CLO2	3	1	2	1	1	0	0	0	3	0
	CLO3	3	3	3	1	1	0	0	0	3	0
	CLO4	3	3	3	2	2	0	0	0	3	0
	CLO5	3	3	3	2	2	0	0	0	3	0
	Avg.	3	2.4	2.6	1.4	1.4	0	0	0	3	0

GOVERNMENT COLLEGE (A), RAJAMAHENDRAVARAM

I B.Sc. ANALYTICAL CHEMISTRY (Hons.) SEMESTER–III 2024-25

CHEMISTRY COURSE-5: ORGANIC CHEMISTRY

QUESTION PAPER BLUE PRINT

TIME: $2^1/_2$ hrs. **MAX. MARKS: 50**

PART – A

Answer **ALL** the following questions. **5x7 = 35 M**

1a *Question from UNIT-I*

OR

1b *Question from UNIT-I*

2a *Question from UNIT-II*

OR

2b *Question from UNIT-II*

3a *Question from UNIT-III*

OR

3b *Questions from UNIT-III*

4a *Question from UNIT-IV*

OR

4b *Question from UNIT-IV*

5a *Question from UNIT-V*

OR

5b *Question from UNIT-V*

PART – B

Answer any **FIVE** of the following questions. **5x3 = 15 M**

6 *Questions from UNIT-I*

7 *Questions from UNIT-II*

8 *Questions from UNIT-III*

9 *Questions from UNIT-III*

10 *Questions from UNIT-III*

11 *Questions from UNIT-III*

12 *Questions from UNIT-IV*

13 *Questions from UNIT-V*

GOVERNMENT COLLEGE (A), RAJAMAHENDRAVARAM **I B.Sc.**

ANALYTICAL CHEMISTRY (Hons.) **SEMESTER–III 2024-25**

CHEMISTRY COURSE-5: ORGANIC CHEMISTRY

MODEL QUESTION PAPER

TIME: $2^1/_2$ hrs. **MAX. MARKS: 50**

PART – A

Answer **ALL** the following questions. **5x7 = 35 M**

		Marks	BL	CLO	PLO	PI
1a)	What is inductive effect? Explain its aplications	*7*	*2*	*1*	*1*	
	OR					
1b)	Explain types of organic reactions with examples	*7*	*2*	*2*	*2*	
2a)	Explain the preparation methods and chemical properties of alkenes	*7*	*2*	*1*	*2*	
	OR					
2b)	Explain 1,2 – and 1,4 – addition reactions in conjugated dienes	*7*	*2*	*3*	*2*	
3a)	Write the preparations and chemical properties of alkynes	*7*	*5*	*1*	*9*	
	OR					
3b)	Explain the chemical properties of higher alkynes	*7*	*2*	*2*	*5*	
4a)	Explain the preparation and chemical properties of cycloalkanes	*7*	*4*	*1*	*3*	
	OR					
4b)	How Baeyer strain theory is used for explaining the stability of cycloalkanes.	*7*	*3*	*4*	*2*	
5a)	Explain the concept of aromaticity based on Huckels rule	*7*	*6*	*5*	*5*	
	OR					
5b)	Explain aromatic substitution reactions of Benzene.	*7*	*3*	*4*	*4*	

PART – B

Answer any **FIVE** of the following questions. **5x3 = 15 M**

		Marks	BL	CLO	PLO	PI
6)	Write briefly about organic reagents	*3*	*1*	*1*	*1*	
7)	Explain the acidity of phenols by using mesomeric effect	*3*	*2*	*2*	*2*	
8)	Discuss Markonikov's rule	*3*	*2*	*1*	*3*	
9)	What is Diels - Alder reaction? Give example	*3*	*6*	*3*	*5*	
10)	Write briefly about the acidity of alkynes.	*3*	*5*	*3*	*9*	
11)	What are cyclo alkanes? Give example	*3*	*2*	*5*	*2*	
12)	What are ring activation groups? give example	*3*	*4*	*4*	*3*	
13)	Differentiate between benzenoid and non – benzenoid aromatic compounds.	*3*	*5*	*5*	*4*	

	Government College (Autonomous) Rajahmundry	Program & Semester			
Course Code C5P	TITLE OF THE COURSE **Course -5: ORGANIC FUNCTIONAL GROUP ANALYSIS**	I B.Sc. ANALYTICAL CHEMISTRY (III Semester)			
Teaching	Hours Allocated: 30 (**Practical**)	L	T	P	C
Pre-requisites	Organic qualitative analysis and functional groups	-	-	2	1

Course Objectives:

12. To provide basic knowledge about organic functional groups
13. To provide knowledge about the analysis of organic functional groups
14. To provide practical handling of laboratory apparatus involving the organic functional groupanalysis

Course Outcomes:

On Completion of the course, the students will be able to	
CO1	Identify different organic functional groups
CO2	Get practical skill to the analysis of different organic functional groups
CO3	Identify different unknown components present in the given organic compounds
CO4	Acquire knowledge on the nature of the organic compounds

Course with focus on employability / entrepreneurship / Skill Development modules

Skill Development		Employability		Entrepreneurship	-

Practical Syllabus: **50 M**

Organic functional group analysis:

Reactions of the following functional groups present in organic compounds (at least 4)
Alcohols ,Phenols, Aldehydes, ketones,Carboxylic Acids and Amines

CLO-PLO Mapping:

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

	CLO\ PLO	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7	PLO8	PLO9	PLO10
Titrimetric Analysis	CLO1	3	2	2	3	2	1	0	0	3	0
	CLO2	3	2	2	3	2	1	0	0	3	0
	CLO3	3	3	3	3	2	1	0	0	3	0
	CLO4	3	3	3	3	2	1	0	0	3	0
	Avg.	3	2.5	2.5	3	2.0	1	0	0	3	0

GOVERNMENT COLLEGE (A), RAJAMAHENDRAVARAM

II B.Sc. ANALYTICAL CHEMISTRY (Hons.)2024-25

III SEMESTER END EXAMINATIONS

LABORATORY COURSE-5: ORGANIC FUNCTIONAL GROUP ANALYSIS - PRACTICAL

Scheme of Valuation

Time: 3 Hours **Max. Marks: 50**

1. Record 10 Marks

2. Practical 35 Marks

3. Viva - voce 5 Marks

Splitting of Practical Marks:

i. Preliminary examination in 10 minutes : 5 M

ii. Confirmation test : 10 M

iii. Preparation derivative : 10 M

v. Report : 10 M

	Government College (Autonomous) Rajahmundry	Program & Semester II B.Sc. ANALYTICAL CHEMISTRY (H) (SEMESTER – III)			
Course Code C6	TITLE OF THE COURSE Course -6: **ORGANIC CHEMISTRY** (Halogen and Oxygen containing organic compounds)				
Teaching	Hours Allocated: 45 (**Theory**) (3 hrs. / Wk.)	L	T	P	C
Prerequisites:	Basic knowledge on structure and reactivity of organic compounds	3	-	-	3

Course Objectives:

16. To provide knowledge on reactivity of Halogen and Oxygen containing organic compounds
17. To provide basic awareness on preparatory methods of Halogen and Oxygen containing organic compounds
18. To understand classification of carbohydrates and structural elucidation of glucose & fructose

Course Outcomes:

On Completion of the course, the students will be able to-		Cognitive Domain
CO1	Understand the concept of SN_1 and SN_2 mechanisms	Understanding
CO2	Describe the reactivity of alkyl halides, alcohols and phenols.	Application
CO3	Achieve the skills required to propose various mechanisms	Skill
CO4	Apply the concepts for synthesising various Halogen &oxygen containing organic compounds	Application

Course with focus on employability / entrepreneurship / Skill Development modules

Skill Development		Employability		Entrepreneurship	

Syllabus:

Unit – I Halogen compounds (9 h)

Alkyl halides: Preparation of alkyl halides from i) alkanes, ii) alkenes and iii) alcohols. Properties - nucleophilic substitution reactions–SN_1 and SN_2 mechanisms with energyprofile diagrams and stereo chemical aspects . Williamson's synthesis.

Aryl halides: Preparation i) from phenols ii) Sandmeyer's reaction, nucleophilic aromatic substitution (Benzyne mechanism); relative reactivity of alkyl, allyl, vinyl and benzyl, aryl halides towards nucleophilic substitution reactions.

Unit II Alcohols and Phenols (9 h)

Alcohols: Nomenclature,classification, Preparation of 1^0,2^0,3^0alcohols from Grignard's reagent, Bouveault–Blanc Reduction; Chemical properties –A) Reactions involving only the hydrogen atom of -OH group B) Reactions involving -OH group as a whole. Distinction between 1^0,2^0,3^0alcohols with lucas reagent. Pinacol Pinacolone arrangement with mechanism.

Phenols : Preparation from diazonium salt and Cumene. Reactions and mechanism–Reimer–Tiemann**,** Kolbe–Schmitt Reactions, Fries and Claisen rearrangements

Unit III Carbonyl Compounds (9 h)

Preparation from-Acid chlorides,1,3-dithiane and nitriles; Structure and reactivity of carbonyl group, Nucleophilic addition reactions with HCN, NaHSO3 and alcohols. addition-

elimination reactions with hydroxylamine, hydrazine, phenyl hydrazine, 2,4DNP, semicarbazide. Oxidations and reductions (Baeyer -Villiger oxidation,KMnO4, Clemmensen's, Wolf–Kishner's, with LiAlH4 & NaBH4).

Reaction & Mechanism- Aldol condensation, Cannizzaro reaction, Perkin reaction, Benzoin condensation, Claisen-Schmidt reaction, Haloform reaction

Unit-IV Carboxylic acid and Active methylene Compounds (9h)

Carboxylic Acids: Preparation from Grignard reagent and hydrolysis of nitriles, Reactions of monocarboxylic acids- Reactions involving -H, -OH and-COOH groups, formation of salts,

esters, acidchlorides, amides and anhydrides. Degradation of carboxylic acids by Huns-Diecker's reaction, decarboxylation by Schmidt reaction, Arndt-Eistert synthesis,halogenation by Hell- Volhard- Zelinsky reaction. Mechanisms of acidic and alkaline hydrolysis of esters, Reformatsky reactions, Curtius rearrangement.

Active methylene compounds: Ketoenol tautomerism, preparation of Aceto Acetic Ester(AAE) by Claisen condensation with mechanism,synthetic applications of AAE in the preparation of mono carboxylic acids, di carboxylic acids, α,β-unsaturated acids and heterocyclic compounds.

Unit V : Carbohydrates (9 h)

Classification and their biological importance, Monosaccharides: Structural elucidation of glucose and fructose, epimers and anomers, mutarotation, determination of ring size of glucose and fructose, Haworth projections and conformational structures; Interconversions of aldoses and ketoses; Killiani-Fischer synthesis and Ruff degradation.

List of Reference Books

a. 1.Morrison, R. N. & Boyd, R. N. Organic Chemistry, Dorling Kindersley (India) Pvt. Ltd. (PearsonEducation).

b. 2.Finar, I. L. Organic Chemistry (Volume 1), Dorling Kindersley (India) Pvt. Ltd. (Pearson Education).

c. Guide book to Mechanism in Organic Chemistry by Peter Sykes 6th edition,1985.

CO-PO Mapping:

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

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

GOVERNMENT COLLEGE (A), RAJAMAHENDRAVARAM II B.Sc.

A N A LY T I C A L CHEMISTRY(H) SEMESTER – III

Course -6: ORGANIC CHEMISTRY

(Halogen and Oxygen containing organic compounds)

WEIGHTAGE TO CONTENT & BLUE PRINT

S.NO.	COURSE CONTENT	LONG ANSWER QUESTIONS	SHORT ANSWER QUESTIONS	TOTAL MARKS	
1.	UNIT - I	2	1	17	
2.	UNIT – II	2	2	20	
3.	UNIT – III	2	2	20	
4.	UNIT – IV	2	2	20	
5.	UNIT - V	2	1	17	
	TOTAL	**10**	**8**	**94**	

GOVERNMENT COLLEGE (A), RAJAHMUNDRY

II B.Sc. ANALYTICAL CHEMISTRY(H)

SEMESTER-III MODEL PAPER

Course - 6: ORGANIC CHEMISTRY (Halogen and Oxygen containing organic compounds)

Time: $2^1/_2$ hrs. **Maximum Marks: 50**

PART-A

Answer ALL the questions. Each carries SEVEN marks **5 x 7 = 35 M**

1. Discuss the mechanism and stereochemistry of SN^1 and SN^2 reactions taking suitable examples. BT2 CO1

(OR)

2. Write a short note on the following BT1 CO3
   i)Sandmeyer reaction b) Benzyne mechanism
3. a) Write the preparation of alcohols using Grignard reagent and Bouveault - Blanc reduction BT1 CO4
   b) Explain Lucas method for identification of $1^0,2^0,3^0$alcohols. BT3 CO2

(OR)

4. Explain the mechanism of Reimer-Tiemann and Kolbe- Schmidt reaction. BT1 CO3

5. How does Acetone react with the following reagents BT3 CO3
   i)HCN ii)$NaSHO_3$ iii) NH_2OH iv) NH_2NH_2

(OR)

6. Discuss the mechanism of Aldol condensation and Cannizaro reaction BT1 CO2

7. Explain the acidic and alkaline hydrolysis of esters with mechanism. BT2 CO2

(OR)

8. Write the preparation and any two synthetic applications of Aceto Acetic Ester.BT2 CO1

9. Discuss the constitution and configuration of glucose with experimental evidence and Write objections for open chain structure of glucose. BT3 CO3

(OR)

10. How do you convert i) Glucose to Fructose ii) Aldopentose to Aldohexose BT2 CO4

PART- B

Answer any FIVE of the following questions. Each carries THREE marks 5 x 3 = 15 M

11 Compare the reactivity of alkyl halides and vinyl halides BT4 CO2
12 Write the mechanism for Pinacol-Pinacolone rearrangement. BT2 CO1
13 Write a short note on Fries rearrangement.BT1 CO3
14 Give any two reduction reactions of carbonyl compounds. BT1 CO4
15 Explain the mechanism of Perkin reaction BT2 CO1
16 Write any two preparation methods for carboxylic acids. BT1 CO4
17 Write the mechanism of Huns-Diecker's reaction BT2 CO3
18 What is mutarotation? Why glucose shows mutarotation? BT2 CO2

	Government College (Autonomous) Rajahmundry	Program & Semester			
Course Code C6P	TITLE OF THE COURSE **Course -6: ORGANIC PREPARATIONS** (Halogen and Oxygen containing organic compounds)	II B.SC ANALYTICAL CHEMISTRY(H) (III Semester)			
Teaching	Hours Allocated: 30 (**Practical**)	L	T	P	C
Pre-requisites	Basic knowledge on handling of glassware and chemicals	-	-	2	1

Course Objectives:

1. To provide basic knowledge about the handling of laboratory apparatus
2. To provide knowledge on calculating limiting reagent, theoretical yield, and percent yield.
3. To provide hands on training on laboratory techniques including reflux, distillation, recrystallization, vacuum filtration.

Course Outcomes:

On Completion of the course, the students will be able to	
CO1	How to use glassware, equipment and chemicals and follow experimental procedures in the laboratory.
CO2	How to calculate limiting reagent, theoretical yield, and percent yield.
CO3	How to perform common laboratory techniques including reflux, distillation, recrystallization, vacuum filtration.
CO4	How to critically evaluate data collected to determine the identity, purity and percent yield of products and to summarize findings in writing in a clear and concise manner.

Course with focus on employability / entrepreneurship / Skill Development modules

Skill Development		Employability		Entrepreneurship	-

Syllabus - Organic preparations (50M)

1. Acetylation of β-naphthol, vanillin and salicylic acid by:
    i. Using conventional method.
    ii. Using green approach
2. Preparation of Nerolin

Reference books:

1. Vogel A.I .Practical Organic Chemistry, Longman Group Ltd.
2. Bansal R.K. Laboratory Manual of Organic Chemistry, Wiley-Eastern.
3. Ahluwalia V. K. and Agarwal R. Comprehensive Practical Organic Chemistry, University press

CO-PO Mapping:

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

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3
CO1	2	3	3	2	3	2	2	2	3	2	2	3	3
CO2	3	3	3	2	3	2	2	3	2	3	3	3	3
CO3	3	2	3	2	3	1	2	2	2	2	2	3	2
CO4	3	3	2	1	3	2	2	1	2	3	3	3	3
Avg.	2.75	2.75	2.75	2	3	2	2	2	2.25	2.5	2.5	3	2.75

	Government College (Autonomous) Rajahmundry	Program & Semester II B.Sc. ANALYTICAL Chemistry (H) III Semester Course 7			
Course Code 7	**TITLE OF THE COURSE** **PHYSICAL CHEMISTRY**				
Teaching	Hours Allocated: (**Theory**) 45	L	T	P	C
Pre-requisites:	Basic Knowledge about Solids, Liquids, Gases and Solutions	3		-	3

Course Objectives:

The objective of this course is to provide students with a comprehensive understanding of the essential concepts and applications of Solids, liquids, gases , solutions and ionic equilibria. The course aims to develop students' critical thinking, problem-solving, and analytical skills in

these areas, enabling them to apply scientific principles to real-world situations.

On Completion of the course, the students will be able to-		Cognitive Domain
CLO1	Gain Knowledge about the concepts of Solutions . solids. Liquids .gases and ionic equilibrium	Knowledge
CLO2	At the end of the course , the students will be able to Understand the basic concepts of Solids, Liquids, Gases. Solutions and ionic equilibria	Understanding
CLO3	application of Distribution law to various systems, application of liquid crystals to LCD devices	Application
CLO4	compare and conclude theoretical concepts and applications to day to situations	Evaluation
CLO5	Analyze and caliculate the mathematical problems on different concepts	Analysis

Course with focus on employability / entrepreneurship / Skill Development modules

Skill Development		Employability		Entrepreneurship	

Syllabus:

PHYSICAL CHEMISTRY 3 hrs/week

.

UNIT-I 9h

SOLID STATE: Symmetry in crystals. Law of constancy of interfacial angles. The law of rationality of indices. The law of symmetry. Definition of lattice point, space lattice, unit cell. X-ray diffraction and crystal structure. Bragg's law. Defects in crystals. Stoichiometric and non-stoichiometric defects.

UNIT-II 9h

GASEOUS STATE Introduction and derivation of Ideal Gas Equation. Vander Waal's equation of state. P-V Isotherms of real gases, Andrew's isotherms of carbon dioxide. Critical phenomena. The vanderwaal's equation and the critical state. Law of corresponding states. Relationship between critical constants and vander Waal's constants. Joule Thomson effect.

UNIT-III: 9h

LIQUID STATE Structural differences between solids, liquids and gases. Liquid crystals, the mesomorphic state. Classification of liquid crystals into Smectic and Nematic. Differences between liquid crystal and solid/liquid. Application of liquid crystals as LCD devices.

UNIT-IV 9h

SOLUTIONS Liquid-liquid - ideal solutions, Raoult's law. Ideally dilute solutions, Henry's law. Non-ideal solutions. Azeotropes-HCl-H2O, ethanol-water systems and fractional distillation. Partially miscible liquids-phenol-water. Effect of impurity on consulate temperature. Immiscible liquids and steam distillation. Nernst distribution law. Calculation of the partition coefficient. Applications of distribution law.

UNIT-V 9h

IONIC EQUILIBRIUM AND HSAB Ionic Product, common ion effect, solubility and solubility product. Definition of acid and base with examples, Pearson concept, HSAB Principle & it's importance definition of buffer solution. Henderson –Hassel batch Equation

List of Reference Books

Books 1. Principles of physical chemistry by Prutton and Marron

4. Solid State Chemistry and its applications by Anthony R. West

5. Text book of physical chemistry by K L Kapoor

6. Text book of physical chemistry by S Glasstone

7. Advanced physical chemistry by Bahl and Tuli

Web Links:

https://youtu.be/IPN0WWWfwts?list=PLHhlnNg2PQWVHNecGWt3YAxFcKTW44nJX

https://youtu.be/cmnqmdTZU80

CLO-PLO Mapping:

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

Proposed Activities:

Skill Development: 1.

Employability

	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7	PLO8	PLO9	PLO10
CLO1	3	2	2	1	1	0	0	0	3	0
CLO2	3	1	2	1	1	0	0	0	3	0
CLO3	3	3	3	1	1	0	0	0	3	0
CLO4	3	3	3	2	2	0	0	0	3	0
CLO5	3	3	3	2	2	0	0	0	3	0
Avg.	3	2.4	2.6	1.4	1.4	0	0	0	3	0

GOVERNMENT COLLEGE (A)

RAJAMAHENDRAVARAM

II B.Sc. ,ANALYTICAL CHEMISTRY(H)

SEMESTER–III

QUESTION PAPER BLUEPRINT

Course -7: PHYSICAL CHEMISTRY

TIME: $2^1/_2$ hrs. **MARKS: 50 M**

PART -A

Answer ALL the Questions **5 x 7 = 35 M**

1. 2 Questions from UNIT- I
2. 2 Questions from UNIT- II
3. 2 Questions from UNIT-III
4. 2 Questions from UNIT IV
5. 2 Questions from UNIT-V

PART – B

Answer any FIVE Questions **5 x 3 = 15 M**

6. 2 Question from UNIT- I
7. 2 Questions from UNIT- II
8. 1 Question from UNIT- III
9. 2 Questions from UNIT- IV
10. 1 Questions from UNIT- V

GOVERNMENT COLLEGE (A), RAJAHMUNDRY II B.Sc. ,Analytical CHEMISTRY (H)

SEMESTER-III

MODEL PAPER (From 2024-25)

Course – 7 Physical chemistry

Time: 2$^{1}/_{2}$ hrs. ***Maximum Marks: 50***

PART-AAnswer ALL the questions. Each carries SEVEN marks **5 x 7 = 35** M

	Marks	BL	CLO	PLO	PI
1. **Explain Crystal deffects (or)**	7	2	1	1	
2. **What is Bragg's Law. Derive braggs equation**	7	2	2	2	
3. **Derive the relationship between Critical &Vanderwaal constants**	7	2	1	2	
(or)					
4. **Derive the Vander Waal's equation of state**	7	2	3	2	
5. **Differenciate between liquid crystals & liquids**	7	5	1	9	
(or)					
6. **Discuss any three applications of Liquid crystals.**	7	2	2	5	
	7	4	1	3	
7. **Explain Nernst distribution Law. Explain its applications**	7	3	4	2	
(or)					
8. **Explain what azeotropes are ,Discuss the behavior of HCl-H2O and ethanol-water systems as azeotropes**	7	6	5	5	
9. ***Explain the Hard and Soft Acids and Bases (HSAB) principle***	7	3	4	4	

(or)

10. Using the Henderson-Hasselbalch Eq describe how the pH of a buffer solution

can be caliculated

PART-B

Answer any FIVE Questions **5 × 3 = 15 M**

	Marks	BL	CLO	PLO	PI
11. write number of atoms in fcc and bcc unit cells	3	1	1	1	
12. Discuss the Law of Constancy of Interfacial Angles	3	2	2	2	
13. Explain the Joule-Thomson effect and its importance in thermodynamics.	3	2	1	3	
14. using Andrew's isotherms how do you explain behavior of carbon dioxide near its critical point?	3	6	3	5	
15. What are Smectic & Nematic liquid Crystals? Explain	3	5	3	9	
16. Describe the principle of steam distillation. Why is it particularly useful for immiscible liquids?	3	2	5	2	
17. A solid X is added to a mixture of benzene and water. After shaking well and allowing to stand, 10 ml of the benzene layer was found to contain 0.13 g of X and100 ml of water layer contained 0.22g of X. Calculate the value of distribution coefficient.	3	4	4	3	
18. , Explain common ion effect	3	5	5	4	

	Government College (Autonomous) Rajahmundry	Program & Semester			
Course Code Major7 practical	TITLE OF THE COURSE **Course -7: Physical chemistry practical**	II B.Sc. ANALYTIC AL CHEMISTR Y(H) (III Semester)			
Teaching	Hours Allocated: 30 (**Practical**)	L	T	P	C
Pre-requisites	Theoritical Knowledge about liquid properties like surface tension and viscosity, Knowledge about partition coefficient	-	-	2	1

Course Objectives:

a. Measurement of liquid property like Surface tension, Viscosity

b. Measurement of partition coefficient of substance between two liquids

c. Correct Usage of different lab equipment

Course Outcomes:

On Completion of the course, the students will be able to	
CO1	Understand the basic concepts surface tension. viscosity and partition coefficient
CO2	Usage of glassware, equipment used for surface tension, viscosity and Partition coefficient measurement
CO3	Acquire knowledge of measurement of surface tension. viscosity of different liquids and distribution coefficient of substance between two liquids procedure.
CO4	Acquire knowledge of accurate measurement . tabulation of readings and caliculation of results

Course with focus on employability / entrepreneurship / Skill Development modules

Skill Development		Employability		Entrepreneurship	-

SYLLABUS Credits: 1 (2 hrs/week)

i. Determination of molecular status and partition coefficient of benzoic acid in Benzene and water.

ii. Determination of Surface tension of liquid 1

iii. Determination of Surface tension of liquid 2

iv. Determination of Viscosity of liquid.1

v. Determination of Viscosity of liquid.2

List of Reference Books

b. O.P. Pandey, D.N. Bajpai& S. Giri, Practical Chemistry, S. Chand & Company Ltd.

c. 2. B. D. Khosla, V. C. Garg& A. Gulati, Senior Practical Physical Chemistry, S. Chand & Co.: New Delhi (2011).

d. 3. C. W. Garland, J.W. Nibler, & D.P. Shoemaker, Experiments in Physical Chemistry 8th Ed.; McGrawHill: New York (2003).

e. 4. R.C. Das and B. Behra, Experiments in Physical Chemistry,; Tata McGraw Hill.

Web Links:

https://youtu.be/xGlXcpcPgYs

CLO-PLO Mapping:

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

	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7	PLO8	PLO9	PLO10
CLO1	3	2	2	3	2	1	0	0	3	0
CLO2	3	2	2	3	2	1	0	0	3	0
CLO3	3	3	3	3	2	1	0	0	3	0
CLO4	3	3	3	3	2	1	0	0	3	0
Avg.	3	2.5	2.5	3	2	1	0	0	3	0

	Government College (Autonomous) Rajahmundry	Program & Semester			
Course Code C8	**TITLE OF THE COURSE** **C8 QUANTITATIVE METHODS OF ANALYSIS**	II B.Sc. Analytical Chemistry (Hons.) III Semester)			
Teaching	Hours Allocated: 45 (**Theory**)	L	T	P	C
Pre-requisites	Introduction to chemical analysis and basic analytical methods	3	1	-	3

Course Objectives:

1. To gain knowledge and get awareness on gravimetric analysis
2. To give basic information about types of gravimetric methods
3. To give knowledge and practical experience on volumetric analysis
4. To give knowledge and practical experience on volumetric analysis
5. To provide knowledge and awareness on thermal methods of analysis

Course Outcomes:

On Completion of the course, the students will be able to		Cognitive Domain
CO1	Get awareness and understanding of Gravimetric analysis and precipitation methods	Understanding
CO2	Get Separate and Determine some of the solutes quantitatively by using gravimetric methods	Skill
CO3	Get practical skill and determine some of the analytes quantitatively by using volumetric titration methods	Application
CO5	Get practical skill and determine some of the analytes quantitatively by using volumetric titration methods	Application
CO4	Get awareness and understand the principles of Thermal methods of analysis	Understanding

Course with focus on employability / entrepreneurship / Skill Development modules

Skill Development		Employability		Entrepreneurship	

II B.Sc. Analytical Chemistry (Hons.)

SEMESTER -III

SYLLABUS

QUANTITATIVE METHODS OFANALYSIS

45 Hrs. (03Hrs. /Wk.)

UNIT – I

GRAVIMETRIC ANALYSIS – I **9 Hours**

A. Gravimetric methods:

1. Introduction
2. Types of gravimetric methods

B. Precipitation Gravimetry:

1. Principle and theory of Precipitation gravimetry
2. Various Steps involved in precipitation gravimetry
3. Applications of precipitation methods

C. Volatilization Gravimetry:

1. Principle and theory of Volatilization methods
2. Various steps involved in volatilization methods
3. Applications of volatilization methods: Determination of the Sodium Hydrogen Carbonates content of ant acid tablets.

UNIT – II

GRAVIMETRIC ANALYSIS – II **9 Hours**

A. Properties of Precipitates and Precipitating Reagents:
Particle size, Filterability of Precipitates, Factors that determine particle size, formation of precipitates (Mechanism of precipitates and Relative super saturation value)

B. Precipitation reagents:
   i. Dimethyl glyoxime for Nickel,
   ii. 8 – Hydroxy quinoline for Aluminium,

C. Colloidal Precipitates (coagulation of colloids, peptization of colloids)

D. Co-precipitation (surface adsorption, mixed-crystal formation, occlusion, and mechanical entrapment, co precipitation errors)

UNIT – III

TITRIMETRIC ANALYSIS -I **9 Hours**

A. Acid-base titrations, Neutralization curves, Neutralization of a strong acid with a strong base, Choice of indicators, Preparation of a standard acid (constant boiling point mixture)
B. Redox titrations: Change of the electrode potential during the titration of a reductant with an oxidant, forma1 potentials, Detection of the end point in oxidation-reduction titrations, Oxidations with potassium permanganate, potassium dichromate

UNIT – IV

TITRIMETRIC ANALYSIS -II **9 Hours**

A. Complexometric titrations: types of EDTA titrations, Direct titration, Back-titration, Replacement or substitution titration; Metal ion indicators, Determination of copper: (direct titration), Determination of calcium and magnesium
B. Precipitation titrations: Precipitation reactions, Determination of end points in precipitation reactions, Mohr titration, Volhard's method

UNIT – V

THERMAL METHODS OF ANALYSIS **9 Hours**

A. Thermal methods of analysis:
   1. Introduction
   2. Types of Thermal methods
B. Thermogravimetry (TG):
   1. Principle
   2. Instrumentation
   3. Applications of Thermogravimetry – ($CuSO_4.5H_2O$) and ($CaC_2O_4.H_2O$)
C. Differential thermal analysis (DTA):
   1. Principle
   2. Instrumentation
   3. Applications of DTA - $(CH_3COO)_2 Ca. H_2O$.

1. Douglas A. Skoog and Donald M. West: Fundamentals of Analytical Chemistry.
2. Quantitative chemical analysis by Vogel's 6^{th} and 7^{th} editions

Reference books:

1. Analytical Chemistry-Methods of Separation (R.V. Dilts).
2. Laboratory Handbook of Chromatographic Methods (O. Mikes, R.A. Chalmers).
3. F.W. Fifield and D. Kealy: Analytical Chemistry.
4. Vogel's textbook of quantitative chemical analysis, 6^{th}edition.

5. Vogel's textbook of quantitative chemical analysis, 7th edition.
6. Keith Wilson and John Walker: Practical Biochemistry.

CO-PO Mapping:

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

	CLO \PLO	PLO 1	PLO 2	PLO3	PLO4	PLO5	PLO6	PLO7	PLO8	PLO9	PLO10
QUANTITATIVE METHODS OF	CLO 1	3	2	2	1	1	0	0	0	3	0
	CLO 2	3	1	2	1	1	0	0	0	3	0
	CLO 3	3	3	3	1	1	0	0	0	3	0
	CLO 4	3	3	3	2	2	0	0	0	3	0
	CLO 5	3	3	3	2	2	0	0	0	3	0
	Avg.	3	2.4	2.6	1.4	1.4	0	0	0	3	0

Proposed activities:

Skill Development:

1. Preparation of Buffer solutions
2. Applications of Volumetric titrations

Employability:

1. Principles of Gravimetric methods
2. Applications of Precipitation methods

Entrepreneurship:

1. Thermogravimetry and Differential thermal analysis

GOVERNMENT COLLEGE (A), RAJAMAHENDRAVARAM
DEPARTMENT OF CHEMISTRY

II B.Sc. ANALYTICAL CHEMISTRY

SEMESTER -III

C8: QUANTITATIVE METHODS OF ANALYSIS

MODEL QUESTION PAPER

Time: $2^1/2$ hrs. **Max. Marks: 50 M**

SECTION - A

Answer ALL the questions **(5 X 7 = 35 M)**

1. Any One Question from Unit -I

(OR)

2. Any One Question from Unit -I
3. Any One Question from Unit -II

(OR)

4. Any One Question from Unit –II
5. Any One Question from Unit –III

(OR)

6. Any One Question from Unit -III
7. Any One Question from Unit -IV

(OR)

8. Any One Question from Unit -IV
9. Any One Question from Unit -V

(OR)

10. Any One Question from Unit -V

SECTION-B

Answer any FIVE of the following **(5 X 3 = 15 M)**

11. Any Question from Unit –I
12. Any Question from Unit –I
13. Any Question from Unit –II
14. Any Question from Unit –II
15. Any Question from Unit –III
16. Any Question from Unit –III
17. Any Question from Unit –IV
18. Any Question from Unit –V

GOVERNMENT COLLEGE (A), RAJAMAHENDRAVARAM
DEPARTMENT OF CHEMISTRY

II B.Sc. ANALYTICAL CHEMISTRY

SEMESTER -III

PAPER – II: QUANTITATIVE METHODS OF ANALYSIS

BLUE PRINT

S. No.	Course Content	Essay Questions (7M)	Short Answer Questions (3M)	Total No. Of Questions from each Unit
1	**Unit –I**	2	2	4
2	**Unit –II**	2	2	4
3	**Unit –III**	2	2	4
4	**Unit –IV**	2	1	3
5	**Unit –V**	2	1	3
	TOTAL	**10**	**8**	**18**

GOVERNMENT COLLEGE (A), RAJAMAHENDRAVARAM

DEPARTMENT OF CHEMISTRY

II B.Sc. ANALYTICAL CHEMISTRY

SEMESTER -III

PAPER – C8: QUANTITATIVE METHODS OF ANALYSIS

MODEL QUESTION PAPER

Time: $2^1/2$ hrs. **Max. Marks: 50 M**

SECTION - A

Answer ALL the questions **(5 X 7 = 35 M)**

		Marks	BL	CLO	PLO	PI
1a	What are Precipitation methods? Explain about the various steps involved in precipitation gravimetry	*7*	*2*	*1*	*1*	
	OR					
1b	Explain the principles of Volatilization method. How do you determine the Sodium Bi-carbonate (NaHCO3) content of Antacid tablets by using volatilization method?	*7*	*2*	*2*	*2*	
2a	What is Co-precipitation? Explain the different types of Co-precipitation methods.	*7*	*2*	*1*	*2*	
	OR					
2b	Explain precipitating agents DMG and 8-Hydroxy Quinoline	*7*	*2*	*3*	*2*	
3a	Write about the neutralization of strong acid by strong base	*7*	*5*	*1*	*9*	
	OR					
3b	Explain briefly about Redox titrations with example	*7*	*2*	*2*	*5*	
4a	Describe Mohr method	*7*	*4*	*1*	*3*	
	OR					
4b	Explain briefly Complexometric titrations with examples	*7*	*3*	*4*	*2*	

5a	Explain the Principle, Experimental set up and application of TGA	*7*	*6*	*5*	*5*	
	OR					
5b	Explain the principle, Experimental set up and application of DTA	*7*	*3*	*4*	*4*	

SECTION-B

Answer any FIVE of the following **(5 X 3 = 15 M)**

		Marks	**BL**	**CLO**	**PLO**	**PI**
6	What are Gravimetric methods and explain briefly?	*3*	*1*	*1*	*1*	
7	Write briefly about Drying and ignition of precipitates	*3*	*2*	*2*	*2*	
8	Explain about Colloidal precipitates	*3*	*2*	*1*	*3*	
9	Explain the factors that determine the particle size	*3*	*6*	*3*	*5*	
10	Explain about choice of indicators in acid base titrations	*3*	*5*	*3*	*9*	
11	What is formal potential	*3*	*2*	*5*	*2*	
12	Define back titration	*3*	*4*	*4*	*3*	
13	Explain the types of thermal methods	*3*	*5*	*5*	*4*	

GOVERNMENT COLLEGE (A),
RAJAMAHENDRAVARAM
II B.Sc. ANALYTICAL CHEMISTRY
SEMESTER -III
QUANTITATIVE METHODS OFANALYSIS

QUESTION BANK

ESSAY QUESTIONS: 07 M

1. Explain the principles of Volatilization method. How do you determine the Sodium Bi-carbonate ($NaHCO_3$) content of Antacid tablets by using volatilization method?
2. What are Precipitation methods? Explain about the various steps involved in precipitation gravimetry.
3. What are gravimetric methods? Write briefly about different types of gravimetric methods
4. Explain the properties of precipitates and precipitating reagents.
5. What is Co-precipitation? Explain the different types of Co-precipitation methods.
6. How do you determine Nickel and Calcium by using Precipitation gravimetric methods
7. Explain precipitating agents DMG and 8-Hydroxy Quinoline
8. Explain briefly about Redox titrations with example
9. Explain briefly Complexometric titrations with examples.
10. Write about the neutralization of strong acid by strong base
11. Describe Mohr method
12. Explain the Volhard method
13. Explain the Principle, Experimental set up and application of TGA
14. Explain the principle, Experimental set up and application of DTA

QUESTION BANK

SHORT ANSWER QUESTIONS –03 Marks

1. What are Gravimetric methods and explain briefly?
2. How do you determine $NaHCO_3$ content in antacid tablet by using volatilization gravimetry?
3. Explain about Colloidal precipitates
4. What is Co-precipitation? Explain Co-precipitation errors
5. Explain the direct and back titration
6. What is Indicator? Write the different types of indicators used in precipitation titrations.
7. What is formal potential.
8. Explain briefly about the various types of thermal methods used in chemical analysis
9. What are thermal methods? write the applications of thermal methods

	Government College (Autonomous) Rajahmundry	Program & Semester			
Course Code ACH C8P	**TITLE OF THE COURSE** **QUANTITATIVE METHODS OF ANALYSIS (PRACTICAL –II)**	II B.Sc.AC (III Semester)			
Teaching	Hours Allocated: 30 (**Practical**)	L	T	P	C
Pre-requisites	Introduction to chemical analysis and basic laboratory apparatus	-	-	3	2

Course Objectives:

1. To provide basic practical knowledge about precipitation methods
2. To give practical experience on volumetric titration methods
3. To provide practical knowledge about quantitative determination of different solutes based on titrimetric analysis
4. To provide practical knowledge about quantitative determination of different solutes based on complexometric titration method

Course Outcomes:

On Completion of the course, the students will be able to	
CO1	Determine Ni (II) quantitatively by using precipitation gravimetry
CO2	Perform redox titration for quantitative determination of Fe (II)
CO3	Determine Ca, Mg and Ni ions quantitatively by using complexometric titration method
CO4	Perform acid – base titrations for determination of acidity and alkalinity of samples

Course with focus on employability / entrepreneurship / Skill Development modules

Skill Development		Employability		Entrepreneurship	

II B.Sc. ANALYTICAL CHEMISTRY
SEMESTER -III

QUANTITATIVE METHODS OF ANALYSIS **30 Hrs. (02 Hrs. /Wk.)**

PRACTICAL SYLLABUS:

1. Determination of Iron (II) by titrating with standard Potassium dichromate solution.
2. Estimation of strength of magnesium sulphate solution by using EDTA solution
3. Determination of amount of Calcium and Magnesium in the given mixture by using EDTA.
4. Determination of amount of Carbonate and Bicarbonate in water by titrating with Hydrochloric acid.

Text books:

1. Douglas A. Skoog and Donald M.West: Fundamentals of Analytical Chemistry.
2. Quantitative chemical analysis by Vogel's 6^{th} and 7^{th} editions

Reference books:

1. Douglas A. Skoog and Donald M.West: Fundamentals of Analytical Chemistry.
2. Adion A. Gordus: Schaum's Outline of Analytical Chemistry, Tata McGraw- Hill.
3. GaryD.Christian: Analytical Chemistry.
4. Freifelder and Kealy: Analytical Chemistry.
5. Quantitative chemical analysis by Vogel's 6^{th} and 7^{th} editions

CO-PO Mapping:

(1: Slight [Low];

2: Moderate [Medium]; 3: Substantial [High], '-' : No

Correlation)

	CLO \PLO	PLO 1	PLO 2	PLO3	PLO4	PLO5	PLO6	PLO7	PLO8	PLO9	PLO10
QUANTITATIVE METHODS OF	CLO 1	3	2	2	3	2	1	0	0	3	0
	CLO 2	3	2	2	3	2	1	0	0	3	0
	CLO 3	3	3	3	3	2	1	0	0	3	0
	CLO 4	3	3	3	3	2	1	0	0	3	0
	Avg.	3	2.5	2.5	3	2.0	1	0	0	3	0

GOVERNMENT COLLEGE (A), RAJAMAHENDRAVARAM

DEPARTMENT OF CHEMISTRY

II B.Sc. ANALYTICAL CHEMISTRY

SEMESTER -III

QUANTITATIVE METHODS OFANALYSIS (PRACTICAL –II)

AT THE END OF SEMESTER –III

SCHEME OF VALUATION

Time: 03 Hrs. **Max. Marks: 50 M**

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1. Record -------- 10 Marks
2. Practical -------- 35 Marks
3. Viva - voce -------- 05 Marks

Splitting of Practical Marks :(35M)

i. Procedure in 10 minutes : 5 M
ii. Formula with units : 5 M
iii. Neat tabulation : 5 M
iv. Correct calculation : 5 M
v. Error < 1 % :15 M
vi. Error up to 5 % :10 M
vii. Error > 5% :5 M

Course with focus on employability / entrepreneurship / Skill Development modules

	Government College (Autonomous) Rajahmundry	Program & Semester II B.Sc. ANALYTICAL CHEMISTRY(H) (SEMESTER – IV)			
Course Code 9	TITLE OF THE COURSE Course -9: **SPECTROSCOPY**				
Teaching	Hours Allocated: 45 (**Theory**) (3 hrs. / Wk.)	L	T	P	C
Pre-requisites:	Basic knowledge about spectrum and its classification	3	-	-	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 K2Cr2O7 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 (σ, π, n). Selection rules for electronic spectra. Types of electronic

transitions in molecules. Concept of chromophore and auxochrome. Bathochromic shift, Hypsochromic shift, hyper chromic shift, hypochromic shift. Effect of conjugation on λ_{max}.

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 fingerprint 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, IR and λ_{max} of UV vis spectroscopies with suitable examples - ethyl bromide, ethanol, acetaldehyde, 1,1,2-tribromo ethane, ethyl acetate, toluene and acetophenone.

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)

	CLO\PLO	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7	PLO8	PLO9	PLO10	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

GOVERNMENT COLLEGE (A), RAJAMAHENDRAVARAM

II B.Sc. ANALYTICAL CHEMISTRY (Hons.) SEMESTER–III

COURSE-9: SPECTROSCOPY

QUESTION PAPER BLUE PRINT

TIME: $2^1/_2$ hrs. **MAX. MARKS: 50**

PART – A

Answer **ALL** the following questions. **5x7 = 35 M**

1a Question from UNIT-I

OR

1b Question from UNIT-I

2a Question from UNIT-II

OR

2b Question from UNIT-II

3a Question from UNIT-III

OR

3b Questions from UNIT-III

4a Question from UNIT-IV

OR

4b Question from UNIT-IV

5a Question from UNIT-V

OR

5b Question from UNIT-V

PART – B

Answer any **FIVE** of the following questions. **5x3 = 15 M**

6 Questions from UNIT-I

7 Questions from UNIT-II

8 Questions from UNIT-III

9 Questions from UNIT-IV

10 Questions from UNIT- V

11 Questions from UNIT-II

12 Questions from UNIT-III

13 Questions from UNIT- IV

GOVERNMENT COLLEGE (A), RAJAMAHENDRAVARAM

II B.Sc. ANALYTICAL CHEMISTRY, SEMESTER–IV

COURSE-9: SPECTROSCOPY

MODEL QUESTION PAPER

TIME: $2^1/_2$ hrs. **MAX. MARKS: 50**

PART – A

Answer **ALL** the following questions. **5x7 = 35**

		Marks	BL	CLO	PLO	PI
1a	Define Absorbance, transmittance, and molar absorptivity. State and explain Beer-Lambert law.	7	2	2	1	
	OR					
1b	Give the experimental procedure of simultaneous determination of chromium in potassium dichromate and manganese in Manganous Sulphate using Beer-Lambert's law.	7	2	2	2	
2a	Classify molecular spectra and selection rules for the formation of spectra.	7	2	1	2	
	OR					
2b	Define Chromophore and auxochrome. How does the conjugation, affect the affect the λ_{max}.	7	2	3	2	
3a	Explain the Fingerprint region. Explain its significance with an example. Write IR spectral data for any one alcohol, aldehyde and ketone.	7	5	1	7	
	OR					
3b	Discuss different modes of vibrations in IR spectroscopy.	7	2	2	5	
4a	Give a detailed explanation on the principle of NMR spectroscopy. What is a chemical shift equivalence?	7	4	1	3	
	OR					
4b	Describe the role of equivalent and non-equivalent protons in NMR spectroscopy.	7	3	4	2	

5a	How many different NMR signals you will see in the following molecules? Ethanol, Ethyl Acetate, toluene and Acetophenone.	7	6	5	5	
	OR					
5b	Describe the applications of UV – Vis and IR spectroscopies in structure determination of organic compounds.	7	3	3	4	

PART – B

Answer any **FIVE** of the following questions. **5x3 = 15 M**

	Marks	BL	CLO	PLO	PI
6. Discuss single and double-beam spectrophotometers.	3	1	1	1	
7. Illustrate different shifts in UV – Vis Spectroscopy.	3	2	1	2	
8. Write a short note on different regions in IR.	3	2	1	3	
9. Explain about spin-spin coupling in NMR.	3	6	3	5	
10. Write any two applications of UV-Visspectroscopy with examples	3	5	3	7	
11. Explain types of electronic transitions inUV – Vis Spectroscopy.	3	2	5	2	
12. Write IR stretching frequencies ofalkanes and amines.	3	4	4	3	
13. Define coupling constant with examples.	3	5	4	3	

GOVERNMENT COLLEGE (A), RAJAMAHENDRAVARAM

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

CHEMISTRY COURSE-9: SPECTROSCOPY

QUESTION BANK

Essay Questions

1. Define Absorbance, transmittance, and molar absorptivity. State and explain Beer-Lambert law
2. Give the experimental procedure of simultaneous determination of chromium in potassium dichromate and manganese in Manganous Sulphate using Beer-Lambert's law.
3. Explain types of molecular spectra and selection rules for the formation of spectra.
4. Write about different energy levels of Electronic spectroscopy.
5. Define Chromophore and auxochrome. How does the conjugation, affect the λ_{max}.
6. Write about characteristic absorption bands of various functional groups.
7. Explain the Fingerprint region. Explain its significance with an example. Write IR spectral data for any one alcohol, aldehyde and ketone.
8. Explain Functional group and finger print regions.
9. Discuss different modes of vibrations in IR spectroscopy.
10. Give a detailed explanation on the principle of NMR spectroscopy. What is a chemical shift equivalence?
11. Describe the role of equivalent and non-equivalent protons in NMR spectroscopy.
12. Explain the position of signals.
13. How many different NMR signals you will see in the following molecules? Ethanol, Ethyl Acetate, toluene and Acetophenone.
14. Explain the applications of UV – Vis and IR spectroscopies in structure determination of organic compounds.
15. Application of NMR to ethyl bromide, ethanol, acetaldehyde, 1,1,2-tribromo ethane, ethyl acetate, toluene and acetophenone.

Short Answer Questions

16. Discuss single and double-beam spectrophotometers.
17. Write briefly about different shifts in UV – Vis Spectroscopy.
18. Explain types of electronic transitions in UV – Vis Spectroscopy.
19. Write a short note on different regions in IR.
20. Write IR stretching frequencies of alkanes and amines.
21. Explain about spin-spin coupling in NMR.
22. Define principle of NMR.
23. Define coupling constant with examples.
24. Write any two applications of UV- Vis spectroscopy with examples.

	Government College (Autonomous) Rajahmundry	Program & Semester II B.Sc. ANALYTICAL (SEMESTER – IV)			
Course Code C9P	TITLE OF THE COURSE **Course 9: SPECTROSCOPY**				
Teaching	Hours Allocated: 30 (**Practical**)	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

Skill Development		Employability		Entrepreneurship	-

Practical- IR-Spectral Analysis **50 M**

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)

	CLO\PLO	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7	PLO8	PLO9	PLO10	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

	Government College (Autonomous) Rajahmundry	Program & Semester II B.Sc. ANALYTICAL CHEMISTRY (SEMESTER – IV)			
Course Code	TITLE OF THE COURSE Course -10: **PHYSICAL CHEMISTRY-II**				
Teaching	Hours Allocated: 45 (**Theory**) (3 hrs. / Wk.)	L	T	P	C
Pre-requisites:	Basic knowledge about material and energy balances	3	-	-	3

Course Objectives:

- To provide basic knowledge on Colligative Properties
- To provide basic awareness on concepts of electrochemistry
- To understand the basic concepts of Electrodes and their usage
- To provide knowledge and understand ability on phase systems
- 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	

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-Onsagar'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 PHASE RULE

Concept of phase, components, degrees of freedom. Thermodynamic Derivation of Gibbs phase rule. Phase equilibrium of one component system - water system. Phase equilibrium of two- component system, solid-liquid equilibrium. Simple eutectic diagram of Pb-Ag system, simple eutectic diagram, desilverisation of lead., NaCl-Water system, Freezing mixtures.

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 offluorescence, phosphorescence, Photosensitized

LIST OF REFERENCE BOOKS

14. Modern Electrochemistry by J.O. M. Bockris and A.K.N.Reddy
15. Advanced Physical Chemistry by Atkins
16. Introduction to Electrochemistry by S. Glasstone

CO-PO Mapping:

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

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

GOVERNMENT COLLEGE (A), RAJAMAHENDRAVARAM

II B.Sc. ANALYTICAL CHEMISTRY

SEMESTER – IV

Course -10: PHYSICAL CHEMISTRY-II WEIGHTAGE TO CONTENT & BLUE PRINT

S.NO.	COURSE CONTENT	LONG ANSWER QUESTIONS	SHORT ANSWER QUESTIONS	TOTAL MARKS	AS PER BLOOMS TAXONOMY
1.	UNIT - I	2	1	17	Understanding, Application
2.	UNIT – II	2	2	20	Remembering, Understanding
3.	UNIT – III	2	2	20	Analyzing, Creation
4.	UNIT – IV	2	2	20	Evaluation, Understanding
5.	UNIT - V	2	1	17	Understanding, Application
	TOTAL	**10**	**8**	**94**	

GOVERNMENT COLLEGE (A), RAJAHMUNDRY

II B.Sc. ANALYTICAL CHEMISTRY (H)SEMESTER-IV

MODEL PAPER (From 2024-25) Course - 10:

PHYSICAL CHEMISTRY-II

Time: $2^{1}/_{2}$ hrs. **Maximum Marks: 50**

PART- A

Answer ALL the questions. Each carry SEVEN marks **5 x 7 = 35 M**

1. What is elevation in boiling point and derive the relation between molecular weight of solute andelevation in boiling point? BT2 CO1 PO1

(OR)

2. Define osmatic pressure and explain their experimental determination? BT2 CO1 PO1
3. Explain arhenious theory of dissociation and its limitations BT2 CO2 PO2

(OR)

4. Define the transport number and determine the transport number by Hittorf's method BT1 CO2 PO2
5. Derive the Nernst equation BT2 CO3 PO3

(OR)

6. Describe the following electrodes (a) Calomel electrode (b) Indicator electrode BT2 CO3 PO3
7. Derive the Gibbs phase rule? BT1 CO4 PO4

(OR)

8. Explain phase diagram of Pb-Ag System BT3 CO4 PO4
9. Describe the laws of photo chemistry BT2 CO5 PO5

(OR)

10. Derive the quantum yield of Hydrogen chlorine photochemical reaction through mechanism BT3 CO5 PO5

PART- B

Answer any FIVE of the following questions. Eac h carry THREE marks 5 x 3 = 15 M

11. Why ethylene glycol used as an antifreeze explain? BT1 CO1 PO1
12. Explain the Kohlrausch law BT2 CO2 PO2
13. How does dilution effect the conductivity of electrolyte solution? BT2 CO2 PO2
14. How does the standard hydrogen electrode (SHE) serve as reference point for measuring electrode potentials? BT3 CO3 PO3
15. Explain how a metal-metal ion electrode works? BT1 CO3 PO3
16. How does pressure influence the phase equilibrium of water? BT3 CO4 PO4
17. How is the eutectic point utilized in the desilverisation process? BT2 CO4 PO5
18. Define fluorescence and phosphorescence? BT1 CO5 PO5

	Government College (Autonomous) Rajahmundry	Program & Semester			
Course Code C10	TITLE OF THE COURSE **Course -10: PHYSICAL CHEMISTRY LAB**	II B.Sc. ANALYTICAL CHEMISTRY (SEMESTER – IV)			
Teaching	Hours Allocated: 30 (**Practical**)	L	T	P	C
Pre-requisites	Preparation of standard solutions and handling of laboratory apparatus	-	-	2	1

Course Objectives:

11. To provide hands-on experience in determining the CST of the phenol-water system through laboratoryexperiments.
12. To guide students in designing and conducting experiments to study the effect of NaCl on the CSTand analyze the resultant data.
13. To train students in performing conductometric titrations using standard NaOH solutions for the accuratedetermination of HCl concentration.
14. To equip students with the skills necessary to conduct conductometric titrations to determine theconcentration of CH3COOH using standard NaOH solutions.

Course Outcomes:

On Completion of the course, the students will be able to	
CO1	Analyze the phase behavior of the phenol-water system at different temperatures and concentrations.
CO2	Predict and explain the shifts in CST due to the addition of NaCl to the phenol-water system.
CO3	Develop the skills to perform conductometric titrations using standard NaOH solutions.
CO4	Interpret conductometric titration curves and derive accurate concentrations of CH3COOH from experimental data

Course with focus on employability / entrepreneurship / Skill Development modules

Skill Development		Employability		Entrepreneurship	-

Practical Syllabus: **50 M**

a. Critical solution temperature of phenol-water system

b. Effect of NaCl on CST (phenol water system)

c. Determination of concentration of HCl conductometrically using standard NaOH Solutions

d. Determination of concentration of CH3COOH conductometrically using standard NaOH Solutions

CO-PO Mapping:

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

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3
CO1	3	3	3	2	3	2	2	2	3	2	2	3	3
CO2	3	3	3	2	3	2	2	3	2	3	3	3	3
CO3	3	2	3	2	3	1	2	2	2	2	2	3	2
CO4	3	3	2	1	3	2	2	1	2	3	3	3	3
Avg.	3	2.75	2.75	2	3	2	2	2	2.25	2.5	2.5	3	2.75

	Government College (Autonomous) Rajahmundry	Program & Semester			
Course Code C11	**TITLE OF THE COURSE** **SEPARATION METHODS - I**	ANALYTICAL CHEMISTRY (IV Semester)			
Teaching	Hours Allocated: 60 (**Theory**)	L	T	P	C
Pre-requisites	Introduction to separation methods and fractional distillation	3	1	-	3

Course Objectives:

1. To provide basic knowledge about separation techniques
2. To give knowledge and awareness on chromatographic techniques
3. To provide knowledge and experimental techniques of column chromatography
4. To provide knowledge and importance of HPLC technique.

Course Outcomes:

On Completion of the course, the students will be able to		Cognitive Domain
CO1	Get awareness and understand the principles of chromatography	Understanding
CO2	Get experimental skill and hands on experience about Paper and Thin layer chromatography	Skill
CO3	Get practical skill and separate some of the analytes by using column chromatography	Application
CO4	Get awareness and understanding about the HPLC technique	Understanding

Course with focus on employability / entrepreneurship / Skill Development modules

Skill Development		Employability		Entrepreneurship	

SYLLABUS

UNIT – I: Chromatography: **15hrs**

Introduction to chromatography,Classification of chromatographic methods: Based on principle of separation(Adsorption & Partition),The Stationary and Mobile phases, Principle of chromatographic separation: Differential migration,Theory of chromatography: Distribution coefficients,Methods of developments in chromatographic process: Frontal analysis, Displacement development and Elution development.Efficiency of a chromatographic column, Retention time and retention volume,Capacity factor and Resolution.

UNIT – II: **15hrs**

A) Paper Chromatography:

Principle and theory of paper chromatography,Experimental set up of paper chromatography,Various modes of developments used in paper chromatography: Ascending mode, Descending mode, Radial or circular mode and Two dimensionalmode,The nature of the papers, Paper supports and Stationary phases used in paper chromatography,The solvent systems and the Mobile phases used in paper chromatography,Detection of spots and retardation factor,Applications of paper chromatography

Thin layer chromatography:

Principle and theory of thin layer chromatography,The techniques of thin layer chromatography: Preparation of plate, Stationary phases, Adsorbents, Sample application, Mobile phases, development of plate, measurement and identification of solutes (Rf – value) quantitative evaluation.Advantages of Thin layer chromatography,Quantitative analysis and applications of Thin layer chromatography

UNIT – III: **15hrs**

Adsorption Chromatography:

Principle of Adsorption chromatography,The nature of forces between adsorbate and adsorbent: Vander waals forces, Polar forces, Ionic forces and Chemisorption, Adsorbents materials and Stationary phases used in adsorption chromatography, Solvents & Mobile phases used in adsorption chromatography and Eluotropic series,Types of adsorption chromatography: Thin layer chromatography and Columnchromatography,Applications of adsorption chromatography.

UNIT – IV: **15hrs**

A) Column Chromatography:

Theory and Principle of Column chromatography,Types of Columns used in column chromatography and column packing,Stationary phases and Mobile phases used in column chromatography,Column development and sample elution, Applications of column chromatography

B) Liquid-Liquid Partition Chromatography:

Principle of Liquid – liquid chromatography,Normal phase liquid chromatography,Reverse-phase liquid chromatography,The column and the support materials,Experimental set up and detectors,Applications.

UNIT – V: **15hrs**

High Performance Liquid Chromatography:

Principle and theory of HPLC,Advantages of HPLC technique,Instrumentation of HPLC, Column, column matrices and Column packing,Stationary phases and mobile phases used in HPLC,Solvent delivery systems and Pumps used in HPLC,Detectors used in HPLC:Bulk property detectors: Refractive index and Conductivity detectors, Solute property detectors: UV –detectors and Fluorescence detectors, Applications of HPLC.

Text books:

1. Separation methods by M.N. Sastri
2. Douglas A. Skoog and Donald M.West: Fundamentals of Analytical Chemistry.
3. Quantitative chemical analysis by Vogel's 6th and 7th editions

Reference books:

1. F.W. Fifield and D. Kealy: Analytical Chemistry.
2. Daniel C Harris: Exploring chemical analysis.
3. Daniel C Harris: Quantitative chemical analysis.
4. R.V. Dilts Analytical Chemistry- Methods of Separation.
5. O. Mikes, R.A. Chalmers: Laboratory Handbook of Chromatographic Methods
6. Chemical separation methods by John A. Dean

CO-PO Mapping:

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

Proposed activities:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3
CO1	3	2	3	2	2	2	3	3	2	2	3	3	3
CO2	2	3	3	3	3	2	2	2	2	3	2	2	3
CO3	3	3	3	2	2	1	1	2	3	1	2	3	3
CO4	2	3	2	1	3	2	3	1	2	3	3	2	2
Avg.	2.5	2.75	2.75	2	2.5	1.75	2.25	2	2.25	2.25	2.5	2.5	2.75

Skill Development:

1. Preparation of TLC plates
2. Separation of compounds by using TLC

Employability:

1. Principles of Chromatography
2. Applications of different chromatography techniques

Entrepreneurship:

1. High performance liquid chromatography technique

GOVERNMENT COLLEGE (A),
RAJAMAHENDRAVARAM

ANALYTICAL CHEMISTRY, SEM IV

SEPARATION METHODS - I

MODEL PAPER

TIME: $2^1/_2$ hr. **MARKS: 50 M**

SECTION - A

Answer ALL the questions **(5 X 7 = 35 M)**

1. Any One Question from Unit -I

(OR)

2. Any One Question from Unit -I
3. Any One Question from Unit -II

(OR)

4. Any One Question from Unit -II
5. Any One Question from Unit -III

(OR)

6. Any One Question from Unit -III
7. Any One Question from Unit -IV

(OR)

8. Any One Question from Unit –IV
9. Any One Question from Unit -IV

(OR)

10. Any One Question from Unit -IV

SECTION-B

Answer any Five of the following **(5 X 3 = 15 M)**

11. Any One Question from Unit –I
12. Any Question from Unit –I
13. Any Question from Unit –II
14. Any Question from Unit –II
15. Any Question from Unit –III
16. Any Question from Unit –IV
17. Any Question from Unit –IV
18. Any Question from Unit –V

GOVERNMENT COLLEGE (A),
RAJAMAHENDRAVARAM

II B.Sc. ANALYTICAL CHEMISTRY

SEMESTER -IV

PAPER – II: SEPARATION METHODS -I

BLUE PRINT

S. No.	Course Content	Essay Questions (7M)	Short Answer Questions (4M)	Total No. Of Questions from each Unit
1	**Unit –I**	2	2	4
2	**Unit –II**	2	2	4
3	**Unit –III**	2	1	4
4	**Unit –IV**	2	2	4
5	**Unit –V**	2	1	4
	TOTAL	**10**	**8**	**20**

GOVERNMENT COLLEGE (A),
RAJAMAHENDRAVARAM

II B.Sc. ANALYTICAL CHEMISTRY
SEMESTER -IV

C11- SEPARATION METHODS - I

QUESTION BANK

ESSAY QUESTIONS: 07M

1. Write about the classification of Chromatographic methods
2. Explain about the various development methods in chromatographic process.
3. Write about the following,
   i. Theory involved in Chromatographic methods
   ii. Efficiency of a chromatographic column
4. Write about various modes of developments in Paper chromatographic technique.
5. Explain about the principle, experimental set up and applications of Paper chromatography.
6. Explain about principle, experimental set up and applications of TLC.
7. Explain about the principle and applications of Adsorption chromatography
8. Explain about the principle and application of Column chromatography.
9. Write about the Column packing and column developments in Column chromatography.
10. Explain about the Experimental set up and detectors used in Liquid – liquid partition chromatography
11. Explain in detail about the instrumentation of HPLC
12. Write about the various Detectors used in HPLC
13. Explain briefly about HPLC technique with applications
14. Explain about Normal phase and Reverse- phase chromatographic techniques.

QUESTION BANK SHORT

ANSWER QUESTIONS –04 MARKS:

1. Explain about the principle of differential migration.
2. Write about the efficiency of a chromatographic column.
3. What are distribution coefficients? Explain briefly
4. Explain briefly about Resolution and capacity factor.
5. Write about nature of paper, detection of spots in paper chromatography.
6. Write about Quantitative analysis of TLC.
7. Explain about Sample application and plate preparation in TLC.
8. Define R_f value and write its significance.
9. Explain briefly about the nature of forces between adsorbate and adsorbent in adsorption chromatography.
10. Write about the adsorbent materials used in adsorption chromatography
11. Explain briefly about the sample elution in column chromatography
12. Explain the principle and advantages of HPLC technique.
13. Write about Stationary phases and Mobile phases used in HPLC.
14. What are the differences between NPC and RPC?
15. Explain the principle of Partition chromatography.

	Government College (Autonomous) Rajahmundry	Program & Semester			
Course Code C11P	TITLE OF THE COURSE SEPARATION METHODS –I PRACTICAL –III)	II B.Sc Analytical Chemistry (IV Semester)			
Teaching	Hours Allocated: 30 (**Practical**)	L	T	P	C
Pre-requisites	Introduction to separation methods and chromatography	-	-	2	2

Course Objectives:

1. To provide basic knowledge about separation techniques
2. To give knowledge and awareness on chromatographic techniques
3. To provide knowledge and practical skill on column chromatography

Course Outcomes:

On Completion of the course, the students will be able to	
CO1	Get overall knowledge on separation methods
CO2	Get knowledge and practical skill on Thin layer chromatography
CO3	Get knowledge and hands on experience on column chromatography
CO4	Separate different analyte species based on separation techniques

Course with focus on employability / entrepreneurship / Skill Development modules

Skill Development		Employability		Entrepreneurship	

II B.Sc. ANALYTICAL CHEMISTRY

SEMESTER -IV

C11- SEPARATION METHODS

PRACTICAL SYLLABUS

30 Hrs. (02 Hrs. / Wk.)

1. Determination of Rf value of amino acids using paper chromatography.
2. Separation and identification of monosaccharide present in a given mixture byPaper Chromatography
3. Preparation of TLC plates
4. Separation of 2, 4 –DNP derivatives of acetone and 2 – butanone by TLC. Separation of mixture of O –Nitro aniline and P –Nitro aniline by using Columnchromatography

Text books:

1. Separation methods by M.N. Sastri
2. Douglas A. Skoog and Donald M.West: Fundamentals of Analytical Chemistry.
3. Quantitative chemical analysis by Vogel's 6th and 7th editions

Reference books:

1. F.W. Fifield and D. Kealy: Analytical Chemistry.
2. Daniel C Harris: Exploring chemical analysis.
3. Daniel C Harris: Quantitative chemical analysis.
4. R.V. Dilts Analytical Chemistry- Methods of Separation.
5. O. Mikes, R.A. Chalmers: Laboratory Handbook of Chromatographic Methods

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

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3
CO1	3	2	3	2	2	2	3	3	2	2	3	3	3
CO2	2	3	3	3	3	2	2	2	2	3	2	2	3
CO3	3	3	3	2	2	1	1	2	3	1	2	3	3
CO4	2	3	2	1	3	2	3	1	2	3	3	2	2
Avg.	2.5	2.75	2.75	2	2.5	1.75	2.25	2	2.25	2.25	2.5	2.5	2.75

GOVERNMENT COLLEGE (A),RAJAMAHENDRAVARAM

II B.Sc. ANALYTICAL CHEMISTRYSEMESTER -IV

C11- SEPARATION METHODS -I(PRACTICAL –III)

AT THE END OF SEMESTER –III

SCHEME OF VALUATIONTime: 03 Hrs. Max. Marks: 50 M

1. Record -------- 10 Marks
2. Practical -------- 35 Marks
3. Viva - voce -------- 05 Marks

Splitting of Practical Marks :(35M)

i. Procedure in 10 minutes : 10 M
ii. Principle : 05 M
ii. Experimental set up : 05 M