

17

**P. R. GOVERNMENT COLLEGE  
(AUTONOMOUS)  
KAKINADA**

odd sam



(Affiliated to Adikavi Nannaya University, Rajamahendravaram)

**DEPARTMENT OF CHEMISTRY**

**B.Sc. Analytical Chemistry**

(Syllabus under CBCS)

**Board of Studies  
(2021-22)**

# P. R. Govt. College (A), Kakinada

*Recommended Composition and Functions of the Board of Studies of Analytical Chemistry: 2021-22*

---

## **I Composition**

### **i. Head of the Department concerned (Chairman):**

Sri. Rambabu Vasamsetti, M.Sc., B.Ed., SET.

### **ii. The entire faculty of each specialization.**

1. Dr. D. Rama Rao, M.Sc., B. Ed., M.Phil. Ph.D.
2. Dr. D. Chenna Rao, M.Sc., Ph.D.
3. Sri V. Sanjeeva Kumar MSc., NET
4. Sri T V V. Satya Narayana, M.Sc., B.Ed., SET.
5. Sri P. Vijaya Kumar, M.Sc., NET.
6. Smt. G. Pavani, M.Sc., B.Ed., SET
7. Dr. T. Uma Maheswara Rao, M.Sc., Ph.D.
8. Dr. N. Bujji Babu, M.Sc., Ph.D.
9. Dr. Ch. Praveen, M.Sc., Ph.D.
10. Kum. A. Lakshmi Bhavani. M.Sc.

### **iii. One expert to be nominated by the Vice-Chancellor from a panel of six recommended by the College Principal**

Dr. Dr. K. Jhansi Lakshmi, Principal, ASD WOMEN'S COLLEGE, KAKINADA

### **iv. One expert in the subject from outside the college to be nominated by the Academic Council**

Sri U. Sai Krishna, Lecturer in Chemistry, Govt. College(A), Rajamahendravaram

### **v. One representative from industry/ Corporate Sector/ allied area relating to Placement.**

Dr. B. Ramesh Babu, Founder & M. D., BogaR Laboratories, Peddapuram

### **vi. One postgraduate meritorious alumnus to be nominated by the Principal.**

The chairman, Board of Studies, may with the approval of the Principal of the College, Co-opt.

Dr. K. Raghava Chari, M.Sc., M.Phil., Ph.D.

## **II. Term.**

The term of the nominated members shall be two years.

## **III. Meeting**

The Principal of the College shall draw the schedule for meeting of the Board of Studies for different Departments. The meeting may be scheduled as and when necessary but at least once a year.

#### **IV. Functions**

The Board of Studies of a Department in the College shall:

- a) Prepare syllabus and various courses keeping in view the objectives of the College interest of the stakeholders and national requirement for consideration and approval of the Academic Council.
- b) Suggest methodologies for innovative teaching and evaluation techniques.
- c) Suggest panel of names to the Academic Council for appointment of examiners.
- d) Coordinate research, Teaching, Extension and other academic activities in the Department/College.



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

**Department of Analytical Chemistry**

**Minutes of board of studies (BOS) meeting 2021-22 on 02. 12. 2021 at 10.00 am**

Meeting of Board of Studies in Chemistry is convened on 02 December 2021 through offline at P.R. Govt. College (A), Kakinada, at 10.00 AM.

**Venue:** Conference Hall, Dt: 02-12-2021, Thursday – 10.00 AM.

The Principal Dr. B.V. Tirupanyam, Chairman, Sri V. Rambabu, University Nominee, Dr.K. Jhansi Lakshmi, Lecturer in Chemistry, ASD Govt. Degree College for Women (Autonomous), Kakinada, Industrialist Dr. B. Ramesh Babu, Founder & M.D., BogaR laboratories, Peddapuram, Subject Expert Sri. U. Sai Krishna, Lecturer in Chemistry, Government College (A) Rajamahendravarm, all the faculty members of Chemistry Department and student alumni attended the meeting.

**Agenda:**

- To discuss the Semester System and Choice Based Credit System (CBCS) being implemented for the past 03 years, i.e., w.e.f. 2018-19.
- To discuss and approve the Continuation/Modifications of the syllabus for the Odd & Even Semesters of I, II & III Years for 2021-22.
- Grant of Extra credits for Online SWAYAM MOOCs etc.
- Syllabus, Model Question Papers and Model Blue Prints for I, II, III, IV, V and VI Semesters.
- Teaching learning methodology by 60:40(External: Internal) ratio for the present II- and III-Year Students and 50:50 (External: Internal) ratio I Year Students w.e.f. 2021-22.
- Panel of paper setters and examiners.
- Proposals for Community Service Projects/Extension activities for the benefit of the society.
- Department action plan for 2021-22.
- To discuss and resolve the minor modifications/refinement if any, in the Chemistry cluster electives CI, CII & CIII as majority of the students opting this cluster as their choice.
- Any Other Proposal with the Permission of the Chairman.

### Resolutions:

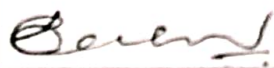
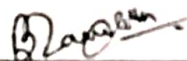
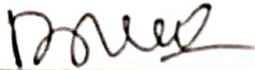
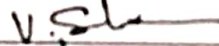
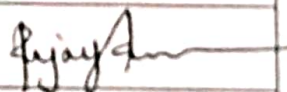
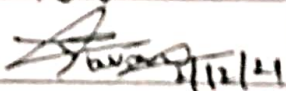
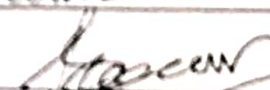
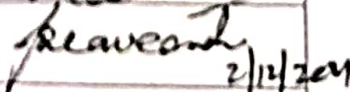
The following agenda items are discussed and resolutions are made.

1. It is resolved to continue choice based credit system in the chemistry combination programmes as per the directions of the CCE, Vijayawada to the first year and second year and final year student's w.e.f. 2018-19.
2. It is resolved to approve the Continuation/Modifications of the syllabus for the Odd & Even Semesters of I, II & III Years for 2021-22.
3. It is resolved to encourage students to active participation in various activities and give extra credits for students after successful completion of a particular activity such as SWAYAM, MOOCS etc., (Annexure –II)
4. It is Resolved to follow 60%-40% external and internal w.e.f. 2017-2018 admitted batches and it continued in present second and third year students.
5. It is resolved to follow 50%-50% external and internal for first year w.e.f 2021-22 admitted batch.
6. It is resolved to allot 50 marks project work for final year students in chemistry preferably in cluster paper C - 3 practical's, w.e.f 2019-20 in accordance with APSCHE.
7. It is resolved to conduct departmental activities such as OZONE DAY, CHEM FEST, CHEMISTRY DAY and SCIENCE DAY. (Annexure-I)
8. It is resolved to implement the recommended andragogy for the first semester 2021-22
9. It is resolved to conduct practical examinations semester wise.
10. It is resolved to organize guest lectures by eminent professors.
11. It is resolved to implement pass minimum for internal assessment for CBSE pattern students as the pattern is learner oriented.
12. It is resolved to maintain status quo for same question paper pattern in II, III years.
13. It is resolved that there is no change in the syllabus in the first year (Sem –I & Sem –II) as prescribed by APSCHE, Vijayawada in the last academic year, the same syllabus will be adopted as such.
14. The following paper setters are recommended.

1. Sri. U. Sai Krishna, Govt. College(A), Rajamahendravaram
2. Dr. V. Narayana Rao, GDC, Perumallapuram.
3. Dr. M. Trinadh, Govt. College(A), Rajamahendravaram.
4. Sri. M. Sudhakar, Govt. College(A), Rajamahendravaram.
5. Sri. K. Anand, GDC, Pithapuram.
6. Dr. CH. Vijay Vardhan, GDC, Perumallapuram.
7. Sri B. Surendra, GDC, Tadepalligudem.



Signatures of the members who attended the  
Board of studies in Analytical Chemistry on 02. 12 .2021 at 10.00 AM

| S. No. | Name of the member       | Designation                                                                                             | Signature                                                                                          |
|--------|--------------------------|---------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------|
| 1      | Sri. Rambabu Vasamsetti  | Chairman, Board of Studies,<br>Lecturer in charge                                                       |                 |
| 2      | Dr. K. Jhansi Lakshmi    | University Nominee<br>Asst. Professor,<br>Department of Chemistry,<br>ASD Women's College,<br>Kakinada. | <br>21/12/21    |
| 3      | Sri. U. Sai Krishna      | Subject Expert<br>Lecturer in Chemistry,<br>Govt.College(A),<br>Rajamahendravaram                       | <br>02/12/21    |
| 4      | Dr. B. Ramesh Babu       | Industry expert/ Founder & M. D.,<br>BogaR Laboratories, Peddapuram.                                    |                 |
| 5      | Dr. K. Raghava Chari     | Alumnus, Retd .Principal,                                                                               |                                                                                                    |
| 6      | Dr. D. Rama Rao          | Member<br>Lecturer I/c - Dept. of Chemistry                                                             |               |
| 7      | Dr. D. Chenna Rao        | Member<br>Lecturer in Chemistry                                                                         |                                                                                                    |
| 8      | Sri V. Sanjeeva Kumar    | Member<br>Lecturer in Chemistry                                                                         |               |
| 9      | Sri T V V. Satyanarayana | Member<br>Lecturer in Chemistry                                                                         |               |
| 10     | Sri P. Vijaya Kumar      | Member<br>Lecturer in Chemistry                                                                         |               |
| 11     | Smt. G. Pavani           | Member<br>Lecturer in Chemistry                                                                         | <br>21/12/21  |
| 12     | Dr. T. Uma Maheswara Rao | Member<br>Lecturer in Chemistry                                                                         |               |
| 13     | Dr. N. Bujji Babu        | Member<br>Lecturer in Chemistry                                                                         |               |
| 14     | Dr.Ch. Praveen           | Member<br>Lecturer in Chemistry                                                                         | <br>2/12/2021 |
| 15     | Kum. A. Lakshmi Bhavani  | Member<br>Guest Faculty in Analytical<br>Chemistry                                                      | <br>2/12/2021 |

**ACTION PLAN BOS MEETING – ANALYTICAL CHEMISTRY HELD ON 02 -12 - 2021.**

**Department activities for AY 2021-22.**

**Annexure - I**

| S.No. | Month    | Activity Proposed                                                                   | Faculty Member of In charge |
|-------|----------|-------------------------------------------------------------------------------------|-----------------------------|
| 1.    | Nov -21  | Departmental staff meeting to review admissions and faculty recruitment             | All Faculty members         |
| 2.    | Nov – 21 | Preparation of curricular plans, time- tables etc.,                                 | All Faculty members         |
| 3.    | Dec-21   | Bridge classes                                                                      | All Faculty members         |
| 4.    | Dec-21   | Student awareness programs on ragging& eve teasing - consequences, self-discipline. | All Faculty members         |
| 5.    | Dec-21   | National Chemistry Day                                                              | All Faculty members         |
| 6.    | Jan – 22 | Career guidance, higher education opportunities etc.,                               | All Faculty members         |
| 7.    | Feb – 22 | Study tour / Field trips                                                            | All Faculty members         |
| 8.    | Feb -22  | NATIONAL SCIENCE DAY                                                                | All Faculty members         |
| 9.    | Mar– 22  | Study tour / Field trips                                                            | All Faculty members         |
| 10    | Mar- 22  | Guest Lecture                                                                       | All Faculty members         |

1. Organizing National/ State level seminars/Workshops/ Conferences/ Training programs etc. With topics and other details.

- i). Staff development programs
- ii) Awareness on OZONE protection
- iii) National Chemistry day
- iv) National Science day 2022
- v) Guest lectures / Invited Talks
- vi) Training on Soil analysis
- vii) Training on water analysis

2.Change of modules in the syllabus content.



3. Plan for utilization of funds for Autonomous /CPE / Other grants available for arranging guest lectures, faculty improvement programmes, study tours, equipping laboratories, reference books & other necessary teaching-learning material with ICT enabled teaching.

**I. Study visits/ Field tours to Final year students: Rs. 20,000**

1. National Institute of Hydrology, Kakinada.
2. SAR Chandra Environ Solutions, Kakinada.
3. ONGC mini refinery, Tatipaka.
4. Soil analysis laboratory, Samalkot.
5. Venky parenteral, Yanam
6. Any other relevant field visits

**II. Lab equipment's: Rs. 5, 00,000**

Lab equipment's required to conduct Practical's and to give hands on training to the students in order to build skill and confidence in the area of Analytical chemistry

**III. Reference books & other necessary teaching – learning material: Rs. 10,000**

**IV. Guest Lectures / Invited talks: Rs. 10,000**

3. Plan for organizing subject oriented community outreach programs & allocation of necessary funds. (Mandatory for each Department)

i) Awareness programs on various social / Health issue Rs. 10,000

4. Introduction of new programs - Certificate courses. Rs. 10,000

6. Any other program that enhances the learning capacity of students and their employable & knowledge skills

7. Examination reforms if any,

8. Suggest panel of examiners/paper setters & other experts/nominees for BOS deliberations.

1. Dr. M. Trinadh, Govt. College(A), Rajamahendravaram
2. Sri. U. Sai Krishna, Govt. College(A), Rajamahendravaram.
3. Dr. V. Narayana Rao, GDC, Perumallpuram.
4. Sri. M. Sudhakar, Govt. College(A), Rajamahendravaram.
5. Sri. K. Anand, GDC, Pithapuram.
6. Dr. CH. Vijay Vardhan, GDC, Perumallpuram.
7. Sri B. Surendra, GDC, Tadepalliigudem.



Semester wise/ Paper wise Marks / Credits allotted.

| YEAR | SEMESTER                                                                             | PAPER    | TITLE                                               | MARKS | CREDITS |
|------|--------------------------------------------------------------------------------------|----------|-----------------------------------------------------|-------|---------|
| I    | I                                                                                    | I        | Basic Principles & Laboratory Operations            | 100   | 04      |
|      |                                                                                      |          | Practical – I                                       | 50    | 01      |
|      | II                                                                                   | II       | Quantitative Methods Of Analysis                    | 100   | 04      |
|      |                                                                                      |          | Practical – II                                      | 50    | 01      |
| II   | III                                                                                  | III      | Separation Methods – I                              | 100   | 04      |
|      |                                                                                      |          | Practical – III                                     | 50    | 01      |
|      | IV                                                                                   | IV       | Separation Methods – II                             | 100   | 04      |
|      |                                                                                      |          | Practical – IV                                      | 50    | 01      |
|      |                                                                                      | V        | Analytical Biochemistry and Environmental Chemistry | 100   | 04      |
|      |                                                                                      |          | Practical – V                                       | 50    | 01      |
| III  | V                                                                                    | V        | Analytical Biochemistry and Environmental Chemistry | 100   | 03      |
|      |                                                                                      |          | Practical – V                                       | 50    | 02      |
|      |                                                                                      | VI       | Instrumental Methods of Analysis                    | 100   | 03      |
|      |                                                                                      |          | Practical – VI                                      | 50    | 02      |
|      | * Any one cluster from VIII, A, B OR C<br><br>* Any one cluster from VIII, A, B OR C | VII      | Analysis of Applied Industrial Products (ELECTIVE)  | 100   | 03      |
|      |                                                                                      |          | Practical – VII                                     | 50    | 02      |
|      |                                                                                      | VIII (C) | VIII-C-1                                            | 100   | 03      |
|      |                                                                                      |          | VIII-C-2                                            | 100   | 03      |
|      |                                                                                      |          | VIII-C-3                                            | 100   | 03      |
|      |                                                                                      |          | Practical – VIII                                    | 50    | 02      |
|      |                                                                                      |          | Practical – IX                                      | 50    | 02      |
|      |                                                                                      |          | Practical –X: Project Work                          | 50    | 02      |

# GUIDELINES FOR ALLOTMENT OF EXTRA CREDITS

## Annexure -II

| S.No. | Activity          | Details of achievement                                                                                                   | Credits                                   |
|-------|-------------------|--------------------------------------------------------------------------------------------------------------------------|-------------------------------------------|
| 1     | MOOC Course       | SWAYAM /NPTEL /CEC etc., (Course Completion certificate with credits should be produced for the claim of extra credits ) | Total credits achieved will be considered |
| 2     | NCC               | B CERTIFICATE                                                                                                            | 2                                         |
|       |                   | Participation in National Camp after 'B' certificate                                                                     | 3                                         |
|       |                   | C certificate                                                                                                            | 4                                         |
|       |                   | Adventure camp/RD parade along with 'B'                                                                                  | 5                                         |
|       |                   | Failed in B certificate Examination                                                                                      | 1                                         |
| 3     | Sports            | Intercollegiate selection                                                                                                | 2                                         |
|       |                   | South zone selection                                                                                                     | 3                                         |
|       |                   | All India participation                                                                                                  | 4                                         |
|       |                   | Winning medals in all India competitions                                                                                 | 5                                         |
| 4     | NSS               | 40% attendance in regular NSS activities                                                                                 | 1                                         |
|       |                   | 50% attendance with Community Service                                                                                    | 2                                         |
|       |                   | Conduct of survey/Youth exchange/RD                                                                                      | 3                                         |
| 5     | JKC               | Enrollment and training                                                                                                  | 1                                         |
|       |                   | Campus recruitment local level                                                                                           | 2                                         |
|       |                   | MNCs/reputed companies                                                                                                   | 3                                         |
| 6     | Community service | Participation in community service by departments (outreach programmes)                                                  | 2                                         |
| 7     | Cultural activity | Winning medals at state level-2,<br>District level-1                                                                     | 2<br>1                                    |
| 8     | COP/Add on Course | Pass in Certificate Exam-1,<br>Diploma-2                                                                                 | 1<br>2                                    |
| 9     | Support services  | Lead India, Health club, RRC and Eco Club etc.,<br>participation in various programmes                                   | 1                                         |



## **Course Structure:**

All theory papers will have 4 hours per week and practical's will have 2 hours per week up to Semester IV (Second year). In final year all theory papers will have 3 hours per week and practical's will have 2 hours per week in Semester V and V I (Final year).

Each Theory Paper shall be of 100 marks and Practical Paper shall be of 50 marks.

Total Number of Papers: 24

Mathematics : 7Papers

Chemistry : 7Papers

Analytical Chemistry: 7 Papers + 1 Cluster elective (3Papers) = 10 Papers

## **Objectives and outcome of the course Analytical Chemistry**

Analytical Chemistry is an applied, experimental field of science and is based not only on chemistry, but also on physics, biology, information theory and many fields of technology. It is of fundamental importance not only to all branches of chemistry but also to all biological sciences, engineering sciences, health, medicine, pharmaceuticals, environment, industrial processes, quality control and implementation of legislation.

The objective of B.Sc. Analytical chemistry course is to provide students exposure to chemistry, physics, biological sciences, environmental science, computer application, instrumentation and analytical techniques.

In this three-year course spread over six semesters, there are 10 papers of Analytical chemistry 7 papers of chemistry and 7 papers of Mathematics.

After graduating in Analytical Chemistry the students can pursue academics in Chemistry, bioinformatics, forensic science, biochemistry and other disciplines of inter- disciplinary sciences. They can also use it as a stepping stone to pharmaceutical industry and for Research and Development in industry.



### Program Outcomes B.Sc. (Chemistry):

Undergraduate students upon graduation with a B.Sc. degree in chemistry:

|         |                                                                                                                                                                                                  |
|---------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| PO : 1  | Have firm foundations in the fundamentals and application of current chemical and scientific theories.                                                                                           |
| PO : 2  | An understanding of major concepts, theoretical principles and experimental findings in chemistry.                                                                                               |
| PO : 3  | Are able to design, carry out, record and analyze the results of chemical experiments                                                                                                            |
| PO : 4  | Are able to use modern instrumentation and classical techniques, to design experiments, and to properly record the results of their experiment.                                                  |
| PO : 5  | Are skilled in problems solving, critical thinking and analytical reasoning.                                                                                                                     |
| PO : 6  | Are able to identify and solve chemical problems and explore new areas of research.                                                                                                              |
| PO : 7  | Are able to use modern library searching and retrieval methods to obtain information about a topic, chemical, chemical technique, or an issue relating to chemistry.                             |
| PO : 8  | Knows the proper procedures and regulations for safe handling and use of chemicals and can follow the proper procedures and regulations for safe handling when using chemicals                   |
| PO : 9  | Are able to communicate the results of their work to chemists and non-chemists.                                                                                                                  |
| PO : 10 | Understand the ethical, historic, philosophical, and environmental dimensions of problems and issues facing chemists.                                                                            |
| PO : 11 | Find gainful employment in industry or government, be accepted at graduate or professional schools (law, medicine, etc.), or find employment in school systems as instructors or administrators. |
| PO : 12 | Are able to pursue Higher education in Chemistry and other disciplines of inter disciplinary                                                                                                     |

**Course outcomes**  
**Analytical Chemistry**

|              |                                                                                                                                                                                                                                 |
|--------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>CO: 1</b> | Analytical Chemistry is an applied, experimental field of science and is based not only on chemistry, but also on physics, biology, information theory and many fields of technology.                                           |
| <b>CO: 2</b> | It gives fundamental knowledge on chemistry and also on all biological sciences, engineering sciences, health, medicine, pharmaceuticals, environment, industrial processes, quality control and implementation of legislation. |
| <b>CO: 3</b> | To provide students exposure to chemistry, physics, biological sciences, environmental science, computer application, instrumentation and analytical techniques                                                                 |
| <b>CO: 4</b> | After graduating in Analytical Chemistry the students can pursue academics in Chemistry, bioinformatics, forensic science, biochemistry and other disciplines of Inter- disciplinary sciences                                   |
| <b>CO: 5</b> | Students can also use Analytical Chemistry as a stepping stone to pharmaceutical industry and for Research and Development in industry.                                                                                         |
| <b>CO: 6</b> | Are able to use modern instrumentation and classical techniques, to design experiments, and to properly record the results of their experiment.                                                                                 |



### Specific Program Out comes

#### Analytical Chemistry

|               |         |                                                                                          |
|---------------|---------|------------------------------------------------------------------------------------------|
| SEMESTER –I   | SPO : 1 | Gains knowledge on basic concepts of analytical methods                                  |
|               | SPO : 2 | Understands the types of errors in chemical analysis                                     |
|               | SPO : 3 | Gains knowledge on principles and applications of Thermo gravimetric methods             |
|               | SPO : 4 | Gains knowledge on use and handling of Common laboratory apparatus.                      |
| SEMESTER –II  | SPO : 1 | Gains knowledge on basic concepts of Gravimetric methods and their importance            |
|               | SPO : 2 | Gains knowledge on volumetric methods and their importance in Chemical analysis.         |
|               | SPO : 3 | Gains knowledge on Centrifugation methods                                                |
|               | SPO : 4 | Gains knowledge on Environmental and water pollutants and their analysis.                |
| SEMESTER –III | SPO : 1 | Gains basic knowledge on Separation techniques and their classification.                 |
|               | SPO : 2 | Gains knowledge on Different chromatographic techniques and their applications.          |
| SEMESTER - IV | SPO : 1 | Gains knowledge on Gas chromatographic technique and their applications.                 |
|               | SPO : 2 | Gains knowledge on Electrophoresis concept and its applications                          |
|               | SPO : 3 | Gains basic knowledge on Filtration techniques.                                          |
| SEMESTER - V  | SPO : 1 | Gains basic knowledge about Carbohydrates, Proteins & Lipids and their analysis          |
|               | SPO : 2 | Gains some basic knowledge about Clinical chemistry and Microbiological assay.           |
|               | SPO : 3 | Gains some basic knowledge and importance of Spectroscopic methods                       |
|               | SPO : 4 | Gains some basic knowledge and importance of Electro analytical methods                  |
| SEMESTER - VI | SPO : 1 | Gains knowledge and awareness about some applied industrial products.                    |
|               | SPO : 2 | Gains knowledge about analysis of cement, Glasses and Gases                              |
|               | SPO : 3 | Gains some knowledge about Industrial standards and Control                              |
|               | SPO : 4 | Gains knowledge on practical Analytical chemistry and its applications in various fields |



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

**B. Sc. (Analytical Chemistry)**

**SEMESTER – III**

**Paper - III (ANALYTICAL CHEMISTRY-3)**

**60 hrs. (4h/w)**

**SEPARATION METHODS - I**

**UNIT-I**

**12hrs**

**SOLVENT EXTRACTION:**

Introduction, principle, techniques, factors affecting solvent extraction.

Different types of Solvent extraction techniques- Batch extraction, continuous extraction and counter current extraction.

Application - Determination of Iron (III)

**UNIT-II**

**12hrs**

**CHROMATOGRAPHY:**

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

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

**UNIT-III**

**12hrs**

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

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

#### **UNIT-IV**

**12hrs**

##### **COLUMN CHROMATOGRAPHY.**

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

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

#### **UNIT-V**

**12hrs**

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

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

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

**B. Sc. (Analytical Chemistry)**

**SEMESTER – III**

**LABORATORY COURSE –III 30 hrs. (2 h /w)**

**Max Marks : 50 M**

**Practical-III: Separation techniques**

**(At the end of Semester-III)**

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

**Suggested Readings:**

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.



### SCHEME OF VALUATION

Max. Marks: 50

- |      |                                                              |       |          |
|------|--------------------------------------------------------------|-------|----------|
| I.   | Procedure to be written in the first 15 minutes              | ....  | 10 Marks |
| II.  | Recording of data and reporting the value upto 2% error..... |       | 20 Marks |
| III. | Error up to 5%                                               | ..... | 10 Marks |
|      | Error greater than 5%                                        | ..... | 5 Marks  |
| IV.  | Viva – Voice                                                 | ..... | 10 Marks |
| V.   | Record                                                       | ..... | 10 Marks |

**P. R. GOVERNMENT COLLEGE, KAKINADA**  
**MODEL QUESTION PAPER**  
**SEMESTER – III**  
**Paper – III (ANALYTICAL CHEMISTRY-3)**  
**SEPARATION METHODS-I**

Duration: 2hrs. 30Min.

Max. Marks: 60

**SECTION – A**

Answer any **FOUR** questions. Each question carries **10** marks.

4 X 10 = 40M

1. Question from Unit –I
2. Question from Unit –II
3. Question from Unit –III
4. Question from Unit - IV
5. Question from Unit – V
6. Question from Unit – III
7. Question from Unit – IV
8. Question from Unit - V

**SECTION – B**

Answer any **four** questions. Each question carries **5** marks.

4 x 5 = 20M

9. Question from Unit - I
10. Question from Unit – II
11. Question from Unit – III
12. Question from Unit – IV
13. Question from Unit – V
14. Question from Unit – II
15. Question from Unit – III
16. Question from Unit - III

P. R. GOVERNMENT COLLEGE, KAKINADA

SEMESTER - III

Paper - III (ANALYTICAL CHEMISTRY - 3)

SEPARATION METHODS-I

Duration: 2hrs. 30Min.

Max. Marks: 60

**Blue Print:**

| S. No. | Course Content | 4.                       |                                | Total No. Of Questions<br>from each Unit |
|--------|----------------|--------------------------|--------------------------------|------------------------------------------|
|        |                | Essay Questions<br>(10M) | Short Answer<br>Questions (5M) |                                          |
| 1      | Unit -I        | 1                        | 1                              | 2                                        |
| 2      | Unit -II       | 1                        | 2                              | 3                                        |
| 3      | Unit -III      | 2                        | 3                              | 5                                        |
| 4      | Unit -IV       | 2                        | 1                              | 3                                        |
| 5      | Unit -V        | 2                        | 1                              | 3                                        |
|        | TOTAL          | 8                        | 8                              | 16                                       |

**Note: Questions should be given from Question bank**



**P. R. GOVERNMENT COLLEGE, KAKINADA**  
**SEMESTER – III**  
**Paper- III (ANALYTICAL CHEMISTRY-3)**  
**SEPARATION METHODS-I**

Duration: 2hrs. 30Min.

Max. Marks: 60

**QUESTION BANK**

**ESSAY QUESTIONS – 10 MARKS:**

1. Explain the principles and applications of Solvent extraction.
2. Explain the principle and experimental techniques of solvent extraction
3. Explain about different types of Solvent extraction techniques.
4. Explain about the Principle and classification of Chromatographic methods
5. Explain about the theory and description of Chromatographic process.
6. Write about various modes of developments in Paper chromatographic technique.
7. Explain about the principle, experimental set up and applications of Paper chromatography.
8. Explain about principle, experimental set up and applications of TLC.
9. Explain briefly about Plate preparation, Adsorbents and development process in TLC
10. Explain about the principle and application of Column chromatography.
11. Explain the principle, Column packing and column developments in Column chromatography.
12. Explain the principle, Experimental set up and applications of HPLC
13. Write about Columns and detectors used in HPLC
14. Explain briefly about HPLC Chromatographic technique
15. Explain about the Principle, Adsorbents, Solvents used in Adsorption Chromatography.
16. Explain about the principle and applications of Adsorption chromatography
17. Write about Principle and applications of Liquid –liquid partition chromatography.
18. Explain about Normal phase and Reversed - phase chromatographic techniques.

## QUESTION BANK

### SHORT ANSWER QUESTIONS – 05MARKS:

1. Explain factors affecting solvent extraction.
2. How do you determine Fe(III) by using solvent extraction technique?
3. Explain the principle and applications of solvent extraction.
4. Explain briefly about efficiency of a chromatographic column.
5. What are distribution coefficients? Explain briefly
6. Write about the principle of differential migration.
7. Explain briefly about Resolution and capacity factor.
8. Write about nature of paper, detection of spots in paper chromatography.
9. Explain about the Quantitative analysis of Paper chromatography.
10. Write about Quantitative analysis of TLC.
11. Explain about Sample application and plate preparation in TLC.
12. Explain about Stationary phase, Support materials and Liquid phases in TLC.
13. Define R<sub>f</sub> value and write its significance.
14. Write about Columns and Column packing in Column chromatography.
15. Explain about Column development and sample elution in Column chromatography.
16. Explain about various Detectors used in HPLC.
17. Write about Stationary phases and Mobile phases used in HPLC.
18. Explain about Retention volumes and Retention times.
19. Write the principle and applications of Adsorption chromatography
20. What are the differences between NPC and RPC?
21. Explain the principle of Partition chromatography.