

SRI VENKATESWARA UNIVERSITY, TIRUPATHI
BOARD OF STUDIES IN CHEMISTRY
CHEMISTRY MINOR
COURSES SELECTED IN 5 th SEMESTER FOR THE ACADEMIC
YEAR: 2025- 2026

SEMESTER	COURSE CODE	TITLE	HOURS/ WEEK	CREDITS
V	5A (T)	Analytical Methods in Chemistry-Quantitative analysis	3	3
	5A (P)	Analytical Methods in Chemistry-Quantitative analysis	2	1
	6A (T)	Chromatography and Instrumental methods of Analysis	3	3
	6 A (P)	Chromatography and Instrumental methods of Analysis	2	1

SEMESTER: V
CHEMISTRY MINOR
COURSE CODE 5 A: ANALYTICAL METHODS IN CHEMISTRY- QUANTITATIVE
ANALYSIS (THEORY)
Credits: 03 ::: Total hours: 45

I. Learning Outcomes:

Students after successful completion of the course will be able to:

- 1) Identify the importance of solvent extraction and ion exchange method.
- 2) Acquire knowledge on the basic principles of volumetric analysis and gravimetric analysis.
- 3) Demonstrate the usage of common laboratory apparatus used in quantitative analysis.
- 4) Understand the theories of different types of titrations.
- 5) Gain knowledge on different types of errors and the minimization methods.

II. Syllabus:

Unit-1: Quantitative analysis-1 (9 hours)

A brief introduction to analytical methods in chemistry. Principles of volumetric analysis, concentration terms- Molarity, Molality, Normality, v/v, w/v, ppm and ppb, preparing solutions- Standard solution, primary standards and secondary standards. Description and use of common laboratory apparatus- volumetric flask, burette, pipette, beakers, measuring cylinders.

Unit-2: Quantitative analysis-2 (9 hours)

Principles of volumetric analysis: Theories of acid-base (including study of acid-base titration curves), redox, complex metric, iodometric and precipitation titrations-choice of indicators for the saturations. **Principles of gravimetric analysis:** precipitation, coagulation, peptization, coprecipitation, post precipitation, digestion, filtration, and washing of precipitate, drying and ignition.

Unit-3: Treatment of analytical data (9 hours)

Types of errors- Relative and absolute, significant figures and its importance, accuracy - methods of expressing accuracy, errors- Determinate and indeterminate and minimization of errors, precision-methods of expressing precision, standard deviation and confidence interval.

Unit-4: Separation techniques (9 hours)

Solvent Extraction: Introduction, principle, techniques, factors affecting solvent extraction, Batch extraction, Continuous extraction and counter current extraction. Synergism. Application-Determination of Iron(III). Ion Exchange method: Introduction, action of ion exchange resins, applications.

Unit-5: Analysis of water (9 hours)

Determination of dissolved solids, total hardness of water, turbidity, alkalinity, Dissolved oxygen, COD, determination of chloride using Mohr's method.

III. Suggested Co-Curricular Activities:

- 1) Training of students by related industrial experts.
- 2) Assignments, Seminars and Quiz(on related topics).
- 3) Visits to laboratories, firms, research organizations etc.
- 4) Invited lectures and presentations on related topics by field/industrial experts.

IV. List of Reference Books:

- 1) Fundamentals of Analytical Chemistry by F. James Holler, Stanley R Crouch, Donald M. West and Douglas A. Skoog, Ninth edition, Cengage.
- 2) Analytical Chemistry by Gary D. Christian, Purnendu K. Dasgupta and Kevin A. Schug, Seventh edition, Wiley.
- 3) Quantitative analysis by R. A. Day Jr. and A. L. Underwood, Sixth edition, Pearson.
- 4) Text book of Vogel's Quantitative Chemical Analysis, Sixth edition, Pearson.
- 5) Text book of Environmental Chemistry and Pollution Control by S. S. Dara and D. D. Mishra, Revised edition, S Chand & Co Ltd.

SEMESTER: V
CHEMISTRY MINOR
COURSE CODE 5 A: ANALYTICAL METHODS IN CHEMISTRY –
QUANTITATIVE ANALYSIS (PRACTICALS)
Credits: 01 :: Total hours: 30

I. Learning Outcomes:

On successful completion of this practical course, student shall be able to:

- 1) Estimate Iron(II) using standard Potassium dichromate solution
- 2) Learn the procedure for the estimation of total hardness of water
- 3) Demonstrate the determination of chloride using Mohr's method
- 4) Acquire skills in the operation and calibration of pH meter
- 5) Perform the strong acid vs strong base titration using pH meter

II. Laboratory course Syllabus:

- 1) Estimation of Iron(II) using standard Potassium dichromate solution (using DPA indicator)
- 2) Estimation of total hardness of water using EDTA
- 3) Determination of chloride ion by Mohr's method
- 4) Study the effect on pH of addition of HCl/NaOH to solutions of acetic acid, sodium acetate and their mixtures.

- 5) Preparation of buffer solutions of different pH (i) Sodium acetate-acetic acid, (ii) Ammonium chloride-ammonium hydroxide.
- 6) pH metric titration of (i) strong acid vs strong base, (ii) weak acid vs. Strong base.
- 7) Determination of dissociation constant of a weak acid.

III. Co-Curricular Activities:

Mandatory: (*Lab /field training of students by teacher: (lab:10+field:05):1*)

1) For Teacher: Training of students by the teacher in laboratory and field for not less than 15 hours on the field techniques / skills of calibration of pH meter, Strong acid vs strong base titration using pH meter, determination of chloride ion, estimation of water quality parameters and estimation of Iron(II).

2) For Student: Student shall visit a related industry / chemistry laboratory in universities / research organizations/private sector facility and observe various methods used for the analysis of water. Write their observations and submit a hand written fieldwork /project work report not exceeding 10 pages in the given format to the teacher.

3) Max marks for Field work / project work Report: 05.

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

5) Unit tests (IE).

IV. List of Reference books:

Text book of Vogel's Quantitative Chemical Analysis, Sixth edition, Pearson.

Format of model question paper

Subject: Chemistry Minor

Semester: V

Course 5 A: Analytical Methods in Chemistry-Quantitative analysis

Max. time: 3 hrs Max. marks: 75

Section: A

*Answer any 5 of the following 10 questions. Each question carries 5 marks
(2 questions should be given from each unit)*

5 QX 5 M = 25 M

- 1.
- 2.
- 3.
- 4.
- 5.
- 6.
- 7.
- 8.
- 9.
- 10.

Section: B

*Answer 5 of the following 10 questions following internal choice. Each
question carries 10 marks
(2 questions should be given from each unit)*

5 QX 10 M = 50 M

11. Questions 11 & 12 from unit 1. One should be answered.
- 12.
13. Question 13 & 14 from unit 2. One should be answered
- 14.
15. Question 15 & 16 from unit 3. One should be answered
- 16.
17. Question 17 & 18 from unit 4. One should be answered
- 18.
19. Question 19 & 20 from unit 5. One should be answered
- 20.

SEMESTER: V
CHEMISTRY MINOR
COURSE CODE 6 A: CHROMATOGRAPHY AND INSTRUMENTAL METHODS OF
ANALYSIS (THEORY)
Credits: 03 ::: Total hours: 45
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Learning Outcomes:

- 1) Students after successful completion of the course will be able to:
- 2) Identify the importance of chromatography in the separation and identification of compounds in a mixture
- 3) Acquire a critical knowledge on various chromatographic techniques.
- 4) Demonstrate skills related to analysis of water using different techniques.
- 5) Understand the principles of spectrochemistry in the determination of metal ions.
- 6) Comprehend the applications of atomic spectroscopy.

Syllabus:

Unit-1: Chromatography-Introduction and classification (9 hours)

Principle, Classification of chromatographic methods, Nature of adsorbents, eluents, R_f values, factors affecting R_f values.

Unit-2: TLC and paper chromatography (9hours)

Thin layer chromatography: Principle, Experimental procedure, preparation of plates, adsorbents and solvents, development of chromatogram, detection of spots, applications and advantages.

Paper Chromatography: Principle, Experimental procedure, choice of paper and solvents, various modes of development- ascending, descending, radial and two dimensional, applications.

Unit-3: Column chromatography (9 hours)

Column chromatography: Principle, classification, Experimental procedure, stationary and mobile phases, development of the Chromatogram, applications.

HPLC: Basic principles, instrumentation–block diagram and applications.

Unit-4: Spectrophotometry (9 hours)

Principle, Instrumentation : Single beam and double beam spectrometer, Beer-Lambert's law Derivation and deviations from Beer-Lambert's law, applications of Beer-Lambert's law, Quantitative determination of Fe⁺², Mn⁺² and Pb⁺²

Unit-5: Polarimetry and Refractometry (9 hours)

Polarimetry and Refractometry: Polarimetry: Nature of polarized light, polarimeter, sample cells, operation of the polarimeter, optical purity. Refractometry; The refractive index,

Refractometer.

Suggested Co-Curricular Activities:

- 1) Training of students by related industrial experts.
- 2) Assignments, Seminars and Quiz(on related topics).
- 3) Visits to laboratories, firms, research organizations etc.
- 4) Invited lectures and presentations on related topics by field/industrial experts

List of Reference books:

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- 3) Quantitative analysis by R. A. Day Jr .and A. L. Underwood, Sixth edition, Pearson.
- 4) Text book of Vogel's Quantitative Chemical Analysis, Sixth edition/Pearson.
- 5) Instrumental methods of Chemical Analysis by Dr. B. K. Sharma 1981

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SEMESTER: V

CHEMISTRY MINOR

COURSE CODE 6A: CHROMATOGRAPHY AND INSTRUMENTAL METHODS OF ANALYSIS (PRACTICALS)

Credits: 01 ::: Total hours: 30

Learning Outcomes:

On successful completion of this practical course, student shall be able to:

- 1) Perform the separation of a given dye mixture using TLC
- 2) Learn the preparation of TLC plates
- 3) Demonstrate the separation of mixture of amino acids using paper chromatography
- 4) Acquire skills in using column chromatography for the separation of dye mixture.

Laboratory course Syllabus:

- 1) Separation of a given dye mixture (methyl orange and methylene blue) using TLC (using alumina as adsorbent).
- 2) Separation of mixture of methyl orange and methylene blue by column chromatography.
- 3) Separation of given mixture of amino acids (glycine and phenyl alanine) using ascending paper chromatography.
- 4) Separation of food dyes using Column Chromatography
- 5) Separation of triglycerides using TLC
- 6) Verification of Beer lambert's law. (Using potassium permanganate solution) using colorimeter / spectrophotometer.

Co-Curricular Activities:

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

1) For Teacher: Training of students by the teacher in laboratory and field for not less than 15 hours on the field techniques/skills of determination of hardness of water, using the calorimeter and or Spectrophotometer, preparation of TLC plate, identification of spots in TLC and Paper chromatographic techniques, loading of column, selection of solvent system, separation of amino acids and dyes mixture using chromatographic techniques.

2) For Student: Student shall visit a related industry/chemistry laboratory in universities/research organizations/private sector facility and observe the chromatographic techniques used for the separation of compounds. Write their observations and submit a hand written fieldwork/project work report not exceeding 10 pages in the given format to the teacher.

3) Max marks for Fieldwork/project work Report: 05 Max marks for Field work / project work Report: 05.

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

5) Unit tests (IE).

List of Reference books:

- 1) Text book of Vogel's Quantitative Chemical Analysis, Sixth edition, Pearson.
- 2) Vogel A.I .Practical Organic Chemistry, Longman Group Ltd.
- 3) Bansal R.K. Laboratory Manual of Organic Chemistry, Wiley-Eastern.
- 4) Ahluwalia V. K. and Agarwal R. Comprehensive Practical Organic Chemistry, University press.
- 5) Mann F. Gand Saunders B.C, Practical Organic Chemistry, Pearson Education.

Format of model question paper

Subject: Chemistry Minor

Semester: V

Course Code 6A: Chromatography and instrumental methods of analysis

Max. time: 3 hrs Max. marks: 75

Section: A

*Answer any 5 of the following 10 questions. Each question carries 5 marks
(2 questions should be given from each unit)*

5 QX 5 M = 25 M

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