

**Swami Ramanand Teerth Marathwada University,
Nanded**

**Faculty of Science
B.Sc. I (First) Year (Semester I & II)**

Analytical Chemistry

Course Structure, Semester-I & II (w.e.f.2013-14)

Swami Ramanand Teerth Marathwada University, Nanded
Faculty of Science
B.Sc. I, II & III Year (Semester I To VI)
Analytical Chemistry
Course Structure (w.e.f.2013-14)
(Skeleton)

B.Sc. I (First) Year (Semester I) (w.e.f.2013-14)

Paper	Course Code	Course	Periods/week	Total Periods	Marks
I	CHAC-101	General Concepts of Analytical Chemistry-I	3	45	50
II	CHAC-102	Basic Analytical Chemistry-I	3	45	50
B.Sc. I (First) Year (Semester II) (w.e.f.2013-14)					
III	CHAC-103	General Concepts of Analytical Chemistry-II	3	45	50
IV	CHAC-104	Basic Analytical Chemistry-II	3	45	50
V	CHAC-105	Laboratory Course-I	4	120	100
B.Sc. II (Second) Year (Semester III) (w.e.f. 2014-15)					
VI	CHAC-201	Inorganic and Organic Analysis – I	03	45	50
VII	CHAC-202	Instrumental Methods of Chemical Analysis – I	03	45	50
B.Sc. II (Second) Year (Semester IV) (w.e.f. 2014-15)					
VIII	CHAC-203	Inorganic and Organic Analysis – II	03	45	50
IX	CHAC-204	Instrumental Methods of Chemical Analysis – II	03	45	50
X	CHAC-205	Laboratory Course – II	04	120	50
XI	CHAC-206	Laboratory Course – III	04	120	50
B.Sc. III (Third) Year (Semester V) (w.e.f. 2015-16)					
XII	CHAC-301	Modern Techniques Of Chemical Analysis - I	03	45	50
XIII	CHAC-302	Applied Analytical Chemistry -I	03	45	50
B.Sc. III (Third) Year (Semester VI) (w.e.f. 2015-16)					
XIV	CHAC-303	Modern Techniques Of Chemical Analysis - II	03	45	50
XV	CHAC-304	Applied Analytical Chemistry -II	03	45	50
XVI	CHAC-305	Laboratory Course – IV	04	120	50
XVII	CHAC-306	Laboratory Course – V	04	120	50

Theory Papers 50 Marks: (External 40 + Internal 10)

Swami Ramanand Teerth Marathwada University, Nanded

Faculty of Science

B.Sc. I (First) Year (Semester I)

Analytical Chemistry

Course Structure, Semester-I (w.e.f.2013-14)

Paper	Course Code	Course	Periods/week	Total Periods	Marks
I	CHAC-101	General Concepts of Analytical Chemistry-I	3	45	50
II	CHAC-102	Basic Analytical Chemistry-I	3	45	50

Swami Ramanand Teerth Marathwada University, Nanded

Faculty of Science

B.Sc. I (First) Year (Semester II)

Analytical Chemistry

Course Structure, Semester-II (w.e.f.2013-14)

Paper	Course Code	Course	Periods/week	Total Periods	Marks
III	CHAC-103	General Concepts of Analytical Chemistry-II	3	45	50
IV	CHAC-104	Basic Analytical Chemistry-II	3	45	50
V	CHAC-105	Laboratory Course-I	4	120	100

Theory Papers 50 Marks: (External 40 + Internal 10)

Swami Ramanand Teerth Marathwada University, Nanded

Faculty of Science

B.Sc. I (First) Year; Semester - I (w.e.f.2013-14)

Analytical Chemistry; Paper - I

General Concepts of Analytical Chemistry-I

Paper Code – CHAC-101

Periods: 45 per semester; 03 per week

Marks-50

UNIT-I

Scope and Importance of Analytical Chemistry:

10 Periods

Introduction to analytical chemistry, Role of analytical chemistry in sciences. Chemical analysis: Qualitative analysis, Quantitative analysis; major, minor and trace constituents. Quantitative methods of analysis- classification of analytical methods according to property, parameter measured, size of the sample with explanation. Steps in typical quantitative analysis. Types of analysis –complete analysis, partial analysis and assay of ingredients, the analytical chemist and analyst.

Unit-II

Preliminary Operations in Quantitative Analysis :

12 Periods

Introduction, sampling: definitions, purpose of sampling, theory of sampling, types of sampling, sampling of solids, liquids and gases. Preparation of laboratory samples: crushing and grinding of laboratory samples; moisture in samples and drying, determination of water in sample, decomposition and dissolution of samples, some general considerations. Acid treatment, decomposition by flux treatment, decomposition of organic matter (Organic compounds) for elemental analysis and preparation of solution of sample.

Unit- III

Mole Concept and Concentration Units :

13 Periods

Mole Concept, molecular weight, formula weight, and equivalent weight.

Concentration units: Molarity, Formality, Normality, Molality, Mole fraction, Percent by weight, Percent by volume, Parts per thousand, Parts per million, Parts per billion, pX, pH, pOH, pM, milliequivalents, Milli moles and titer. Numericals.

Unit-IV

Aspects of Co-ordination Compounds in Chemical Analysis:

10 Periods

Definition of terms: Co-ordination complex, Co-ordination number, Chelate: difference between complex and chelates. Types of chelating agents, significant properties of metal ions and ligands which influence co-ordination. Stability and stability constant of complexes, Stepwise formation constant. Evidence for complex formation. Application of Complexes in Identification of Metal ions, Separation of metal ions and estimation of metal ions.

Swami Ramanand Teerth Marathwada University, Nanded

Faculty of Science

B.Sc. I (First) Year; Semester - I (w.e.f.2013-14)

Analytical Chemistry; Paper - II

Basic Analytical Chemistry-I

Paper Code – CHAC-102

Periods: 45 per semester; 03 per week

Marks-50

Unit – I

Measurement of Mass :

14 Periods

Distinction between mass and weight; Types of analytical balances: Semi-micro analytical balance, single pan analytical balance, electronic analytical balance. Two-pan balance (Equal arm balance). General features, principle of construction, working of typical analytical balance. Single pan balance: principle, construction and working, instruction for use of single pan balance. Electronic analytical balance: Principle, construction and working. Sources of errors in weighing and their elimination. Weights and calibration of weights.

Unit-II

Measurement of Volume :

7 Periods

Units of volume, effect of temperature on volume measurement. Apparatus for precise measurement of volume; pipette, burette and volumetric flask & their calibration.

Unit – III

Principles of Volumetric Analysis – I :

12 Periods

Definition of terms: Titrant, titrand, analyte, end point and equivalence point, indicator, standard titrant, titration. Acid-base titration: Theory of acid base indicators, Theory of acid-base titration, titration of strong acid-strong base, weak acid-weak base, strong acid-weak base with titration curve and choice of indicators.

Unit-IV

Principles of Volumetric Analysis-II :

12 Periods

Redox Titration: Theoretical basis of volumetric analysis involving (i) Potassium Permanganate (ii) Potassium dichromate and (iii) Iodine.

Precipitation titration: Titration curve for precipitation reaction, end point detection, Mohr's method and Volhard's method.

Complexometric Titration: Theory of complexometric titration, indicators for EDTA titration, Types of EDTA titration-direct and back titration.

Swami Ramanand Teerth Marathwada University, Nanded

Faculty of Science

B.Sc. I (First) Year; Semester - II (w.e.f.2013-14)

Analytical Chemistry; Paper - III

General Concepts of Analytical Chemistry-II

Paper Code – CHAC-103

Periods: 45 per semester; 03 per week

Marks-50

Unit – I

Errors in Chemical Analysis :

10 Periods

Replicate analysis, reliability of analytical data, mean and median & range precision and accuracy, methods of expressing precision and accuracy: deviation, mean deviation, relative mean deviation, and standard deviation. Errors, absolute error, relative error. Determinate errors, classification of determinate errors and their minimization, indeterminate error and normal frequency distribution curve.

Unit-II

Statistical Treatment of Analytical Data:

13 Periods

Statistical treatment of analytical data, confidence limits, students T-test, rejection of data: Q test, 4d rule and 2.5d rule. Graphical representation of results, methods of averages, methods of least squares. Significant figures, Reporting of analytical data, Numericals.

Unit-III

Introduction to Chromatographic Techniques:

10 Periods

Introduction, general principle of chromatography, classification of chromatographic techniques. Principle, technique and applications of paper and thin layer chromatographic techniques.

Unit-IV

Purification Methods used in Organic Chemistry:

12 Periods

Theory of distillation, fractional distillation & Crystallisation

Swami Ramanand Teerth Marathwada University, Nanded

Faculty of Science

B.Sc. I (First) Year; Semester - II (w.e.f.2013-14)

Analytical Chemistry; Paper - IV

Basic Analytical Chemistry-II

Paper Code – CHAC-104

Periods: 45 per semester; 03 per week

Marks-50

Unit – I

Gravimetric Methods of Analysis-I :

12 Periods

Introduction to gravimetric analysis, general principle, entire gravimetric procedure and gravimetric steps. Gravimetric Conversion Factor (GCF) - illustrations with reference to sulfate, chloride, ferric, calcium and phosphate as analyte ions.

Precipitation: Saturation, super saturation, nucleation and crystal growth. Properties of precipitates-partical size, colloidal state; types of precipitates-crystalline, curdy and gelatinous precipitates.

Unit-II

Gravimetric Methods of Analysis-II :

12 Periods

Purity of precipitates, co-precipitation, post-precipitation and procedures to minimize. Factors affecting precipitation. Precipitation from homogeneous solution. Ageing and filtration of precipitate, filter papers, filter mats, Gooch crucible, Sintered glass crucible, washing, drying and ignition of precipitates. Comparison of gravimetric analysis with volumetric analysis.

Unit – III

Types of Precipitants and Their Applications :

11 Periods

Inorganic precipitants, organic precipitants, their advantages and disadvantages. Uses of inorganic precipitants: silver nitrate for chloride, dilute sulfuric acid for barium and lead, barium chloride for sulfate and ammonium hydroxide for iron (III). Uses of organic precipitants: dimethyl glyoxime for Nickel, 8-hydroxy quinoline for aluminum and α -benzoinoxime (Cupron) for copper.

Unit-IV

Solvents and Reagents:

10 Periods

Solvents: Solute, Solvent & Solution, classification of solvents (i) Protic and aprotic (ii) Acidic, basic amphiprotic and neutral (iii) Aqueous and non-aqueous (iv) Polar and non-polar. Each type to be explained with at least one example.

Reagents: Classification of reagents according to their action; (i) acids (ii) bases (iii) salts (iv) complexing agents (v) oxidizing and reducing agents (vi) precipitating agents (vii) chelating agents. Each type to be explained with at least one suitable example.

Primary and secondary standards: Definition, characteristics, uses, examples for different types of reactions.

Swami Ramanand Teerth Marathwada University, Nanded

Faculty of Science

B.Sc. I (First) Year; Semester – I & II (w.e.f.2013-14)

Analytical Chemistry; Paper – V

Laboratory Course-I

Paper Code – CHAC-105

Periods: 120 per year; 04 per week

Marks-100

Note: Out of 23 experiments 16 experiments should be completed.

1. Calibration of volumetric apparatus : Pipette / Standard flask.
2. Preparation of standard solution of potassium hydrogen phthalate and standardization of sodium hydroxide solution.
3. Preparation of standard solution of $K_2Cr_2O_7$ and standardization of given $FeSO_4$ solution.
4. Preparation of standard solution of $(COONa)_2$ and standardization of given $KMnO_4$ solution.
5. Preparation of $Na_2S_2O_3$ solution and its standardization using standard $K_2Cr_2O_7 / KIO_3$ solution.
6. Preparation of standard solution of NaCl and standardization of given $AgNO_3$ solution.
7. Separation of metal ions (Cu^{2+} , Pb^{2+} and Cd^{2+}) / (Z^{2+} , Co^{2+} & Ni^{2+}) by paper chromatography.
8. Assay of commercial sodium hydroxide/ barium hydroxide.
9. Assay of H_2O_2 solution.
10. Assay of formaldehyde.
11. Determination of alkalinity of water sample.
12. Determination of free chloride in a sample of water.
13. Determination of acetic acid content in a commercial sample of vinegar.
14. Determination of moisture content in a soil/ coal sample.
15. Estimation of HCl and CH_3COOH in mixture using acid base indicators.
16. Estimation of iodine in the given solution using standard $Na_2S_2O_3$ solution.
17. Preparation of EDTA solution and its standardization using standard Zn^{++} solution.
18. Estimation of Al^{+++} in the given solution using standard EDTA solution (Back Titration).
19. Estimation of calcium in the given sample of Lime stone or Dolomite or Calcite using standard EDTA solution.
20. Estimation of ester by hydrolysis.
21. Determination of Carbon Dioxide in a polluted water sample.
22. Determination of Calcium in Calcium Gluconate.
23. Determination of iron as iron (III) oxide by Gravimetry.

Reference Books:

1. Analytical chemistry: an introduction: D. A. Skoog, D. M. West and F. J. Holler, Saunders College publishers, 6th edition.
2. An introduction to analytical chemistry, S. A. Iqbal, M. Satake, Y. Mido and M. S. Shethi.
3. College analytical chemistry: Joshi, Baliga and Shetty, Himalaya Publishing house.
4. Qualitative analysis: Day and Underwood.
5. Qualitative inorganic analysis: A. I. Vogel.
6. Principles of analytical chemistry: Pandit and Soman.
7. Analytical chemistry, G. D. Christian, J. Wiley eastern press Ltd.
8. Analytical chemistry: Alka Gupta.
9. Basic concepts of analytical chemistry: S. M. Khopkar.
10. Advanced practical organic chemistry: Vishnoi.
11. Qualitative analysis: A laboratory manual: Day and Underwood.
12. Fundamentals of analytical chemistry: D. A. Skoog, D.M. West and H. J. Holler, 7th edition.
13. Analytical chemistry principles: J. H. Kennedy, W. B. S. Saunders pub. Ltd.
14. Analytical chemistry: Principles and Techniques: L. G. Hargis, Prentice Hall.
15. Principles in semi-micro qualitative analysis: G. R. Chatwal edited by M. Arora.
16. Experiments in chemistry: D. V. Jahagirdar.
17. A text book of experimental and calculation in engineering chemistry: S. S. Dara.
18. Analytical chemistry: Pitzyk and Frank, second edition.
19. Modern analytical chemistry: W. F. Pickering, Marcel Decker INC. New York.
20. Introduction to chromatography: Srivastava and Srivastava.
21. University Practical Chemistry by PC Kamboj, Vishal Publishing Company, Jalandhar.
22. Practical Chemistry (for B.Sc.I, II & III Year Students of All Indian Universities) Dr.O.P. Panday, D.N. Bajpai & Dr. S. Giri, S.Chand & Company, New Delhi.