

Swami Ramanand Teerth Marathwada University, Nanded



B. O. S. In Chemistry

**B. Sc. First Year Semester-I & II
Analytical Chemistry
Syllabus**

In force from June - 2009

**B. Sc. First Year, Semester-I
Analytical Chemistry**

Paper	Course No.	Course	Periods/ week	Total Periods	Marks
I	CHAC-101	General concepts of analytical chemistry-I	3	45	60
II	CHAC-102	Basic analytical chemistry-I	3	45	60

**B. Sc. First Year, Semester-II
Analytical Chemistry**

Paper	Course No.	Course	Periods/ week	Total Periods	Marks
III	CHAC-103	General concepts of analytical chemistry-II	3	45	60
IV	CHAC-104	Basic analytical chemistry-II	3	45	60
V	CHAC-105	Laboratory Course-I	4	120	0

Theory Papers 60 Marks: (External 50 + Internal 10)

B. Sc. First Year; Semester-I
Paper-I [CHAC-101]
General Concepts in Analytical Chemistry-I

Marks: 60

Periods: 45

UNIT-I

1.1 Scope and importance of analytical chemistry: 10P

Introduction to analytical chemistry, Role of analytical chemistry in science. 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, partials analysis and assay of ingredients, the analytical chemist and analyst.

Unit-II

Priliminary oprations in quantitative analysis

- 2.1** Introduction, sampling: definitions, purpose of sampling, theory of sampling, types of sampling, sampling of solids, liquids and gases. Effect of sampling, uncertainties. Clinical sample, preparation laboratory samples: crushing and grindings of laboratory samples; moisture in samples and drying, determination of water ion sample weighing, decomposition and dissolution of samples, some general consideration. Acid treatment, decomposition by flux treatment, decomposition of organic matter (Organic compounds) for elemental analysis, preparation and preservation of solution of sample. **12P**

Unit-III

3.1 Mole concept, molecular weight, formula weight, and equivalent weight. 13P

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

Unit-IV

4.1 Aspects of Co-ordination compounds in chemical analysis: 10P

Definition of terms: Co-ordination complex, coordination number, Chelate: difference between complex and chelates. Types of chelating agents, significant properties of metal ions and ligands, which influence coordination. Stability and stability constant of complexes, Stepwise formation constant. Evidence for complex formation. Practical aspects of coordination compounds in chemical analysis.

B. Sc. First Year; Semester-II
Paper-III [CHAC-103]
General Concepts in Analytical Chemistry-II

Marks: 60

Periods: 45

UNIT-I

1.1 Errors in chemical analysis: 10P

Replicate analysis, reliability of analytical data, mean and median; precision and accuracy, methods of expressing precision and accuracy: deviation, mean deviation, relative mean deviation, and standard deviation. Errors, absolute error, methods of determination of determinate errors, indeterminate error, sources of indeterminate errors and normal frequency distribution curves.

Unit-II

2.1 Statistical treatment of analytical data: 13P

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 and computation rules: Numericals.

UNIT-III

3.1 Introduction to chromatographic techniques: 10P

A general description of chromatography, general principle of chromatography, classification of chromatographic techniques. Principles, techniques and applications of paper and thin layer chromatographic techniques.

Unit-IV

4.1 Purification methods used in organic chemistry: 12P

Theory of distillation, fractional distillation, steam distillation, distillation under reduced pressure and crystallization.

B. Sc. First Year; Semester-I
Paper-II [CHAC-102]
Basic Analytical Chemistry-I

Marks: 60

Periods: 45

UNIT-I

1.1 Measurements of Mass **14P**

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

Unit-II

2.1 Measurements of Volume **07P**

Units of volume, effect of temperature on volume measurement. Apparatus for precise measurements of volume, pipettes, burettes and volumetric flask. Directions for use and their calibration. Rules for maintenance of laboratory note book and format. Volume measurements in analysis.

UNIT-III

3.1 Principles of volumetric analysis-I **12P**

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

Unit-IV

Principles of volumetric analysis-II **12P**

Redox Titration: Theoretical basis of volumetric analysis involving (i) Potassium Permanganate, (ii) Potassium dichromate, (iii) Iodine, theory of redox indicators.

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

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

B. Sc. First Year; Semester-II
Paper-IV [CHAC-104]
Basic Analytical Chemistry-II

Marks: 60

Periods: 45

UNIT-I

1.1 Gravimetric methods of analysis-I **12P**

Gravimetric analysis, comparison of gravimetric analysis with volumetric analysis. General principles, entire gravimetric procedure and gravimetric steps. Stoichiometry and gravimetric conversion factors, illustrations with reference to sulfate, chloride, ferric, calcium and phosphate.

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

Unit-II

2.1 Gravimetric methods of analysis-II **12P**

Purity of precipitates, coprecipitations, post-precipitation and procedures to minimize. Factors affecting precipitation. Precipitation from homogeneous solutions. Ageing and filtration of precipitate, filter papers, filter mats, Gooch crucible, Sintered glass crucibles, washing, drying and ignition of precipitates. Theory of washing reagents.

UNIT-III

3.1 Types of precipitants and their applications: **11P**

Inorganic precipitants, organic precipitants, their advantages and disadvantages. Uses of inorganic precipitants: silver nitrate for chloride, dilute sulfuric acid for barium, 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

4.1 Solvents and reagents: **10P**

Solvents: properties of solvents, 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 reagents (v) oxidizing and reducing reagents (vi) precipitating reagents (vii) chelating reagents each type to be explained with at least one suitable example.

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

B. Sc. First Year; Semester-I & II
Paper-V [CHAC-105]
Laboratory course-I
Analytical Chemistry

Marks: 60

Periods: 120

Note: Out of 25 experiments 18 experiments should be completed.

1. Calibration of weight.
2. Calibration of volumetric apparatus.
3. Preparation of standard solution potassium hydrogen phthalate and standardization of sodium hydroxide solution.
4. Preparation of standard solution of $K_2Cr_2O_7$ and standardization of given $FeSO_4$ solution.
5. Preparation of standard solution of $(COONa)_2$ and standardization of given $KMnO_4$ solution.
6. Preparation of $Na_2S_2O_3$ solution and its standardization using standard $K_2Cr_2O_7$ / KIO_3 solution.
7. Preparation of standard solution of $NaCl$ and standardization of given $AgNO_3$ solution.
8. Separation of metal ions/indicators by paper chromatography.
9. Separation of dyestuff on activated silica gel by thin layer chromatography.
10. Separation of amino acids on deactivated silica gel by thin layer chromatography.
11. Assay of commercial sodium hydroxide/ barium hydroxide.
12. Assay of H_2O_2 solution.
13. Assay of ferrous ammonium sulfate.
14. Assay of formaldehyde.
15. Determination of alkalinity of commercial soda ash.
16. Determination of alkalinity of water sample.
17. Determination of free chloride in a sample of water.
18. Determination of acetic acid content in a commercial sample of vinegar.
19. Determination of moisture content in a soil/ coal sample.
20. Estimation of HCl and CH_3COOH in mixture using acid base indicators.
21. Estimation of iodine in the given solution using standard $Na_2S_2O_3$ solution.
22. Preparation of EDTA solution and its standardization using standard Zn^{++} solution.
23. Estimation of Al^{+++} in the given solution using standard EDTA solution (Back Titration).
24. Estimation of calcium in the given sample lime stone or Dolomite or Calcite using standard EDTA solution (Back Titration).
25. Estimation of ester by hydrolysis.

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 Shettya, 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 eater press ltd.
8. Analytical chemistry: Alka Gupta.
9. Basic concepts of analytical chemistry: S. M. Kopkar.
10. Advanced practical organic chemistry, Vishnoi.
11. Qualitative analysis: A laboratory manual: Day and Underwood.
12. Fundamental of analytical chemistry: D. A. Skoog, Don. West and H. J. Holler, 7th edition.
13. Analytical chemistry principles: J. H. Kennedy, W. B. S. Aunders 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, Marcal Decker INC. New York.
20. Introduction to chromatography: Srivastava and srivastava.

QUESTION PAPER FORMAT

FACULTY OF SCIENCE
B. Sc. First Year EXAMINATION
Semester Pattern

Analytical chemistry

Time: 2 Hrs.

Maximum Marks: 50

N. B.:

- (i) Attempt all questions.
- (ii) Use of logarithmic table and calculator is allowed.
- (iii) Figures to the right hand side indicates full marks.
- (iv) Questions No.1 should be attempt only once on page number three of answer book with complete answer.

Q. 1	Answer any <i>three</i> of the following	15
	a)	
	b)	
	c)	
	d)	
	e)	
Q. 2	A	08
	OR	
	A	
	B	07
	OR	
	B	
Q. 3	Objective type-(MCQ, fill in the blanks, match of the following, true or false)	10
	10 bits	
Q. 4	Write short notes on any two of the following	10
	i)	
	ii)	
	iii)	