RAJARSHI SHAHU MAHAVIDYALAYA, (AUTONOMOUS)

LATUR – 413512

DEPARTMENT OF ANALYTICAL CHEMISTRY

Syllabus

B.Sc. (First Year) Analytical Chemistry
CBCS Pattern

(I & II Semester)

With Effect From 2018-2019

Rajarshi Shahu Mahavidyalaya, Latur
(Autonomous)
BoS in Analytical Chemistry

1.Introduction:

The syllabus of B.Sc Analytical Chemistry is prepared to give sound knowledge and understanding of Analytical Chemistry to undergraduate students of the B.Sc.Analytical Degree course. The goal of the syllabus is to make the study of Analytical Chemistry as a stimulating, interesting and relevant as possible. The syllabus is prepared by keeping in mind the aim to make the students capable of studying Analytical Chemistry in academic and industrial courses. Also, to expose the students to Analytical Chemistry and to built up their interest in various fields of Analytical Chemistry. The new and updated syllabus is based on disciplinary approach with vigor and depth, taking care that the syllabus is not heavy not the same time it is comparable to the syllabi of other Universities at the same level.

The syllabus is prepared after discussions of number of faculty members of the subject and by considering the syllabi of NET, SET, GATE examinations, UGC model curriculum, syllabi of different entrance examinations and syllabi of other Universities.

2. Title of the Programme: B.Sc Analytical Chemistry

3. Learning Objectives of the Programme:

- To promote understanding of basic facts and concepts in chemistry while retaining the excitement of chemistry
- To make students capable of studying chemistry in academic and industrial courses .
- To expose the students to various emerging new areas of chemistry and apprise them with there prevalent in their future studies and their applications to various spheres of chemical sciences.
- To develop problem solving skills in students.
- To expose the students to different processes used in industries and their applications.
- To develop ability and to acquire the knowledge of terms, facts, concepts, processes, techniques and principles of subject.
- To develop ability to apply the knowledge, contents and principles of chemistry.
- To acquire new knowledge of chemistry and developments therein
- To expose and to develop interest in the fields of chemistry
- To develop skills required in chemical analysis and synthesis in chemical laboratories such as the proper handling of apparatus and chemicals, to develop new modern techniques of analysis and synthesis etc.

4. Programme Specific outcomes/ Programme Outcomes:

The purpose of the three year B.Sc Analytical chemistry programme is to provide the key knowledge base and laboratory resources to prepare students for careers as professionals in the field of Analytical chemistry.

B.Sc Analytical chemistry outcome-

The three year graduate programme in Analytical Chemistry provides students with specialized knowledge and professional skills to prepare them for a career.
Upon successful completion,of three year master programme in chemistry students should:

1. Have firm foundations in the fundamentals and application of current chemical and scientific theories.
2. Be able to integrate their knowledge from each of these areas with critical thinking skills in order to become problem solvers.

3. Be proficient in the chemistry laboratory, especially with respect to the abilities to

- Follow and understand general laboratory practice guidelines, including safety.
- Perform qualitative chemical analyses.
- Perform chemical synthesis.
- Understand and use modern chemical instrumentation.

4.They are able to interpret and analyze quantitative data.

5.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.

6.Find gainful employment in industry or government, be accepted at graduate or professional schools or find employment in school systems as instructors or administrators

5.Advantages of Course:

The B.Sc Analytical Chemistry course is useful for the students in various aspects and offers them with bright career. The course helps the students in improving their diverse skills in various areas such as laboratory skills, numerical and computing skills, ability to approach to the problems both analytically and logically, time management skills, etc .The B.Sc Analytical chemistry graduates have many options for their higher studies. Majority of these graduates opt for master's degree in the same. But they can also choose various specialized areas in this field for the post graduation courses.

Some of the higher study options after B.Sc Analytical Chemistry are:

- M.Sc.Organic Chemistry
- M.Sc.Physical Chemistry
- M.Sc.Inorganic Chemistry
- M.Sc.Analytical Chemistry
- M.Sc.Biochemistry

6. Duration of the Course: Three year
7. Eligibility of the Course: 10+2
8. Strength of the Students: As per the University/College rules.
9. Fees for Course: As per University/College rules.
10. Admission / Selection procedure: Admission by merit through Registration
11. Teacher's qualifications: As per UGC/University/College rules
12. Standard of Passing: As per UGC/University/College rules
13. Nature of question paper with scheme of marking: As per UGC/University/College rules
14. List of book recommended: Included in syllabus

15. List of Laboratory Equipment's, Instruments, and Measurements etc.:

List of major Laboratory Equipment's, Instruments, and Measurements:

Particulars	Quantity	Particulars	Quantity
Digital balance	05	Flame Photometer	01
Centrifuge machine	03	Refrigerator	01
Conductometer	12	Freezing point Apparatus	02
Colorimeter	15	Heating Mental	04
Distillation plant	01	pH-Meter	12
Electric Burner	08	Polarimeter	05
Digital Photofluorometer	02	Melting point Apparatus	02
Potentiometer	14	Rotary Shaker	01
Terbidometer	02	Abbes Refractometer	02
Ultrasonicator	01	FT-IR	01
Suction Machine	01	Magnetic Stirrer	12

16. Rules and regulations and ordinance if any: As per UGC/University/College rules
17. Course duration: Each theory course is of 60 Contact hours
18. Medium of the language: English

Rajarshi Shahu Mahavidyalaya (Autonomous), Latur
Syllabus
B.Sc. (First Year) Chemistry
Semester – I & II
CORE COURSE ANALYTICAL CHEMISTRY

Sr No	SEM	Core Courses	Course Title	Total Periods	Periods / Week	Credits	CIA	End Sem Exam	Total Marks
1.	I	U-ANC-150	General Concepts of Analytical Chemistry	45	03	2	20	30	50
		U-ANC-151	Basic Analytical Chemistry & Titrimetry	45	03	2	20	30	50
		U-ANC-152	Analytical Chemistry Laboratory Course-I	45	03	1	20	30	50
2.	II	U-ANC-249	Errors, Statistical Treatment of Analytical Data and Separation Techniques	45	03	2	20	30	50
		U-ANC-250	Gravimetric Methods of Analysis, Laboratory Reagents and Solvents	45	03	2	20	30	50
		U-ANC-251	Analytical Chemistry Laboratory Course-II	45	03	1	20	30	50
			Total			**10**			**300**

CCAC-I- Core Course Analytical Chemistry Semester I
CCAC-II- Core Course Analytical Chemistry Semester II
CCACL-I Core Course Analytical Chemistry Lab. Course Semester I
CCACL-II Core Course Analytical Chemistry Lab. Course Semester II

Theory Papers 100 Marks: (Internal 40*+External 60*)

- External S.E.E. 60 Marks Theory
- Internal 40 Marks (Two unit test -30 marks+ Attendance 10Marks)
- Unit Test I : Activity Based 60 Marks
- Unit Test II : MCQ patterns 60 MCQ questions
- Unit test (I+ II) = 120 converted to 30 Marks

Board of Studies in Analytical Chemistry

Sr. No.	Name of Member	Designation	Sign	Sr. No.	Name of Member	Designation	Sign
1.	Dr. S.D. Salunke	Chairman		7.	Dr. C.V. Reddy	Member(ACM)	
2.	Mr. B.B. Sanap	Member		8.	Prof. D.H. More	Member(ACM)	
3.	Mr. D.G. Palke	Member		9.	Dr. Mrs. S.S. Makone	Member (VC Nominee)	
4.	Mr. K.I. Momin	Member		10.	Mr. R.S. Patil	Member (Industry Expert)	
5.	Dr. K.C. Tayade	Member		11.	Mr. G.R. Nagargoje	Member (PG Alumni)	
6.	Mr. M.S. Sudewad	Member		12.	Dr. V.S. Shembekar	Member (Same Faculty)	
				13.	Dr. S.H. Gaikwad	Special Invitee.	

Semester- I
ANALYTICAL CHEMISTRY
Course Code: CCAC-I
Section A
GENERAL CONCEPTS OF ANALYTICAL CHEMISTRY
U-ANC-150

Marks: 100 **Credits: 04**
Periods: 90 **6 per week**

Learning Objective:

1. Understanding the unit operations, uses of analytical methods in chemistry.
2. To know the role of qualitative and quantitative analysis.
3. To gain the knowledge of chemical methods applied for elemental and compound analysis.

Course Outcome:

1. Students acquire the knowledge of the qualitative and quantitative analysis.
2. They can know how the chemical methods applied for elemental and compound analysis

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**

1. 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 laborat1. Understanding the unit operations, uses of analytical methods in chemistry.
2. To know the role of qualitative and quantitative analysis.
3. To gain the knowledge of chemical methods applied for elemental and compound analysis.ory 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. Numaricals.

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 (Illustration with one example each).

Section B

BASIC ANALYTICAL CHEMISTRY AND TITRIMETRY

Course Code: CCAC-I

U-ANC-151

Marks: 100 **Credits: 04**

Periods: 90 **6 per week**

Learning Objective:

1. To understand the types of analytical balances, weights and calibration of weights.
2. To understand the units of volume, effect of temperature on volume measurement
3. To know the Principles of Titrimetric Analysis.

Course Outcome:

1. They can know the types of analytical balances, Weights and calibration of weights
2.They can understand the units of volume, effect of temperatue on volume measurement
3. They understand the principle of titrimetric analysis.

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 Titrimetric 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 indictors.

Unit-IV Principles of Titrimetric 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

Core Course Analytical Chemistry (Practical)
Course Code: CCAC-L-I
U-ANC-152

Marks 50 **Credit – 01**
Periods: 45/Semester **03/week**

Learning Objective:
To familiarize students with basics of calibration, titration processes and assay methods.

Course Outcome:
Students can practically calibrate the apparatus, became familiar with the basic titration processes and able to assay the commercial chemical samples.

Note: Out of 11 experiments 08 experiments should be completed by each student.

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 $K_2Cr_2O_7/KIO_3$
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+}) / (Zn^{2+}, Co^{2+} and 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.

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Semester- II

Core Course Analytical Chemistry (Theory)

ANALYTICAL CHEMISTRY

Errors, Statistical Treatment of Analytical Data and Separation Techniques

Course Code: CCAC-II

U-ANC-249

Marks: 100 **Credits: 04**

Periods: 90 **6 per week**

Learning Objective:

Understanding the chromatographic methods and chemometrics**.**

Course Outcome:

Students understand the principle and handling procedures of chromatographic techniques and chemometrics.

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 Separation Techniques: Introduction, Classification of separation techniques.

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 Sublimation, distillation, , fractional distillation & Crystallisation

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GRAVIMETRIC METHODS OF ANALYSIS, LABORATORY REAGENTS AND SOLVENTS

U-ANC-250

Learning Objective:

1. Understanding various steps involved in gravimetric methods of analysis
2. Understanding gravimetric conversion factors
3. Understanding different types of precipitants for gravimetric analysis
4. Understanding classification of solvents and reagents.

Course Outcome:

1. Student will write the steps involved in gravimetric analysis
2. Students can apply the knowledge of gravimetric conversion factor in analysis
3. Students are able to use the precipitants for particular ions in gravimetry
4. Students can classify the given solvents and reagents

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. Fractional Precipitation, 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 Laboratory Reagents & Solvents: 10 Periods

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.

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.

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Core Course Analytical Chemistry (Practical)
Course Code: CCAC-L-II
U-ANC-251

Marks 50 **Credit – 01**
Periods: 45/Semester **03/week**

Learning Objective:
Studying the experimental procedures for quantitative determination of various ions by volumetric titration.

Course Outcome:
Students able to determine quantitative analysis of various ions by volumetric titration

Note: Out of 11 experiments 09 experiments should be completed by each student.

1. Determination of free chloride in a sample of water.
2. Determination of acetic acid content in a commercial sample of vinegar.
3. Determination of moisture content in a soil/ coal sample.
4. Estimation of HCl and CH_3COOH in mixture using acid base indicators.
5. Estimation of Iodine in the given solution using standard $Na_2S_2O_3$ solution.
6. Preparation of EDTA solution and its standardization using standard Zn^{2+} solution
7. Estimation of Al^{3+} in the given solution using standard EDTA solution (Back Titration)
8. Determination of Carbon Dioxide in a polluted water sample.
9. Determination of Calcium in Calcium Gluconate
10. Determination of iron as iron (III) oxide by Gravimetry.
11. Determination of Ni as Ni $(DMG)_2$ by Gravimetry.

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Reference :

1. Analytical chemistry: an introduction: D. A. Skoog, D. M. West and F. J. Holler, Saunders the College publishers, 6 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 pratical 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, 7 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: Pitrzyk 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.

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RAJARSHI SHAHU MAHAVIDYALAYA, (AUTONOMOUS) LATUR - 413512
DEPARTMENT OF ANALYTICAL CHEMISTRY
Skeleton of Question Paper at Semester end examination (Theory)

Time: 2.30 hours (for Theory) Max. Marks = 60

INTERNAL 30 MARKS (30*4=120/4)

- UNIT TEST -I

MCQ Examination 60 Marks

Section A- 30 Marks

Section B- 30 Marks

- UNIT TEST -II

Choice based System –60 Marks

Section A - 30 Marks

Section B - 30 Marks

RAJARSHI SHAHU MAHAVIDYALAYA, (AUTONOMOUS) LATUR - 413512
DEPARTMENT OF CHEMISTRY
Skeleton of Question Paper of continuous assessment (Internal)

Maximum Marks. 40

A) Unit Test - I (16 marks)
B) Unit Test - II (16 marks)
C) Attendance 08

- Below 75 % 0.0
- 75.1 - 80.00 % 1.0
- 80.1 - 85.0 % 2.0
- 85.1 - 90.0 % 3.0
- 90.1 and above 4.0

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