

University of Mumbai



No. AAMS_UGS/ICC/2024-25/09

CIRCULAR:-

Attention of the Principals of the Affiliated Colleges and Directors of the Recognized Institutions in Faculty of Science & Technology is invited to this office Circular No. UG/73 of 2018-19 dated 06th July, 2018 relating to the revised syllabus as per the (CBCS) for the Chemistry of T.Y.B.Sc. Physical Chemistry, Inorganic Chemistry, Organic Chemistry and Analytical Chemistry (Sem -V & VI) (3 and 6 units) including Applied Component Drugs and Dyes, Heavy Fine Chemicals and Petrochemicals.

They are hereby informed that the recommendations made by the **Board of Studies in Chemistry** at its meeting held on 11th May, 2024 and subsequently passed by the Board of Deans at its meeting held on 24th May, 2024 vide item No. 6.12 (R) have been accepted by the Academic Council at its meeting held on 24th May, 2024 vide item No. 6.12 (R) and that in accordance therewith, the **revised syllabus for T.Y.B.Sc. (Analytical Chemistry) – Sem V & VI (CBCS)** has been brought into force with effect from the academic year 2024-25.

(The said circular is available on the University's website www.mu.ac.in).

MUMBAI – 400 032
25th June, 2024

Baliram
(Prof. (Dr.) Baliram Gaikwad)
I/c. REGISTRAR

To,

The Principals of the Affiliated Colleges and Directors of the Recognized Institutions in Faculty of Science & Technology.

A.C/6.12 (R) /24/05/2024

Copy forwarded with Compliments for information to:-

- 1) The Dean, Faculty of Science & Technology,
- 2) The Chairman, Board of Studies **Chemistry**,
- 3) The Director, Board of Examinations and Evaluation,
- 4) The Director, Board of Students Development,
- 5) The Director, Department of Information & Communication Technology,
- 6) The Co-ordinator, MKCL,
- 7) The Deputy Registrar, Admissions, Enrolment, Eligibility & Migration Department (AEM),
- 8) The Deputy Registrar, Result Unit,
- 9) The Deputy Registrar, College Affiliations Development Department (CAD)

Copy to :-

- 1. The Deputy Registrar, Academic Authorities Meetings and Services (AAMS),**
- 2. The Deputy Registrar, College Affiliations & Development Department (CAD),**
- 3. The Deputy Registrar, (Admissions, Enrolment, Eligibility and Migration Department (AEM),**
- 4. The Deputy Registrar, Research Administration & Promotion Cell (RAPC),**
- 5. The Deputy Registrar, Executive Authorities Section (EA),**
- 6. The Deputy Registrar, PRO, Fort, (Publication Section),**
- 7. The Deputy Registrar, (Special Cell),**
- 8. The Deputy Registrar, Fort/ Vidyanagari Administration Department (FAD) (VAD), Record Section,**
- 9. The Director, Institute of Distance and Open Learning (IDOL Admin), Vidyanagari,**

They are requested to treat this as action taken report on the concerned resolution adopted by the Academic Council referred to in the above circular and that on separate Action Taken Report will be sent in this connection.

- 1. P.A to Hon'ble Vice-Chancellor,**
- 2. P.A Pro-Vice-Chancellor,**
- 3. P.A to Registrar,**
- 4. All Deans of all Faculties,**
- 5. P.A to Finance & Account Officers, (F.& A.O),**
- 6. P.A to Director, Board of Examinations and Evaluation,**
- 7. P.A to Director, Innovation, Incubation and Linkages,**
- 8. P.A to Director, Board of Lifelong Learning and Extension (BLLE),**
- 9. The Director, Dept. of Information and Communication Technology (DICT) (CCF & UCC), Vidyanagari,**
- 10. The Director of Board of Student Development,**
- 11. The Director, Department of Students Welfare (DSD),**
- 12. All Deputy Registrar, Examination House,**
- 13. The Deputy Registrars, Finance & Accounts Section,**
- 14. The Assistant Registrar, Administrative sub-Campus Thane,**
- 15. The Assistant Registrar, School of Engg. & Applied Sciences, Kalyan,**
- 16. The Assistant Registrar, Ratnagiri sub-centre, Ratnagiri,**
- 17. The Assistant Registrar, Constituent Colleges Unit,**
- 18. BUCTU,**
- 19. The Receptionist,**
- 20. The Telephone Operator,**
- 21. The Secretary MUASA**

for information.

University of Mumbai



Revised Syllabus for
T.Y.B.Sc. (Analytical Chemistry)
Semester – (Sem V and VI)
(Choice Based Credit System)

(With effect from the academic year 2024-25)

University of Mumbai



Syllabus for Approval

O: _____ Title of Course	T.Y.B.Sc. (Analytical Chemistry)
O: _____ Eligibility	As per University Ordinance
R: _____ Passing Marks	40%
No. of years/Semesters:	Three
Level:	UG
Pattern:	Semester
Status:	Revised
To be implemented from Academic Year :	From Academic Year: 2024-25

Sign of the BOS
Coordinator
Dr. Sunil Patil
BOS in Chemistry

Sign of the
Offg. Associate Dean
Dr. Madhav R. Rajwade
Faculty of Science &
Technology

Sign of the
Offg. Dean
Prof. Shivram S. Garje
Faculty of Science &
Technology

Preamble

1) **Introduction**

The B.Sc (Chemistry) program is meticulously structured to foster a deep understanding of chemical principles and their real-world applications. The curriculum is a blend of theoretical knowledge and hands-on experience, ensuring that students not only grasp the core concepts but also develop a passion for the subject. With a focus on continuous assessment through quizzes, class tests, and assignments, the program emphasizes the importance of a strong conceptual foundation. This approach is complemented by practical experiments, where theoretical knowledge is applied, enhancing the learning experience and preparing students to tackle the multifaceted challenges in the field of chemistry.

2) **Aims and Objectives**

The B.Sc (Chemistry) program is structured to equip students with a comprehensive understanding of chemical principles and their real-world applications. It aims to foster a deep appreciation for the subject, encouraging students to engage in critical thinking and problem-solving. By integrating theoretical knowledge with practical skills, the course prepares graduates for diverse careers in research, industry, education, and beyond, contributing to their holistic academic and professional growth.

3) **Learning Outcomes**

A strong foundation in the fundamental principles of Physical, Inorganic, organic, and Analytical chemistry is essential for a successful career in the sciences. Continuous learning and self-improvement are critical for staying current in the ever-evolving field of chemistry. A curiosity-driven approach to scientific inquiry fosters innovation and discovery. Identifying potential career paths in chemistry-related fields opens up a world of opportunities in diverse industries. Applying acquired skills to entry-level positions can lead to significant advancements in sectors like pharmaceuticals, materials science, and environmental science.

4) **Any other point (if any)**

The program is meticulously designed to lay a solid foundation in the subject, equipping students with essential skills and knowledge. Through a blend of theoretical understanding and practical application, the curriculum aims to fortify the students' grasp of the basics, ensuring they are well-prepared for advanced study or professional application in the field. This foundational strength is crucial for their academic and career progression, providing a robust platform from which they can build expertise and specialization.

T.Y.B.Sc. CHEMISTRY (6 UNITS)

Choice Based Credit System

To be implemented from the Academic year 2024-25

Paper IV: Analytical Chemistry

SEMESTER V

Course Code: USCH504	Credits: 02	Lectures: 60
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Unit	Topic		No. of Lectures	Total No. of Lectures
I Introduction to quality concepts, chemical calculations, and sampling	1)	Quality in Analytical Chemistry	05	15
	2)	Chemical Calculations	04	
	3)	Sampling	06	
II Classical methods of Analysis	1)	Neutralization Titrations	03	15
	2)	Redox Titrations	04	
	3)	Complexometric Titrations	08	
III Optical Methods	1)	Atomic Spectroscopy: Flame Emission spectroscopy (FES) and Atomic Absorption Spectroscopy(AAS)	07	15
	2)	Molecular Fluorescence and Phosphorescence Spectroscopy	04	
	3)	Turbidimetry and Nephelometry	04	
IV Methods of Separation -I	1)	Solvent Extraction	06	15
	2)	Gas Chromatography	09	

Unit	Topic	No. of Lectures	
	1.1 Quality in Analytical Chemistry	05	
Unit I	1.1.1	Concepts of Quality, Quality Control and Quality Assurance	
	1.1.2	Importance of Quality concepts in Industry	
	1.1.3	Chemical Standards and Certified Reference Materials; Importance in chemical analysis Quality of material: Various grades of laboratory reagents	
		1.2 Chemical Calculations (Numericals and word problems are expected)	04
	1.2.1	Inter conversion of various concentration units. (Conversion of concentration from one unit to another unit with examples)	
	1.2.2	Percent composition of elements in chemical compounds	
	1.3 Sampling	06	
	1.3.1	Sampling of solids: Sample size – bulk ratio, size to weight ratio, multistage and sequential sampling, size reduction methods, sampling of compact solids, equipments and methods of sampling of compact solids, sampling of particulate solids, methods and equipments used for sampling of particulate solids.	
	1.3.2	Sampling of liquids: Homogeneous and heterogeneous, Static and flowing liquids.	
	1.3.3	Sampling of gases: Ambient and stack sampling: Apparatus and methods for sampling of gases.	
	1.3.4	Collection, preservation and dissolution of the sample.	
Unit II	2.1 Neutralization Titrations (Calculation of pH in the beginning, at equivalence point and after the equivalence point)	03	
	2.1.1	Strong acid vs Strong Base	
	2.1.2	Weak acid vs Strong Base	
		2.2 Redox Titrations (Numerical and word problems are expected)	04
	2.2.1	Introduction	
	2.2.2	Construction of the titration curves and calculation of E_{system} in aqueous medium in case of One electron system	
	2.2.3	Theory of redox indicators, Criteria for selection of an indicator Use of diphenyl amine and ferroin as redox indicators	
		2.3 Complexometric Titrations	08
	2.3.1	Introduction, construction of titration curve	
	2.3.2	Use of EDTA as titrant and its standardisation, absolute and conditional formation constants of metal EDTA complexes, Selectivity of EDTA as a titrant. Factors enhancing selectivity of EDTA as a titrant with examples. Advantages and limitations of EDTA as a titrant.	
2.3.3	Types of EDTA titrations.		
2.3.4	Metallochromic indicators, theory, examples and applications		
UNIT III:	3.1 Atomic Spectroscopy: Flame Emission spectroscopy(FES) and Atomic Absorption Spectroscopy(AAS)	07	

	3.1.1	Introduction, Absorption and Emission Spectra	
	3.1.2	Flame Photometry – Principle, Instrumentation (Flame atomizers, types of Burners, Wavelength selectors, Detectors)	
	3.1.3	Atomic Absorption Spectroscopy – Principle, Instrumentation (Source, Chopper, Flame and Electrothermal Atomiser)	
	3.1.4	Qualitative and Quantitative analysis with respect to FES and AAS – Calibration curve method, Standard addition method and Internal standard method.	
	3.1.5	Comparison between FES and AAS	
	3.1.6	Applications, Advantages and Limitations	
	3.2 Molecular Fluorescence and Phosphorescence Spectroscopy		04
	3.2.1	Introduction and Principle	
	3.2.2	Relationship of Fluorescence intensity with concentration	
	3.2.3	Factors affecting Fluorescence and Phosphorescence	
	3.2.4	Instrumentation and applications	
	3.2.5	Comparison of Fluorimetry and Phosphorimetry	
	3.2.6	Comparison with Absorption methods	
	3.3 Turbidimetry and Nephelometry		04
	3.3.1	Introduction and Principle	
	3.3.2	Factors affecting scattering of Radiation: Concentration, particle size, wavelength and refractive index	
	3.3.3	Instrumentation and Applications	
Unit IV	4.1 Solvent Extraction		06
	4.1.1	Factors affecting extraction: Role of complexing agents in solvent extraction Chelation, Ion pair formation and Solvation	
	4.1.2	Graph of percent extraction versus pH. Concept of $[pH]_{1/2}$ and its significance (derivation not expected)	
	4.1.3	Craig's counter current extraction: Principle, apparatus and applications	
	4.1.4	Solid phase extraction: Principle, process and applications with special reference to water and industrial effluent analysis.	
	4.1.5	Comparison of solid phase extraction and solvent extraction.	
	4.2 Gas Chromatography (Numerical and word problems are expected)		09
	4.2.1	Introduction, Principle, Theory and terms involved	
	4.2.2	Instrumentation: Block diagram and components, types of columns, stationary phases in GSC and GLC, Detectors: TCD, FID, ECD	
	4.2.3	Qualitative, Quantitative analysis and applications	
	4.2.4	Comparison between GSC and GLC	

Reference Books:

1.	3000 solved problems in Chemistry, David E. Goldberg,PhD.,Schaums Outline	Unit/s: (1.2)
2.	A guide to Quality in Analytical Chemistry: An aid to accreditation, CITAC and EURACHEM, (2002),	Unit/s (1.1)
3.	A premier sampling solids, liquids and gases, Smith Patricia I, American statistical association and the society for industrial and applied mathematics, (2001)	Unit/s (1.3)
4.	Analytical Chemistry, Gary.D Christan, 5th edition	Unit/s (4.1,4.2,4.3)
5.	Analytical Chemistry, Skoog, West ,Holler,7th Edition	Unit/s (2.1, 2.2 2.3)
6.	Analytical Chromatography, Gurdeep R Chatwal, Himalaya publication	Unit/s (4.1,4.2)
7.	Basic Concepts of Analytical Chemistry, by S M Khopkar, new Age International (p) Limited	Unit/s (4.1,4.2)
8.	Chemical methods of separation, J A Dean, Van Nostrand Reinhold, 1969	Unit/s (4.1,4.2)
9.	Fundamentals of Analytical Chemistry by Skoog and West , 8th Edition	Unit/s (4.1,4.2)
10.	Handbook of quality assurance for the analytical chemistry laboratory, 2ndEdn., James P. DuxVanNostr and Reinhold, 1990	Unit/s (1.1)
11.	Instrumental methods of Analysis, by Dr Supriya S Mahajan, Popular Prakashan Ltd	Unit/s (4.1,4.2)
12.	Instrumental methods Of Analysis, by Willard Merritt Dean, 7thEdition, CBS Publisher and distribution Pvt Ltd	Unit/s (3.1,3.2,3.3)
13.	Instrumental Methods of Chemical Analysis by B.K. Sharma Goel Publishing House	Unit/s (4.1,4.2)
14.	Principles of Instrumental Analysis , 5th Edition, By Skoog, Holler, Nieman	Unit/s (4.1,4.2) (3.1,3.2,3.3)
15.	Quality control and Quality assurance in Analytical Chemical Laboratory, Piotr Konieczka and Jacek Namiesnik, CRC press (2018)	Unit/s (1.1)
16.	Quality in the Analytical Chemistry Laboratory, Elizabeth Prichard, Neil T. Crosby, Florence Elizabeth Prichard, John Wiley and Sons, 1995	Unit/s (1.1)
17.	Solvent extraction and ion exchange, J Marcus and A. S. Kertes Wiley INC 1969	Unit/s (4.1,4.2)

PRACTICALS

Course Code: USCHP504

Credits: 02

Non-Instrumental Experiments

1. To determine the amount of persulphate in the given sample solution by back titration with standard Fe (II) ammonium sulphate solution.
2. To determine the amount of Iron present in iron sample by redox titration using potassium dichromate with diphenyl amine as an indicator.
3. To estimate amount of Calcium from given sample by complexometric titration.

Instrumental Experiments

1. To determine potassium content of a Fertilizer by Flame Photometry (Calibration curve Method)
2. To determine the amount of sulphate in given water sample turbidimetrically.
3. Estimation of Chromium in water sample spectrophotometrically by using Diphenyl Carbazide.

Reference Books:

1. Vogel's Textbook of Quantitative Chemical Analysis, 5th Edn., G. H. Jeffery, J Bassett, J Mendham and R C Denney, ELBS with Longmann (1989).

2. Vogel's Textbook of Quantitative Chemical analysis, Sixth edition, J. Mendham et al

T.Y.B.Sc. CHEMISTRY (6 UNITS)

Choice Based Credit System

To be implemented from the Academic year 2024-25

Paper IV: Analytical Chemistry**SEMESTER VI**

Course Code: USCH604	Credits: 02	Lectures: 60
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Unit	Topic		No. of Lectures	Total No. of Lectures
I Electroanalytical Techniques	1)	Polarography	11	15
	2)	Amperometric Titrations	04	
II Methods of Separation - II	1)	High Performance Liquid chromatography (HPLC)	06	15
	2)	High Performance Thin Layer Chromatography (HPTLC)	03	
	3)	Ion Exchange Chromatography	06	
III Food and Cosmetics Analysis	1)	Introduction to food chemistry	10	15
	2)	Cosmetics	05	
IV Thermal and Radioanalytical Methods	1)	Thermal Methods	12	15
	2)	Radio Analytical Methods	03	

Unit	Topic	No. of Lectures	
Unit I	1.1 Polarography (Numerical and word problems are expected)	11	
	1.1.1		Difference between potentiometry and voltammetry, Polarizable and non-polarizable electrodes.
	1.1.2		Basic principle of polarography H-shaped polarographic cell, DME (construction, working, advantages and limitations)
	1.1.3		DC polarogram: Terms involved - Residual current, Diffusion current, Limiting current, Half-Wave Potential Role and selection of supporting electrolyte, Interference of oxygen and its removal, polarographic maxima and Maxima Suppressors Qualitative aspects of Polarography: Half wave potential $E_{1/2}$, Factors affecting $E_{1/2}$ Quantitative aspects of polarography: Ilkovic equations: various terms involved in it (No derivation)
	1.1.4		Quantification 1) Wave height – Concentration plots (working plots/calibration) 2) Internal standard (pilot ion) method 3) Standard addition method
	1.1.5		Applications, advantages and limitations
	1.2 Amperometric Titrations	04	
	1.2.1	Principle, Rotating Platinum Electrode(Construction, advantages and limitations)	
	1.2.2	Titration curves with example	
	1.2.3	Advantages and limitations	
Unit II	2.1 High Performance Liquid chromatography (HPLC)	06	
	2.1.1		Introduction and Principle Instrumentation- components with their significance: Solvent Reservoir, Degassing system, Pumps-(reciprocating pumps, screw driven- syringe type pumps, pneumatic pumps, advantages and disadvantages of each pump), Precolumn, Sample injection system, HPLC Columns, Detectors(UV – Visible detector, Refractive index detector)
	2.1.2	Qualitative and Quantitative Applications of HPLC	
		2.2 High Performance Thin Layer Chromatography (HPTLC)	03
	2.2.1	Introduction and Principle Stationary phase, Sample application and mobile phase	
	2.2.2	Detectors a) Scanning densitometer- Components. Types of densitometer- Single beam and Double beam Fluorometric Detector	
	2.2.3	Advantages, disadvantages, and applications	
2.2.4	Comparison of TLC and HPTLC		

	2.3 Ion Exchange Chromatography	06
	2.3.1 Introduction, Principle	
	2.3.2 Types of Ion Exchangers , Ideal properties of resin	
	2.3.3 Ion Exchange equilibria and mechanism, selectivity coefficient and separation factor Factors affecting separation of ions.	
	2.3.4 Ion exchange capacity and its determination for cation and anion exchangers.	
Unit III	3.1 Introduction to food chemistry	10
	3.1.1 Food processing and preservation: Introduction, need, chemical methods, action of chemicals (sulphur dioxide, boric acid, sodium benzoate, acetic acid, sodium chloride and sugar) and pH control Physical methods (Pasteurization and Irradiation)	
	3.1.2 Determination of boric acid by titrimetry.	
	3.1.3 Study and analysis of food products and detection of adulterants 1) Milk: Composition & nutrients, types of milk (fat free, organic and lactose milk) Analysis of milk for lactose by Lane Eynon's Method	
	2) Honey: Composition, Analysis of reducing sugars in honey by Wilstater's method 3) Tea: Composition, types (green tea and mixed tea) Analysis of Tannin by Lowenthal's method. 4) Coffee: Constituents and composition, Role of Chicory .	
	3.2 Cosmetics	05
	3.2.1 Introduction and sensory properties	
	3.2.2 Study of cosmetic products – 1) Face powder: Composition, Estimation of calcium and Magnesium in Face powder by complexometric titration 2) Lipstick: Constituents, Ash analysis for water soluble salts: borates, carbonates and zinc oxide. 3) Deodorants and Antiperspirants: Constituents, properties, Estimation of zinc by gravimetry.	
UNIT IV	4.1 Thermal Methods	12
	4.1.1 Introduction to various thermal methods (TGA, DTA and Thermometric titration)	
	4.1.2 Thermogravimetric Analysis(TGA) Instrumentation-block diagram, thermobalance (Basic components: balance, furnace, temperature measurement and control, recorder) Thermogram (TG curve)for $\text{CaC}_2\text{O}_4 \cdot \text{H}_2\text{O}$ and $\text{CuSO}_4 \cdot 5\text{H}_2\text{O}$ Factors affecting thermogram-Instrumental factors and Sample characteristics. Applications: Determination of drying and ignition temperature range, Determination of percent composition of binary mixtures (Estimation of Calcium and Magnesium oxalate)	
	4.1.3 Differential Thermal Analysis (DTA): Principle, Instrumentation and types of reference materials used	

	Differential thermogram (DTA curve) $\text{CaC}_2\text{O}_4 \cdot \text{H}_2\text{O}$ and $\text{CuSO}_4 \cdot 5\text{H}_2\text{O}$, Applications of DTA	
	Comparison between TGA and DTA.	
4.1.4	Thermometric Titrations – Principle and Instrumentation Thermometric titrations of : 1) HCl v/s NaOH 2) Mixture of Ca^{+2} and Mg^{+2} v/s EDTA 3) Boric acid v/s NaOH .	
4.2 Radio Analytical Methods		03
4.2.1	Introduction, Classification of Radio analytical methods	
4.2.2	Neutron activation analysis (NAA) :Principle and theory Advantages, limitations and applications of NAA	

REFERENCES

1.	An Advance Dairy chemistry, V 3, P. F. Fox, P. L. H. McSweeney Springer	Unit/s (3.1,3.2)
2.	Analysis of food and Beverages, George Charalanbous, Academic press 1978	Unit/s (3.1,3.2)
3.	Analytical Chemistry of Open Learning(ACOL),James W. Dodd & Kenneth H. Tonge	Unit/s (4.1,4.2)
4.	Analytical chemistry David Harvey The ,McGraw Hill Companies, Inc.	Unit/s (4.1,4.2)
5.	Analytical Chemistry, Gary.D Christan, 5th edition	Unit/s (2.1,2.2)
6.	Analytical chemistry, R. K. Dave.	Unit/s (2.3)
7.	Chemical methods of separation, J A Dean, Van Nostrand Reinhold, 1969	Unit/s (2.1,2.2)
8.	Egyankosh.ac.in/bitstream/123456789/43329/1/Unit-8	Unit/s (1.1,1.2)
9.	Food Analysis, Edited by S. Suzanne Nielsen, Springer	Unit/s (3.1,3.2)
10.	Food Analysis: Theory and practice, Yeshajahu Pomeranz, Clifton E. Meloan, Springer	Unit/s (3.1,3.2)
11.	Formulation and Function of cosmetics, Sa Jellineck	Unit/s (3.2)
12.	Fundamentals of Analytical Chemistry, D .A. Skoog and D. M. West and F. J. Holler Holt., Saunders 6th Edition (1992)	Unit/s (2.1,2.2,2.3)(4.1,4.2)
13.	Government of India publications of food drug cosmetic act and rules.	Unit/s (3.1,3.2)
14.	Harry's Cosmetology, Longman scientific co.	Unit/s (3.2)
15.	High Performance Thin Layer Chromatography in Food analysis, by Prem kumar, CBS Publisher and distributer	Unit/s (2.2)
16.	Instrumental methods Of Analysis, by Willard Merritt Dean, 7thEdition, CBS Publisher and distribution Pvt Ltd	Unit/s (1.1,1.2) (4.1,4.2)
17.	Introduction to Polarography and Allied Techniques, By Kamala Zutshi, New Age International, 2006.	Unit/s (1.1,1.2)
18.	Modern cosmetics, E. Thomessen Wiley Inter science	Unit/s (3.2)

PRACTICALS

Course Code: USCHP604

Credits: 02

Non-Instrumental Experiments

1. Estimation of reducing sugar in honey by Willstatter method.
2. Estimation of magnesium content in Talcum powder by complexometric titration, using standardized solution of EDTA.
3. Estimation of Sodium using cation exchanger.

Instrumental Experiments

1. Estimation of acetic acid in Vinegar sample by using Quinhydrone electrode potentiometrically.
2. Determination of phosphoric acid in cola sample pH metrically.
3. Determination of the amount of fluoride in the given solution colorimetrically/spectrophotometrically.

References:

1.	Vogel's Textbook of Quantitative Chemical Analysis, 5thEdn., G. H. Jeffery, J Bassett, J Mendham and R C Denney, ELBS with Longmann (1989).
2.	Vogel's Textbook of Quantitative Chemical analysis, Sixth edition, J.Mendham et.al
3.	The chemical analysis of food and food products III edition Morris Jacob
4.	The chemical analysis of food by David Pearson and Henry Edward

Evaluation Pattern for Semesters V and VI

Semester End Theory Examination

Internal Continuous Assessment: 25% (25 Marks)	Semester End Examination: 75% (75 Marks)	Duration for End Semester Examination
Continuous Evaluation through: Quizzes, Class Tests, Presentations, Projects, Role Plays, Creative Writings, Assignments, etc.	As per following pattern	2 hrs 30 minutes

Pattern for Semester End Examination (75 Marks):

1. Duration - This examination shall be of **Two hours and 30 minutes** duration.
2. Theory question paper pattern:
 - a. There shall be **05** questions each of **15 marks**.
 - b. All questions shall be compulsory with internal choice within the questions.

Question	Option	Marks	Based on Units
Q.1	Subjective questions 3 out of 5	15	Unit I
Q.2	Subjective questions 3 out of 5	15	Unit II
Q.3	Subjective questions 3 out of 5	15	Unit III
Q.4	Subjective questions 3 out of 5	15	Unit IV
Q.5	A. True or False (Any Five out of Eight)	05	All Units
	B. Fill in the Blank with correct alternative. (MCQs with Four Options) (Any Five out of Eight)	05	
	C. Match the following (Any Five out of Eight)	05	
Total		75	--

Practical

1. Total Marks for Practical Examination per major component is 50 Marks.
2. Every student shall perform **one experiment** from each Major Component
3. Scheme of Examination:
 - a. Experiment : 40 Marks
 - b. Journal : 05 Marks
 - c. Viva-Voce : 05 Marks

Total : 50 Marks

Practical Book/Journal:

The students are required to perform 75% of the Practical for the journal to be duly certified. The students are required to present a duly certified journal for appearing at the practical examination, failing which they will not be allowed to appear for the examination.

**Sign of the BOS
Coordinator
Dr. Sunil Patil
BOS in Chemistry**

**Sign of the
Offg. Associate Dean
Dr. Madhav R. Rajwade
Faculty of Science &
Technology**

**Sign of the
Offg. Dean
Prof. Shivram S. Garje
Faculty of Science &
Technology**