Shiv Chhatrapati Shikshan Sanstha's

Rajarshi Shahu Mahavidyalaya, Latur

(Autonomous)

Structure and Curriculum of

Under Graduate Programme (III Year) of

Analytical Chemistry

B.Sc. in Analytical Chemistry

Approved by

Board of Studies

in

Analytical Chemistry

Rajarshi Shahu Mahavidyalaya, Latur

(Autonomous)

w.e.f. June, 2025

(In Accordance with NEP-2020)

Review Statement

The NEP Cell reviewed the Curriculum of **B.Sc. III (Analytical Chemistry)** to be effective from the **Academic Year 2025-26.** It was found that, the structure is as per the NEP-2020 guidelines of Govt. of Maharashtra.

Date: 11/04/2025

Place: Latur

NEP CELL

Rajarshi Shahu Mahavidyalaya, Latur

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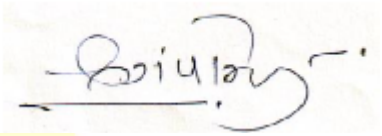
CERTIFICATE

I hereby certify that the documents attached are the Bonafide copies of the Curriculum of **B.Sc. III (Analytical Chemistry)** to be effective from the **Academic Year 2025-26.**

Date: 02/04/2025

Place: Latur



(Dr. D.G. Palke)

Chairperson

Board of Studies in Analytical Chemistry

Rajarshi Shahu Mahavidyalaya, Latur

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Shiv Chhatrapati Shikshan Sanstha's

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Members of Board of Studies in Analytical Chemistry

Under the Faculty of Science

Sr. No.	Name	Designation	In position
1	Dr. D. G. Palke	Chairperson	HoD
2	Prof. S. M. Lonkar	Member	V.C. Nominee
3	Prof. S. V. Bhosale	Member	Academic Council Nominee
4	Dr. Bhaskar Sathe	Member	Academic Council Nominee
5	Dr. S. S. Makone	Member	Expert from outside for Special Course
6	Dr. A. A. Yadav	Member	Expert from outside for Special Course
7	Dr. P. S. Sane	Member	Expert from Industry
8	Dr. M. S. Gaikwad	Member	P.G. Alumni
9	Dr. K. I. Momin	Member	Faculty Member
10	Dr. K.C. Tayade	Member	Faculty Member
11	Dr. M.S. Sudewad	Member	Faculty Member

From the Desk of the Chairperson…

The Department of Analytical Chemistry was established in the academic year 1985. Need of Analytical Chemist, is at the forefront of the noteworthy growth in industries, the college took initiative in starting the Analytical Chemistry Program at Undergraduate (B.Sc.) level. Now, this course is successfully flourishing the need of industries by availing Analytical Chemist with sound subject knowledge. From Academic Year 2023- 24 we are implementing National Education Policy-2020 (NEP-2020) & Started B.Sc. (Honors/Research) Analytical Chemistry Programme to be effective from the same academic year. Department has well equipped laboratories with number of sophisticated instruments. In 2006-07, UGC recognized this department as a "Star Department" in the college and awarded CPE status. The B.Sc. Analytical Chemistry Programme is designed to give sound knowledge and understanding of Analytical Chemistry to undergraduate students of the B.Sc. Degree course. The goal of the Programme is to make the study of Analytical Chemistry as stimulating, interesting, and relevant as possible. The curriculum is prepared with the aim of making the students capable of studying Analytical Chemistry in academic and industrial courses. Also, to expose the students to Chemistry and build up their interest in various fields of chemistry. The new and updated Curriculum is based on National Education Policy-2020 (NEP-2020) Guidelines which includes multiple entries & multiple Exit & interdisciplinary approach with vigor and depth. The curriculum is designed on the basis of Feedbacks & suggestion given by Various Stakeholders and by considering the syllabi of Competitive examination like, IIT-JAM, NET, SET, GATE examinations, UGC model curriculum, syllabi of different entrance examinations and syllabi of other Universities. Our Vision to evolve as a world class dynamic center of higher education disseminating knowledge rigorously at affordable cost and to emerge as a premier centre that promotes technological competence and democratic values.

* "Pursuit of Excellence" in higher education to make our students globally competent.
* Enable students to develop as responsible citizens with human values.
* Provide value and need based education.
* Develop scientific attitude among students.

Board of Studies in Analytical Chemistry
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Faculty of Science

Structure for Four Year Multidisciplinary Undergraduate Degree Programme in Analytical Chemistry Multiple Entry and Exit (In accordance with NEP-2020)

Year & Level	Sem	Major		Minor	GE/ OE	VSC/ SEC (VSEC)	AEC/ VEC	OJT, FP, CEP, RP	Credit per Sem.	Cum./Cr. per exit
		DSC	DSE							
1	**2**	**3**		**4**	**5**	**6**	**7**	**8**	**9**	**10**
III 5.5	V	DSC IX: 04 Cr. DSC X: 04 Cr.	DSE-I :04 Cr	DSM III: 04 Cr. DSM IV: 02 Cr.	NA	VSC III: 02 Cr	VEC II: 02 Cr EVS	NA	22	132 Cr. UG Degree
	VI	DSC XI: 04 Cr. DSC XII: 04 Cr.	DSE-I :04 Cr	DSM V: 04 Cr.	NA	VSC IV: 02 Cr	NA	Academic Project: 04 Cr.	22	
	Cum. Cr.	16	08	10	-	06		04	44	
Exit Option: Award of UG Degree in Major with 132 Credits or continue with Major and Minor										

Note :

A) Co-Curricular Courses (CC) includes –

1. Health and Wellness
2. Yoga Education
3. Sports and fitness
4. Cultural activities
5. NSS
6. NCC
7. Fine Applied Visual Performing Arts
8. Study Tour
9. Publication of articles in newspaper / magazine.

B) Field Project concerned with Major

Abbreviations:

1.	DSC	: Discipline Specific Core (Major)
2.	DSE	: Discipline Specific Elective (Major)
3.	DSM	: Discipline Specific Minor
4.	GE/OE	: Generic/Open Elective
5.	VSEC	: Vocational Skill and Skill Enhancement Course
6.	VSC	: Vocational Skill Course
7.	SEC	: Skill Enhancement Course
8.	AEC	: Ability Enhancement Course
9.	MIL	: Modern Indian Languages
10.	IKS	: Indian Knowledge System
11.	VEC	: Value Education Course
12.	OJT	: On Job Training
13.	FP	: Field Project
14.	CEP	: Fostering Social Responsibility & Community Engagement (FSRCE)
15.	CC	: Co-Curricular Course
16.	RP	: Research Project/Dissertation
17.	SES	: Shahu Extension Services

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Faculty of Science

Programme Outcomes (POs) for Analytical Chemistry	
PO 1	**Disciplinary Knowledge** Comprehensive knowledge of science subjects which constitute the graduate programme and execution of scientific knowledge in the specific area.
PO 2	**Scientific Outlook** The qualities of a science graduate such as observation, precision, analytical mind, logical thinking, clarity of thought and expression and systematic approach.
PO 3	**Self-Directed Life-long Learning** Ability to appear for various competitive examinations or choose the post graduate programme or other related programme of their choice.
PO 4	**Research Skills** Functional knowledge and applications of instrumentation and laboratory techniques to do independent experiments, interpret the results and develop research ethos.
PO 5	**Problem Solving Skills** Analytical and logical skills and critical thinking to extract information from qualitative and quantitative data, formulate and solve problems in a systematic and rational manner.
PO 6	**Professional Competence and Ethics** Aptitude and skills to perform the jobs in diverse fields such as science, engineering, industries, survey, education, banking, development and planning, business, public service, self-business etc. with human rationale and moral values.

Programme Specific Outcomes (PSOs) for Analytical Chemistry	
PSO No.	After completion of this programme the students will be able to -
PSO 1	**Academic Competence** knowledge of various concepts of General Concepts of Analytical Chemistry, Basic Analytical Chemistry and Titrimetry, Errors, Statistical Treatment of Analytical Data and Separation Techniques, Gravimetric Methods of Analysis, etc.
PSO 2	**Scientific Outlook** An ability to perform and demonstrate experiments in Analytical Chemistry to study Stoichiometry, Optical density, Optical Rotation, Refractive Index, pH, Potential, Conductance of analyte. Analysis of Organic and Inorganic Compounds like Drugs, Paints, Dyes, Oils, Blood, Cosmetics, Soil etc by Qualitatively and Quantitatively using various Instrumental and chemical methods.
PSO 3	**Personal and Professional Competence** Students acquire core competency in the subject Analytical Chemistry, and in subject areas, Systematic and coherent understanding of the fundamental concepts in Analytical Chemistry and all other related allied Analytical Chemistry subjects, the evidence based comparative Analytical Chemistry approach to explain the chemical analysis, the characterization of materials and the basic principle of equipments, instruments used in the Analytical Chemistry laboratory.
PSO 4	**Entrepreneurial Competence** The curriculum has been designed to provide opportunity to act as team player by contributing in laboratory, field based situation and industry. Find gainful employment in industry or government, be accepted at graduate or professional schools and find employment in school systems as instructors or administrators.
PSO 5	**Research Competence** Students become proficient in their specialized area of Analytical Chemistry and successfully complete an advanced research project, acquire the basic tools needed to carry out independent chemical research, communicate scientific results in writing and in oral presentation and develop an inquisitive characteristic among the students through appropriate questions, planning and reporting experimental investigation.

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Faculty of Science

Analytical Chemistry

Year & Level	Semester	Course Code	Course Title	Credits	No. of Hrs.
I 5.5	V	(DSC-IX)	--	04	60
		(DSC-X)	--	04	60
		DSE-I(a)	--	04	60
		DSE-I(b)	--		
		301ACH5301 (DSM-III)	Instrumental Methods of Chemical Analysis	03	45
		301ACH5302 (DSM-III)	Laboratory Course III	01	30
		301ACH5303 (DSM-IV)	Environmental Analysis	02	30
		301ACH5304 (VSC-III)	Laboratory Course-IV	02	30
		(VEC-II)	--	02	30
	Total Credits			**22**	
	VI	(DSC-XI)	--	04	60
		(DSC-XII) IKS	--	04	60
		DSE-II(a)	--	04	60
		DSE-II(b)	--		
		301ACH6301 (DSM-V)	Modern Techniques of Chemical Analysis	04	60
		301ACH3302 (DSM-IV)	Laboratory Course V	01	30
		301ACH6303 (VSC-IV)	Laboratory Course-VI	02	30
		AIPC/OJT-I	Academic Project	04	60
	Total Credits			**22**	
Total Credits (Semester I & II)				**44**	

Curriculum

Major and VSC Courses

Semester - V

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Department of Chemistry& Analytical Chemistry

B.Sc. III Semester-V

Course Type: DSM-III

Course Title: Instrumental Methods of Chemical Analysis

Course Code:301ACH5301

Credits: 03 **Max. Marks: 75** **Lectures: 45 Hrs.**

Learning Objectives:

LO 1. To understand the fundamental concepts in Analytical Chemistry.

LO 2. To learn Instrumental methods of Chemical Analysis.

LO 3. To inculcate the spectroscopic methods, namely visible & Atomic Absorption Spectroscopy.

LO 4. To Learn Electron Microscopic Methods – SEM, TEM & AFM.

Course Outcomes:

After completion of the course, the student will be able to,

CO 1. Clarify the fundamental concepts in Spectroscopic & Microscopic Techniques.

CO 2. Elaborate concepts of instrumental methods of Chemical analysis such as visible, atomic absorption spectroscopic techniques.

CO 3. Explain the principle, working and instrumentation of microscopic methods such as SEM, TEM.

CO 4. Explain the concept underlying instrumentation of AFM with principle.

Unit No.	Title of Unit & Contents	Hrs.
I	**Spectroscopic Methods - Visible Spectroscopy**	**15**
	1.1 Basic Concepts in Spectroscopy: Definition, Electromagnetic Radiation-introduction, Properties of electromagnetic radiation: Wave properties –Wavelength, Frequency, Wave number, Velocity, Relation between frequency, velocity and wavenumber. Particle Properties-Relation between wavelength and particle properties of electromagnetic radiation. Electromagnetic spectrum. Interaction of electromagnetic radiation with matter-process of emission, absorption and	

Unit No.	Title of Unit & Contents	Hrs.
	fluorescence of radiation. Visible spectrophotometry and colorimetry– Difference between photometer, Spectrophotometer and colorimeter. Theory of visible spectrophotometry and colorimetry, Lambert Beer's law, nature of molar absorptivity and absorbance, deviations from Beer's law. Instrumentation of spectrophotometer: radiation sources, filters and monochromators, slits, cells and detection of radiation. Direct reading double beam recording spectrophotometer- schematic diagram and working, Difference between Colorimeter & spectrophotometer. **1.2 Applications:** Quantitative analysis-calibration curve showing the relationship between absorbance and concentration.	
	Unit Outcomes:	
	UO 1. Know the Concepts of Spectroscopy.	
	UO 2. Apply the Knowledge of Spectroscopy in Quantitative Analysis	
II	**Spectroscopic Methods - Absorption Spectroscopy**	**10**
	2.1 Atomic Absorption Spectroscopy (AAS): Introduction, principle, Instrumentation: Radiation Source-Hollow cathode lamp, chopper, flame atomizer, nebulization of liquid sample, monochromators, detectors, amplifier and readout system; schematic diagram and working of single beam atomic absorption spectrophotometer, interferences, typical analysis, applications.	
	Unit Outcomes:	
	UO 1. Elaborate the Principle & Technique of AAS.	
	UO 2. Apply the Knowledge of AAS for Qualitative Analysis	
III	**Microscopic Methods**	**12**
	3.1 Scanning Electron Microscope (SEM) & its application 3.2 Transmission Electron Microscope (TEM): Instrumentation, General Design, Resolution, Electron Sources, TEM grids, electron lenses, Methods of TEM, Applications.	
	Unit Outcomes:	
	UO 1. Compare Optical and Microscopic Methods.	
	UO 2. Explain the Principle, Instrumentation and Working of SEM & TEM	
IV	**Atomic Force Microscope (AFM)**	**08**

Unit No.	Title of Unit & Contents	Hrs.
	4.1 Introduction, Instrumentation, and Applications. Analysis Technique (Gold, Mica and Graphite)	
	Unit Outcomes:	
	UO 1. Elaborate the Principle & Technique of AFM.	
	UO 2. Discuss various applications of AFM	

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Department of Chemistry & Analytical Chemistry

B.Sc. III Semester-V

Course Type: DSM III Practical

Course Title: Minor Laboratory Course-III

Course Code: 301ACH5302

Credits: 01 **Max. Marks: 50** **Lectures: 30 Hrs.**

Experiments:

1. Analysis of permanganate and dichromate mixture.
2. Determination of pKa value of acid base indicator.
3. Determination of molar extinction coefficient of potassium permanganate & Potassium dichromate.
4. Determination of stability constant of iron-orthophenanthroline complex by mole ratio method calorimetrically.
5. Determination of ththe e formula of ferric sulpho-salicylic acid complex colorimetricallyby Job's method.
6. Photometric titration of copper by EDTA.
7. Colorimetric estimation of Iron by Ortho Phenanthroline.
8. Determine fluoride in a given solution / tooth paste by Zirconyl-Alizarin red method colorimetrically.
9. Colorimetric estimation of titanium in the given solution by hydrogen peroxide.
10. Determination of amount of vitamin B-12 in given sample by fluorometry.
11. Estimation of Iron in drug sample spectrophotometrically.
12. Estimation of Iron content in Steel Sample by AAS.
13. Estimation of paracetamol in given sample by UV-visible spectrophotometry.
14. Determination of concentration of riboflavin by UV-visible spectrophotometer.
15. Determination of Caffein in given sample by spectrophotometry.

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Department of Chemistry & Analytical Chemistry

B.Sc. III Semester-V

Course Type: DSM-IV

Course Title: Environmental Analysis

Course Code: 301ACH5303

Credits: 02 **Max. Marks: 50** **Lectures: 30 Hrs.**

Learning Objectives:

LO 1. To understand pollution, types of pollution and the activity of pollutants on the community.

LO 2. To learn the methods of sampling and chemical analysis various pollutants in water.

Course Outcomes: After completion of course the student will be able to-

CO 1. Explain the concept of pollution and its effect on community.

CO 2. Analyze the parameters, constituents and pollutants in water.

Unit No.	Title of Unit & Contents	Hrs.
I	**Analysis of Air**	**15**
	Composition of natural atmospheric air, pollution, pollutants in air, causes of pollution, sampling of air, Determination of i) particulate matter suspended and settled ii) Sulphur dioxide iii) Nitrogen dioxide iv) Carbon mono and dioxide as pollutants.	
	Unit Outcomes:	
	UO1: Explain the composition of air and concepts of pollution	
	UO 2: Elaborate on various constituents and their level in air	
II	**Analysis of Water**	**15**
	Introduction to potable water quality standards, objectives of water analysis. Methods of measurement of water quality parameters: Physical parameters - pH, conductivity, total dissolved solids. Determination of chemical parameters	

Unit No.	Title of Unit & Contents	Hrs.
	– Temporary and Permanent Hardness, Dissolved oxygen, Chemical Oxygen Demand and Bio chemical Oxygen Demand.	
	Unit Outcomes:	
	UO 1: Explain the concept of potable and hard water	
	UO 2: Determine various parameters of water.	

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Department of Chemistry & Analytical Chemistry

B.Sc. III Semester-V

Course Type: VSC

Course Title: Laboratory Course-III

Course Code: 301ACH5304

Credits: 02 **Max. Marks: 50** **Lectures: 30 Hrs.**

Experiments:

1. Using indicators in a pH estimation.
2. To determine the isosbestic point of given indicator (methyl red) by spectrophotometry.
3. Determination of Vitamin A by colorimetry.
4. Determination of chloride by adsorption indicator method.
5. Determination of phosphate ions in detergent colorimetrically.
6. Determining the Concentration of Citric Acid in soft drink (7-Up) Using Titration.
7. Photometric Determination of Equilibrium Constant of a complex ion $Fe(SCN)_x^{(3-x)}$.
8. Spectrophotometric Analysis of a Mixture: Caffeine and Benzoic Acid in a Soft Drink.
9. Study of Hydrogen Phosphate Buffer Systems: Sorensen's Buffer.
10. Calculating Molarity from % solutions.
11. Assay of aspirin by conductivity meter.
12. Determination of strength of acetic acid in commercial sample of vinegar by conductivity meter.
13. Determination of iron in pharmaceutical preparation by potentiometry.
14. Determination of percentage purity of commercial washing soda by potentiometry.
15. Determination of pH of Hair shampoos.
16. Potentiometric titrations: (a) FAS Vs $K_2Cr_2O_7$ (b) FAS Vs $KMnO_4$.

Learning Resources:

1. Fundamentals of Analytical Chemistry: 7th Edition – Douglas A. Skoog, Donald M. West and Holler, Harcourt College Pub
2. Principles of instrumental analysis: D.A Skoog and D. M. West saunder's college publishers.
3. Standard methods of chemical analysis: Part A & B – Editor: Welcher, Van Nostrand Reinhold Co.
4. Text Book of Microbiology: Freeman Burrows, WB saunders.
5. Text Book of Biochemistry: West and Tood/ Lehninger.
6. Practical physiological chemistry: Hawn, Oser and summerson, Tata- Mograw Hill book Co
7. A Text book of quantitative Inorganic Analysis: A. I Vogel
8. Quantitative Analysis: Cumming and Key
9. Quantitative Chemical Analysis: Kolthoff, sandell and others 4th Edition
10. Analytical Chemistry: Gary D. Christain, 4th Edition, John Wiley and Sons, New York
11. Environmental analysis: G. R. Chatawal, MC Mehra, M. satake and others – Amol Publications, New Delhi
12. Analytical Agricultural Chemistry: SL Chopra and J. S. Kanwar Kalyani Publishers, Ludhiana
13. Chemistry of the Soil: Edited by Firman E. Bear 2nd Edition, Americal Chem. Soc. Monograph Series Oxford & IBH Publishers.
14. A text Book of Experiments & Calculations in Engineering Chemistry S. S. Dara S. Chand and Co.
15. Elements of Environmental Chemistry: H. V. Jadhav, Himalaya Publishing House, New Delhi.
16. Methodology for water Analysis: IAAB Editional Board M. S. Kodarkar, AD Diwan and others, IAAB Publication, V.V. College, Hyderabad.

Semester - VI

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Department of Chemistry& Analytical Chemistry

B.Sc. III Semester-VI

Course Type: DSM-V

Course Title: Modern Techniques of Chemical Analysis

Course Code: 301ACH6301

Credits: 03 **Max. Marks: 75** **Lectures: 45 Hrs.**

Learning Objectives:

LO 1. To understand the fundamental concepts in Analytical Chemistry.

LO 2. To learn Instrumental methods of Chemical Analysis.

LO 3. To inculcate the spectroscopic methods, namely visible & Atomic Absorption Spectroscopy.

LO 4. To Learn Electron Microscopic Methods – SEM, TEM & AFM.

Course Outcomes:

After completion of the course, the student will be able to,

CO 1. Clarify the fundamental concepts in Spectroscopic & Microscopic Techniques.

CO 2. Elaborate concepts of instrumental methods of Chemical analysis such as visible, atomic absorption spectroscopic techniques.

CO 3. Explain the principle, working and instrumentation of microscopic methods such as SEM, TEM.

CO 4. Explain the concept underlying the instrumentation of AFM with principle.

Unit No.	Title of Unit & Contents	Hrs.
I	**Infrared Spectrophotometry**	**12**
	Range of IR-radiation, Theory- Requirements for IR radiation absorption, Different normal modes of vibrations of atoms in polyatomic molecules, Hook's Law, Instrumentation and Experimental Technique, Applications of IR spectroscopy.	
	Unit Outcomes:	
	UO 1. Know the Concepts of IR Spectroscopy.	
	UO 2. Apply the Knowledge of IR Spectroscopy in Quantitative Analysis	
II	**^{1}H NMR Spectroscopy**	**10**

Unit No.	Title of Unit & Contents	Hrs.
	Theory of ^{1}H NMR Spectroscopy, Instrumentation, Experimental technique, NMR spectra, Number of signals- equivalent and nonequivalent protons, Chemical Shift, Measurement of Chemical Shift, Factors affecting chemical shift, Spin-spin coupling, Interpretation of ^{1}H NMR spectra in structure determination and identification.	
	Unit Outcomes:	
	UO 1. Elaborate the Principle and Technique of ^{1}H NMR.	
	UO 2. Apply the Knowledge of NMR for Interpretation	
III	**Mass Spectrometry**	**12**
	Theory, Instrumentation, components of mass spectrometer, Recording of mass spectrum, Resolution of mass spectrometer, McLafferty Rearrangement Reaction, Types of ions produced in a mass spectrometer, Interpretation of Mass Spectra, Applications of mass spectrometry.	
	Unit Outcomes:	
	UO 1. Explain Principle and Technique Mass Spectrometry.	
	UO 2. Apply the knowledge of Mass Spectrometry in interpretation.	
IV	**Fluorescence Spectroscopy**	**08**
	Theory, Relation between fluorescence intensity and concentration, Single and Double beam filter fluorometers, Applications.	
	Unit Outcomes:	
	UO 1. Elaborate the Principle & Technique of Fluorometry.	
	UO 2. Discuss various applications of Fluorometry	

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Department of Chemistry & Analytical Chemistry

B.Sc. III Semester-VI

Course Type: DSM V Practical

Course Title: Minor Laboratory Course-III

Course Code:301ACH6302

Credits: 01 **Max. Marks: 50** **Lectures: 30 Hrs.**

Experiments:

1. Determination of B_{12} in given drug sample by fluorometry.
2. Green synthesis on microwave synthesizer.
3. Determination of functional groups of given compounds by IR spectrophotometry.
4. Study of complexes by IR spectrophotometry.
5. Table work for UV, IR, ^{1}H-NMR, ^{13}C-NMR and Mass Spectrometry.
6. Determination of Cobalt and Nickel Colorimetrically.
7. Determination of Cromium and Manganese Colorimetrically
8. Determination of phosphates in natural water.
9. Determination of specific rotation of cane sugar.
10. Determination of iron in food sample by spectrophotometry
11. Determination of fluoride in given sample solution by zirconyl-Alizarin red method colorimetrically.
12. Determination of chloride nephelometrically.
13. Determination of phosphate in detergents by spectrophotometry.
14. Dye Concentration Using a UV-Vis Spectrophotometer

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Department of Chemistry & Analytical Chemistry

B.Sc. III Semester-VI

Course Type: VSC

Course Title: Laboratory Course-IV

Course Code: 301ACH6303

Credits: 02 **Max. Marks: 50** **Lectures: 30 Hrs.**

Experiments:

1. Estimation of lipids in egg yolk.
2. Estimation of protein in milk by formal titration/ casein nitrogen.
3. Analysis of milk for its lactose/ total solid.
4. Determination of ascorbic acid in fruit juices/ citrus fruits.
5. Determination of total acidity, fixed acidity and volatile acidity in pickeles / titratableacidity in fruits/ fruits juices.
6. Determination of iron in food sample by spectrophotometer.
7. Determination of acid value of rosin.
8. Determination of R_f value of amino acids by paper chromatography.
9. Determination of ion exchange capacity of cation exchanger resin by batch method.
10. Determination of ion exchange capacity of anion exchanger resin by batch method.
11. Spectroscopic estimation of Aspirin in APC tablets.
12. Determination of Chemical Oxygen Demand(COD) of water sample.
13. Determination of dissolved oxygen (DO) in water sample.
14. Estimation of sulpha drug by TLC.

Learning Resources:

1. Experiments in general Chemistry: C. N. R. Rao and U. C. Agrawala, 4th Edition Affiliated East – West Press
2. Chemistry of air and air pollution: S.A. Iquabal and Y. Mido, Discovery Publishing house, New Delhi.
3. A Text Book of Environmental Chemistry and Pollution Control: S. S. Dara
4. Environmental Chemistry: A.K. De, Wiley Estern Pub.
5. Pearsons Chemical Analysis of Foods: Harold Egan, Ronald S. Kirk and Ronald Sawyer, 8th Edition, Churchill Livingstone.
6. Hand Book of Analysis & Quality Control for fruit and vegetable products: S. Ranganna, Tata Mc Graw Hill Pub. Co.
7. Chemical analysis of food and food products: M.B. Jacob
8. Food analysis – Lab Experiments: Melon and Pomerazu
9. Quantitative Pharmaceutical Chemistry: Jenkins and others
10. Bentley and Drivers T. B. of Pharmaceutical Chemistry: Revised by L. M. Atherden, 8th Edition Oxford University Press, New Delhi
11. Air Pollution: Henry C. Perkins
12. Chemical Analysis of Water: Dickinson
13. Applied Inorganic Analysis: Hoffmann, Lundell & others.
14. Commercial Method of Analysis: Foster D Snell and Frank M. Biffen
15. Quantitative Analysis: Day & Underwood
16. Biochemical Laboratory Technique: Chey kin
17. ISI Standard methods of Water and Air analysis: Blackie, USA
18. Experiments in modern Analytical Chemistry: D.Kealey, Chapman & Hall.
19. Analytical Chemistry -H, Kaur, Pragati Prakashan, Meerut (for Fuel & Soil Analysis)
20. Welcher, F.J., 1917. Standard Methods of Chemical Analysis Sixth Edition.
21. Analytical Chemistry: Gary D. Christain, 4th Edition, John Wiley and Sons, New York
22. Environmental Analysis: G. R. Chatawal, MC Mehra, M. Satake and others – Amol Publications, New Delhi
23. Analytical Agricultural Chemistry: SL Chopra and J. S. Kanwar Kalyani Publishers, Ludhiana
24. Chemistry of the Soil: Edited by Firman E. Bear 2nd Edition, American Chem. Soc.
25. Monograph Series Oxford & IBH Publishers.
26. Official Methods of Analysis, 15th edition, 1990, Association of Official Analytical Chemist, inc.

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Extra Credit Activities

Sr. No.	Course Title	Credits	Hours T/P
1	MOOCs	Min. of 02 credits	Min. of 30 Hrs.
2	Certificate Courses	Min. of 02 credits	Min. of 30 Hrs.
3	IIT Spoken English Courses	Min. of 02 credits	Min. of 30 Hrs.

Guidelines:

Extra -academic activities

1. All extra credits claimed under this heading will require sufficient academic input/ contribution from the students concerned.
2. Maximum 04 extra credits in each academic year will be allotted.
3. These extra academic activity credits will not be considered for calculation of SGPA/CGPA but will be indicated on the grade card.

Additional Credits for Online Courses:

1. Courses only from SWAYAM and NPTEL platform are eligible for claiming credits.
2. Students should get the consent from the concerned subject Teacher/Mentor/Vice Principal and Principal prior to starting of the course.
3. Students who complete such online courses for additional credits will be examined/verified by the concerned mentor/internal faculty member before awarding credits.
4. Credit allotted to the course by SWAYAM and NPTEL platform will be considered as it is.

Additional Credits for Other Academic Activities:

1. One credit for presentation and publication of paper in International/National/State level seminars/workshops.
2. One credit for measurable research work undertaken and field trips amounting to 30 hours of recorded work.
3. One credit for creating models in sponsored exhibitions/other exhibits, which are approved by the concerned department.
4. One credit for any voluntary social service/Nation building exercise which is in collaboration with the outreach center, equivalent to 30 hours
5. All these credits must be approved by the College Committee.

Additional Credits for Certificate Courses:

1. Students can get additional credits (number of credits will depend on the course duration) from certificate courses offered by the college.
2. The student must successfully complete the course. These credits must be approved by the Course Coordinators.
3. Students who undertake summer projects/ internships/ training in institutions of repute through a national selection process, will get 2 credits for each such activity. This must be done under the supervision of the concerned faculty/mentor.

Note:

1. The respective documents should be submitted within 10 days after completion of Semester End Examination.
2. No credits can be granted for organizing or for serving as office bearers/ volunteers for Inter-Class/ Associations / Sports / Social Service activities.
3. The office bearers and volunteers may be given a letter of appreciation by the respective staff coordinators. Besides, no credits can be claimed for any services/ activities conducted or attended within the college.
4. All claims for the credits by the students should be made and approved by the mentor in the same academic year of completing the activity.
5. Any grievances of denial/rejection of credits should be addressed to Additional Credits Coordinator in the same academic year.
6. Students having a shortage of additional credits at the end of the third year can meet the Additional Credits Coordinator, who will provide the right advice on the activities that can help them earn credits required for graduation.

Shiv Chhatrapati Shikshan Sanstha's

Rajarshi Shahu Mahavidyalaya, Latur

(Autonomous)

Examination Framework

Theory:

40% Continuous Assessment Tests (CATs) and 60% Semester End Examination (SEE)

Practical:

50% Continuous Assessment Tests (CATs) and 50% Semester End Examination (SEE)

Course	Marks	CAT & Mid Term Theory				CAT Practical		Best Scored CAT & Mid Term	SEE	Total
1	2	3				4		5	6	5 + 6
		Att.	CAT I	Mid Term	CAT II	Att.	CAT			
DSC/DSE/ GE/OE/Minor	100	10	10	20	10	-	-	40	60	100
DSC	75	05	10	15	10	-	-	30	45	75
Lab Course/AIPC/ OJT/FP	50	-	-	-	-	05	20	-	25	50
VSC/SEC/ AEC/VEC/CC	50	05	05	10	05	-	-	20	30	50

Note:

1. All Internal Exams are compulsory
2. Out of 02 CATs best score will be considered
3. Mid Term Exam will be conducted by the Exam Section
4. Mid Term Exam is of Objective nature (MCQ)
5. Semester End Exam is of descriptive in nature (Long & Short Answer)
6. CAT Practical (20 Marks): Lab Journal (Record Book) 10 Marks, Overall Performance 10 Marks