॥ सा विद्या या विमुक्तये ॥

स्वामी रामानंद तीर्थ मराठवाडा विद्यापीठ, नांदेड

'ज्ञानतीर्थ', विष्णुपुरी, नांदेड – ४३१ ६०६ (महाराष्ट्र राज्य) भारत

SWAMI RAMANAND TEERTH MARATHWADA UNIVERSITY, NANDED

'Dnyanteerth', Vishnupuri, Nanded - 431 606 (Maharashtra State) INDIA

Established on 17th September, 1994, Recognized By the UGC U/s 2(f) and 12(B), NAAC Re-accredited with'B++' grade

स्वामी रामानंद तीर्थ मराठवाडा विद्यापीठ, नांदेड

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विज्ञान व तंत्रज्ञान विद्याशाखे अंतर्गत राष्ट्रीय शैक्षणिक धोरण २०२० नुसार पदवी द्वितीय वर्षाचे अभ्यासक्रम (Syllabus) शैक्षणिक वर्ष २०२५–२६ पासून लागू करण्याबाबत.

प रि प त्र क

या परिपत्रकान्वये सर्व संबंधितांना कळविण्यात येते की, दिनांक २७ मे २०२५ रोजी संपन्न झालेल्या मा. विद्यापरिषद बैठकीतील विषय क्रमांक १६/६१–२०२५ च्या ठरावानुसार विज्ञान व तंत्रज्ञान विद्याशाखेतील राष्ट्रीय शैक्षणिक धोरण–२०२० नुसारचे पदवी द्वितीय वर्षाचे अभ्यासक्रम (Syllabus) शैक्षणिक वर्ष २०२५–२६ पासून लागू करण्यास मा. विद्यापरिषदेने मान्यता प्रदान केली आहे. त्यानुसार विज्ञान व तंत्रज्ञान विद्याशाखेतील बी. एस्सी द्वितीय वर्षाचे खालील विषयाचे अभ्यासक्रम (Syllabus) शैक्षणिक वर्ष २०२५–२६ पासून लागू करण्यात येत आहेत.

01	B.Sc. Agriculture Microbiology	11	B.Sc. Physics
02	B.Sc. Botany	12	B.Sc. Seed Technology
03	B.Sc. Dairy Science	13	B.Sc. Horticulture
04	B.Sc. Electronics	14	B.Sc. Statistics
05	B.Sc. Environmental Science	15	B.Sc. Biochemistry
06	B.Sc. Fishery Science	16	B.Sc. Analytical Chemistry
07	B.Sc. Food Science	17	B.Sc. Agrochemical & Fertilizers
08	B.Sc. Geology	18	B.Sc. Industrial Chemistry
09	B.Sc./B.A. Mathematics	19	B.Sc. Industrial Microbiology
10	B.Sc. Microbiology		

सदरील परिपत्रक व अभ्यासक्रम प्रस्तुत विद्यापीठाच्या **www.srtmun.ac.in** या संकेतस्थळावर उपलब्ध आहेत. तरी सदरील बाब ही सर्व संबंधितांच्या निदर्शनास आणून द्यावी, ही विनंती.

'ज्ञानतीर्थ' परिसर,
विष्णुपुरी, नांदेड – ४३१ ६०६.
जा.क्र.:शै–१/एनइपी/विवत्रंविपदवी/२०२५–२६/११६
दिनांक ०५.०६.२०२५

सहाय्यक कुलसचिव
शैक्षणिक (१–अभ्यासमंडळ) विभाग

प्रत : माहितीस्तव तथा कार्यवाहीस्तव.

१) मा. कुलगुरू महोदयांचे कार्यलय, प्रस्तुत विद्यापीठ.
२) मा. प्र. कुलगुरू महोदयांचे कार्यलय, प्रस्तुत विद्यापीठ.
३) मा. आधिष्ठाता, विज्ञान व तंत्रज्ञान विद्याशाखा, प्रस्तुत विद्यापीठ.
४) मा. संचालक, परीक्षा व मुल्यमापन मंडळ, प्रस्तुत विद्यापीठ.
५) मा. प्राचार्य, सर्व संबधित संलग्नित महाविद्यालये, प्रस्तुत विद्यापीठ.
६) सिस्टीम एक्सपर्ट, शैक्षणिक विभाग, प्रस्तुत विद्यापीठ. याना देवून कळविण्यात येते की, परिपत्रक अभ्यासक्रम संकेतस्थळावर प्रसिध्द करण्यात यावेत.

SWAMI RAMANAND TEERTH MARATHWADA UNIVERSITY, NANDED

SYLLABUS

(As per NEP-2020)

Faculty of Science and Technology

Structure for Four Year Multidisciplinary Degree Program with Multiple Entry and Exit

Subject: ANALYTICAL CHEMISTRY

In force from June - 2025

Details of the Board of Studies Members in the subject Chemistry under the faculty of Science & Technology of S.R.T.M. University, Nanded Distribution of credits for Analytical Chemistry

Sr. No.	Name of the Member	Designation	Address	Contact No.
1	Dr. D. R. Munde	Chairman	Science College Nanded	9421756689
2.	Dr N. V. Shitole	Member	Shri Shivaji college Parbhani	9420530672
3	Dr. A. R. Shinde	Member	Sanjeevanee Mahavidyalaya, Chapoli	8275265483

Swami Ramanand Teerth Marathwada University, Nanded

Faculty of Science and Technology

Credit Framework for B.Sc.II Year

Multidisciplinary Degree Program with Multiple Entry and Exit

Subject: ANALYTICAL CHEMISTRY (Major) /ANALYTICAL CHEMISTRY (Minor)

Year & Level	Semester	Major *(From the same Faculty)*	Minor 1 *(From the same Faculty)*	(Minor 2) *(From the same Faculty)*	Generic Elective (GE) (select from Basket 3 of *Faculties other than Science and Technology*)	Vocational & Skill Enhancement Course	Ability Enhancement Course (AEC) (Basket 4) Value Education Courses (VEC) / Indian Knowledge System (IKS) (Basket 5) *(Common across all faculties)*	Field Work / Project/Internship/ OJT/ Apprenticeship / Case Study Or Co-curricular Courses (CCC) (Basket 6 for CCC) *(Common across all faculties)*	Credits	Total Credits
1	2	3	4	5	6	7	8	9	10	11
2 (5.0)	III	SACHCT1201 (2cr) SACHCT1202 (2cr) SACHCP1201 (2cr) SACHCP1202 (2cr) 8 Credits	SACHMT1201 (2Cr) SACHMP1201 (2Cr) 4 Credits		SACHGE1201 (2cr)	SACVC1201 2 Credits	ACEENG1201 (2cr) ACEMIL1201 (2Cr) 4 Credits	CCCXXX1201(2Cr) *(NCC/NSS/SPT(sports)/ CLS(Cultural Studies)/HWS(Health Wellness)/ YGE(Yoga Education) / FIT(Fitness)* 2 Credits	22	88
	IV	SACHCT1251 (2cr) SACHCT1252 (2cr) SACHCP1251 (2cr) SACHCP1252 (2cr) 8 Credits	SACHMT1251 (2Cr) SACHMP1251 (2Cr) 4Credits		SACHGE1251 (2cr)	SACVC1251 2 Credits	ACEENG1201 (2cr) ACEMIL1201 (2Cr) VECEVS1251 (2Cr) 6 Credits		22	
	Cum. Cr.	24	16	08	08	08	22	02	44	

***Exit option*: UG Diploma in Major ANALYTICAL CHEMISTRY and Minor ANALYTICAL CHEMISTRY on completion of 88 credits and** additional **4 credits NSQF / internship in ANALYTICAL CHEMISTRY**

B. Sc. Second Year Semester III*(Level 5)*

Teaching Scheme

	Course Code	CourseName	Credits Assigned			Teaching Scheme (Hrs/ week)	
			Theory	Practical	Total	Theory	Practical
Major	SACHCT1201	**Inorganic and Organic Analysis – I**	02	--	**04**	02	--
	SACHCP1201	**Laboratory Course -III (Practical)**	-	02			04
	SACHCT1202	**Instrumental Methods of Chemical Analysis-I**	02	--	**04**	02	--
	SACHCP1202	**Laboratory Course -IV (Practical)**	-	02			04
Minor	SACHMT1201	**Fundament Analytical Chemistry**	02	--	**04**	02	--
	SACHMP1201	**Laboratory Course -III (Practical)**	-	02			04
Generic Electives *(from other Faculty)*	SACHGE1201	**(Basket 3)**	02	--	**02**	02	--
Vocational Course (related to Major)	SACHVC1201	**Analysis based on Chromatography and P^H Measurement**	--	02	**02**	--	04
Ability Enhancement Course	AECENG1201	L1 – Compulsory English	02	--	**02**	02	--
Ability Enhancement Course	**ACEMIL1201**	**(MAR/HIN/URD /KAN/PAL)**	02	--	**02**	02	--
(NCC/NSS/SPT(sports)/ CLS(Cultural Studies)/HWS(Health Wellness)/ YGE(Yoga Education) / FIT(Fitness) **2 Credits**	**CCCXXX1201**	Select from **Basket 5**	02	--	**02**	02	--
Total Credits			**14**	**08**	**22**	**14**	**16**

B. Sc. Second Year Semester III*(Level 5)*

Examination Scheme

[20% Continuous Assessment (***CA***) and 80% End Semester Assessment (***ESA***)]

(For illustration we have considered a paper of 02 credits, 50 marks, need to be modified depending on credits assigned to individual paper)

Subject (1)	Course Code (2)	Course Name (3)	Theory				Practical		Total Col (6+7) / Col (8+9) (10)
			Continuous Assessment (CA)			ESA			
			Test I (4)	Test II (5)	Average of T1 & T2 (6)	Total (7)	CA (8)	ESA (9)	
Major	SACHCT1201	**Inorganic and Organic Analysis – I**	10	10	10	40	--	--	50
	SACHCP1201	**Laboratory Course -III (Practical)**	--	--	--	--	20	30	50
	SACHCT1202	**Instrumental Methods of Chemical Analysis-I**	10	10	10	40	--	--	50
	SACHCP1202	**Laboratory Course -IV (Practical)**	--	--	--	--	20	30	50
Minor	SACHMT1201	**Fundament Analytical Chemistry**	10	10	10	40	--	--	50
	SACHMP1201	**Laboratory Course -III (Practical)**	--	--	--	--	20	30	50
Generic Electives	SACHGE1201	**(Basket 3)**	10	10	10	40	--	--	50
Vocational Course	SACHVC1201	**Analysis based on Chromatography and P^H Measurement**	--	--	--	--	20	30	50
Ability Enhancement Course	AECENG1201	L1 – Compulsory English	--	--	--	--	20	30	50
Ability Enhancement Course	ACEMIL1201	**(MAR/HIN/URD /KAN/PAL)**	--	--	--	--	20	30	50
(NCC/NSS/SPT(sports)/ CLS(Cultural Studies)/HWS(Health Wellness)/ YGE(Yoga Education) / FIT(Fitness) **2 Credits**	CCCXXX1201	Select from **Basket 5**	10	10	10	40	--	--	50

B. Sc. Second Year Semester IV *(Level 5)*

Teaching Scheme

	Course Code	Course Name	Credits Assigned			Teaching Scheme (Hrs/ week)	
			Theory	Practical	Total	Theory	Practical
Major	SACHCT1251	**Inorganic and Organic Analysis – II**	02	--	**04**	02	--
	SACHCP1251	**Laboratory Course -V (Practical)**	-	02			04
	SACHCT1252	**Instrumental Methods of Chemical Analysis-II**	02	--	**04**	02	--
	SACHCP1252	**Laboratory Course -VI (Practical)**	-	02			04
Minor	SACHMT1251	**Industrial Analytical Chemistry**	02	--	**04**	02	--
	SACHMP1251	**Laboratory Course -III (Practical)**	-	02			04
Generic Electives *(from other Faculty)*	SACHGE1251	**(Basket 3)**	02	--	**02**	02	--
Vocational Course (related to Major)	SACHVC1251	**Analysis based on Food adulterant, Colorimetry and Spectrophotometry**	--	02	**02**	--	04
Ability Enhancement Course	AECENG1251	L1 – Compulsory English	02	--	**02**	02	--
Ability Enhancement Course	**ACEMIL1251**	**(MAR/HIN/URD /KAN/PAL)**	02	--	**02**	02	--
(NCC/NSS/SPT(sports)/ CLS(Cultural Studies)/HWS(Health Wellness)/ YGE(Yoga Education) / FIT(Fitness) **2 Credits**	**CCCXXX1251**	Select from **Basket 5**	02	--	**02**	02	--
Total Credits			**14**	**08**	**22**	**14**	**16**

B. Sc. Second Year Semester IV*(Level 5)*

Examination Scheme

[20% Continuous Assessment (***CA***) and 80% End Semester Assessment (***ESA***)]

(For illustration we have considered a paper of 02 credits, 50 marks, need to be modified depending on credits assigned to individual paper)

Subject (1)	Course Code (2)	Course Name (3)	Theory				Practical		Total Col (6+7) / Col (8+9) (10)
			Continuous Assessment (CA)			ESA			
			Test I (4)	Test II (5)	Average of T1 & T2 (6)	Total (7)	CA (8)	ESA (9)	
Major	SACHCT1251	**Inorganic and Organic Analysis –II**	10	10	10	40	--	--	50
	SACHCP1251	**Laboratory Course -V (Practical)**	--	--	--	--	20	30	50
	SACHCT1252	**Instrumental Methods of Chemical Analysis-II**	10	10	10	40	--	--	50
	SACHCP1252	**Laboratory Course -VI (Practical)**	--	--	--	--	20	30	50
Minor	SACHMT1251	**Industrial Analytical Chemistry**	10	10	10	40	--	--	50
	SACHMP1251	**Laboratory Course -III (Practical)**	--	--	--	--	20	30	50
Generic Electives	SACHGE1251	**(Basket 3)**	10	10	10	40	--	--	50
Vocational Course (related to Major)	SACHVC1251	**Analysis based on Food adulterant, Colorimetry and Spectrophotometry**	--	--	--	--	20	30	50
Ability Enhancement Course	AECENG1201	L1 – Compulsory English	--	--	--	--	20	30	50
Ability Enhancement Course	**ACEMIL1201**	**(MAR/HIN/URD /KAN/PAL)**	--	--	--	--	20	30	50
(NCC/NSS/SPT(sports)/ CLS(Cultural Studies)/HWS(Health Wellness)/ YGE(Yoga Education) / FIT(Fitness) **2 Credits**	**CCCXXX1201**	Select from **Basket 5**	10	10	10	40	--	--	50

Swami Ramanand Teerth Marathwada University, Nanded

Faculty of Science and Technology

NEP-2020 Pattern

B.Sc.II (Second) Year; Semester-III (w.e.f. 2025-26)

Analytical Chemistry; Paper- I (Major)

Name of Paper: Inorganic and Organic Analysis-I

Paper Code– SACHCT1201

Periods: 30 per semester; 02 per week **Credit-2**

Module-I Principles of Semi micro Qualitative Analysis of Inorganic Salts. 10 Periods

1.1 Chemical analysis, types of Qualitative inorganic analysis. Theoretical principles involved in separation of cations into groups – Law of mass action, solubility product, common ion effect and complex ion formation.

1.2 Spot – Test Analysis: Definition, Advantages, and spot test procedures.

Module-II Semi–micro Determination of Elements in the Organic Compounds.

10 Periods

2.1 Semi-micro-Estimation: Semi micro determination of Carbon, Hydrogen, Sulphur, Nitrogen and Halogens in the Organic Compounds.

2.2 Functional Group Analysis: Estimation of the following functional groups in the organic Compounds: Hydroxy (phenolic only), carbonyl, ester, Nitro, Amino and Carboxylic acid.

Module – III Metallurgical Analysis. 05 Periods

3.1 Estimation of main constituents in the following ores- Hematite, Pyrolusite, Bauxite and Lime stone.

Module– IV Analysis of Metals and Alloys 05 Periods

4.1 Analysis of Copper, Silicon and Aluminum metals for their percentage purity.

4.2 Composition and analysis of following alloys- Stainless steel, Brass and Solder.

Objective(s)	To understand the students basic knowledge of inorganic salt, Inorganic and Organic analysis and metallurgical analysis.
Course Outcome(s)	
CO- I	Understand the concepts of Qualitative inorganic analysis & spot test procedures.
CO-II	Aware the knowledge of Semi–micro Determination of Elements in the Organic Compounds and functional determination.
CO-III	Illustrate the main constituents in ores by Metallurgical Analysis.
CO-IV	Aware the composition of metals and alloy and estimation of their constituents.

Swami Ramanand Teerth Marathwada University, Nanded

Faculty of Science and Technology

NEP-2020 Pattern

B.Sc. II (Second) Year; Semester-III (w.e.f.2025-26)

Analytical Chemistry; Paper- II (Major)

Instrumental Methods of Chemical Analysis-I

Paper Code–SACHCT1202

Periods: 30 per semester; 02 per week **Credit-2**

Module-I Spectroscopic Methods - Visible Spectroscopy: 10 Periods

1.1 Spectroscopy-Introduction to Electromagnetic spectrum. Interaction of electromagnetic radiation with matter, process of emission, absorption and fluorescence of radiations. Visible Spectrophotometry. Theory of visible spectrophotometry and colorimetry, Lambert Beer's law nature of molar absorptivity and absorbance, deviations from Beer's law. Instrumentation: radiation sources, filters and monochromators, slits, cells and detection of radiation. Double beam photoelectric colorimeter-schematic diagram and working. Difference between photometer, spectrophotometer and colorimeter. Applications-Molar composition of complexes: Job's method of continuous variation. Quantitative analysis-calibration curve method, Method of Least Square.

Module-II Spectroscopic Methods (Photometric Titrations, AS & FES): 10 Periods

2.1 Photometric Titrations: Principle, Photometric titration curves, instrumentation and applications.

2.2 Atomic Absorption Spectroscopy (AAS) : Introduction, principle, Instrumentation : Radiation source-Hollow cathode lamp, chopper, flame atomizer, nebulization's of liquid sample, monochromators, detectors, amplifier and readout system; schematic diagram and working of single beam atomic absorption spectrophotometer. Application of AAS.

2.3 Flame Emission Spectroscopy (FES): Introduction, General principle of flame photometry, Limitations of flame photometry, Instrumentation: burners, mirrors, slits, monochromators, filters and detectors, schematic diagram and working of first type- simple modified flame spectrophotometer and Quantification of analyte by Calibration Curve method, standard addition method and Internal standard addition method. Other applications of flame photometry.

Module – III Electron Microscopy: 05 Periods

3.1 Transmission Electron Microscope (TEM): Instrumentation, General Design, Resolution, Electron Sources, TEM grids electron lenses. General Applications.

Module– IV Atomic Force Microscope (AFM): 05 Periods

4.1 Introduction, Instrumentation and General Applications.

Objective(s)	To acquire fundamental knowledge about interaction of electromagnetic radiation with matter and study the spectroscopic phenomenon like visible spectrometry, atomic absorption spectroscopy, flame photometry, electron microscopy, atomic force microscopy and their instrumental techniques.
Course Outcome(s)	
CO- I	Understand basic fundamentals of Spectroscopic techniques.
CO-II	Learn the Photometric titrations and Atomic Spectroscopy.
CO-III	Understand the Microscopic techniques used for scanning.
CO-IV	Aware the knowledge of Atomic Force Microscope.

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Swami Ramanand Teerth Marathwada University, Nanded

Faculty of Science and Technology

NEP-2020 (Pattern)

B.Sc. II (Second) Year; Semester-III (w.e.f.2025-26)

Analytical Chemistry; Paper- I (Major)

Name of Paper: Laboratory Course-III Paper Code– SACHCP1201

Periods: 60 per semester; 04 per week **Credit-2**

Note: Out of 16 experiments at least 12 experiments should be completed.

1) Estimation of Iron in hematite ore volumetrically.

2) Estimation of Manganese in Pyrolusite ore.

3) Estimation of calcium in Lime stone volumetrically.

4) Determination of percentage purity of aluminum metal.

5) Determination of percentage purity of copper metal.

6) Determination of Nickel in stainless steel by gravimetric method.

7) Determination of percentage purity of silver metal.

8) Determination of Copper in Brass.

9) Determination of Nickel in German silver.

10) Estimation of sulphur in the organic compound by semi-micro method.

11) Estimation of phenolic hydroxy group in the organic compound.

12) Estimation of ester group in the organic compound.

13) Determination of amino group by acetylation method.

14) Estimation of copper and nickel in a mixture by gravimetric.

15) Determination of halogen in the organic compound.

16) Determination of density of Cu/ Al/ Zn/ Ag/ Ni metal powder using density bottle.

Objective(s)	To familiarize the students with the determination/ estimation of analyte in consumable and non-consumable materials
Course Outcome(s)	
CO- I	Students become aware of preparation of sample, Standardization of solution, determination / estimation of analyte in consumable and non-consumable materials

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Name of Paper: Laboratory Course-IV Paper Code– SACHCP1202

Periods: 60 per semester; 04 per week **Credit-2**

Note: Out of 16 experiments at least 12 experiments should be completed.

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 acid neutralizing capacity of antacid tablet titrimetrically.
5) Determination of formula of ferric sulpho-salicylic acid complex calorimetrically by Job's method.
6) Photometric titration of copper by EDTA.
7) Determination of lithium by Flame Photometry.
8) Determination of calcium from milk by flame photometry.
9) Determination of sodium / potassium by flame photometry.
10) Colorimetric estimation of Iron by Ortho Phenanthroline.
11) Determination of fluoride in a given solution / tooth paste by Zirconyl-Alizarin red method colorimetrically.
12) Colorimetric estimation of titanium in the given solution by hydrogen peroxide.
13) Determination of Iron (III) using potassium thiocyanate
14) Colorimetric estimation of proteins by biuret method.
15) Estimation of amino acids by colorimetry.
16) Determination of nitrite in drinking water sample by diazotization method.

Objective(s)	To familiarize the students with the determination/ estimation of analyte in consumable and non-consumable materials
Course Outcome(s)	
CO- I	Students become aware of preparation of sample, Standardization of solution, determination / estimation of analyte in consumable and non-consumable materials

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Swami Ramanand Teerth Marathwada University, Nanded

Faculty of Science and Technology

NEP-2020 Pattern

B.Sc. II (Second) Year; Semester-IV (w.e.f.2025-26)

Analytical Chemistry; Paper-III (Major)

Name of Paper: Inorganic and organic Analysis-II

Paper Code– SACHCT1251

Periods: 30 per semester; 02 per week **Credit-2**

Module-I Principles and Methods of Analysis of Saponifiable Oils and Fats: 10 Periods

1.1 Definition, Classification, Nomenclature & Fatty acid composition of oils and fats. Analysis by physical and chemical methods- Density, Specific gravity, colour, smoke point, acid value, peroxide value, iodine value, Saponification value and shelf stability value. Determination and significance of these aspects in quality control.

Module-II Analysis of Cement: 06 Periods

2.1 Definition, types of cements, manufacturing processes, raw materials. Composition and analysis of Portland cement**.**

Module – III Analysis of Fertilizers and Pesticides: 07 Periods

3.1 Fertilizers: Definition, Classification, Characteristics of a good fertilizer. Analysis of Nitrogenous, Phosphatic and potash fertilizers.

3.2 Pesticides: Definition, Classification, Characteristics of a good pesticide. Analysis of DDT and Malathion.

Module– IV Introduction to Quality Assurance and Quality Control: 07 Periods

4.1 Quality and objectives of Analytical Chemistry: Definitions of the terms: Quality policy, Quality Management, Quality system, Quality Control, Quality Assurance and Quality. General considerations quality assurance and quality control spiral, influencing the quality spiral.

Objective(s)	To enable the students acquire the fundamental knowledge in QA/QC and study the analysis of oils, fat, cement, fertilizers and pesticides.
Course Outcome(s)	
CO- I	Learn basic knowledge of Analysis of Saponifiable Oils and Fats, aspects in quality control
CO-II	General awareness about Analysis of Cement.
CO-III	Understand fundamental knowledge of Analysis of Fertilizers and Pesticides.
CO-IV	Understand the basic knowledge of Quality Assurance and Quality Control and its applications.

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Swami Ramanand Teerth Marathwada University, Nanded

Faculty of Science and Technology

NEP-2020 Pattern

B.Sc.II (Second) Year; Semester-IV (w.e.f.2025-26)

Analytical Chemistry; Paper- VI (Major)

Name of Paper: Instrumental Methods of Chemical Analysis-II

Paper Code– SACHCT1252

Periods: 30 per semester; 02 per week **Credit-2**

Module-I Radiochemical Methods: **07 Periods**

1.1 Introduction to nuclear radiations, detection and measurement of nuclear radiations by Geiger Muller (G.M.) Counter and scintillation counter. Tracer technique, Isotope dilution analysis and Neutron activation analysis.

Module-II Thermal Methods of Analysis: **07 Periods**

2.1 Thermal gravimetric (TG): Theory, instrumentation and applications. Thermometric titrations.

2.2. Differential Thermal Analysis (DTA): Theory, instrumentation and applications.

Module – III Optical Methods: **07 Periods**

3.1. Theory, Experimental techniques of measurement and application of each of the following properties in Chemical analysis: (i) Refractive Index (ii) Optical Activity.

Module–IV Chromatographic Techniques -1 **09 Periods**

4.1. Gas Chromatography (GC): Introduction, Types of Gas Chromatography: Gas Liquid Chromatography (GLC), Gas Solid Chromatography (GSC), Principle of Gas Solid Chromatography (GSC).

4.2. Gas liquid Chromatography (GLC): Principle, instrumentation, Qualitative and Quantitative analysis, Other Applications of GLC.

4.3. High Performance Liquid Chromatography (HPLC): Introduction, Principle, Instrumentation, Solvent Delivery System, pumping systems, sample injection systems, columns, Detectors, Recorder, Mobile phases, column efficiency and Qualitative and Quantitative analysis, Other Applications of HPLC.

Objective(s)	To familiarize the students with Radiochemical, thermal, Optical and Chromatographic techniques.
Course Outcome(s)	
CO- I	Understand Radiochemical Methods of Analysis.
CO-II	Learn the Thermal methods and Its Correlation with extensive and Intensive property of substance
CO-III	Know the Optical methods used to check purity of optically active compounds.
CO-IV	Aware the modern methods of separation Techniques and its application for Quantification of analyte in different samples.

Swami Ramanand Teerth Marathwada University, Nanded

Faculty of Science and Technology
NEP-2020 (Pattern)
B.Sc.II (Second) Year; Semester-IV (w.e.f.2025-26)
Analytical Chemistry; Paper- II (Major)
Name of Paper: Laboratory Course-V
Paper Code– SACHCP1251

Periods: 60 per semester; 04 per week **Credit-2**

Note: Out of 16 experiments at least 12 experiments should be completed.

1) Estimation of SiO2 in the given sample of Portland cement.
2) Estimation CaO in the given sample of Portland cement by gravimetric method.
3) Determination of total nitrogen in a fertiliser sample.
4) Estimation of phosphorus in a phosphate fertiliser sample.
5) Estimation of potassium ion in a potash fertiliser sample (solid / liquid).
6) Determination of acid value of an oil sample.
7) Determination of saponification value of an oil sample.
8) Preparation and standardization of acetic acid from the data of specific gravity and percentage by weight.
9) Determination of Iodine value of an oil sample.
10) Determination of volatile thinner in a paint sample.
11) Separation and determination of total pigment in a paint sample.
12) Determination of specific gravity of an oil sample.
13) Determination of loss on ignition of Portland cement.
14) Estimation of combined oxides of Fe and Al in a cement sample.
15) Determination of sodium and potassium in a given sample of fertilizer.
16) Determination of phosphate in fertilizers by flame photometry.

Objective(s)	To familiarize the students with the determination/ estimation of analyte in consumable and non-consumable materials
Course Outcome(s)	
CO- I	Students become aware of preparation of sample, Standardization of solution, determination / estimation of analyte in consumable and non-consumable materials

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Swami Ramanand Teerth Marathwada University, Nanded

Faculty of Science and Technology

NEP-2020 (Pattern)

B.Sc.II (Second) Year; Semester-IV (w.e.f.2025-26)

Analytical Chemistry; Paper- II (Major)

Name of Paper: Laboratory Course-VI Paper Code– SACHCP1252

Periods: 60 per semester; 04 per week **Credit-2**

Note: Out of 16 experiments at least 12 experiments should be completed.

1) Determination of solubility and solubility product of sparingly soluble salt by conductance measurement.
2) Assay of boric acid by conductometry.
3) Estimation of the amount of hydrochloric acid and oxalic acid in the given mixture by conductometry.
4) Determination of Phosphoric acid in Soft drink sample by pH meter.
5) Estimation of chloride and Iodide in the given mixture by Potentiometry.
6) Determination of the concentration of an optically active compound in the given unknown solution by Polarimetry.
7) Determination of sulphate present in water turbimetrically.
8) Determination of purity of commercial HCl using pH metric titration.
9) Determination of Ascorbic Acid in Vitamin C Tables By redox titration.
10) Determination of refractive index of a given organic liquid by Abbe's Refrctometer.
11) Titration of phosphate mixture by potentiometry.
12) To study the variation of viscosity with composition of the mixture of liquids.
13) Determination of percentage purity of an optically active compound by polarimetry.
14) Estimation of boric acid by potentiometry.
15) Determination of purity of commercial H_2SO_4 using pH metric titration.
16) Determination of the pKa of a weak acid by potentiometric/pH titration.

Objective(s)	To familiarize the students with the determination/ estimation of analyte in consumable and non-consumable materials
Course Outcome(s)	
CO- I	Students become aware of preparation of sample, Standardization of solution, determination / estimation of analyte in consumable and non-consumable materials

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Swami Ramanand Teerth Marathwada University, Nanded

Faculty of Science and Technology

NEP-2020 Pattern

B.Sc.II (Second) Year; Semester-III (w.e.f.2025-26)

Analytical Chemistry; Paper- III (Minor)

Name of Paper: Fundament Analytical Chemistry-I

Paper Code– SACHMT1201

Periods: 30 per semester; 02 per week **Credit-2**

Module - I **10 Periods**

Mathematical concept and SI Units

(A) Mathematical concept: Periods: Logarithm: Rules of logarithm, Characteristic and Mantissa, Change of sign and base, Numerical problems. Definition of pH and pOH, Relation between pH and POH, Numerical Problems based on pH and OH. Graphical representation: Rules for drawing graph, coordinates etc., Equation of straight lines, slope and intercept and Numerical Problems.

Derivative: Rules of differentiation, partial differentiation, Algebraic, logarithmic and exponential functions. Integration: - Rules of integration, Algebraic and exponential functions. Permutation, combinations and Probability, Numerical Problems.

(B) SI Units: International systems of units, derived units, subsidiary units, prefixes used in SI units, internal conversions of these units.

Module -II **8 Periods**

Errors in Chemical Analysis:

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. Numerical Problems.

Module -III **5 Periods**

Analysis of water

water pollutant and their sources, determination of physicochemical parameters, acidity, alkalinity, hardness, chloride, sulphate, nitrate, fluoride, nitrogen in water sample

Module -IV **7 Periods**

Principles of Volumetric Analysis

Definition of terms: Titrant, titrant, 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.

Objective(s)	To acquire the basic knowledge about Mathematical concept and SI Units errors in chemical analysis, statistical treatment of analytical data. Aware about water analysis and understanding about types of analysis.

Course Outcome(s)	
CO1	The students are expected to understand the fundamentals, principles, mathematical concepts and recent developments in the subject area. To enable the students to understand basic concepts, nomenclature,
CO2	Understand about the errors in chemical analysis.
CO3	Understand about the Properties of water
CO4	Understand about the Types of volumetric analysis

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Name of Paper: Laboratory Course-III Paper Code– SACHMP1201

Periods: 60 per semester; 04 per week **Credit-2**

Note: Out of 18 experiments at least 12 experiments should be completed.

1. Purification of organic compound by crystallisation (from water and alcohol)
2. Purification of organic compound by distillation
3. Criteria of purity: Determination of M.P./B.P.
4. Estimation of magnesium using EDTA
5. Determination of total hardness of water,
6. Separation of mixtures by chromatography: Measure the Rf value in each case (combination of two compounds to be given) a) Identify and separate the components of a given mixture of two amino acids (glycine, aspartic acid, glutamic acid, tyrosine or any other amino acid) by radial/ascending paper chromatography.
7. Separation of mixtures by chromatography: Measure the Rf value in each case b) Identify and separate the sugars present in the given mixture by radial/ascending paper chromatography.
8. Use of pH meter: determination of pH of given dilute solutions of shampoos and soaps
9. Estimation of Mohr's salt by titrating it with $KMnO_4$.
10. Estimation of Fe (II) ions by titrating it with $K_2Cr_2O_7$ using internal indicator.
11. Estimation of Cu (II) ions iodometrically using $Na_2S_2O_3$.
12. Estimation of water of crystallization in Mohr's salt by titrating with $KMnO_4$
13. Determination of halogen in the organic compound.
14. Determination of density of Cu/ Al/ Zn/ Ag/ Ni metal powder using density bottle.
15. Photometric titration of copper by EDTA.
16. Determination of fluoride in a given solution / tooth paste by Zirconyl-Alizarin red method colorimetrically.
17. Colorimetric estimation of titanium in the given solution by hydrogen peroxide. Determination of solubility and solubility product of sparingly soluble salt by conductance measurement.
18. Assay of boric acid by conductometry.

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Faculty of Science and Technology

NEP-2020 Pattern

B.Sc.II (Second) Year; Semester-IV (w.e.f.2025-26)

Analytical Chemistry; Paper- IV (Minor)

Name of Paper: Industrial Analytical Chemistry-I

Paper Code– SACHMT1251

Periods: 30 per semester; 02 per week **Credit-2**

Module -I

Sugar Industry

Introduction, Manufacture of cane sugar in India. Extraction of juice, Clarification, Concentration, crystallization, centrifugation and other details of industrial process. Byproducts of sugar industry. Manufacture of Ethyl Alcohol from Molasses by Fermentation.

Module -II

Manufacture of industrial heavy chemicals

Introduction, Manufacture of Ammonia (NH_3), Physico-chemical principles, Manufacture by Haber's process.

Manufacture of Sulphuric acid (H_2SO_4) Physico-chemical principles. Manufacture by Contact process.

Manufacture of Nitric acid (HNO_3) Physico-chemical principles. Manufacture by Ostwald's process (Ammonia oxidation process).

Module -III

Gas Chromatography

Introduction of Gas Chromatography, Principle, Instrumentation and Applications of Gas Chromatography. Advantages and disadvantages of Gas Chromatography.

Module -IV

Metallurgy

Sources of raw material, Concentration of ores, methods of metal dressing (hand picking, magnetic separation, centrifuge, froth flotation etc.), pollution due to metallurgical process (Metal dressing, calcinations, smelting). Principles of pyrometallurgy-roasting, agglomeration, smelting, refining & secondary refining, extraction of Fe from Hematite ore. Principles of hydrometallurgy, extraction of Al from bauxite. Principles of Electrometallurgy, extraction of Cu from Copper pyrites.

EXPECTED LEARNING OUTCOMES:

Objective(s)	To acquire the basic knowledge about Sugar Industry, Manufacture of Industrial Heavy Chemicals, Gas Chromatography and Quality Control
Course Outcome(s)	
CO1	Learning and understanding the whole process of manufacture of sugar and byproducts of sugar industry
CO2	Learning and understanding of physico-chemical principles of production of ammonia, sulfuric acid and nitric acid along with its manufacturing plant.
CO3	Understanding the basics of Gas Chromatography its applications.
CO4	Learning and understanding the whole process of Metallurgy

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NEP-2020 (Pattern)

B.Sc.II (Second) Year; Semester-IV (w.e.f.2025-26)

Analytical Chemistry; Paper- II (Minor)

Name of Paper: Laboratory Course-IV Paper Code– SACHMP1251

Periods: 60 per semester; 04 per week **Credit-2**

Note: Out of 18 experiments at least 12 experiments should be completed.

1. Estimation of Iron in haematite ore volumetrically. Estimation of Manganese in Pyrolusite ore.
2. Determination of percentage purity of aluminium metal.
3. Determination of percentage purity of copper metal.
4. Determination of Nickel in stainless steel by gravimetric method.
5. Determination of percentage purity of silver metal.
6. Determination of Copper in Brass.
7. Determination of Nickel in German silver.
8. Determination of specific gravity of an oil sample.
9. Determination of loss on ignition of Portland cement.
10. Estimation of combined oxides of Fe and Al in a cement sample.
11. Determination of nitrogen in urea. Determination of percentage of phenol in household disinfectant (e.g. black phenyl)
12. Determination of pKa value of acid base indicator.
13. Determination of molar extinction coefficient of potassium permanganate Potassium dichromate.
14. Determination of acid neutralizing capacity of antacid tablet titrimetrically.
15. Determination of formula of ferric sulpho-salicylic acid complex calorimetrically by Job's method.
16. Determination of sulphate present in water turbimetrically.
17. Colorimetric estimation of proteins by biuret method.
18. Determination of Ascorbic Acid in Vitamin C Tables By redox titration.

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Faculty of Science and Technology
NEP-2020 Pattern
B.Sc.II (Second) Year; Semester-III (w.e.f.2025-26)
Analytical Chemistry; Paper- I Generic Elective
Name of Paper: General Analytical Chemistry-I
Paper Code– SACHGE1201

Periods: 30 per semester; 02 per week **Credit-2**

Module-I **08 periods**

General concepts of Analytical Chemistry-I

1.1 Introduction, definition of analytical chemistry, need of analytical chemistry, importance of analytical chemistry, chemical analysis: qualitative and quantitative analysis, classification of quantitative analysis. Major, minor, trace ultra-trace constituents.

Module-II **08 periods**

General concepts of Analytical Chemistry-II

2.1 Quantitative analysis: volumetric analysis, gravimetric analysis, typical steps in gravimetric analysis: precipitation, digestion, filtration, washing, drying, cooling and weighing. Types of precipitates: curdy precipitate, gelatinous precipitates. Co-precipitation, post precipitation, minimization of co-precipitation.

Module-III **07 periods**

Mole concept and concentration units

3.1 Molecular weight, equivalent weight, mole concept, concentration units: normality, molarity, molality, formality, mole fraction, parts per thousand, parts per billion, parts per million, percentage by weight, percentage by volume.

Module-IV **07 periods**

Solvents and reagents

4.1 Definition of solvents, solutions, types of solvents polar solvents, nonpolar solvents, protic and aprotic solvents, reagents: types of reagents acidic, basic, and oxidizing and reducing agents.

Objective(s)	To familiarize the students about concepts of general analytical chemistry and enhance their knowledge about analytical chemistry
Course Outcome(s)	
CO- I	Students able to know about the meaning of analytical chemistry and aware about the general concepts of analytical chemistry as well as importance of analytical chemistry.

CO-II	Students able to know about the various general concepts of analytical chemistry such as types of chemical analysis, qualitative and quantitative analysis and concepts related to the qualitative and quantitative analysis.
CO-III	To make students aware about mole concepts and various concentration units used in the analytical chemistry.
Co-IV	Students able to know about the various solvents and reagent used in the chemical analysis.

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NEP-2020 Pattern

B.Sc.II (Second) Year; Semester-IV (w.e.f.2025-26)

Analytical Chemistry; Paper- II Generic Elective

Name of Paper: General Analytical Chemistry-II Paper Code– SACHGE1251

Periods: 30 per semester; 02 per week **Credit-2**

Module-I Measurement of mass **08 periods**

1.1 Definition of mass, weight, distinction between mass and weight, apparatus for the measurement of mass, weighing balances types of weighing balances, single pan balance, double pan balance electronic hybrid balance, care should be taken during the working with balance. Calibration of weights.

Module-II Measurement of volume **08 periods**

2.1. Units of volume measurements, apparatus for the precise measurement of volume, burette, pipette, standard flask, effect of temperature on volume measurement, need of calibration of volumetric apparatus. Calibration of burette, pipette and standard flask.

Module-III Operations in typical quantitative analysis **07 periods**

3.1 Definition of term sample, subsample, gross sample, increment, universe, population, theory of sampling, random and nonrandom sampling, sampling of solid, sampling of liquid and gases.

Module-IV Volumetric Analysis: **07 periods**

4.1 Introduction, definition of terms Titrant, titrand, analyte, end point and equivalence point, indicator, titration. Types of titration, theory of acid base titration.

Objective(s)	To familiarize the students about concepts of general analytical chemistry and enhance their knowledge about analytical chemistry
Course Outcome(s)	
CO- I	Students able to know about measurements of mass and various types of balances used for the measurements of mass.
CO-II	Students able to know about the various units and apparatus used for the precise measurement of volume and familiarize about their calibration
CO-III	To make students aware about preliminary operations undertaken the typical quantitative analysis and to learn about the sampling methods of the variety of samples.

CO-IV	Students able to know about the various terms used in the volumetric analysis.

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NEP-2020 (Pattern)

B.Sc.II (Second) Year; Semester-III (w.e.f.2025-26)

Analytical Chemistry; Paper- **Skill Course - I**)

Name of Paper: **Analysis based on Chromatography and P^H Measurement**

Paper Code– SACHVC1201

Periods: 60 per semester; 04 per week **Credit-2**

Module-I

1.0 OVERVIEW OF pH MEASUREMENT **12Periods**

1.1 Introduction 1.2 Operational Definition of pH 1.3 pH Measurements in Industry

2.0 CELLS FOR MEASURING pH

2.1 General introduction 2.2 Measuring Electrode 2.3 Reference Electrode 2.4 Liquid Junction Potential 2.5 Double Junction Reference Electrodes

3.0 MAKING THE pH MEASUREMENT

3.1 Converting Voltage to pH 3.2 Glass Electrode Slope3.3 Buffers and Calibration 3.4 Precautions Using Buffers, 3.5 Isopotential pH, 3.6 Solution Temperature Compensation 3.7 Shields, Insulation, and Preamplifiers, 3.8 Sensor Diagnostics.

4.0 FUNDAMENTAL LIMITATIONS

4.1 Junction Potential Mismatch 4.2 Sodium Error .

Module-II

5.0 ORP MEASUREMENTS **08Periods**

5.1 Introduction, 5.2 Measuring Electrode, 5.3 Interpreting ORP Measurements, 5.4 Calibration

6.0 INSTALLING THE SENSOR

6.1 General , 6.2 Safety, 6.3 Immersion and Insertion Applications ,6.4 Electrical Connections

7.0 MAINTENANCE

7.1 General 7.2 Cleaning pH Sensors 7.3 Calibrating pH Sensors 7.4 Storing pH Sensors

Note: Out of 12experiments at least 10 experiments should be completed.

1.Separation and identification of monosaccharides present in the given mixture by radial paper Chromatography.

2.Separation of ortho-nitrophenol and para-nitrophenol by thin layer chromatography.

3.Analysis of soil. i Determination of pH of soil. ii. Determination of total soluble salts.

4. Determination of carbonate and bicarbonate in soil sample.

5. Determination of calcium, magnesium and iron in soil sample.

6.Calibration of PH meter and maintenance of pH electrode filled with KCL solution

7.Study of pH of tap water and polluted water.

8. Measurement of pH of different solutions like aerated drinks, Thin Juices, RTS beverages etc using PH meter.

9. Measurement of pH of different solutions like Fresh fruits & vegetables, dried fruits, preserves, jams, marmalades pickles, Fruit pulps, squashes, syrups, cordial etc. shampoos and soaps (use dilute solutions of soaps and shampoos to prevent damage to the glass electrode) using pH-meter.

10. Preparation of buffer solutions: (i) Sodium acetate-acetic acid (ii) Ammonium chloride-ammonium hydroxide Measurement of the pH of buffer solutions and comparison of the values with theoretical values.

11.Determine pKa value of given organic acid by pH measurement.

12. Determine the Hammett constant of given substituted benzoic acid by pH measurements.

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Faculty of Science and Technology

NEP-2020 (Pattern)

B.Sc.II (Second) Year; Semester-IV (w.e.f.2025-26)

Analytical Chemistry; Paper- **Skill Course - II**)

Name of Paper: Analysis based on Food adulterant, Colorimetry and Spectrophotometry

Paper Code– SACHVC1251

Periods: 60 per semester; 04 per week **Credit-2**

Module-I VOLUMETRIC ANALYSIS **08 Periods**

A. Definitions, Titrimetry, Volumetric titrimetry, Gravimetric titrimetry, Coulometric titrimetry. The equivalence point, the end point. Volumetric methods of analysis, Classification of volumetric methods, theory of indicators and buffers. · Aqueous and non-aqueous acid-base titration. · Redox titrations · Complexometric titrations · Precipitation titrations.

Module-II COLORIMETRY AND SPECTROPHOTOMETRY **12 Periods**

Theory of colorimetry and spectrophotometry. Lambert Beer's law, deviation from Beer's law. Terms used in colorimetry and spectrophotometry. Classification of methods of 'colour' measurement or comparison. Photoelectric colorimeter method–Single beam photo-electric colorimeter. Spectrophotometer method–Single beam direct reading spectrophotometer. Determination of unknown concentration by using concentration-absorbance plot. Applications of colorimetry

Note: Out of 12 experiments at least 10 experiments should be completed.

1. Determination of adulterant in some common food items.
    i. Chicory in coffee powder.
    ii. Foreign resin in asafetida.
2. Determination of adulterant in some common food items.
    i. Chilli powder
    ii. Turmeric powder.
3. Determination of adulterant in some common food items.
    i. Pulses
    ii. Milk
4. Determine λ_{max} for $KMnO_4$ by colorimetric measurements.
5. Verify Beer's law by colorimetric measurements.
6. To determined equilibrium quotient for the formations of cupper-ammonia complex by colorimetric measurements

7. Determine the empirical formula of ferric salicylate complex by job's method and verify the slope ratio method
8. Separation of a mixture of Ni2+ and Cu2+ by TLC and identify the ions.
9. Determination of amount of chlorophyl pigment in plant leaf by colorimetric.
10. Determine indicator constant of a given indicator by by colorimetric measurements
11. Determined the stability constant of the complex formed between Fe^{+3} and 5-SSA at 2-pH and 3-pH by colorimetric measurements.
12. Investigate reaction kinetics between potassium persulphate and potassium iodide by colorimetric measurement.

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