॥ 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

Fax : (02462) 215572

Phone: (02462)215542

Academic-1 (BOS) Section

website: srtmun.ac.in

E-mail: bos@srtmun.ac.in

एनईपी–२०२० सुधारित श्रेयांक आराखडयानुसार विज्ञान व तंत्रज्ञान विद्याशाखेतील पदवी प्रथम वर्षाचे अभ्यासक्रम शैक्षणिक वर्ष २०२६–२७ पासून लागू करण्याबाबत.

प रि प त्र क

या परिपत्रकान्वये सर्व संबंधितांना कळविण्यात येते की, दिनांक २२ एप्रिल २०२६ रोजी संपन्न झालेल्या मा.विद्यापरिषद बैठकीतील विषय क्र.०४/६४–२०२६ च्या ठरावानुसार विज्ञान व तंत्रज्ञान विद्याशाखेतील राष्ट्रीय शैक्षणिक धोरण–२०२० सुधारित श्रेयांक आराखडयानुसार पदवी प्रथम वर्षाचे अभ्यासक्रम शैक्षणिक वर्ष २०२६–२७ पासून लागू करण्यास मा.विद्यापरिषदेने मान्यता प्रदान केली आहे. त्यानुसार विज्ञान व तंत्रज्ञान विद्याशाखेतील बी.एस्सी. प्रथम वर्षाचे खालील विषयाचे अभ्यासक्रम शैक्षणिक वर्ष २०२६–२७ पासून लागू करण्यात येत आहे.

01	B.Sc. I Year Botany	06	B.Sc. I Year Geology
02	B.Sc. I Year Chemistry	07	B.Sc. I Year Enviornment & Earth Science
03	B.Sc. I Year Mathematics	08	B.Sc. I Year Statistics
04	B.Sc. I Year Zoology	09	B.Sc. I Year Dairy Science
05	B.Sc. I Year Microbiology	10	B.Sc. I Year Agrochemical & Fertilizers

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/परिपत्रक/पदवी/बीएस्सी/२०२६–२७/ 66
दिनांक : २२.०६.२०२६

सहा.कुलसचिव
शैक्षणिक (१–अभ्यासमंडळ) विभाग

प्रत माहिती व पुढील कार्यवाहीस्तव :–
१) मा. कुलगुरू महोदयांचे कार्यालय, प्रस्तुत विद्यापीठ.
२) मा. प्र.कुलगुरू महोदयांचे कार्यालय, प्रस्तुत विद्यापीठ
३) मा. अधिष्ठाता, विज्ञान व तंत्रज्ञान विद्याशाखा,प्रस्तुत विद्यापीठ.
४) मा. संचालक, परिक्षा व मुल्यमापन मंडळ, प्रस्तुत विद्यापीठ.
५) मा. प्राचार्य, सर्व संबंधित संलग्नित महाविद्यालये, प्रस्तुत विद्यापीठ.
६) सिस्टीम एक्सपर्ट, शैक्षणिक विभाग, प्रस्तुत विद्यापीठ. यांना देवून कळविण्यात येते की, परिपत्रक अभ्यासक्रम संकेतस्थळावर प्रसिध्द करण्यात यावेत.

SWAMI RAMANAND TEERTH MARATHWADA UNIVERSITY

NANDED – 431 606 (MS)

UNDER GRADUATE PROGRAMME OF SCIENCE & TECHNOLOGY

B.Sc. FIRST YEAR

SUBJECT — CHEMISTRY

With Effect from the Academic Year 2026–2027

(As per NEP-2020)

TABLE OF CONTENTS

From the Desk of the Dean

Faculty of Science and Technology

Swami Ramanand Teerth Marathwada University, Nanded, enduring to its vision statement "Enlightened Student: A Source of Immense Power", is trying hard consistently to enrich the quality of science education in its jurisdiction by implementing several quality initiatives. Revision and updating curriculum to meet the standard of the courses at national and international level, implementing innovative methods of teaching-learning, improvisation in the examination and evaluation processes are some of the important measures that enabled the University to achieve the 3Es, the equity, the efficiency and the excellence in higher education of this region. To overcome the difficulty of comparing the performances of the graduating students and also to provide mobility to them to join other institutions the University has adopted the cumulative grade point average (CGPA) system in the year 2014-2015. Further, following the suggestions by the UGC and looking at the better employability, entrepreneurship possibilities and to enhance the latent skills of the stakeholders the University has adopted the Choice Based Credit System (CBCS) in the year 2018-2019 at graduate and post-graduate level. This provided flexibility to the students to choose courses of their own interests. To encourage the students to opt the world-class courses offered on the online platforms like, NPTEL, SWAYM, and other MOOCS platforms the University has implemented the credit transfer policy approved by its Academic Council and also has made a provision of reimbursing registration fees of the successful students completing such courses. SRTM University has been producing a good number of high calibre graduates; however, it is necessary to ensure that our aspiring students are able to pursue the right education. Like the engineering students, the youngsters pursuing science education need to be equipped and trained as per the requirements of the R&D institutes and industries. This would become possible only when the students undergo studies with an updated and evolving curriculum to match global scenario. Higher education is a dynamic process and in the present era the stakeholders need to be educated and trained in view of the self-employment and self-sustaining skills like startups. Revision of the curriculum alone is not the measure for bringing reforms in the higher education, but invite several other initiatives. Establishing industry-institute linkages and initiating internship, on job training for the graduates in reputed industries are some of the important steps that the University would like to take in the coming time. As a result, revision of the curriculum was the need of the hour and such an opportunity was provided by the New Education Policy 2020. National Education Policy 2020 (NEP 2020) aims at equipping students with knowledge, skills, values, leadership qualities and initiates them for lifelong learning. As a result the students will acquire expertise in specialized areas of interest, kindle their intellectual curiosity and scientific temper, and create imaginative individuals. The curriculum given in this document has been developed following the guidelines of NEP-2020 and is crucial as well as challenging due to the reason that it is a transition from general science based to the discipline-specific-based curriculum. All the recommendations of the Sukanu Samiti given in the NEP Curriculum Framework-2023 have been followed, keeping the disciplinary approach with rigor and depth, appropriate to the comprehension level of learners. All the Board of Studies (BoS) under the Faculty of Science and Technology of this

university have put in their tremendous efforts in making this curriculum of international standard. They have taken care of maintaining logical sequencing of the subject matter with proper placement of concepts with their linkages for better understanding of the students. We take this opportunity to congratulate the Chairman(s) and all the members of various Boards of Studies for their immense contributions in preparing the revised curriculum for the benefits of the stakeholders in line with the guidelines of the Government of Maharashtra regarding NEP-2020. We also acknowledge the suggestions and contributions of the academic and industry experts of various disciplines. We are sure that the adoption of the revised curriculum will be advantageous for the students to enhance their skills and employability. Introduction of the mandatory On Job Training, Internship program for science background students is praise worthy and certainly help the students to imbibe firsthand work experience, team work management. These initiatives will also help the students to inculcate the workmanship spirit and explore the possibilities of setting up of their own enterprises.

Dr. M. K. Patil
Dean Faculty of Science and Technology
Swami Ramanand Teerth Marathwada University,
Nanded

From the Desk of Chairman
Board of Studies in Chemistry

It gives me immense pleasure to present the revised syllabus for B.Sc. First Year Chemistry (Semester I & II), prepared in accordance with the guidelines of the National Education Policy (NEP) 2020 and the academic framework of Swami Ramanand Teerth Marathwada University. The curriculum has been carefully structured to provide students with a strong foundation in Organic, Inorganic, and Physical Chemistry along with adequate practical exposure, skill enhancement, and interdisciplinary learning opportunities.

The present syllabus emphasizes conceptual understanding, laboratory competence, analytical thinking, and outcome-based education (OBE). The curriculum integrates theoretical knowledge with practical applications through courses such as *Everyday Chemistry*, *Soil and Fertilizer Chemistry*, *Water Pollution*, *Soil Pollution*, *Fundamentals of Chemistry Laboratory*, and *Common Laboratory Techniques*. These courses are designed to enhance scientific aptitude, environmental awareness, and employability skills among students.

Special emphasis has been given to laboratory training and skill-based learning through practical courses in Organic, Inorganic, and Physical Chemistry. The syllabus includes experiments related to synthesis, purification, volumetric analysis, physicochemical measurements, environmental analysis, and laboratory safety practices, enabling students to develop hands-on experience and research orientation.

The curriculum also incorporates modern pedagogical approaches including continuous assessment, practical-based learning, numerical problem-solving, and application-oriented teaching methods. The inclusion of environmental chemistry, pollution studies, soil analysis, and computer applications in laboratory work reflects the growing need for sustainable scientific practices and multidisciplinary education.

I sincerely appreciate the valuable contributions and dedicated efforts of all the members of the Board of Studies, subject experts, teachers, and academic stakeholders who actively participated in the preparation and refinement of this syllabus.

I am confident that this revised curriculum will significantly contribute to the academic growth, skill development, and professional competence of students, preparing them for higher education, research, entrepreneurship, and opportunities in industry and allied scientific fields.

Dr. D. R. Munde
Chairman
Board of Studies in Chemistry
Swami Ramanand Teerth Marathwada University, Nanded

Details of the Members of the Board of Studies in Chemistry under the Faculty of Science & Technology, Swami Ramanand Teerth Marathwada University, Nanded.

Sr. No.	Name	Address	Designation
1.	Dr. D. R. Munde	Science College, Nanded	Chairman
2.	Dr. Sangeeta S. Makone	School of Chemical Sciences, SRTMU, Nanded	Member
3.	Dr. Yogesh S. Nalwar	Toshniwal ACS College, Sengaon	Member
4.	Dr. Anil B. Chidrawar	Degloor College, Degloor	Member
5.	Dr. A. S. Bondge	ShivneriMahavidyalaya, Shirur (Anantpal)	Member
6.	Dr. B.C.Khade	D.S.M.College, Parbhani	Member
7.	Dr. Suresh D. Dhage	ACS College, Gangakhed	Member
8.	Dr. Krishna Chaitanya	School of Chemical Sciences, SRTMU, Nanded	Member
9.	Dr. Shivraj B. Sirsat	Yeshwant Mahavidyalaya, Nanded	Member
10	Dr. Jaman Angulwar	Dayanand Science College, Latur	Member
11	Dr. Nitish Kumar S. Kaminwar	Lal Bahadur Shastri College, Dharmabad	Member
12	Dr. S. P. Hungirgekar	Shivaji University, Kolhapur	Member
13	Dr. Siddhnath V. Bhosale	Principal Scientist, CSIR–IICT, Hyderabad	Expert Member
14	Dr. P. Bhaskar Reddy	Associate Vice President, R & D Biophore Pharmaceuticals Pvt. Ltd., Hyderabad	Industry Expert
15	Mr. R. T. Sonkamble	Maharashtra Mahavidyalaya, Nilanga	Member

ABBREVIATIONS USED

Abbreviation	Full Form
POs	Program Outcomes
PS	Program Structure
PSOs	Program Specific Outcomes
COs	Course Outcomes
TLP	Teaching-Learning Process
AM	Assessment Method
DSC	Discipline Specific Core
DSE	Discipline Specific Elective
GE	Generic Elective
OE	Open Elective
VSC	Vocational Skill Course
SEC	Skill Enhancement Course
IKS	Indian Knowledge System
AEC	Ability Enhancement Course
VEC	Value Education Course
OJT	On Job Training (Internship)
FP	Field Project
CC	Co-curricular Courses
RM	Research Methodology
RP	Research Project
MJ	Major Course
MN	Minor Course

INTRODUCTION TO UNDERGRADUATE DEGREE IN CHEMISTRY

As per the guidelines of the **University Grants Commission (UGC)** and the framework adopted by **Swami Ramanand Teerth Marathwada University, Nanded**, the **Undergraduate (UG) Programme in Chemistry** is structured under the **National Education Policy (NEP)** with a flexible **Four-Year (Eight Semesters)** framework, with an option to exit after **Three Years (Six Semesters)**.

The **Teaching–Learning Process (TLP)** is designed to be **student-centric, outcome-based, and skill-oriented**, integrating theory, practical, vocational, and experiential learning components. The curriculum ensures a **strong foundation in core Chemistry subjects** along with opportunities for advanced learning and interdisciplinary exposure.

The programme includes a combination of the following course types:

- **Major (DSC/MJ – Discipline Specific Core / Major Courses)**
- **Minor (MN/DSE – Discipline Specific Electives)**
- **Vocational Skill Courses (VSC)**
- **Skill Enhancement Courses (SEC)**
- **Indian Knowledge System (IKS)**
- **Open/Generic Electives (OE/GE)**
- **Ability and Value Enhancement Courses (AEC/VEC)**
- **Field Projects, Internships (OJT), and Community Engagement Projects (CEP)**

This structure promotes a multidisciplinary and interdisciplinary approach, allowing students to explore diverse academic areas alongside their core discipline. The programme offers flexibility in course selection, credit accumulation, and academic progression, enabling students to design their learning pathway based on their interests, aptitude, and career aspirations.

Furthermore, the provision of multiple entry and exit options ensures that students can obtain Certificate, Diploma, Degree, or Honours Degree at different stages, thereby enhancing employability and supporting higher education opportunities.

Overall, the UG Programme in Chemistry under SRTMU aims to develop scientific knowledge, practical skills, critical thinking, research aptitude, and professional competence, preparing students for higher studies, research, and diverse career opportunities in industry, academia, and allied fields.

PROGRAM DURATION AND EXIT OPTIONS

The duration of the **Undergraduate (UG) Programme in Chemistry** at **Swami Ramanand Teerth Marathwada University, Nanded** shall be **four years (Eight Semesters)** under the NEP framework. Students shall have **multiple entry and exit options** as per NEP guidelines:

- Students completing only three years (Six Semesters) will be awarded a Bachelor of Science (B.Sc.) Degree in Chemistry.
- Students exiting after the first year (Two Semesters) will be awarded an Undergraduate Certificate in Chemistry, provided they have earned the prescribed credits.
- Students exiting after the second year (Four Semesters) will be awarded an Undergraduate Diploma in Chemistry, subject to fulfilment of required credits.
- Students completing the four-year programme (Eight Semesters) will be awarded a Bachelor of Science in Chemistry (Honours / Honours with Research) as per university regulations.

Students who exit the programme at any stage (Certificate/Diploma) shall be eligible for re-entry within a maximum period of three years, subject to university rules and availability of seats.

The credit framework is designed to ensure flexibility in academic progression:

- Minimum credits per semester: 18
- Maximum credits per semester: 26
- Recommended credits per semester: 22

Table 1: Awards and Required Credits

Sr. No.	NCrF / NHEQF Level	Type of Award	Stage of Exit/ Programme Duration	Credits Required
1	Level 4.5	Undergraduate Certificate in Chemistry	After successful completion of First Year (Semester I & II)	**44**
2	Level 5.0	Undergraduate Diploma in Chemistry	After successful completion of Second Year (Semester III & IV)	**88**
3	Level 5.5	Bachelor of Science (B.Sc.) in Chemistry	After successful completion of Third Year (Semester V & VI)	**132**
4	Level 6.0	Bachelor of Science in Chemistry (Honours / Honours with Research)	After successful completion of Fourth Year (Semester VII & VIII)	**176**

OBJECTIVES OF THE PROGRAM

- To strengthen students' understanding of fundamental and advanced concepts in Physical, Organic, and Inorganic Chemistry.
- To develop the ability to apply chemical principles to solve theoretical and practical problems in chemistry.
- To enhance laboratory skills and experimental techniques required for qualitative and quantitative analysis.
- To promote critical thinking, analytical ability, and scientific reasoning among students.
- To familiarize students with the applications of chemistry in industry, environment, health, and daily life.
- To develop awareness about green chemistry, safety practices, and environmental sustainability.
- To encourage research orientation, innovation, and higher learning in the chemical sciences.

PROGRAM OUTCOMES

After successful completion of the B.Sc. Chemistry programme, students will be able to:

PO1: Disciplinary Knowledge

Demonstrate comprehensive knowledge of fundamental and advanced concepts in **Physical, Organic, and Inorganic Chemistry**, including theoretical and practical aspects.

PO2: Problem Analysis

Apply chemical principles, mathematical tools, and scientific reasoning to identify, formulate, and solve complex theoretical and experimental problems.

PO3: Critical Thinking

Develop critical thinking and analytical skills to evaluate scientific data, interpret results, and draw logical conclusions.

PO4: Experimental Skills & Laboratory Competence

Perform qualitative and quantitative chemical analysis using standard laboratory techniques, instruments, and modern tools with accuracy and precision.

PO5: Modern Tool Usage

Utilize contemporary chemical software, instrumentation, and ICT tools for data analysis, simulation, and research applications.

PO6: Environment and Sustainability

Understand the role of chemistry in environmental protection and sustainable development, including principles of **green chemistry** and pollution control.

PO7: Ethics and Safety

Follow ethical practices, laboratory safety protocols, and professional responsibilities in academic and industrial settings.

PO8: Communication Skills

Communicate scientific information effectively through oral presentations, laboratory reports, and technical writing.

PO9: Lifelong Learning

Recognize the need for continuous learning and professional development in the field of chemical sciences and related disciplines.

PO10: Research and Innovation

Develop research aptitude, creativity, and innovation skills for pursuing higher studies, research, and entrepreneurship.

PO11: Teamwork and Leadership

Work effectively as an individual and as a member or leader in multidisciplinary teams.

PO12: Application in Society and Industry

Apply chemical knowledge in solving real-life problems related to **industry, health, agriculture, and environment**.

PROGRAM SPECIFIC OUTCOMES

After completion of the programme, students will be able to:

PSO1: Core Chemistry Competence

Acquire in-depth knowledge of core areas such as:

- Thermodynamics, kinetics, and quantum chemistry
- Organic reaction mechanisms and synthesis
- Coordination chemistry, spectroscopy, and materials chemistry

PSO2: Laboratory Proficiency

Develop hands-on skills in:

- Volumetric, gravimetric, and instrumental analysis
- Organic synthesis and purification techniques
- Handling modern instruments like pH meter, conductometer, spectrophotometer, etc.

PSO3: Application of Chemical Knowledge

Apply chemical concepts in:

- Industrial processes (fertilizers, polymers, pharmaceuticals)
- Environmental monitoring and pollution control
- Health, food chemistry, and daily life applications

PSO4: Green Chemistry and Sustainability

Implement principles of green chemistry, waste minimization, and eco-friendly practices in laboratory and industrial contexts.

PSO5: Research Orientation

Design and conduct basic research experiments, analyze data, and present findings scientifically.

PSO6: Interdisciplinary Understanding

Integrate chemistry with related fields such as **biology, physics, environmental science, and material science**.

PSO7: Employability and Skill Development

Develop skills relevant to:

- Chemical industries
- Quality control laboratories
- Teaching and academic research
- Competitive examinations and higher education

GENERAL GUIDELINES FOR THE SELECTION OF SUBJECTS

1. A student has to choose three subjects from the same faculty in the first year. At the start of the second year, he/she has to opt for one subject as the Major subject and one (from the remaining two subjects) as the Minor subject; the last one will be dropped by the student.
2. A student cannot select a subject as Major or Minor other than the subjects taken in the first year.
3. OE (Open Elective) is to be chosen compulsorily from a faculty other than that of the Major.
4. SEC is to be selected from the basket of Skill Courses approved by the university.
5. VSC, FP/OJT/CEP should be related to the Major subject.
6. AEC, VEC, IKS (Generic), and CC will be provided by the university separately.

TEACHING-LEARNING PROCESS

a. Courses will be taught through the traditional chalk-and-talk method, laboratory work, ICT-enabled teaching–learning tools, project work, seminars, case studies, field work, internships, hands-on training, etc.

b. Students will be engaged in various student-centric activities including experiential learning, problem-solving methodologies, participative learning, and ICT-based teaching–learning processes.

c. ICT tools in Basic and Advanced Chemistry software will be used to make the teaching–learning process efficient and engaging.

d. Critical, analytical, and problem-solving abilities will be developed through project-based learning, internships, industrial visits, and hands-on training.

e. Problem-solving methodologies such as quizzes, review of books and research papers, workshops, and research-based competitions will be employed.

f. Vocational and skill training will be conducted through vocational and skill-based courses.

g. Students will be introduced to advanced laboratory instruments for hands-on training.

METHODS OF ASSESSMENT

The primary objective of assessment is to evaluate the attainment of learning outcomes of the course in alignment with the broader goals of strengthening core theoretical knowledge, developing practical laboratory skills, and promoting research aptitude among students.

The assessment system shall be based on **Continuous Internal Evaluation (CIE)** and **End Semester University Examination (ESE)** as per the norms of **Swami Ramanand Teerth Marathwada University, Nanded**.

Continuous Internal Evaluation (CIE)

During the semester, students' performance and mastery of the prescribed learning outcomes will be evaluated through various academic activities such as:

- Short answer tests
- Class tests
- Seminars and presentations
- Group discussions
- Quizzes and MCQs
- Assignments and tutorials
- Project work

Each theory and practical course shall carry **10 marks for internal assessment (for each-credit course)**. The internal assessment will be conducted by the respective colleges as per university guidelines.

End Semester Examination (ESE)

The End Semester Examination will be conducted by **Swami Ramanand Teerth Marathwada University, Nanded** for both theory and practical courses. Each credit course shall carry **15 marks for the End Semester Examination (ESE)**.

Scheme of Examination

- Total marks for 2-credit course: 50 (20 Internal + 30 ESE)
- Total marks for 4-credit course: 100 (40 Internal + 60 ESE)
- Internal examinations will be conducted by the respective colleges.
- External examinations will be conducted by SRTMU, Nanded at the end of each semester.

Marks distribution under CA (40%)

Sr. No.	Continuous Assessment Modes	For 4 Credit (Marks)	For 2 Credit (Marks)	For 3 Credit (Marks)
1	Class Test	20	10	15
2	Assignment, Presentation, Viva, Quiz, Open Book, etc.	12	06	09
3	Attendance	08	04	06
	Total	**40**	**20**	**30**

Swami Ramanand Teerth Marathwada University, Nanded

Faculty of Science & Technology

STRUCTURE OF B.Sc. First Year — Semester I & II (Level 4.5)

STRUCTURE

Credit Framework for Four Year Multidisciplinary Degree Program with Multiple Entry and Multiple Exit

Year & Level	Semester	Optional 1 (Major) *(From the same Faculty)*	Optional 2 (Minor) *(From the same Faculty)*	Optional 3 (Minor) *(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)*	Field Work / Project/Internship/ OJT/Apprenticeship/ Case Study Or Co-curricular Courses (CCC) *(Basket 6 for CCC) (Common cross all faculties)*	Credits
1	2	3	4	5	6	7	8	9	10
I (4.5)	I	SXXXCT 1101 (T 2 Cr) SXXXCP 1101 (P 2 Cr) 4 Credits	SXXXCT 1101 (T 2 Cr) SXXXCP 1101 (P 2 Cr) 4 Credits	SXXXCT 1101 (T 2 Cr), SXXXCP 1101 (P 2 Cr) 4 Credits	GE1101 2 Credits	SEC 1101 2 Credits	AEC ENG1 (2Cr) IKS (2Cr) 4 Credits	CCC (2Cr) (NCC/NSS/SPT/CLS/ HWS/YGE/FIT) 2 Credits	22
	II	SXXXCT 1151 (T 2 Cr) SXXXCP 1151 (P 2 Cr) 4 Credits	SXXXCT 1151 (T 2 Cr) SXXXCP 1151 (P 2 Cr) 4 Credits	SXXXCT 1151 (T 2 Cr), SXXXCP 1151 (P 2 Cr) 4 Credits	GE1151 2 Credits	SEC 1151 2 Credits	ACE MIL1 (2Cr) CI (2Cr) 4 Credits	CCC (2Cr) (NCC/NSS/SPT/CLS/ HWS/YGE/FIT) 2 Credits	22
	Cum. Cr.	08	08	08	04	04	08	04	44

Exit option: UG Certificate in Opt1, Opt2 and Opt3 on completion of 44 credits and additional 4 from NSQF/Internship

B.Sc. First Year — Semester I & II

Teaching & Examination Scheme

Sem.	Paper	Paper Number	Name of the Course	Instruction Hrs. /Week	Total period	Internal CA	ESE	Total Marks	Credits
I	Optional-I	SCHECT 1101	Organic + Inorganic Chemistry (Theory)	02	30	20	30	50	2
		SCHECP 1101	Organic + Inorganic Chemistry (Practical)	04	60	20	30	50	2
	Generic Electives (other than Faculty)	SCHEGE 1101	Everyday Chemistry	02	30	20	30	50	2
	Skill Course (Basket - 3)	SCHESEC 1101 OR SCHESEC 1102	Fundamentals of Chemistry Laboratory OR Water Pollution	02	60	20	30	50	2
II	Optional-I	SCHECT 1151	Physical +Inorganic Chemistry (Theory)	02	30	20	30	50	2
		SCHECP 1151	Physical +Inorganic Chemistry (Practical)	04	60	20	30	50	2
	Generic Electives (other than Faculty)	SCHEGE 1151	Soil and Fertilizer Chemistry	02	30	20	30	50	2
	Skill Course (Basket - 3)	SCHESEC 1151 OR SCHESEC 1152	Common Laboratory Techniques OR Soil Pollution	02	60	20	30	50	2

Swami Ramanand Teerth Marathwada University, Nanded

Faculty of Science & Technology

Name of the Program	B.Sc. (Chemistry), First Year
Title of the Paper/Course	Organic & Inorganic Chemistry
Course Code	SCHECT 1101
Semester	I
Paper Type	Core Major
Credits	02 (Theory)
Total Hours	30
Formative Assessment Marks	20
Summative Assessment Marks	30
Total Marks	50

Course Objectives

1. To develop understanding of fundamental concepts in Organic, Inorganic and Physical Chemistry.
2. To enhance analytical, experimental and problem-solving abilities among students.
3. To familiarize students with laboratory techniques, safety procedures and scientific methods.
4. To promote application-oriented, skill-based and research-oriented learning in Chemistry.

Course Outcomes (COs)

After completing this course, students will be able to:

CO No.	Upon completion of this course, students will be able to:	Bloom's Level	PO Mapped
CO1	Explain basic concepts of organic reactions, reaction intermediates and electronic effects.	Remember / Understand	PO1, PO2
CO2	Interpret aromaticity, electrophilic substitution reactions and orientation effects in aromatic compounds.	Understand / Analyze	PO2, PO3
CO3	Describe preparation, properties and reactions of alcohols, epoxides and phenols.	Apply / Analyze	PO3, PO4
CO4	Explain periodic properties such as ionization energy, electron affinity and electronegativity.	Apply / Evaluate	PO4, PO5

Detailed Syllabus

Unit No.	Unit Title	Topics	Hours
I	An Introduction to Organic Reactions	1.1 Basic terms: Substrate and Reagents, types of reagents (Electrophilic and Nucleophilic).Notation ofarrows: curved arrow, half headed arrow, double headed arrow, straight arrow. 1.2 Electronic displacement effects :- Inductive Effect , Resonance Effect And Hyperconjugation andtheir Applications in A) Acidic Strength B) Basic Strength 1.3 Bond fission: Homolytic and heterolytic fission. 1.4 Types of reactions and Reaction intermediates: Carbocation, Carbanion, Free radical, carbene, (Introduction, structure & Stability), nitrene&benzyne (only introduction).	07
II	Aromatic Hydrocarbons and Aromaticity	2.1 Introduction, Nomenclature, kekule and resonance structure of benzene, stability, Orbital picture ofbenzene. 2.2 Aromaticity, antiaromaticity and homoaromaticity by Huckel's Rule for homocyclic andhetrocyclic compounds. 2.3 Electrophilic Substitution reaction of benzene (with mechanism): Nitration, Halogenation, FriedelCraft alkylation and acylation. 2.4 Orientation effect: Effect of activating and deactivating groups (-OH, NO_2, CH_3, Cl) on aromaticelectrophilic (Nitration) substitution reaction (with mechanism).	05
III	Alcohols, Epoxides and Phenols	3.1 Alcohols: Introduction, Nomenclature and Classification. 3.2 Dihydric alcohol (ethylene glycol): Preparation methods: i) Hydroxylation of alkene ii) 1,2-dihaloalkane. Chemical reactions: 1) $Pb(OAc)_4$, 2) $P_2O_5/ZnCl_2$. 3.3 Trihydric alcohol (Glycerol): Preparation methods from: 1) Oils and fats 2) Propene. Chemical reactions: action of 1) Nitric acid, 2) Acetylchloride on tryhydric alcohol. 3.4 Epoxides: Introduction and nomenclature. Preparation methods: a) Oxidation of ethene in presenceof Ag catalyst, b) Epoxidation of ethene with peracetic acid. 3.5 Chemical reactions: a) Ring opening reactions of propylene oxide. a) Hydrolysis in acidic and basic medium. b) Action of Grignard reagent. 3.6 Phenols: Introduction, classification and acidic	08

		character of phenol (compare with ethanol).Chemical reactions with mechanism: Reimer-Tiemann reaction, Acetylation, Fries rearrangement, Kolbe's carboxylation reaction.	
IV	Periodic Table and Periodicity	4.1 Brief introduction to development of periodic table. Modern periodic law, long form of the periodic table, Sketch, Cause of periodicity. Division and general characteristics of s, p, d and f block elements. 4.2 Atomic and Ionic size: Definition and explanation of atomic radius, ionic radius, covalent radius, Vander Waals radius. Variation of atomic size along a period and in a group. 4.3 Ionization Energy (Ionization enthalpy): Definition and Explanation, Successive ionization energy, Factors affecting ionization energy. Variation of ionization energy along a period and in a group. Applications of ionization energy to chemical behavior of an element. 4.4 Electron Affinity (Electron gain enthalpy): Definition and Explanation, Successive electron affinity, Factors affecting electron affinity. Variation of electron affinity along a period and in agroup. Applications of electron affinity to chemical behavior of an element. 4.5 Electronegativity: Definition and Explanation, Factors affecting electronegativity. Variation of electronegativity along a period and in a group. Pauling's approach of electronegativity. Calculations of electronegativity by Pauling's method (Numerical), Mulliken's approach. Applications of electronegativity to bond properties such as percent ionic character, bond length, bond angle.	10

Total Hours: 30

Recommended Textbooks

1. A New Pattern Text Book of Organic Chemistry for Competition: O.P.Tandon and A.K.Virmani(G.R.Bathla& Sons Publication) 2009 Edition
2. Chemistry for Degree Students: R.L.Madan (S.Chand Publication) 2010 Edition
3. A Textbook of Organic Chemistry: ArunBahl and B.S. Bahl (S.Chand Publication) 2011 RevisedColour Edition.
4. Organic chemistry: S M Mukherji and S P Singh, (New Age International Publication) vol. I, Secondedition, 2010.
5. Principles of Organic Chemistry by R.O.C. Norman and J.M. Coxon.
6. Organic Chemistry by Robert Thornton Morrison and Robert Neilson Boyd
7. A Guide book to mechanism on Organic Chemistry: Peter Sykes.

8. Text Book of organic Chemistry: P. L. Soni.
9. Organic Chemistry : T. W. Graham Solomons, Sixth edition.
10. Modern Organic Chemistry: M. K. Jain and S. C. Sharma.
11. Principles of inorganic chemistry by Puri, Sharma and Kalia, Milestone Publishers and Distribution.
12. Inorganic Chemistry by Shriver and Atkins' Oxford University press 5th edition.
13. Advanced inorganic chemistry by Gurudeep Raj and ChatwalAnand.
14. Concise Inorganic Chemistry by J. D. Lee.
15. Basic Inorganic Chemistry by F. A. Cotton, G. Wilkinson and P. L. Gaus.
16. Inorganic Chemistry by A. G. Sharp.
17. Inorganic Chemistry by G. L. Miessler and D. A. Tarr.
18. Chemistry for degree students by Dr. R.L. Madan, (S. Chand)

E-Resources / MOOCs

1. SWAYAM / NPTEL – Organic Chemistry
2. SWAYAM – Inorganic Chemistry and Periodicity
3. e-PG Pathshala Resources in Chemistry

Swami Ramanand Teerth Marathwada University, Nanded

Faculty of Science & Technology

Name of the Program	B.Sc. (Chemistry), First Year
Title of the Paper/Course	Organic & Inorganic Chemistry Practicals
Course Code	SCHECP1101
Semester	I
Paper Type	Core Major Practical
Credits	02 (Practical)
Total Hours	60
Formative Assessment Marks	20
Summative Assessment Marks	30
Total Marks	50

Course Objectives

1. To develop understanding of fundamental concepts in Organic, Inorganic and Physical Chemistry.
2. To enhance analytical, experimental and problem-solving abilities among students.
3. To familiarize students with laboratory techniques, safety procedures and scientific methods.

5. To promote application-oriented, skill-based and research-oriented learning in Chemistry.

Course Outcomes (COs)

CO No.	Upon completion of this course, students will be able to:	Bloom's Level	PO Mapped
CO1	Perform synthesis and purification of organic compounds.	Apply	PO3, PO4
CO2	Determine physical constants of liquids and solids.	Apply / Analyze	PO4, PO5
CO3	Identify acidic and basic radicals using semi-micro qualitative analysis.	Analyze	PO2, PO3
CO4	Demonstrate safe laboratory practices and proper handling of chemicals.	Apply	PO6, PO7

Detailed Syllabus

1. Preparations (Any Four)

1. Phthalimide from phthalic anhydride and urea
2. Acetanilide from aniline
3. Iodoform from acetone
4. Phenyl azo β-naphthol from aniline
5. m-Dinitrobenzene from nitrobenzene
6. Phthalic anhydride from phthalic acid

(Recrystallization and melting point determination compulsory)

2. Determination of Physical Constants (Any Two)

1. Aniline
2. Ethanol
3. Toluene
4. Benzene
5. Ortho and meta toluidine
6. Chlorobenzene
7. Nitrobenzene

3. Demonstration on Purification Techniques (Any Two)

1. Recrystallizationof Phthalic acid/Benzoic acid from hot water.
2. Distillationof Ethyl alcohol
3. Sublimationof Napthalene.

4. Semi-Micro Qualitative Analysis

Identification of Two acidic and Two basic radicals by Semi-micro qualitative analysis

technique.(Including interfering radicals). (Any Seven)

Spot- tests (of each radical) are compulsory.

Recommended Textbooks

1. A.I. Vogel, *Vogel's Qualitative Inorganic Analysis*, Prentice Hall.
2. V.K. Ahluwalia and R. Aggarwal, *Comprehensive Practical Organic Chemistry*, Universities Press.
3. R.K. Bansal, *Lab Manual of Organic Chemistry*, New Age Publication.
4. B.D. Khosla, *Senior Practical Physical Chemistry*, R. Chand & Co.

E-Resources / MOOCs

1. NPTEL Chemistry Laboratory Courses
2. SWAYAM Practical Organic Chemistry

Swami Ramanand Teerth Marathwada University, Nanded

Faculty of Science & Technology

Name of the Program	B.Sc. (Chemistry), First Year
Title of the Paper/Course	Everyday Chemistry
Course Code	SCHEGE 1101
Semester	I
Paper Type	Generic Elective
Credits	02
Total Hours	30
Formative Assessment Marks	20
Summative Assessment Marks	30
Total Marks	50

Course Objectives

1. To develop understanding of fundamental concepts in Organic, Inorganic and Physical Chemistry.
2. To enhance analytical, experimental and problem-solving abilities among students.
3. To familiarize students with laboratory techniques, safety procedures and scientific methods.
4. To promote application-oriented, skill-based and research-oriented learning in Chemistry.

Course Outcomes (COs)

CO No.	Upon completion of this course, students will be able to:	Bloom's Level	PO Mapped
CO1	Explain chemistry involved in day-to-day products and materials.	Understand	PO1, PO2
CO2	Describe the chemistry of soaps, detergents, cosmetics and food additives.	Understand / Analyze	PO2, PO3
CO3	Explain environmental hazards of plastics and processed food.	Analyze / Evaluate	PO4, PO5
CO4	Describe medicinal importance and chemistry of common drugs.	Apply	PO5, PO6

Detailed Syllabus

Module No.	Title	Topics	Hours
I	**Soaps, Detergents and Cosmetics**	**Soaps:** Introduction, fats and oils used in soaps, types of soaps, liquid soaps, synthesis of soaps, total fatty matter, cleaning action of soaps. **Detergents:** Introduction, classification, synthesis, additive in detergents, enzymatic detergents, cleaning action of detergents. **Cosmetics:** Introduction, toothpaste, shampoos, hair dyes, creams and lotions, lipstick, perfumes, shaving cream, after shave lotion, deodorants, bath oil, talcum powder. Toxicity of cosmetics..	10
II	**Food Additives and Flavouring Agents**	Introduction, food colours, flavouring agents, emulsifying agents, preservative, leavening agents, taste nhancers, antioxidants. Government regulations. Soft drinks, its ingredients and health effects. Food adulteration, food laws and standards. Prevention of food adulteration (PFA) Act 1954 Essentials commodities act 1955 Food and safety and standards act 2006	10
III	**Chemistry of Plastics**	Introduction, Plastic in everyday life, plastic and polymers, classification of polymers, polymerization reaction Application of plastics: Polyethylene, low density polyethylene, high density polyethylene, polypropylene, polyvinyl chloride, polyethylene terephthalate and acrylonitrile-butadiene-styrene. Environmental hazards and recycling of plastics.	05
IV	**Drug Chemistry**	Introduction Classification of drugs. Analgesics, antipyretics, antihistamines, antacids, tranquilizers, sedatives, antibiotics, antifertility drugs.(Name, structure, simple one preparation and uses are expected)	05

Total Hours: 30

Recommended Textbooks

1. Advanced chemistry by Philip Matthews Cambridge low price editions.
2.Organic chemistry by Maitland Jones Jr.,Steven A.Fleming fourth edition,Intrnational student edition .
3.Principles of inorganic chemistry Puri Sharma Kalia, Milestone publishers and distributors,
4.Principles of environmental chemistry second edition,JamesE.Girad by Jones and Bartlett studentedition.

5.Chemistry in everyday life by G,D, Gem Matjew, Vishal publishing co.
6. Foye's Principles of medicinal chemistry by Thomas L.Lemke, David A.Williams,VictoriaF.Rochoand S.WilliamZito, International edition.
7.Every day chemistry by Julia Sooy ,illustrated by Bonnie Pang.

E-Resources / MOOCs

1. SWAYAM – Chemistry in Everyday Life
2. NPTEL – Polymer Chemistry

Swami Ramanand Teerth Marathwada University, Nanded

Faculty of Science & Technology

Name of the Program	B.Sc. (Chemistry), First Year
Title of the Paper/Course	Fundamentals of Chemistry Laboratory
Course Code	SCHESEC1101
Semester	I
Paper Type	Skill Enhancement Course (SEC)
Credits	02
Total Hours	60
Formative Assessment Marks	20
Summative Assessment Marks	30
Total Marks	50

Course Objectives

1. To familiarize students with laboratory safety rules, hazard symbols and safe handling of chemicals and apparatus.
2. To develop practical skills in handling, cleaning, calibration and maintenance of common laboratory apparatus and glassware.
3. To train students in accurate weighing, preparation of standard solutions, indicators and buffer solutions using analytical methods.
4. To develop basic laboratory techniques such as filtration, crystallization, determination of pH, boiling point and melting point of compounds.
5. To enhance observational, analytical and scientific skills required for laboratory work and experimental chemistry.
6. To promote scientific attitude, precision, discipline and good laboratory practices among students.

Course Outcomes (COs)

CO No.	Course Outcomes	Bloom's Level	PO Mapped
CO1	Demonstrate laboratory safety practices and identify hazard symbols, laboratory apparatus and their uses correctly.	Remember / Apply	PO1, PO6
CO2	Perform cleaning, calibration and handling of laboratory glassware and analytical instruments accurately.	Apply / Analyze	PO2, PO3

CO3	Prepare standard solutions, indicators and buffer solutions using appropriate calculations and laboratory techniques.	Apply	PO3, PO4
CO4	Determine pH, boiling point and melting point of compounds and perform basic laboratory operations such as filtration and crystallization.	Apply / Analyze	PO4, PO5
CO5	Develop scientific observation, accuracy, analytical thinking and proper laboratory reporting skills.	Analyze / Create	PO5, PO7

Detailed Syllabus

Module No.	Unit Title	Topics
I	**Introduction of Chemistry Laboratory**	General introduction of chemistry laboratory, common instruction for safe working in chemical laboratories, Safety provisions, Organization of practical work, Cleaning of laboratories and preparation room.
II	**Introduction of Laboratory Apparatus**	*Glass apparatus* - Beaker, Test tube, boiling tube, funnel, separating funnel, filtration flask, round bottom flask, flat bottom flask, condenser, watch glass, condenser, petridish, desiccator, etc. *Volumetric Apparatus* - Measuring cylinder, burette, pipette, Volumetric flask, analytical balance, singlepan electronic balance/ electrical analytical balance etc. *Miscellaneous apparatus*- Buchner funnel, burette stand, retort clamp, china dish, wire gauze, cork borers, filter pumps, crucible, pipe clay triangle, pestle and mortar, sprit lamp, spatulas, thermometer, pH paper etc**.** *and* laboratory centrifuge**.** *Apparatus for heating*: Bunsen burner, water bath, oil bath, hot plate, sand bath, hot air oven, heating mantle etc**.** *Handling and storage of glass apparatus Kipp's apparatus*
III	**Solution Preparation**	Water as a solvent, types of solutions, components of a solution, solubility, concentration of solutions: percentage, molarity, normality, molality (in ppm) calculation of masses and volumes for preparation of solutions solids, liquids.
IV	**Practical Work**	1. Study of common laboratory safety rules and identification of hazard symbols. 2. Identification and handling of common laboratory apparatus such as beaker, test tube, burette, pipette, volumetric flask, condenser, crucible, desiccator, etc. 3. Cleaning, drying and proper storage of laboratory glassware.

		4. Demonstration and use of analytical balance for accurate weighing of chemicals. 5. Cork boring experiment and fitting of glass tubing in corks. 6. Calibration of measuring cylinder, pipette and burette. 7. Preparation of standard sodium chloride solution of known concentration. 8. Preparation of standard oxalic acid solution using analytical balance. 9. Preparation of molar, normal and percentage solutions. 10. Preparation of dilute solutions from concentrated stock solutions. 11. Preparation and use of common laboratory indicators such as phenolphthalein and methyl orange. 12. Preparation of acidic and basic buffer solutions and determination of their pH using pH paper/pH meter. 13. Determination of pH of different given solutions using universal indicator and pH paper. 14. Preparation, filtration and crystallization of a simple inorganic salt. 15. Determination of boiling point and melting point of simple organic compounds.

Total Hours: 60

Recommended Textbooks

1. Vogels Qualitative Inorganic Analysis, A. I. Vogel, *Prentice Hall,*.
2. Vogels textbook of chemical quantitative analysis**,** *Longman Scientific*
3. The golden book of chemistry experiments, R. Brent, *Golden press, NY*
4. Comprehensive Practical Organic Chemistry, V. K. Ahluwalia, & R. Aggarwal,
Universities Press.
5. Lab Manual of Organic Chemistry, R. K. Bansal, *New Age Pub*.
6. Senior Practical Physical Chemistry, B. D. Khosla, R. *Chand & Co*
7. Chemistry Practical, O. P. Pandey, D.N. Bajpai, S. Giri, *S. Chand*
8. Advanced practical chemistry, J .Singh etal.*PragatiPrakashan*
9. Computer fundamental ,B Ram, *New Age Pub.*

Swami Ramanand Teerth Marathwada University, Nanded

Faculty of Science & Technology

Name of the Program	B.Sc. (Chemistry), First Year
Title of the Paper/Course	Water Pollution
Course Code	SCHESEC1102
Semester	I
Paper Type	Skill Enhancement Course (SEC)
Credits	02
Total Hours	60
Formative Assessment Marks	20
Summative Assessment Marks	30
Total Marks	50

Course Objectives

1. To provide practical knowledge of physical and chemical parameters used in water quality analysis.
2. To develop skills in sampling, testing and analysis of potable water, river water and wastewater samples.
3. To train students in the use of analytical instruments and standard laboratory methods for water pollution analysis.
4. To create awareness regarding the impact of water pollution on human health and environment through experimental studies.
5. To develop analytical, interpretative and reporting skills related to water quality assessment and environmental monitoring.
6. To familiarize students with standard methods for determination of DO, BOD, COD, hardness, chloride, sulphate and other water quality parameters.

Course Outcomes (COs)

CO No.	Course Outcomes	Bloom's Level	PO Mapped
CO1	Measure and analyze physical parameters of water such as temperature, pH, electrical conductance, TDS and TSS using standard laboratory techniques.	Apply / Analyze	PO2, PO3
CO2	Determine chemical parameters including DO, BOD, COD, hardness, chloride and sulphate in water samples accurately.	Apply	PO3, PO4
CO3	Interpret analytical data and compare the quality of potable water, river water and industrial wastewater samples.	Analyze / Evaluate	PO4, PO5
CO4	Demonstrate proper handling of instruments, reagents and analytical procedures used in environmental chemistry laboratories.	Apply	PO5, PO6
CO5	Prepare scientific laboratory reports and assess water	Analyze /	PO6, PO7

	quality based on experimental observations and standard pollution parameters.	Create	

Detailed Syllabus

Unit No.	Title	Topics
I	**Pollution**	Introduction, Definition, Sources & effect of water pollution. Control measures of water pollutions.
III	**(Practicals)**	1. Determination of temperature of different water samples. 2. Determination of pH of water samples using pH meter/pH paper. 3. Determination of electrical conductance of water samples using conductivity meter. 4. Determination of total dissolved solids (TDS) in water samples. 5. Determination of total suspended solids (TSS) in wastewater samples. 6. Determination of dissolved oxygen (DO) in water by Winkler's method. 7. Determination of biochemical oxygen demand (BOD) of wastewater. 8. Determination of chemical oxygen demand (COD) of sewage/wastewater samples. 9. Determination of total hardness of water by EDTA titration method. 10. Determination of calcium hardness of water sample. 11. Determination of chloride ions in water by argentometric method. 12. Determination of sulphate ions in water by turbidimetric method. 13. Determination of oil and grease content in polluted water samples. 14. Comparative analysis of potable water, river water and industrial wastewater samples for physicochemical parameters. 15. Preparation of laboratory report on water quality assessment based on analyzed parameters.

Total Hours: 60

Recommended Textbooks

1. A.K. De, *Environmental Pollution*, New Age International Publishers.
2. R.K. Khitoliya, *Environmental Pollution Management*, S. Chand Publication.
3. AradhanaSalpekar, *Water Pollution*, Himalaya Publishing House.
4. M. Jindal, *Introduction to Waste Water Treatment Process*, CBS Publishers.
5. B.K. Sharma, *Environmental Chemistry*, Goel Publishing House.
6. Ajay Kumar Bhagi, *Environmental Chemistry*, Krishna Prakashan Media.
7. S.K. Banerji, *Environmental Chemistry*, Prentice Hall of India.
8. V.P. Kudesia, *Water Pollution*, PragatiPrakashan.

E-Resources / MOOCs

1. SWAYAM – Environmental Chemistry
2. NPTEL – Water and Wastewater Treatment
3. e-PG Pathshala – Environmental Pollution

Swami Ramanand Teerth Marathwada University, Nanded

Faculty of Science & Technology

Name of the Program	B.Sc. (Chemistry), First Year
Title of the Paper/Course	Physical & Inorganic Chemistry
Course Code	SCHECT1151
Semester	II
Paper Type	Core Major
Credits	02
Total Hours	30
Formative Assessment Marks	20
Summative Assessment Marks	30
Total Marks	50

Course Objectives

1. To understand atomic structure and gaseous state theories.
2. To develop understanding of adsorption, colloids and redox reactions.
3. To study chemistry and applications of noble gases.
4. To enhance analytical and numerical problem-solving abilities.

Course Outcomes (COs)

CO No.	Upon completion of this course, students will be able to:	Bloom's Level	PO Mapped
CO1	Explain atomic models, quantum numbers and electronic configuration.	Remember / Understand	PO1, PO2
CO2	Apply concepts of gaseous state and critical phenomena in numerical problems.	Apply / Analyze	PO3, PO4
CO3	Explain adsorption, colloidal systems and their applications.	Understand / Analyze	PO3, PO5
CO4	Balance redox reactions and describe chemistry of noble gases.	Apply / Create	PO5, PO6

Detailed Syllabus

Module No.	Title	Topics	Hours
I	**Atomic Structure**	1.1. Introduction, Rutherford's alpha particle scattering experiment, Rutherford's atomic model and its drawbacks. 1.2. Bohr's theory of hydrogen atom: Bohr's atomic model- Postulates, Derivation for radius of an orbit and energy of an electron. Energy difference in terms of wave number and Rydberg constant. Bohr's explanation of hydrogen spectrum. Merits and demerits of Bohr's theory. 1.3. Quantum numbers, Electronic configuration of elements:	06

		Aufbau principle, Pauli's Exclusion principle, Hund's rule of maximum multiplicity. Numericals on radius and energy.	
II	**Gaseous State**	2.1 Kinetic theory of gases: Postulates of kinetic molecular theory of gases. Ideal and non-ideal gases. 2.2 Deviation of gases from Ideal behavior and Compressibility factor (Z), Boyle's Temperature (Tb) Inversion Temperature (Ti). Derivation of Vander-Waals equation, Units for Vander-Waals constants. 2.3 Critical phenomenon: Definitions of critical constants. Relation between critical constants (Tc, Vc, Pc) and Vander-Waals constants (a, b). Units of critical constants. 2.4 Molecular velocities-Root mean square, average and most probable velocities, Relation between molecular velocities, Numericals on Root mean square velocity and critical constants.	07
III	**Adsorption and Colloids**	3.1 Introduction, Definition of Adsorbate, Adsorbent, Adsorption, factors affecting adsorption. Difference between adsorption and absorption. Types of adsorption: Physical adsorption and chemical adsorption. 3.2 Introduction, Definition of Dispersed phase (dp) and Dispersion medium (dm) Classification of colloidal systems. 3.3 Sols: Types of sols, Properties of sols- Colour, Optical (Tyndall effect), Kinetic (Brownian movement) and electrical properties (electrophoresis and electro osmosis). 3.4 Coagulation of colloidal solution, Hardy-Schulze rule's. Protective action of sol and Gold Number. 3.5 Emulsions: Types of emulsions, preparation of emulsion, Emulsifier. 3.6 Applications of colloids.	07
IV	**A. Oxidation-Reduction and** **B. Noble Gas Chemistry**	**A. Oxidation and reduction:** 4.1 Definition of oxidation, Reduction, Oxidizing agent and reducing agents according to classical concept, electronic concept, oxidation number concept. 4.2 Rules for assigning oxidation number. 4.3 Balancing of redox reaction by 1) Ion-electron method and 2) Oxidation number method. **B. Noble Gas Chemistry:** 4.4 Introduction and Position in the Periodic table. 4.5 Electronic configuration. 4.6 Compounds of noble gases, under excited condition, through coordination, by physical trapping (Clathrates). 4.7 Fluorides of xenon: Preparation, properties and structure of XeF_2, XeF_4, XeF_6. 4.8 Uses of Noble gases.	10

Total Hours: 30

Recommended Textbooks

1. Puri, Sharma and Kalia, *Principles of Inorganic Chemistry*, Milestone Publishers.
2. Shriver and Atkins, *Inorganic Chemistry*, Oxford University Press, 5th Edition.
3. Gary L. Miessler and Donald Tarr, *Inorganic Chemistry*, Pearson Publication.
4. F. Daniels, *Mathematical Preparation for Physical Chemistry*, McGraw Hill.
5. Maron and Prutton, *Principles of Physical Chemistry*, Oxford and IBH Publication.
6. B.S. Bahl, G.D. Tuli and ArunBahl, *Essentials of Physical Chemistry*, S. Chand Publication.
7. P.W. Atkins, *The Elements of Physical Chemistry*, Oxford University Press.
8. Harish Gurudeep,*Advanced Physical Chemistry*, PragatiPrakashan.

E-Resources / MOOCs

1. SWAYAM – Physical Chemistry
2. NPTEL – Atomic Structure and Chemical Bonding
3. NPTEL – Colloids and Surface Chemistry

Swami Ramanand Teerth Marathwada University, Nanded

Faculty of Science & Technology

Name of the Program	B.Sc. (Chemistry), First Year
Title of the Paper/Course	Physical & Inorganic Chemistry Practicals
Course Code	SCHECP1151
Semester	II
Paper Type	Core Major Practical
Credits	02
Total Hours	60
Formative Assessment Marks	20
Summative Assessment Marks	30
Total Marks	50

Course Objectives

1. To develop practical skills in physical and inorganic chemistry experiments.
2. To train students in quantitative analysis and titrimetric methods.
3. To understand physicochemical properties such as viscosity, surface tension and CST.
4. To develop scientific observation, analytical thinking and laboratory skills.

Course Outcomes (COs)

CO No.	Upon completion of this course, students will be able to:	Bloom's Level	PO Mapped
CO1	Determine physicochemical properties of liquids and solutions.	Apply	PO3, PO4
CO2	Perform volumetric and complexometric estimations accurately.	Apply / Analyze	PO4, PO5
CO3	Study kinetics and thermodynamic properties experimentally.	Analyze / Evaluate	PO4, PO5
CO4	Demonstrate laboratory safety and analytical skills.	Apply / Create	PO5, PO6

Detailed Syllabus

1. Determination of viscosity of liquid by Ostwald's viscometer.
2. Determination of surface tension by stalagmometer method.
3. Equivalent weight of magnesium by hydrogen displacement method.
4. Kinetics of hydrolysis of ester in presence of mineral acid.
5. Kinetics of cooling of hot water.
6. Distribution of benzoic acid between benzene and water.
7. Critical solution temperature (CST) of phenol-water system.
8. Determination of heat of solution.
9. Determination of heat of reaction.
10. Preparation of arsenic sulphide sol.
11. Estimation of sodium carbonate and sodium hydroxide mixture.
12. Estimation of $CaCO_3$ in chalk sample.
13. Estimation of $KMnO_4$ solution.

14. Estimation of ferrous and ferric ions.
15. Determination of nickel using murexide indicator.
16. EDTA estimation of Zn ions.
17. Determination of hardness of water using EDTA.

Total Hours: 60

E-Resources / MOOCs

1. SWAYAM – Physical Chemistry Laboratory
2. NPTEL – Volumetric Analysis and Instrumentation

Swami Ramanand Teerth Marathwada University, Nanded

Faculty of Science & Technology

Name of the Program	B.Sc. (Chemistry), First Year
Title of the Paper/Course	Soil and Fertilizer Chemistry
Course Code	SCHEGE1151
Semester	II
Paper Type	Generic Elective
Credits	02
Total Hours	30
Formative Assessment Marks	20
Summative Assessment Marks	30
Total Marks	50

Course Objectives

1. To understand concepts of soil and fertilizer chemistry.
2. To create awareness regarding soil fertility and pollution.
3. To understand importance of agriculture in economy and sustainability.
4. To study management of soil fertility and environmental issues.

Course Outcomes (COs)

CO No.	Upon completion of this course, students will be able to:	Bloom's Level	PO Mapped
CO1	Explain fundamentals of soil chemistry and classification.	Remember / Understand	PO1, PO2
CO2	Analyze soil acidity, salinity and fertility management.	Apply / Analyze	PO3, PO4
CO3	Describe different fertilizers and their applications.	Understand / Evaluate	PO4, PO5
CO4	Explain sustainable farming and soil pollution control methods.	Apply / Create	PO5, PO6

Detailed Syllabus

Module No.	Title	Topics	Hours
I	**Fundamentals of Soil:**	Introduction, soil classification, chemical composition of soil, composition of Earth's crust, soil minerals: primary, secondary minerals, elemental composition of soils. Essential nutrients: introduction, essential, functions and deficiency symptoms of nutrients, beneficial element's.	05
II	**Soil analysis and management.**	Soil acidity ,sources of hydrogen and hydroxyl ions, nature of acidity, soil reaction correlation, acid forming factors, determination of soil pH, genesis, occurrence and characteristics of acid soils, naturally occurring liming materials, management of acid soils. Soil salinity and	10

		alkalinity, introduction, common sources of salts, origin of salt affected soils, characterization, classification, effect of salts on plant growth, management of soil salinity and alkalinity problem. Analysis of soil: Introduction, extraction techniques, soil analysis.	
III	**Fertilizers at a glance.**	Introduction, manures in ancient India, fertilizers in Indian agriculture, history of fertilizer production. Classification of fertilizers, nitrogenous fertilizers, phosphatic fertilizers, potash fertilizers, secondary nutrients, mixed fertilizers, characteristics of fertilizers.	05
IV	**Soil fertility managements and sustainable farming.**	Introduction, soil fertility constraints, management of soil fertility, optimum fertilizer rates, balanced use of fertilizer nutrients. Efficient use of fertilizer, nutrient needs of cropping systems, integrated nutrient management. Soil pollution and its control.	10

Total Hours: 30

Reference books:

1. Fundamentals of soil science, Indian society of soil science.
2. Soil and fertilizers at a glance by L.L.Somani, P.C.Kanthaliya, agrotech publishing academy Udaipur.
3. Principles of environmental chemistry second edition by James E.Girad Jones and Bartlett student edition.
4. Principles of inorganic chemistry by Puri, Sharma and Kalia, Milestone Publishers and Distributors Delhi.

E-Resources / MOOCs

1. SWAYAM – Soil Science
2. NPTEL – Environmental Chemistry and Agriculture

Swami Ramanand Teerth Marathwada University, Nanded

Faculty of Science & Technology

Name of the Program	B.Sc. (Chemistry), First Year
Title of the Paper/Course	Common Laboratory Techniques
Course Code	SCHESEC1151
Semester	II
Paper Type	Skill Enhancement Course (SEC)
Credits	02
Total Hours	60
Formative Assessment Marks	20
Summative Assessment Marks	30
Total Marks	50

Course Objectives

1. To train students in common laboratory techniques such as refluxing, filtration, recrystallization and distillation used in chemical laboratories.
2. To develop practical skills in purification, separation and preparation of chemical compounds using standard laboratory procedures.
3. To familiarize students with laboratory safety practices related to fire hazards, chemical hazards and gas handling.
4. To provide hands-on experience in handling laboratory apparatus such as Quick-fit assemblies, Büchner funnel, Kipp's apparatus and distillation units.
5. To introduce students to analytical techniques including titration, boiling point determination and preparation of distilled/deionized water.
6. To develop basic computer skills for preparation of laboratory reports, tables, graphs and data presentation using MS Office and internet resources.

Course Outcomes (COs)

After successful completion of this course, students will be able to:

CO No.	Course Outcomes	Bloom's Level	PO Mapped
CO1	Assemble and operate laboratory apparatus for refluxing, filtration, recrystallization and distillation techniques efficiently.	Apply	PO3, PO4
CO2	Perform purification, separation and preparation techniques such as recrystallization, distillation and preparation of inorganic double salts accurately.	Apply / Analyze	PO3, PO5
CO3	Demonstrate safe laboratory practices related to fire safety,	Apply /	PO5, PO6

	handling of hazardous chemicals and gas leakage management.	Analyze	
CO4	Carry out basic analytical experiments including boiling point determination and acid-base titration using standard procedures.	Apply	PO4, PO5
CO5	Utilize computer applications for laboratory data processing, preparation of reports, tables, graphs and scientific documentation.	Apply / Create	PO6, PO7

Detailed Syllabus

Module No.	Title	Topics
I	**Purification and Separation Techniques in Chemistry Laboratory**	1. Refluxing: Apparatus with interchangeable ground glass joints (Quick fit), 2. Filtration: Techniques and filter media, filter paper, simple filtration, 3. Recrystallization: Choice of solvent and precautions with flammable solvents, 4. Distillation: recovery of solvents through partial distillation, distillation under reduced pressure, and 5. Determination of Boiling Point
II	**Chemistry Laboratory Safety**	1. Fire Hazards: Causes of fires, classification of fires, fire prevention protocols and measures, fire alarms, fire escapes, fire Extinguishers and their uses. 2. Chemical Hazards: Classification and handling of hazardous chemicals, storage of chemicals, transfer from large containers 3. Gas Hazards: safer usage of LPG in the laboratory, detection and handling of Gas Leakage, health hazards of gases.
III	**Use of Computer in Laboratory**	Hardware in computer, CPU, I/O devices, data input, data processing, data output, application MS office software and Internet.
IV	**Practical**	1. Assembly and handling of refluxing apparatus using interchangeable ground glass joints (Quick-fit apparatus). 2. Refluxing of a simple organic reaction mixture under controlled heating conditions. 3. Simple filtration using filter paper and glass funnel. 4. Vacuum filtration using Büchner funnel and filtration flask. 5. Selection of suitable solvent for recrystallization of organic compounds. 6. Purification of benzoic acid/phthalic acid by recrystallization method. 7. Recovery of solvent by simple distillation.

		8. Distillation under reduced pressure using vacuum distillation setup. 9. Determination of boiling point of organic liquids by capillary method. 10. Preparation of distilled water and deionized water in laboratory. 11. Preparation of hydrogen sulphide (H_2S) gas using Kipp's apparatus. 12. Preparation of inorganic double salts such as potash alum or Mohr's salt. 13. Simple acid-base titration using standard acid and base solutions. 14. Demonstration and study of laboratory fire extinguishers and fire safety measures. 15. Introduction to computer applications in laboratory work: preparation of experimental reports, tables and graphs using MS Office software and internet resources.

Total Hours: 60

Reference books:

1. Vogels Qualitative Inorganic Analysis, A. I. Vogel, Prentice Hall,.
2. Vogels textbook of chemical quantitative analysis, Longman Scientific
3. The golden book of chemistry experiments, R. Brent, Golden press, NY
4. Comprehensive Practical Organic Chemistry, V. K. Ahluwalia, & R. Aggarwal, Universities Press.
5. Lab Manual of Organic Chemistry, R. K. Bansal, New Age Pub.
6. Senior Practical Physical Chemistry, B. D. Khosla, R. Chand & Co
7. Chemistry Practical, O. P. Pandey, D.N. Bajpai, S. Giri, S. Chand
8. Advanced practical chemistry, J . Singh etal. Pragati Prakashan
9. Computer fundamental , B Ram, New Age Pub.

Swami Ramanand Teerth Marathwada University, Nanded

Faculty of Science & Technology

Name of the Program	B.Sc. (Chemistry), First Year
Title of the Paper/Course	Soil Pollution
Course Code	SCHESEC1152
Semester	II
Paper Type	Skill Enhancement Course (SEC)
Credits	02
Total Hours	60
Formative Assessment Marks	20
Summative Assessment Marks	30
Total Marks	50

Course Objectives

1. To develop understanding about soil environment, soil composition and physicochemical properties of soil.
2. To train students in analytical techniques used for the determination of important soil parameters such as pH, electrical conductivity, organic matter and nutrient content.
3. To create awareness regarding causes, effects and prevention of soil pollution, soil degradation and conservation methods.
4. To develop practical skills in handling laboratory instruments such as pH meter, conductivity meter and flame photometer for soil analysis.
5. To enhance scientific observation, analytical thinking and interpretation of soil quality data for environmental assessment and sustainable soil management.

Course Outcomes (COs)

CO No.	Course Outcomes	Bloom's Level
CO1	Explain the physical, chemical and biological properties of soil and the causes of soil pollution and degradation.	Remember / Understand
CO2	Perform laboratory analysis of soil parameters such as pH, electrical conductivity, alkalinity, organic matter and nutrient content.	Apply
CO3	Analyze and interpret soil quality data for assessment of soil fertility and pollution status.	Analyze / Evaluate
CO4	Use laboratory instruments and standard analytical methods for determination of soil nutrients and pollutants safely and effectively.	Apply / Analyze
CO5	Demonstrate awareness regarding soil conservation, pollution prevention and sustainable environmental management practices.	Evaluate / Create

Detailed Syllabus

Module No.	Title	Topics
I	**General geology and soil formation**	Definition of soil environment, Soil formation process, Physical and chemical of soil environment Summary of teaching methodology, Soil structure, texture and energy, Composition of gas and water phases in soil, metabolism in soil environment, Gas phase, Water in soil, Colloid, Soil solution, Biological composition in soil.
II	**Soil degradation and prevention and conservation methods**	Soil degradation Soil acidicity Soil salinity Soil desertification Soil erosion, Prevention and conservation methods
III	**Soil pollution and prevention methods**	Soil pollution Soil pollution by agricultural waste Soil pollution by industrial waste Soil pollution by oil and effects of oil pollution Soil pollution due to natural and biological factors, Self cleaning ability of soil environment, Land use planning methods to prevent soil pollution, Mothods to prevent soil pollution.
IV	**Laboratory Work (Any eight practicals)**	1. Determination of pH of different soil samples. 2. Determination of electrical conductivity of different soil samples. 3. Determination of total alkalinity of soil samples. 4. Determination of moisture content of soil samples. 5. Determination of water holding capacity of soil. 6. Determination of soil texture by sedimentation method. 7. Determination of total organic matter in soil samples. 8. Determination of available nitrogen in soil samples. 9. Determination of total phosphorus in soil samples. 10. Determination of calcium [Ca(II)] and magnesium [Mg(II)] ions from soil samples by EDTA method. 11. Determination of ferrous [Fe(II)] and ferric [Fe(III)] ions from soil samples. 12. Determination of potassium (K) in soil samples by flame photometry. 13. Determination of sodium (Na) in soil samples by flame photometry. 14. Determination of available sulphur in soil samples. 15. Comparative analysis of polluted and non-polluted soil samples for physicochemical parameters and preparation of soil quality assessment report.

Total Hours: 60

Reference Books:

1. R. E. White, Principles and Practice of Soil Science, The soil as a natural resource. 4th Ed., Blackwell Publishing, 2006.
2. Le Van Khoa, Nguyen Xuân Cu, Le Duc, Tran Khac Hiep, Tran Cam Van, Dat va Moi Truong, NXB Giao Duc – 2003.
3. Ku. Jeff, Practical Design Calculations for Groundwater and Soil Remediation, CRC Press LLC, 1999Vietnam environmental protect law, HCM Tonghop Publisher, 2015.
4. Ibrahim A. Mirsal, Soil Pollution Origin, Monitoring & Remediation, Springer-Verlag Berlin Heidelberg, 2008.

E-Resources / MOOCs

1. SWAYAM – Soil Pollution and Remediation
2. NPTEL – Environmental Engineering and Soil Chemistry