



સૌરાષ્ટ્ર યુનિવર્સિટી

એકેડેમિક વિભાગ

યુનિવર્સિટી કેમ્પસ, યુનિવર્સિટી રોડ, રાજકોટ-૩૬૦૦૦૫

ફોન નં.(૦૨૮૧)૨૫૭૮૫૦૧ એક્સટે. નં.૨૦૨, ૩૦૪ ફેક્સ નં.(૦૨૮૧)૨૫૭૬૩૪૭ ઈ-મેઈલ : academic@sauuni.ac.in

નં.એકે/વિજ્ઞાન/૨૫૦૧૨૬૩/૨૦૨૪

તા.૦૫/૦૪/૨૦૨૪

રસાયણશાસ્ત્ર

પરિપત્ર:-

સૌરાષ્ટ્ર યુનિવર્સિટીની વિજ્ઞાન વિદ્યાશાખા હેઠળની સ્નાતક કક્ષાના બી.એસસી (રસાયણશાસ્ત્ર)ના અભ્યાસક્રમ ચલાવતી સર્વે સંલગ્ન કોલેજોના આચાર્યશ્રીઓને આથી જાણ કરવામાં આવે છે કે, ચેરમેનશ્રી દ્વારા રસાયણશાસ્ત્ર સેમેસ્ટર ૧ અને ૨ નો નવો સુધારેલો અભ્યાસક્રમ રસાયણશાસ્ત્ર વિષયની અભ્યાસ સમિતિ, વિજ્ઞાન વિદ્યાશાખા, એકેડેમિક કાઉન્સિલ તથા બોર્ડ ઓફ મેનેજમેન્ટની બહાલીની અપેક્ષાએ મંજૂરી આપવા માન.કુલપતિ સાહેબને ભલામણ કરેલ જે માન.કુલપતિશ્રીએ મંજૂર કરેલ છે. જેથી સંબંધિત તમામે તે મુજબ તેની ચુસ્તપણે અમલવારી કરવી.

(મુસદ્દો કુલસચિવશ્રીએ મંજૂર કરેલ છે.)

સહી/-

(ડૉ.આર.જી.પરમાર)

કુલસચિવ

બિડાણ:- ઉક્ત અભ્યાસક્રમ (સોફ્ટ કોપી)

રવાના કર્યું

પ્રતિ,

એકેડેમિક ઓફીસર

(૧) વિજ્ઞાન વિદ્યાશાખા હેઠળની રસાયણશાસ્ત્ર વિષય ચલાવતી સ્નાતક કક્ષાની સર્વે સંલગ્ન કોલેજોના આચાર્યશ્રીઓ તરફ

નકલ જાણ અર્થે રવાના:-

૧. માન.કુલપતિશ્રી/કુલસચિવશ્રીના અંગત સચિવ

નકલ રવાના (યોગ્ય કાર્યવાહી અર્થે):-

૧. પરીક્ષા વિભાગ

૨. પી.જી.ટી.આર.વિભાગ

૩. જોડાણ વિભાગ



SAURASHTRA UNIVERSITY



FACULTY OF SCIENCE

Course Structure and Syllabus for Science FYUGP

B.Sc. Honours/ Honours with Research in Chemistry

Based on

UGC's guidelines NEP-2020 "Curriculum and Credit Framework for Undergraduate Programmes- CCFUP" and

Education Department, Government of Gujarat's
Uniform Credit Structure for all HEIs of Gujarat State and
Implementation of the Common Curriculum and Credit Framework under the
National Education Policy-2020

(No: KCG/admin/2023-24/0607/kh.1 Sachivalaya, Gandhinagar dated 11/07/2023) and

Standard Operating Procedure for Implementation of NEP-2020 for the State of
Gujarat- HEIs of Gujarat

(No: KCG/admin/2023-24/865/ dated 26/07/2023) and

Additional content to be added to SOP published by KCG

(No: KCG/NEP-2020/2023-24/893/ dated 28/07/2023)

General Guidelines for Implementation of **Four Year Under Graduate
Programmes** for Saurashtra University (16 pages) published in August 2023
(E-mail from Academic Section Saurashtra University dated Oct 11, 2023)

Effective from November –2023 & onwards

(Submitted on 23/11/2023)



PREFACE

Timely revision of the curriculum to encompass new knowledge and information is a prime criterion of IQAC and a prime need for the institute educational systems affiliated with Universities. Under the NEP -2020 and UGC guidelines, a student must be offered the latest courses of varied requirement of technology with societal, environmental, and economic implications. The curriculum should offer multiple entry-exits and a choice of vast subjects to choose from to a student to facilitate his learning abilities, aptitude, and inclination. Chemistry is a foundation subject for Chemical Sciences, Life Sciences, Chemical Engineering, Agriculture, Environmental Science, Genetic engineering, Pharmaceuticals, Fertilizers, Textiles, Polymers, and so many and hence holds the central position in the curriculum of these subjects. Looking at the rapid inventions and technological developments in the field of Chemistry and keeping in view the recommendations of UGC, NEP-2020 and Standard Operating Procedure for Implementation of NEP-2020 for the State of Gujarat- HEIs of Gujarat. This syllabus has been formulated by the combined and coordinated efforts of all the faculty members of Chemistry Departments of all the Colleges affiliated to Saurashtra University.

The composition of a curriculum for a particular subject requires the following criteria to be Considered:

1. Guidelines, Model curriculum, SOP and Evaluation norms provided by the UGC, State Government, and the University.
2. Regional needs and Present National and International trends in the subject.
3. Geographical parameters of the University and its demographic property.
4. Relationship with other related subjects and resources of educational needs.
5. Financial and statutory provisions of the State Government.

The content of a syllabus should be such that it maintains continuity with the course content of Higher secondary classes and post-graduate courses. Keeping this in mind, the current curriculum is made; and is an effort to impart fundamental knowledge of the subject needed at this level. The curriculum is designed as per the guidelines of UGC, NEP-2020 and Standard Operating Procedure for Implementation of NEP-2020 for the State of Gujarat- HEIs of Gujarat, reflects the courses' total credit, teaching hours, and question paper style. The syllabus units are well defined, and the scope of each is given in detail. A list of reference books is provided at the end of each course. Chemistry being a logical and application based subject, sufficient emphasis is given to problem solving skills.



The following objectives have been considered while formulating the curriculum:

1. To provide an updated, feasible, and modern syllabus to the students, emphasizing knowledge and skill to build up their employment oriented career.
2. To frame the comprehensive syllabus in accordance with the CBCS, UGC- NEP 2020 recommendations and considering the Standard Operating Procedure for Implementation of NEP-2020 in the State of Gujarat- HEIs of Gujarat, University guidelines and in consultation with all stakeholders.
3. To offer the students an array of Core, Interdisciplinary, Multidisciplinary, Skill enhancement, Ability enhancement and Value-added courses to select from and to facilitate their academic ,intellectual and social grooming.

The Board of Studies for Chemistry expresses heartfelt gratitude to the Dean, Faculty of Science, Saurashtra University, for valuable guidelines and the Academic Section for much-needed cooperation. The Board wishes all the students a very bright future.

Date: 23rd November 2023

On behalf of the BoS- Chemistry,

Dr. M.G. Borisagar,
Subject Expert, Chemistry
Saurashtra University, Rajkot

Dr. K.D. Ladva,
Other than Chairman
BoS- Chemistry
Saurashtra University, Rajkot

Prof. H. S. Joshi,
Chairman,
BoS- Chemistry
Saurashtra University, Rajkot

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Graduate Attributes:

Graduates should be able to demonstrate the acquisition of the following:

• Graduate attributes for FOUR YEAR UNDER GRADUATE PROGRAM

- **Academic excellence:** Ability to identify key questions, research and pursue rigorous evidence-based arguments
- **Critical Thinking and Effective communications:** Analysis and evaluation of information to form a judgement about a subject or idea and ability to communicate effectively the same in a structured form.
- **Global Citizenship:** Mutual understanding with others from diverse cultures, perspectives and backgrounds
- **Research-related skills:** the ability to understand basic research ethics and skills in practicing/doing ethics in the field/ in personal research work, regardless of the funding authority or field of study.
- **Leadership qualities and Teamwork abilities:** The graduates should be able to demonstrate the capability for mapping out the tasks of a team and setting direction and inspiring vision, and building a team that can help achieve the goals
- **Life Long Learning:** Open, curious, willing to investigate, and consider new knowledge and ways of thinking

Program Learning Outcomes:

The student graduating with the Degree B.Sc. (Honours/Honours with Research) Chemistry should be able to acquire;

1. **Core Competency:** Students will acquire core competency in the subject chemistry, and in allied subject areas with following competencies:
 - Systematic and coherent understanding of the fundamental concepts in Physical chemistry, Organic Chemistry, Inorganic Chemistry, Analytical Chemistry and all other related allied chemistry subjects.
 - Students will be able to use the evidence based comparative chemistry approach to explain the chemical synthesis and analysis.
 - The students will be able to understand the characterization of materials.
 - Students will be able to understand the basic principle of equipment, instruments used in the chemistry laboratory.
 - Students will be able to demonstrate the experimental techniques and methods of their area of specialization in Chemistry.
2. **Disciplinary knowledge and skill:** A graduate student is expected to be capable of demonstrating comprehensive knowledge and understanding of both theoretical and experimental/applied chemistry knowledge in various fields of interest like Analytical Chemistry, Physical Chemistry, Inorganic Chemistry, Organic Chemistry, Material Chemistry etc. Further, the student will be capable of using of advanced instruments and related software for in-depth characterization of materials/chemical analysis and separation technology.



3. **Skilled communicator:** The course curriculum incorporates basics and advanced training in order to make a graduate student capable of expressing the subject through technical writing as well as through oral presentation.
4. **Critical thinker and problem solver:** The course curriculum also includes components that can be helpful to graduate students to develop critical thinking ability by way of solving problems/numerical using basic chemistry knowledge and concepts.
5. **Sense of inquiry:** It is expected that the course curriculum will develop an inquisitive characteristics among the students through appropriate questions, planning and reporting experimental investigation.
6. **Team player:** The course curriculum has been designed to provide opportunity to act as team player by contributing in laboratory, field based situation and industry.
7. **Skilled project manager:** The course curriculum has been designed in such a manner as to enabling a graduate student to become a skilled project manager by acquiring knowledge about chemistry project management, writing, planning, study of ethical standards and rules and regulations pertaining to scientific project operation.
8. **Digitally literate:** The course curriculum has been so designed to impart a good working knowledge in understanding and carrying out data analysis, use of library search tools, and use of chemical simulation software and related computational work.
9. **Ethical awareness/reasoning:** A graduate student requires understanding and developing ethical awareness/reasoning, which the course curriculum adequately provides.
10. **Lifelong learner:** The course curriculum is designed to inculcate a habit of learning continuously through use of advanced ICT technique and other available techniques/books/journals for personal academic growth as well as for increasing employability opportunity.

PROGRAM EDUCATIONAL OUTCOMES (PEO):

This program will produce Graduates who will attain the following PEOs after a few years..

PEO ₁	Core competency	Understand and apply the fundamental core of chemistry to a broad variety of chemical problems.
PEO ₂	Breath of knowledge	Competent chemistry graduates with strong fundamental knowledge to cater the needs of GOs and NGOs related to chemical science domain.
PEO ₃	Preparedness	Demonstrate ability to use necessary tools & techniques of applied chemistry domain.
PEO ₄	Professionalism	Graduates who can work individually or in teams to interpret chemical literature and propose solutions for problems significant to industries and society as a whole.
PEO ₅	Learning environment	Inculcate the aptitude to engage in life- long learning from social, economic, and scientific activities of the time.

**PROGRAM OUTCOMES (PO):****After completion of the FYUGP Chemistry, the Graduate will be able to:**

PO ₁	Foundational Knowledge	Understand major concepts, theoretical principles and experimental findings in chemistry.
PO ₂		Conduct experiments, analyse data, and interpret results, while maintaining responsible and ethical scientific conduct.
PO ₃	Scientific Aptitude	Employ critical thinking and efficient problem-solving skills in the four basic areas of chemistry - organic, inorganic, analytical, and physical.
PO ₄		Exhibit awareness about safety and chemical hygiene regulations and good laboratory practices.
PO ₅	Modern Tool Usage	Apply classical and minor instruments for chemical analysis and separation.
PO ₆		Able to use computers and electronic resources for data management and retrieval.
PO ₇		Communicate effectively in written and oral forms to transmit technical information in a clear and concise manner.
PO ₈	Lifelong Learning	Comprehend and exhibit fundamental aspects of chemical sciences facilitating placement into PG programs, professional organizations, or other related job.
PO ₉		Effectively work in diverse teams in all curricular, co-curricular and extra-curricular activities.
PO ₁₀	Global Citizenship	Appraise and demonstrate Universal brotherhood

PROGRAM SPECIFIC OUTCOMES (PSO):**After completion of the program, the Graduate will...**

PSO ₁	Acquire knowledge on the fundamentals aspects of chemistry leading to functional understanding of emerging concepts and technologies in chemical sciences.
PSO ₂	Able to pursue higher education and research in the institutes of national and international repute.
PSO ₃	Apply conceptual knowledge of Chemistry to identify practical & innovative solutions for socio-economically relevant issues.
PSO ₄	Demonstrate ability to skilfully utilize the chemical literature to identify existing problems and employ tools & techniques of applied chemistry for finding sustainable & ethical solutions.
PSO ₅	Acquire the ability to engage in life- long learning in the broadest context of socio-technological changes.



B.Sc. Honours/ Honours with Research in Chemistry
(NCrF Level- 4.5 First Year – Certificate in Chemistry)
Semester II

SN	Course Category As per GoG- NEP-SOP - July 2023& additional content 28/7/23	Course Title	Credit			Hrs./ Wk.		Evaluation - Weightage CCE: SEE = 50:50				
			T	P	Total	T	P	CCE Marks		SEE Marks		Total Marks
								T	P	T	P	
1	Major (Core)-3 (Chemistry)	Chemistry -3: Fundamental Chemistry-3 (4- Credit Course including Theory & Practical components)	3	1	4	3	2	25	25	50	-	100
2	Major (Core)-4 (Chemistry)	Chemistry -4: Fundamental Chemistry-4 (4- Credit Course including Theory & Practical components)	3	1	4	3	2	25	25	50	-	100
3	Minor(Elective)*-2	(As per GoG- NEP- SOP July 2023& additional content 28/7/23 – Clause 3.3.2) Any One from Basket (As per the expertise and resources available in the college) (4- Credit Course including Theory & Practical components)	3	1	4	3	2	25	25	50	-	100
4	Multi/Inter - Disciplinary Course -2 (MDC/IDC-1) (Elective)** 4- Categories: Natural & Physical Science/ Maths.,Stat.and Comp. Appl./Lib.,Info.and Media Sci./Comm. and Mgt./Huma., and Social Sci./ Sanskrit etc...	(As per GoG- NEP- SOP July 2023& additional content 28/7/23 – Clause 3.3.3) Any One from Basket (As per the expertise and resources available in the college) (4- Credit Course including Theory & Practical components)	3	1	4	3	2	25	25	50	-	100
5	Ability Enhancement Course -2 (AEC-2)	(As per GoG- NEP- SOP July 2023& additional content 28/7/23 – Clause 3.3.4) English Language	2	-	2	2	-	25	-	25	-	50



6	Skill Enhancement Course-2 (SEC-2)	(As per GoG- NEP- SOP July 2023& additional content 28/7/23 – Clause 3.3.5) Skill based Course-2: Analysis of Oils & Fats (2- Credit Course including Theory & Practical components)	1	1	2	1	2	-	25	25	-	50
7	Common Value Added Course-2 (C-VAC-1)*** NSS/NCC/ Sports & Fitness/ Ethics and Culture/ Culture and Communication/ Ethics and Values in Ancient Indian Traditions/ Human Values and Ethics/IPDC	(As per GoG- NEP- SOP July 2023& additional content 28/7/23 – Clause 3.3.6) Any One from Basket VAC based on IKS: NSS/NCC/Sports & Fitness/Human Values and Ethics	-	2	2	-	4	-	25	25	-	50
Total Credits and Marks (Semester-II)			14	08	22	14	16	125	150	225	50	550

* Any one course from the basket is to be selected as a Minor elective course as per the expertise and resources available in the college. The same course will continue as a Minor in the semester-II as well.

** Any one course from the basket is to be selected as Multi/Inter disciplinary elective courses (MDC/IDC) as per the expertise and resources available in the college. The same MDC/IDC course as selected in Sem.- I will be continued in the semester-II as well.

*** **Common Value Added Elective Courses (C-VAC-2)** common to all is to be selected from University Basket for semester 2, as per the expertise and resources available in the college.

Courses Offered by BoS - Chemistry to other FYUGP- B.Sc. Program in Semester-II												
SN	Course Category As per GoG- NEP- SOP - July 2023& additional content 28/7/23	Course Title	Credit			Hrs./ Wk.		Evaluation - Weightage CCE: SEE = 50:50				
			T	P	Total	T	P	CCE Marks		SEE Marks		Total Marks
								T	P	T	P	
1	Minor (Elective)-2 (Chemistry) (In addition to courses mentioned in SOP basket; Recommended for Physical Science, Mathematical Science, Life science Programs)	Chemistry-2: Fundamental Chemistry-2 (4- Credit Course including Theory & Practical components)	3	1	4	3	2	25	25	50	-	100
2	Multi/Inter - Disciplinary Course -2 (MDC/IDC-2) (Elective) (In addition to courses mentioned in SOP basket; Recommended	Chemistry: Introduction to Basic Chemistry-2 (4- Credit Course including Theory & Practical components)	3	1	4	3	2	25	25	50	-	100



for Physical Science, Mathematical Science, Life science Programs)										
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Evaluation Scheme: (As per GoG- NEP-SOP July 2023& additional content 28/7/23 – Chapter-7: Evaluation Reforms)

The evaluation process should be formulated to make a systematic evaluation of students' progress based on UGC guidelines. The evaluation must be designed with learner attributes in mind. These attributes have clear linkages to Programme Education Objectives and Outcomes. The evaluation consists of the following two components:

1. Continuous and Comprehensive Evaluation (CCE)- Formative
2. Semester End Evaluation (SEE)- Summative

CCE carries 50% of the total marks allotted to a subject and the other 50% being assigned to the SEE.

In each course, every credit carries 25 marks, of which 50% marks is assigned for CCE and rest 50% marks for SEE. The 50% marks assigned to the CCE is distributed between the continuous classroom evaluation and mid-term evaluation. The pattern may be as follow:

SN	Evaluation	*T-3 + P-1 = Total 4 credit subjects (Marks)	*T-1 + P-1 = Total 2 credit SEC# (Marks)
1	CCE (50%) Classroom/Lab & Mid-Term/Course End Evaluation	T-25 + P- 25	P#- 25
2	SEE (50%)	50	T#- 25
	Total	100	50

*T = Theory; P= Practical #Details are given with syllabus

Continuous and Comprehensive Evaluation (CCE)

Subject-wise CCE will be undertaken by the concerned faculty member. The mode of evaluation will be decided by the faculty member concerned with the subject. Normally CCE consists of class participation, case analysis and presentation, assignment, tutorials, slip tests (announced/ surprised), quizzes, attendance etc. or any combination of these. The students are expected to submit their answer scripts/ reports of internal evaluation within the stipulated time. Failure to do so may result in the script not being valued. Another part of CCE consists of mid-term written evaluation, which is compulsory for all students. It can be done in a scheduled manner. The duration of the mid-term evaluation shall be one hour.

Semester End Evaluation (SEE)

The SEE carries 50% of the marks assigned to a course. SEE shall be of 2 ½ hours for 3/4 credit course and 2 hours in case of 1/2 credit courses. The controller of the examination will conduct these examinations. Paper setting and evaluation will be done by the external examiners to an extent of 50% of the evaluation process. This examination shall be conducted as per a schedule which shall be notified in advance.

The backlog exam will be conducted twice a year just after the result declared of the semester evaluation. Students shall have a second chance to clear their backlog and avoid the burden to carry forward the backlog with the next semester exam.



Appearance in all the evaluations is mandatory and no exemption can be granted except in the following case:

1. In case of inability to attend the exam due to reasons considered genuine by the controller of examination in consultation with the Director/Board.
2. In case of medical emergency, a certificate from the registered medical practitioner must be produced before the commencement of exams. The evaluation board will then take final decision on the recommendation for exemption.

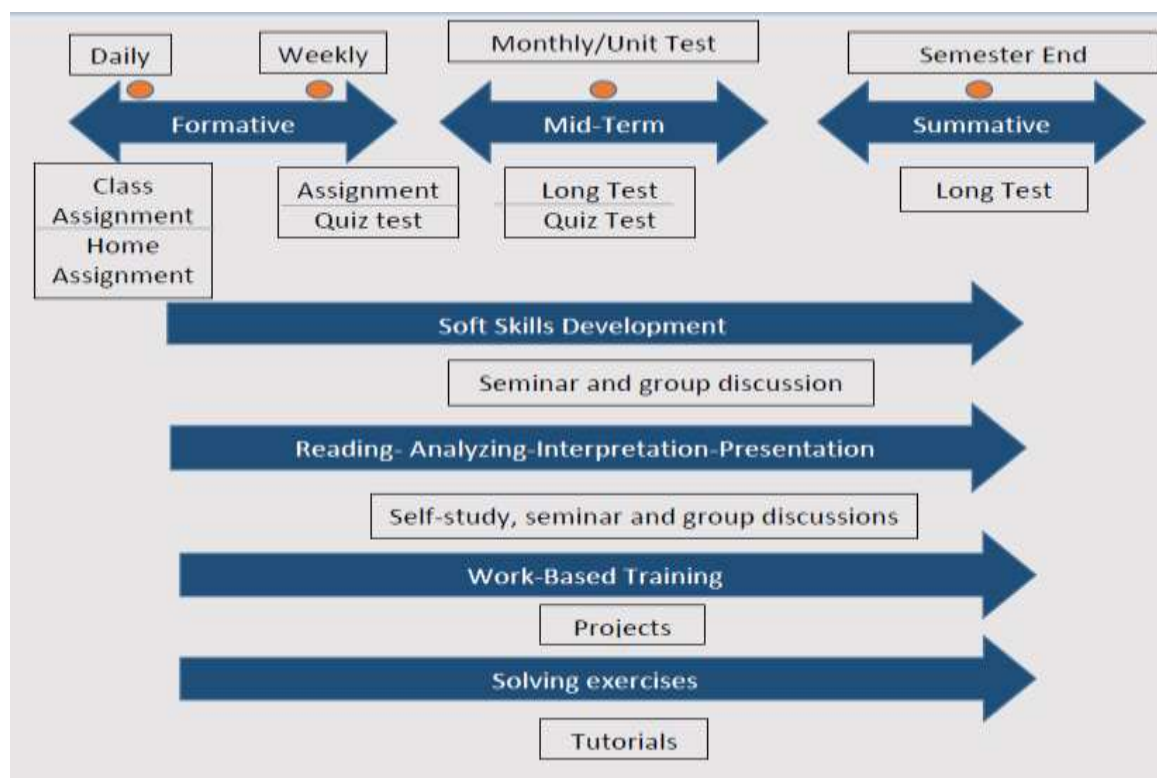
Eligibility Criteria to appear in SEE

To be able to appear for the SEE, a student must comply with the following conditions:

1. Should have at least 75% of attendance in all the courses put together.
2. Should have at least 70% of attendance in each course/subject.
3. Should not have any disciplinary proceedings pending against him/her.
4. Should have no pending due.

Continuum of Evaluation

Evaluation must be continuous which may include both formative and summative components in a timely manner for continuous feedback as follow:





Mode of Evaluation

A wide range of modes of evaluation for evaluating students is available for the teachers/institutions to use. A suitable compendium of such a mode needs to be carefully chosen for a particular program depending on its nature, objectives, and available resources. The mode of evaluation can be as below:

Written Mode	Oral Mode	Practical Mode	Integrated Mode
Semester Exam Class Test Open book exam/test Open note exam/test Self-test/Online test Essay/Article writing Quizzes/Objective test Class assignment Home assignment Reports writing Research/Dissertation Class Studies	Viva/Oral exam Group Discussion Role Play Authentic Problem Solving Quiz Interview	Lab work Computer simulation/virtual labs Craft work Co-curricular work	Paper presentation/Seminar Field Assignment Poster Presentation

Written Mode		
Evaluation Type	Nature	Objective
Semester Exam	Traditionally essay type, with objective / short answer questions to evaluate Lower Order Thinking (LOT) OBE skills	For depth and planned preparation
Class test	Traditionally essay type	Fixed date forces students to learn
Open book test	Allowed choice of reference book	Measures what students can do with resources, less stress on memory
Open note test	To get used to the system	Encourage good note taking
Self-test	For subjective and objective items	Mastery learning occurs with proper feedback
Article/essay writing	Individual long written assignment	Individual expression and creativity
Quizzes/Objective test	Short duration structured test	Excellent validity as greater syllabus coverage
Class assignment	With defined time	Student's performance to make decision
Home assignment	With undefined time	Reinforce learning and facilitate mastery of specific skills
Reports Writing	On activities performed or event observed	Develop a key transferable skill
Research/Dissertation	Detailed research-based report	To judge creativity and research skills
Case Studies	Analyse a given case (real or fictional)	To assess thinking, value, and attitude



Oral Mode		
Evaluation Type	Nature	Objective
Viva/Oral exam	Individually or in small group	Practical experience towards job interview situation
Group discussion	Small group of 2-5 members work on a joint task	Encourage teamwork
Role Play	Small group of 2-5 members work on a joint task	Develop personality
Authenticate problem solving	Small group of 2-5 members work on a joint task	Communication of ideas
Quiz	Small group of 2-5 members work on a joint task	Assess memory power
Interview	Individually	Judge the personal confidence level

Practical Mode		
Evaluation Type	Nature	Objective
Lab work	Component of working with one's hand	Keep the students on the task
Computer simulation/virtual labs	Component of working with one's hand	To understand the practical exposure
Craft work	Component of working with one's hand	Encourage application of concepts learnt
Co-curricular work	Component of working with one's hand	For immediate feedback

Integrated Mode		
Evaluation Type	Nature	Objective
Paper presentation/Seminar	Group or individual work	Learn from others presentation
Field Assignment	Field visit with report	Develop observation and recording skills
Poster presentation	Group or individual work	Develop research, creativity, and discussion skills
Paper presentation/Seminar	Group or individual work	Learn from others presentation

Models of Evaluation

Based on the types of evaluation, various models of evaluation implementation are suggested for theory, practical, self-study and work-based learning. The focus of these models is to encourage the students to improve on skills and performance.

Evaluation Norms & Question Paper Pattern for Theory & Practical Courses: Please refer General Guidelines for Implementation of **Four Year Under Graduate Programmes** for Saurashtra University (16 pages) published in August 2023.



Model for Theory Courses- Theory-3+Practical-1 = 4 Credit Course	
CCE-50% (50 Marks) SEE-50% (50 Marks)	
Exam Pattern	Marks
Class Test (Average of TWO tests)	T-25 + P-25
Quiz (Average of TWO quiz)	
Home Assignment	
Active Learning- PBL/CSBL/Seminar/Flipped Class Room etc. OBE evaluation tools.	
Class Assignment	
Attendance	
Continuous and Comprehensive Evaluation	
Semester-End Evaluation	T-50

Model for Practical Courses-1 Credit Course	
CCE-100% (25 Marks)	
Exam Pattern	Marks
Lab work assessment	10
Viva voce/Lab quiz	10
Attendance	05
Continuous and Comprehensive Evaluation	25

Model for Skill Enhancement Course SEC (1 Credit theory + 1 Credit Practical)	
CCE-P-50% (25 Marks) and SEE-T-50% (25 Marks)	
Evaluation Components	Marks
Lab work Assessment – Performance : Lab quiz, Attendance, Aim achievement & Journal- Record book	05+05
Course End Practical Examination & Viva voce - One & Half Hours Duration	10+05
Total marks of CCE- Continuous and Comprehensive Evaluation	25
Semester-End Evaluation- Theory Examination– One Hours Duration	25
Total Marks for the Skill Enhancement Course	50



B.Sc. Honours/ Honours with Research in Chemistry

(NCrF Level- 4.5 First Year – Certificate in Chemistry)

Semester II

Course Category	Major-3
Title of the Course	Chemistry -3: Fundamental Chemistry-3
Course Credit	03
Teaching Hours per Sem.	45
Total Marks	CCE- 25+ SEE- 50

1	Employability/Entrepreneurship/Skill Development પર કેન્દ્રિત થયેલ છે કે નહિ ?	Yes/No				
2	Value added Courses Imparting Transferable and Life Skillsનું ગુણો ધરાવે છે?	Yes/No				
3	Major	Yes/No	Minor	Yes/No		
	Skill Enhancement Courses	Yes/No	Ability Enhancement Courses	Yes/No		
	Value Added Courses	Yes/No	Exit/ Vocational Courses	Yes/No		
4	Holistic Education	Yes/No	Multidisciplinary	Yes/No	Interdisciplinary	Yes/No
5	દિવ્યાંગ માટે વિષય અંતર્ગત આનુસંગિક જોગવાઈ કરાયેલ છે ?				Yes/No	
6	New India Literacy Programme (NILP) મુજબનો વિષય છે?				Yes/No	
7	Swayam પ્લેટફોર્મ પરના MOOC વિષય પર આધારિત આ વિષય છે ?				Yes/No	
8	ઇન્ડિયન નોલેજ સીસ્ટમ (IKS) પર આધારિત વિષય છે ?				Yes/No	

Course Outcomes - COs

Course out comes: This course will provide a broad foundation in chemistry that stresses scientific reasoning and analytical problem solving capability with a molecular perspective.

On completion of this course, the students will be able to understand:

- Electronic configuration, physical, spectral, magnetic and catalytic properties of first transition element 3D-series.
- Coordination complex theory, various ligands, geometry of complex and structural/stereo isomerism in complexes.
- Preparation , Properties and Reactions of Alkyl & Aryl Halides
- Principle, mechanism and applications of Named Organic Reactions and Reagents
- Types of electrolytes, degree of dissociation and factors affecting degree of dissociation Ionic product of water, dissociation constants of weak acids and bases
- Common ion effect and calculation of concentrations, Solubility and solubility products of sparingly soluble salts and Applications of solubility product principle
- Hydrolysis of salts: Definition of hydrolysis of salts, Salts of strong acids and bases.
- Buffersolutions:Definitionandtypesofbuffersolutions,Bufferaction

The course will also strengthen the problem solving capacity of students.



Unit No.	Topics	Hrs	Mks
1	<p>UNIT-1: Chemistry of elements of 3d series Introduction, definition, electronic configuration, reversal of energies of 3d and 4s orbitals,</p> <p>Physical properties such as atomic properties (atomic radii, Ionic radii, and ionization potential), metallic conductivity, reducing properties, tendency of formation of alloys, catalytic properties and magnetic properties.</p> <p>Calculation of spin only magnetic momentum of inner orbital and outer orbital complexes $[\text{NiCl}_4]^{-2}$, $[\text{Ni}(\text{CN})_4]^{-2}$, $[\text{FeF}_6]^{-4}$, $[\text{Fe}(\text{CN})_6]^{-4}$</p>	9	10
2	<p>UNIT- 2: Basics of Co-ordination Chemistry Werner theory, types of ligands (simple ligands, π-acid ligands, according to number of donating electrons, chelating ligands) with definition and examples</p> <p>Co-ordination number and geometry related to co-ordination number. Isomerism and its classification (structural & stereo isomerism)</p> <p>Structural isomerism: (a) ionization (b) hydration (c) co-ordination (d) co-ordination positions</p> <p>Geometric/cis-trans-isomerism in ML_4 and ML_6 types of complexes</p>	9	10
3	<p>UNIT-3: Alkyl and Aryl Halides</p> <p>Alkyl Halide: Nomenclature & Classification Preparation of Monohaloalkanes – From Alkene, From Alcohols, From Monocarboxylic acid (Hunsdiecker Reaction), From Alkyl halide (Finkelstein Reaction). Physical Properties of Haloalkane Nucleophilic Substitution reaction of Alkyl halide – Reaction with Moist Silver oxide, Sodium Alkoxides, Ammonia or Amines, Alkaline KCN & AgCN, Potassium hydrogen Sulphide, Alkali metal sulphides, Metallic Alkynides Dihaloalkanes : Gem & Vicinal, Preparation of Gem Dihalide from Alkynes & Carbonyl compounds, Preparation of Vicinal Dihalide From Alkynes & Vicinal Diols Introduction of Polyhaloalkanes : Haloforms, Tetrahaloalkanes & Chlorofluoro Carbons (CFS's) Acidic Character of Haloform & Relative acidity of Haloforms Reaction of Haloform - Hydrolysis, Addition reaction with Ketones, Reaction with Alkali (Dichlorocarbene preparation), Reduction, Oxydation</p>	9	10



	<p>Introduction to Unsaturated Halides : Vinyl Halide & Allyl Halides</p> <p>Aryl Halide: Preparation (by direct halogenation, from diazonium salts) Physical Properties of Aryl Halides; Chemical Reactions of Aryl Halides: Nucleophilic aromatic substitution S_NAr (Benzyne mechanism or Elimination- Addition mechanism) Reactions of Aryl halides: Formation of Organometallic Compounds Relative reactivity of alkyl halides vs allyl, vinyl, and aryl halides towards nucleophilic substitution reactions.</p>		
4	<p>UNIT-4: Name Reactions and Reagents</p> <p>Name Reactions: Principle, Mechanism and 02 Applications</p> <ul style="list-style-type: none"> • Wurtz Reaction & Wurtz-Fittig Reaction • Ullmann reaction • Haloform Reaction • Diels-Alder Reaction <p>Oxidizing Reagents (Oxidants) - Only Formula and 02 Applications</p> <ul style="list-style-type: none"> • Manganese Oxidants : $KMnO_4$, MnO_2 • Chromium Oxidants : Chromic Acid, Na or K-Dichromates • Other Oxidants : Hydrogen Peroxides, Selenium Dioxide, Osmium Tetroxide, Periodic acid & Nitric acid 	9	10
5	<p>UNIT-5: Ionic Equilibrium</p> <p>Types of electrolytes, degree of dissociation and factors affecting degree of dissociation Ionic product of water, dissociation constants of weak acids and bases Common ion effect and calculation of concentrations of OH^- ions ($NH_4Cl + NH_4OH$) and H^+ ions ($H_2S + HCl$), Solubility and solubility products of sparingly soluble salts. Applications of solubility product principle (solubility, whether precipitate out, salt out, and inorganic qualitative analysis) Hydrolysis of salts: Definition of hydrolysis of salts, Salts of strong acids and bases. Relation among K_h, K_a, or K_b and K_w. Degree of hydrolysis and pH of the solution of salts of weak acids and strong bases, salts of weak bases and strong acids and salts of weak bases and weak acids. Buffer solutions: Definition and types of buffer solutions, Buffer reaction, Derivation of Henderson-Hassel Balch equation</p> <p>Numerical</p>	9	10



Reference books

1. UGC Inorganic Chemistry– Volume-III.H.C.Khera (Pragati Prakashan)
2. Coordination Chemistry-Gurdeep Chatwal and M.S.Yadav
3. Advanced Inorganic Chemistry by S.K.Agarwala & KeemtiLal (APragatiEdition)
4. Concise of Inorganic Chemistry-J. D. Lee
5. Essentials of Physical Chemistry, B. S. Bahl, G. D. Tuli and ArunBahl, S. Chand & Co.New Delhi
6. Elements of Physical Chemistry, B. R. Puri, L. R. Sharma and Madan Pathania, Vishal Publishing Co. Jalandhar.
7. Physical Chemistry, B. K. Sharma, Goel Publication House, Meerut.
8. Organic Reaction Mechanism, including Reaction Intermediates, V.K. Ahluwalia, Ane's Chemistry active series.
9. OrganicChemistry, Vol-1, bySultanat,Ane'sStudentEdition,AneBookPvtLtd
10. Undergraduate Organic Chemistry, Vol-1, Jagdamba Singh, L.D.S.Yadav, Pragati Prakashan, 8thedition-2013

Pedagogic tools:

- Chalk and Board
- Power point presentation
- Video
- As per facilitator's choice

Suggested MOOCs: SWAYAM-NPTEL



B.Sc. Honours/ Honours with Research in Chemistry

(NCrF Level- 4.5 First Year – Certificate in Chemistry)

Semester II

Course Category	Major Practical -3
Title of the Course	Chemistry -3P: Fundamental Chemistry-3 Practical
Course Credit	01
Teaching Hours per Sem.	30
Total Marks	CCE- 25

Course Outcomes - COs

Course outcomes: This course will provide abroad foundation in chemistry that stresses scientific reasoning and analytical problem solving capability with a molecular perspective.

On completion of this course, the students will be able to perform/do independently:

- Determine various parameters of Water
- Determine the strength of various Redox titrants
- Determine the strength of commercial chemicals Volumetrically

1	Employability/Entrepreneurship/Skill Development પર કેન્દ્રિત થયેલ છે કે નહિ ?	Yes/No
2	Value added Courses Imparting Transferable and Life Skills ના ગુણો ધરાવે છે?	Yes/No
3	Major	Yes/No
	Skill Enhancement Courses	Yes/No
	Value Added Courses	Yes/No
4	Holistic Education Yes/No Multidisciplinary Yes/No Interdisciplinary	Yes/No
5	દિવ્યાંગ માટે વિષય અંતર્ગત આનુસાંગિક જોગવાઈ કરાયેલ છે ?	Yes/No
6	New India Literacy Programme (NILP) મુજબનો વિષય છે ?	Yes/No
7	Swayam પ્લેટફોર્મ પરના MOOC વિષય પર આધારિત આ વિષય છે ?	Yes/No
8	ઇન્ડિયન નોલેજ સીસ્ટમ (IKS) પર આધારિત વિષય છે ?	Yes/No



Major Practical-3

Exercise-I: Water Analysis

- pH & Conductivity
- Acidity
- Alkalinity
- Temporary, Permeant and Total Hardness

Exercise-II: Complexometric Analysis

- Quantitative estimation of Cu^{2+} in a given $\text{CuCl}_2 \cdot 2\text{H}_2\text{O}$ solution using 0.01M EDTA solution
- Quantitative estimation of Ni^{2+} in a given $\text{NiSO}_4 \cdot 7\text{H}_2\text{O}$ solution using 0.01M EDTA solution
- Quantitative estimation of Zn^{2+} in a given ZnCl_2 solution using 0.01M EDTA solution
- Quantitative estimation of Fe^{2+} by dichromate method (Internal indicator method)

Exercise-III: Industrial analysis

- Determination of acetic acid in a commercial vinegar using 0.1M NaOH solution
- Determination of alkali in antacid using 0.1M HCl solution
- To Estimate Vitamin C by titrimetric method.
- To determine amount of bleach / bleaching powder by thiosulphate titrimetric method.
- To determine sodium carbonate in soda ash

Reference Books:

- Vogel's Textbook of Quantitative Chemical Analysis, John Wiley & Sons, 1989.
- Willard, H. H., Merritt, L.L., Dean, J. & Settle, F.A. Instrumental Methods of Analysis, 7th Ed. Wadsworth Publishing Company Ltd., Belmont, California, USA, 1988.
- Christian, G.D; Analytical Chemistry, VI Ed. John Wiley & Sons, New York, 2004.
- Harris, D. C. Exploring Chemical Analysis, Ed. New York, W.H. Freeman, 2001.
- Skoog, D. A. Holler F.J. & Nieman, T.A. Principles of Instrumental Analysis, Cengage Learning India Ed, 2017.

Pedagogic tools:

- Chalk and Board
- Power point presentation
- Video
- As per facilitator's choice

Suggested MOOCs: Swayam-NPTEL



B.Sc. Honours/ Honours with Research in Chemistry

(NCrF Level- 4.5 First Year – Certificate in Chemistry)

Semester II

Course Category	Major-4
Title of the Course	Chemistry -4: Fundamental Chemistry-4
Course Credit	03
Teaching Hours per Sem.	45
Total Marks	CCE- 25+ SEE- 50

Course Outcomes - COs

Course out comes: This course will provide a broad foundation in chemistry that stresses scientific reasoning and analytical problem solving capability with a molecular perspective.

On completion of this course, the students will be able to understand:

- Structure and forms of solids, various laws of crystallography and analytical methods of crystalline solids.
- Occurrence, Importance, Isolation, Electronic configuration, Physical & Chemical properties of Lanthanides
- Functional group based Organic chemistry wrt Alcohol, Phenol, Epoxides & Ethers
- Principle, mechanism and applications of Named Organic Reactions and Reagents
- Physical properties viz., Surface tension, Viscosity, Parachor, RI, Optical activity & Dipole moment

The course will also strengthen the problem solving capacity of students.

1	Employability/Entrepreneurship/Skill Development પરકેન્દ્રિતથયેલછેકેનહિ ?	Yes/No
2	Value added Courses Imparting Transferable and Life Skillsનાગુણોધરાવેછે?	Yes/No
3	Major	Yes/No
	Skill Enhancement Courses	Yes/No
	Value Added Courses	Yes/No
4	Holistic Education	Yes/No
	Multidisciplinary	Yes/No
5	દિવ્યાંગમાટેવિષયઅંતર્ગતઆનુસાંગિકજોગવાઈકરાયેલછે ?	Yes/No
6	New India Literacy Programme (NILP) મુજબનોવિષયછે?	Yes/No
7	Swayam પ્લેટફોર્મપરના MOOC વિષયપરઆધારિતઆવિષયછે ?	Yes/No
8	ઇન્ડિયનનોલેજસીસ્ટમ (IKS) પરઆધારિતવિષયછે ?	Yes/No



Unit No.	Topics	Hrs	Mks
1	UNIT-1: Solid State Forms of solids, unit cells, crystal systems, Bravais lattices Laws of crystallography:(1)Law of Symmetry,(2)Law of constancy of interfacial angles and (3)law of rational indices, Miller and Weiss indices, Bragg's law X-Ray diffraction methods: Rotating crystal method and Powder method Structures of NaCl and KCl, Numerical	9	10
2	UNIT-2: Basics of Lanthanide Elements Introduction, Position in the periodic table, Occurrence & Important ores, Isolation of Lanthanide Elements from ore, Individual Isolation by (I) Ion Exchange Method (II) Solvent Extraction Method, Electronics Configuration with necessary Explanation, Oxidation State & their Stability, Magnetic properties, Color. Isotopes, Spectral properties, Lanthanide Contraction, Misch Metal, Uses of Lanthanides & their Compounds.	9	10
3	UNIT-3: Alcohols, Phenol, Ethers and Epoxides Alcohols Preparation of Monohydric alcohols: From Grignard reagent; by reduction of aldehydes, ketones, carboxylic acid, and esters. Physical Properties of alcohols and Chemical Reactions: Reaction with sodium, with carboxylic acids (esterification), with acid chloride & anhydride; Reaction with HX, reaction with PX ₅ , PX ₃ , SOCl ₂ Dehydration of alcohols and Oxidation (with alkaline KMnO ₄ , acidic dichromate conc. HNO ₃) Distinction between Primary, secondary & tertiary alcohols: Lucas test, Victor Meyer Test Phenol : Physical properties; Acidity and factors affecting it; Electrophilic substitution Reactions (Nitration, Halogenation & Sulphonation), Ethers : Preparation of Ethers by Williamson Synthesis; Reactions: Substitution Reaction [Reaction with Cl ₂ in dark & Reaction of Cl ₂ in light], Reactions involving C-O bond cleavage [hydrolysis, reaction with H ₂ SO ₄ , cold HI & hot HI] Epoxides : Reactions of epoxides with alcohols, ammonia derivatives and LiAlH ₄ .	9	10
4	UNIT-4: Name Reactions and Reagents Name Reactions: Principle, Mechanism and 02Applications <ul style="list-style-type: none">• Aldol Condensation• Pechmann Condensation• Benzidine Rearrangement• Chinchibabin Reaction	9	10



	<p>Reducing Reagents - Only Formula & 02 Applications</p> <ul style="list-style-type: none"> • LiAlH_4, NaBH_4 • Di isobutyl aluminium hydride – DiBAL- H • BH_3 • Na or Li – NH_3 		
5	<p>UNIT-5: Study of Physical Properties</p> <p>Introduction, Types of Physical Properties: Additive and Constitutive Properties</p> <p>Molar Volume: Kopp's Law, Atomic Volume</p> <p>Surface Tension: Explanation of Surface Tension, Name of Methods to Determine Surface Tension, The Drop Weight Method</p> <p>Parachor: Macleod Equation and $P_1/P_2 = V_1/V_2$, Atomic Parachor, To Determine Structure of (i) Quinine (ii) Benzene (iii) Isocyanides group (iv) Nitro group</p> <p>Viscosity: Explanation (Briefly), Unit and Factors Affecting the Viscosity, Measurement of Viscosity (Derivation of $\eta_1/\eta_2 = d_1t_1/d_2t_2$), Ostwald's Viscometer.</p> <p>Refractive Index and Refractivity: Introduction, Specific and Molecular Refractivity, Abbe Refractometer, Molecular Refractivity and Chemical Constitution.</p> <p>Optical Activity: Polarization of Light, Optical Activity, Factors Affecting Angle of Rotation, Specific Rotation</p> <p>Dipole Moment: Polar and Non-polar molecule</p> <p>The Mosotti Clausious Equation, Kinds of Molar Polarization [Electron & Nuclear Polarization, Orientation Polarization (Permanent Dipole Moment)];</p> <p>Application of Dipole Moment: Identification of Polar and Non- polar molecules,</p> <p>Molecular Structure :(i) Mono-atomic molecules, (ii) Diatomic molecules (iii) Triatomic molecules (CO_2, H_2O, SO_2) (iv) Tetratomic molecules (NH_3, BCl_3) (v) Aromatic Compounds (Benzene) (vi) Resonance Structure (N_2O) (vii) Cis-Trans Isomer (viii) Orientations in Organic Molecules (o, m and p substitution)</p> <p>Numerical</p>	9	10

Reference Books:

1. UGC Inorganic Chemistry– Volume-III.H.C.Khera (Pragati Prakashan)
2. Coordination Chemistry-Gurdeep Chatwal and M.S.Yadav



3. Advanced Inorganic Chemistry by S.K. Agarwala & Keemti Lal (A Pragati Edition)
4. Concise of Inorganic Chemistry-J. D. Lee
5. Essentials of Physical Chemistry, B. S. Bahl, G. D. Tuli and Arun Bahl, S. Chand & Co. New Delhi
6. Elements of Physical Chemistry, B. R. Puri, L. R. Sharma and Madan Pathania, Vishal Publishing Co. Jalandhar.
7. Physical Chemistry, B. K. Sharma, Goel Publication House, Meerut.
8. Organic Reaction Mechanism, including Reaction Intermediates, V.K. Ahluwalia, Ane's Chemistry active series.
9. Organic Chemistry, Vol-1, by Sultanat, Ane's Student Edition, Ane Book Pvt Ltd
10. Undergraduate Organic Chemistry, Vol-1, Jagdamba Singh, L.D.S. Yadav, Pragati Prakashan, 8th edition-2013

Pedagogic tools:

- Chalk and Board
- Power point presentation
- Video
- As per facilitator's choice

Suggested MOOCs: Swayam-NPTEL



B.Sc. Honours/ Honours with Research in Chemistry
(NCrF Level- 4.5 First Year – Certificate in Chemistry)

Semester II

Course Category	Major Practical -4
Title of the Course	Chemistry -4P: Fundamental Chemistry-4 Practical
Course Credit	01
Teaching Hours per Sem.	30
Total Marks	CCE- 25

Course Outcomes - COs	
Course outcomes: This course will provide abroad foundation in chemistry that stresses scientific reasoning and analytical problem solving capability with a molecular perspective.	
On completion of this course, the students will be able to perform/do independently:	
➤	Identification of Inorganic salts having TWO radicals
➤	Preparation of various reagents

1	Employability/Entrepreneurship/Skill Development પર કેન્દ્રિત થયેલ છે કે નહિ ?			Yes/No		
2	Value added Courses Imparting Transferable and Life Skillsના ગુણો ધરાવે છે?			Yes/No		
3	Major	Yes/No	Minor	Yes/No		
	Skill Enhancement Courses	Yes/No	Ability Enhancement Courses	Yes/No		
	Value Added Courses	Yes/No	Exit/ Vocational Courses	Yes/No		
4	Holistic Education	Yes/No	Multidisciplinary	Yes/No	Interdisciplinary	Yes/No
5	દિવ્યાંગ માટે વિષય અંતર્ગત આનુસાંગિક જોગવાઈ કરાયેલ છે ?			Yes/No		
6	New India Literacy Programme (NILP) મુજબનો વિષય છે ?			Yes/No		
7	Swayam પ્લેટફોર્મ પરના MOOC વિષય પર આધારિત આ વિષય છે ?			Yes/No		
8	ઇન્ડિયન નોલેજ સીસ્ટમ (IKS) પર આધારિત વિષય છે ?			Yes/No		



Major Practical-4

Exercise:- Qualitative Analysis of Inorganic Salts:

(Minimum 12 / 15 Salts be given –containing TWO radicals)

Inorganic Soluble & Insoluble salts containing Cations viz., Group- I to V & Anions viz., Chloride, Bromide, Iodide, Nitrate, Nitrite, Sulphates, Sulphites, Sulphides, Carbonate, Phosphate (soluble & insoluble), Oxide, Chromate and Dichromate)

Reference Books:

- Vogel's Textbook of Inorganic Chemical Analysis, John Wiley & Sons, 1989.

Pedagogic tools:

- Chalk and Board
- Power point presentation
- Video
- As per facilitator's choice

Suggested MOOCs: SWAYAM-NPTEL



B.Sc. Honours/ Honours with Research in Chemistry
(NCrF Level- 4.5 First Year – Certificate in Chemistry)

Semester II

Course Category	Skill Enhancement Course (SEC)-2 Credit Skill based Theory + Practical Course; In addition to courses mentioned in SOP basket
Title of the Course	Analysis of Oils & Fats
Course Credit	02 (1T + 1P)
Teaching Hours per Sem.	15 hrs. Theory & 30 hrs. Practical
Total Marks	As per SU SOP: CCE-25 marks + SEE-25 marks

Course Outcomes - COs

Course outcomes: This course will provide a broad foundation in analytical chemistry that stresses hands-on experiential skill development and analytical problem-solving capability with a laboratory perspective.

On completion of this course, the students will be able to:

- Analyze & evaluate the Oil Quality
- Create Analytical reports
- Outline the theoretical bases of the Analysis
- Compare different methods of Analysis
- Describe the basic principles of Instrument Operation

1	Employability/Entrepreneurship/Skill Development પર કેન્દ્રિત થયેલ છે કે નહિ ?	Yes/No				
2	Value added Courses Imparting Transferable and Life Skillsના ગુણો ધરાવે છે?	Yes/No				
3	Major	Yes/No	Minor	Yes/No		
	Skill Enhancement Courses	Yes/No	Ability Enhancement Courses	Yes/No		
	Value Added Courses	Yes/No	Exit/ Vocational Courses	Yes/No		
4	Holistic Education	Yes/No	Multidisciplinary	Yes/No	Interdisciplinary	Yes/No
5	દિવ્યાંગ માટે વિષય અંતર્ગત આનુસાંગિક જોગવાઈ કરાયેલ છે ?	Yes/No				
6	New India Literacy Programme (NILP) મુજબનો વિષય છે ?	Yes/No				
7	Swayam પ્લેટફોર્મ પરના MOOC વિષય પર આધારિત આ વિષય છે ?	Yes/No				
8	ઇન્ડિયન નોલેજ સીસ્ટમ (IKS) પર આધારિત વિષય છે ?	Yes/No				



Skill Enhancement Course (SEC)-2

Theory :

- Introduction, Properties & Classification of Oil & Fats
- Oil & Fats Quality Parameters
- Definition and Practical Procedure of followings:
 1. Saponification Value
 2. Unsaponifiable matter
 3. Acid Value
 4. Iodine Value
 5. Reichert Meissl & Polenske Value
 6. Specific gravity
 7. Refractive Index
- Qualitative Tests for Oil & Fats
 1. Sesame oil (Baudouins Test)
 2. Cottonseed oil
 3. Linseed oil
 4. Mustard oil
 5. Rice Bran oil
- Detection of Various IMPURITIES in Edible Oil : Rancidity, Argemone oil, Cottonseed oil, Karanjia oil, Mineral oil, Castor oil, Mobile oil (Lube)
- Detection of Adulteration in Coconut oil
- Detection of Vanaspati/Hydrogenated edible fats in Ghee

Practical :Analysis of Oils and Fats

- Determination of Specific Gravity
- Determination of Refractive Index
- Determination of Saponification Value
- Determination of Unsaponifiable Matter
- Determination of Acid Value
- Determination of Iodine Value
- Determination of Reichert Meissl and Polenske Value
- Test for Sesame Oil (Baudouins Test)
- Test for Cottonseed Oil (Halphens Test)
- Test for presence of Rice Bran Oil
- Test for presence of Linseed oil (Hexabromide Test)
- Polybromide test for Mustard Oil
- Detection of Rancidity
- Detection of Argemone oil
- Detection of Cottonseed oil
- Detection of Karanjia Oil
- Detection of Mineral Oil
- Detection of Castor oil



- Detection of mobile oil (Lube) in edible Oil
- Detection of Adulteration in coconut oil
- Detection of Vanaspati/Hydrogenated Edible Fat In Ghee

Reference Book/ Manual:

FSSAI- Manual of Methods of Analysis of Foods Oils & Fats, 2016

Pedagogic tools:

- Chalk and Board
- Power point presentation
- Video
- As per facilitator's choice

Suggested MOOCs: SWAYAM-NPTEL

Evaluation of Skill Enhancement Course -:

SEC (1 Credit theory + 1 Credit Practical)	
CCE-P-50% (25 Marks) and SEE-T-50% (25 Marks)	
Evaluation Components	Marks
Lab work Assessment – Performance : Lab quiz, Attendance, Aim achievement & Journal- Record book	05+05
Course End Practical Examination & Viva voce - One & Half Hours Duration	10+05
Total marks of CCE- Continuous and Comprehensive Evaluation	25
Semester-End Evaluation- Theory Examination– One Hours Duration	25
Total Marks for the Skill Enhancement Course	50

Semester End Exam Question Paper Pattern for SEC Theory:-

Time: 1 Hour

Marks: 25

Q. 1	10 Marks
(A) Objective QA: 06 Out of 10 MCQs carrying 01 mark each	(A) 06 Marks
(B) Subjective QA: 02 Out of 04 Subjective Que. carrying 02 mark each	(B) 04 Marks
Q. 2	10 Marks
(A) Objective QA: 06 Out of 10 Objective Que. carrying 01 mark each	(A) 06 Marks
(B) Subjective QA: 02 Out of 04 Subjective Que. carrying 02 mark each	(B) 04 Marks
Q. 3	05 Marks
Subjective QA: 01 Out of 03 Subjective Question related to Experimental Procedures	05 Marks



Courses Offered by BoS - Chemistry to other FYUGP- B.Sc. Program in Semester-II

SN	Course Category As per GoG- NEP- SOP - July 2023 & additional content 28/7/23	Course Title	Credit			Hrs./ Wk.		Evaluation - Weightage CCE: SEE = 50:50				
			T	P	Total	T	P	CCE Marks		SEE Marks		Total Marks
								T	P	T	P	
1	Minor (Elective)-2 (Chemistry) (In addition to courses mentioned in SOP basket; Recommended for Physical Science, Mathematical Science, Life science Programs)	Chemistry-2: Fundamental Chemistry-2 (4- Credit Course including Theory & Practical components)	3	1	4	3	2	25	25	50	-	100
2	Multi/Inter - Disciplinary Course -2 (MDC/IDC-2) (Elective) (In addition to courses mentioned in SOP basket; Recommended for Physical Science, Mathematical Science, Life science Programs)	Chemistry: Introduction to Basic Chemistry-2 (4- Credit Course including Theory & Practical components)	3	1	4	3	2	25	25	50	-	100

B.Sc. Honours/ Honours with Research in Chemistry (NCrF Level- 4.5 First Year – Certificate in Chemistry) Semester II

Course Category	Minor-2 In addition to courses mentioned in SOP basket; Recommended for Physical Science, Mathematical Science, Life science Programs
Title of the Course	Chemistry -2: Fundamental Chemistry-2
Course Credit	03
Teaching Hours per Sem.	45
Total Marks	CCE- 25 + SEE- 50

Course Outcomes - COs

Course out comes: This course will provide a broad foundation in chemistry that stresses scientific reasoning and analytical problem solving capability with a molecular perspective.

On completion of this course, the students will be able to understand:

- Electronic configuration, physical, spectral, magnetic and catalytic properties of first transition element 3D-series.
- Coordination complex theory, various ligands, geometry of complex and structural/stereo isomerism in complexes



- Water quality, type, effect and treatment.
 - Preparation , Properties and Reactions of Alkyl & Aryl Halides
 - Types of electrolytes, degree of dissociation and factors affecting degree of dissociation Ionic product of water, dissociation constants of weak acids and bases
 - Common ion effect and calculation of concentrations, Solubility and solubility products of sparingly soluble salts and Applications of solubility product principle
 - Hydrolysis of salts: Definition of hydrolysis of salts, Salts of strong acids and bases.
 - Buffersolutions:Definitionandtypesofbuffersolutions,Bufferaction
- The course will also strengthen the problem solving capacity of students.

1	Employability/Entrepreneurship/Skill Development પર કેન્દ્રિત થયેલ છે કે નહિ ?					Yes/No
2	Value added Courses Imparting Transferable and Life Skillsના ગુણો ધરાવે છે?					Yes/No
3	Major	Yes/No		Minor	Yes/No	
	Skill Enhancement Courses	Yes/No		Ability Enhancement Courses	Yes/No	
	Value Added Courses	Yes/No		Exit/ Vocational Courses	Yes/No	
4	Holistic Education	Yes/No	Multidisciplinary	Yes/No	Interdisciplinary	Yes/No
5	દિવ્યાંગ માટે વિષય અંતર્ગત આનુસંગિક જોગવાઈ કરાયેલ છે ?					Yes/No
6	New India Literacy Programme (NILP) મુજબનો વિષય છે?					Yes/No
7	Swayam પ્લેટફોર્મ પરના MOOC વિષય પર આધારિત આ વિષય છે ?					Yes/No
8	ઇન્ડિયન નોલેજ સીસ્ટમ (IKS) પર આધારિત વિષય છે ?					Yes/No

Unit No.	Topics	Hrs	Mks
1	<p>UNIT-1: Chemistry of elements of 3d series Introduction, definition, electronic configuration, reversal of energies of 3d and 4s orbitals,</p> <p>Physical properties such as atomic properties (atomic radii, Ionic radii, and ionization potential), metallic conductivity, reducing properties, tendency of formation of alloys, catalytic properties and magnetic properties.</p> <p>Calculation of spin only magnetic momentum of inner orbital and outer orbital complexes $[\text{NiCl}_4]^{-2}$, $[\text{Ni}(\text{CN})_4]^{-2}$, $[\text{FeF}_6]^{-4}$, $[\text{Fe}(\text{CN})_6]^{-4}$</p>	9	10



2	<p>UNIT- 2: Basics of Co-ordination Chemistry</p> <p>Werner theory, types of ligands (simple ligands, π-acid ligands, according to number of donating electrons, chelating ligands) with definition and examples</p> <p>Co-ordination number and geometry related to co-ordination number. Isomerism and its classification (structural & stereo isomerism)</p> <p>Structural isomerism: (a) ionization (b) hydration (c) co-ordination (d) co-ordination positions</p> <p>Geometric/cis-trans-isomerism in ML_4 and ML_6 types of complexes</p>	9	10
3	<p>UNIT-3: Alkyl and Aryl Halides</p> <p>Alkyl Halide: Nomenclature & Classification Preparation of Monohaloalkanes – From Alkene, From Alcohols, From Monocarboxylic acid (Hunsdiecker Reaction), From Alkyl halide (Finkelstein Reaction). Physical Properties of Haloalkane Nucleophilic Substitution reaction of Alkyl halide – Reaction with Moist Silver oxide, Sodium Alkoxides, Ammonia or Amines, Alkaline KCN & AgCN, Potassium hydrogen Sulphide, Alkali metal sulphides, Metallic Alkynides Dihaloalkanes : Gem & Vicinal, Preparation of Gem Dihalide from Alkynes & Carbonyl compounds, Preparation of Vicinal Dihalide From Alkynes & Vicinal Diols Introduction of Polyhaloalkanes : Haloforms, Tetrahaloalkanes & Chlorofluoro Carbons (CFS's) Acidic Character of Haloform & Relative acidity of Haloforms Reaction of Haloform - Hydrolysis, Addition reaction with Ketones, Reaction with Alkali (Dichlorocarbene preparation), Reduction, Oxydation Introduction to Unsaturated Halides : Vinyl Halide & Allyl Halides</p> <p>Aryl Halide: Preparation (by direct halogenation, from diazonium salts) Physical Properties of Aryl Halides; Chemical Reactions of Aryl Halides: Nucleophilic aromatic substitution S_NAr (Benzyne mechanism or Elimination- Addition mechanism) Reactions of Aryl halides: Wurtz-Fittig and Fittig reaction, Ullmann reaction, Formation of Organometallic Compounds</p> <p>Relative reactivity of alkyl halides vs allyl, vinyl, and aryl halides towards nucleophilic substitution reactions.</p>	9	10
4	<p>UNIT- 4: Water Treatment</p> <p>Introduction, Hard water & Soft water, Type, Method of expression & Units of hardness of hard water.</p>	9	10



	<p>Estimation of hardness of water by EDTA method with example</p> <p>Water Softening Process: 1. Sodalime 2. Permutit 3. Ion exchange 4. Reverse Osmosis.</p> <p>Treatment of Drinking water: 1. Sedimentation 2. Coagulation 3. Filtration 4. Sterilization by Chlorination</p> <p>Numerical related to Interconversion of Units & total hardness</p>		
5	<p>UNIT-5: Ionic Equilibrium</p> <p>Types of electrolytes, degree of dissociation and factors affecting degree of dissociation</p> <p>Ionic product of water, dissociation constants of weak acids and bases</p> <p>Common ion effect and calculation of concentrations of OH⁻ ions (NH₄Cl+NH₄OH) and H⁺ ions (H₂S+HCl),</p> <p>Solubility and solubility products of sparingly soluble salts. Applications of solubility product principle (solubility, whether precipitate out, salt out, and inorganic qualitative analysis)</p> <p>Hydrolysis of salts: Definition of hydrolysis of salts, Salts of strong acids and bases. Relation among K_h, K_a, or K and K_w.</p> <p>Degree of hydrolysis and pH of the solution of salts of weak acids and strong bases, salts of weak bases and strong acids and salts of weak bases and weak acids.</p> <p>Buffer solutions: Definition and types of buffer solutions, Buffer reaction, Derivation of Henderson-Hassel Balch equation</p> <p>Numerical</p>	9	10

Reference books

- UGC Inorganic Chemistry– Volume-III. C. Khera (Pragati Prakashan)
- Coordination Chemistry- Gurdeep Chatwal and M.S. Yadav
- Advanced Inorganic Chemistry by S.K. Agarwala & Keemti Lal (A Pragati Edition)
- Concise of Inorganic Chemistry- J. D. Lee
- Essentials of Physical Chemistry, B. S. Bahl, G. D. Tuli and Arun Bahl, S. Chand & Co. New Delhi
- Elements of Physical Chemistry, B. R. Puri, L. R. Sharma and Madan Pathania, Vishal Publishing Co. Jalandhar.
- Physical Chemistry, B. K. Sharma, Goel Publication House, Meerut.
- Organic Reaction Mechanism, including Reaction Intermediates, V.K. Ahluwalia, Ane's Chemistry active series.
- Organic Chemistry, Vol-1, by Sultanat, Ane's Student Edition, Ane Book Pvt Ltd
- Undergraduate Organic Chemistry, Vol-1, Jagdamba Singh, L.D.S. Yadav, Pragati Prakashan, 8th edition-2013

Pedagogic tools:

- Chalk and Board
- Power point presentation
- Video
- As per facilitator's choice

Suggested MOOCs: SWAYAM-NPTEL



B.Sc. Honours/ Honours with Research in Chemistry

(NCrF Level- 4.5 First Year – Certificate in Chemistry)

Semester II

Course Category	Minor Practical -2 In addition to courses mentioned in SOP basket; Recommended for Physical Science, Mathematical Science, Life science Programs
Title of the Course	Chemistry -2P: Fundamental Chemistry-2 Practical
Course Credit	01
Teaching Hours per Sem.	30
Total Marks	CCE- 25

Course Outcomes - COs

Course outcomes: This course will provide abroad foundation in chemistry that stresses scientific reasoning and analytical problem solving capability with a molecular perspective.

On completion of this course, the students will be able to perform/do independently:

- Determine various parameters of Water
- Determine the strength of various Redox titrants
- Determine the strength of commercial chemicals Volumetrically

1	Employability/Entrepreneurship/Skill Development પર કેન્દ્રિત થયેલ છે કે નહિ ?	Yes/No				
2	Value added Courses Imparting Transferable and Life Skillsનું ગુણો ધરાવે છે?	Yes/No				
3	Major	Yes/No	Minor	Yes/No		
	Skill Enhancement Courses	Yes/No	Ability Enhancement Courses	Yes/No		
	Value Added Courses	Yes/No	Exit/ Vocational Courses	Yes/No		
4	Holistic Education	Yes/No	Multidisciplinary	Yes/No	Interdisciplinary	Yes/No
5	દિવ્યાંગ માટે વિષય અંતર્ગત આનુસાંગિક જોગવાઈ કરાયેલ છે ?	Yes/No				
6	New India Literacy Programme (NILP) મુજબનો વિષય છે ?	Yes/No				
7	Swayam પ્લેટફોર્મ પરના MOOC વિષય પર આધારિત આ વિષય છે ?	Yes/No				
8	ઇન્ડિયન નોલેજ સીસ્ટમ (IKS) પર આધારિત વિષય છે ?	Yes/No				



Minor Practical-2

Exercise-I: Water Analysis

- pH & Conductivity
- Acidity
- Alkalinity
- Temporary, Permeant and Total Hardness

Exercise-II: Complexometric Analysis

- Quantitative estimation of Cu^{2+} in a given $\text{CuCl}_2 \cdot 2\text{H}_2\text{O}$ solution using 0.01M EDTA solution
- Quantitative estimation of Ni^{2+} in a given $\text{NiSO}_4 \cdot 7\text{H}_2\text{O}$ solution using 0.01M EDTA solution
- Quantitative estimation of Zn^{2+} in a given ZnCl_2 solution using 0.01M EDTA solution
- Quantitative estimation of Fe^{2+} by dichromate method (Internal indicator method)

Exercise-III: Industrial analysis

- Determination of acetic acid in a commercial vinegar using 0.1M NaOH solution
- Determination of alkali in antacid using 0.1M HCl solution
- To Estimate Vitamin C by titrimetric method.
- To determine amount of bleach / bleaching powder by thiosulphate titrimetric method.
- To determine sodium carbonate in soda ash

Reference Books:

- Vogel's Textbook of Quantitative Chemical Analysis, John Wiley & Sons, 1989.
- Willard, H. H., Merritt, L.L., Dean, J. & Settle, F.A. Instrumental Methods of Analysis, 7th Ed. Wadsworth Publishing Company Ltd., Belmont, California, USA, 1988.
- Christian, G.D; Analytical Chemistry, VI Ed. John Wiley & Sons, New York, 2004.
- Harris, D. C. Exploring Chemical Analysis, Ed. New York, W.H. Freeman, 2001.
- Skoog, D. A. Holler F.J. & Nieman, T.A. Principles of Instrumental Analysis, Cengage Learning India Ed, 2017.

Pedagogic tools:

- Chalk and Board
- Power point presentation
- Video
- As per facilitator's choice

Suggested MOOCs: Swayam-NPTEL



B.Sc. Honours/ Honours with Research in Chemistry
(NCrF Level- 4.5 First Year – Certificate in Chemistry)

Semester II

Course Category	MDC/IDC-2 In addition to courses mentioned in SOP basket; Recommended for Physical Science, Mathematical Science, Life science Programs
Title of the Course	Introduction to Basic Chemistry-2
Course Credit	03
Teaching Hours per Sem.	45
Total Marks	CCE- 25 + SEE-50

Course Outcomes - COs

Course out comes: This course will provide a broad foundation in chemistry that stresses scientific reasoning and analytical problem solving capability with a molecular perspective.

On completion of this course, the students will be able to understand:

- Electronic configuration, physical, spectral, magnetic and catalytic properties of first transition element 3D-series.
- Coordination complex theory, various ligands, geometry of complex and structural/stereo isomerism in complexes
- Water quality, type, effect and treatment.
- Preparation , Properties and Reactions of Alkyl & Aryl Halides
- Functional group based Organic chemistry wrt Alcohol, Phenol & Ethers

The course will also strengthen the problem solving capacity of students.

1	Employability/Entrepreneurship/Skill Development પર કેન્દ્રિત થયેલ છે કે નહિ ?	Yes/No				
2	Value added Courses Imparting Transferable and Life Skillsનું ગુણો ધરાવે છે?	Yes/No				
3	Major	Yes/No	Minor	Yes/No		
	Skill Enhancement Courses	Yes/No	Ability Enhancement Courses	Yes/No		
	Value Added Courses	Yes/No	Exit/ Vocational Courses	Yes/No		
4	Holistic Education	Yes/No	Multidisciplinary	Yes/No	Interdisciplinary	Yes/No
5	દિવ્યાંગ માટે વિષય અંતર્ગત આનુસંગિક જોગવાઈ કરાયેલ છે ?	Yes/No				
6	New India Literacy Programme (NILP) મુજબનો વિષય છે?	Yes/No				
7	Swayam પ્લેટફોર્મ પરના MOOC વિષય પર આધારિત આ વિષય છે ?	Yes/No				
8	ઇન્ડિયન નોલેજ સીસ્ટમ (IKS) પર આધારિત વિષય છે ?	Yes/No				



Unit No.	Topics	Hrs	Mks
1	<p>UNIT-1: Chemistry of elements of 3d series Introduction, definition, electronic configuration, reversal of energies of 3d and 4s orbitals,</p> <p>Physical properties such as atomic properties (atomic radii, Ionic radii, and ionization potential), metallic conductivity, reducing properties, tendency of formation of alloys, catalytic properties and magnetic properties.</p> <p>Calculation of spin only magnetic momentum of inner orbital and outer orbital complexes $[\text{NiCl}_4]^{-2}$, $[\text{Ni}(\text{CN})_4]^{-2}$, $[\text{FeF}_6]^{-4}$, $[\text{Fe}(\text{CN})_6]^{-4}$</p>	9	10
2	<p>UNIT- 2: Basics of Co-ordination Chemistry Werner theory, types of ligands (simple ligands, π-acid ligands, according to number of donating electrons, chelating ligands) with definition and examples</p> <p>Co-ordination number and geometry related to co-ordination number. Isomerism and its classification (structural & stereo isomerism)</p> <p>Structural isomerism: (a) ionization (b) hydration (c) co-ordination (d) co-ordination positions</p> <p>Geometric/cis-trans-isomerism in ML_4 and ML_6 types of complexes</p>	9	10
3	<p>UNIT-3: Alkyl and Aryl Halides</p> <p>Alkyl Halide: Nomenclature & Classification</p> <p>Preparation of Monohaloalkanes – From Alkene, From Alcohols, From Monocarboxylic acid (Hunsdiecker Reaction), From Alkyl halide (Finkelstein Reaction).</p> <p>Physical Properties of Haloalkane</p> <p>Nucleophilic Substitution reaction of Alkyl halide – Reaction with Moist Silver oxide, Sodium Alkoxides, Ammonia or Amines, Alkaline KCN & AgCN, Potassium hydrogen Sulphide, Alkali metal sulphides, Metallic Alkynides</p> <p>Dihaloalkanes : Gem & Vicinal, Preparation of Gem Dihalide from Alkynes & Carbonyl compounds, Preparation of Vicinal Dihalide From Alkynes & Vicinal Diols</p> <p>Introduction of Polyhaloalkanes : Haloforms, Tetrahaloalkanes & Chlorofluoro Carbons (CFS's)</p> <p>Acidic Character of Haloform & Relative acidity of Haloforms</p>	9	10



	<p>Reaction of Haloform - Hydrolysis, Addition reaction with Ketones, Reaction with Alkali (Dichlorocarbene preparation), Reduction, Oxydation</p> <p>Introduction to Unsaturated Halides : Vinyl Halide & Allyl Halides</p> <p>Aryl Halide: Preparation (by direct halogenation, from diazonium salts)</p> <p>Physical Properties of Aryl Halides;</p> <p>Chemical Reactions of Aryl Halides: Nucleophilic aromatic substitution S_NAr (Benzyne mechanism or Elimination- Addition mechanism)</p> <p>Reactions of Aryl halides: Wurtz-Fittig and Fittig reaction, Ullmann reaction, Formation of Organometallic Compounds</p> <p>Relative reactivity of alkyl halides vs allyl, vinyl, and aryl halides towards nucleophilic substitution reactions.</p>		
4	<p>UNIT-3: Alcohols, Phenol, Ethers and Epoxides</p> <p>Alcohols Preparation of Monohydric alcohols: From Grignard reagent; by reduction of aldehydes, ketones, carboxylic acid, and esters.</p> <p>Physical Properties of alcohols and Chemical Reactions: Reaction with sodium, with carboxylic acids (esterification), with acid chloride & anhydride; Reaction with HX, reaction with PX_5, PX_3, $SOCl_2$ Dehydration of alcohols and Oxidation (with alkaline $KMnO_4$, acidic dichromate conc. HNO_3)</p> <p>Distinction between Primary, secondary & tertiary alcohols: Lucas test, Victor Meyer Test</p> <p>Phenol :Physical properties; Acidity and factors affecting it;</p> <p>Electrophilic substitution Reactions (Nitration, Halogenation & Sulphonation),</p> <p>Ethers: Preparation of Ethers by Williamson Synthesis</p> <p>Reactions: Substitution Reaction [Reaction with Cl_2 in dark & Reaction of Cl_2 in light], Reactions involving C-O bond cleavage [hydrolysis, reaction with H_2SO_4, cold HI & hot HI]</p>	9	10
5	<p>UNIT- 5: Water Treatment</p> <p>Introduction, Hard water & Soft water, Type, Method of expression & Units of hardness of hard water.</p> <p>Estimation of hardness of water by EDTA method with example</p> <p>Water Softening Process: 1. Sodalime 2. Permutit 3. Ion exchange 4. Reverse Osmosis.</p> <p>Treatment of Drinking water: 1. Sedimentation 2. Coagulation 3. Filtration 4. Sterilization by Chlorination</p> <p>Numerical related to Interconversion of Units & total hardness</p>	9	10



Reference Books:

- Advanced Inorganic Chemistry by S.K. Agarwal & KeemtiLal (A Pragati Edition)
- Concise of Inorganic Chemistry-J. D. Lee
- Essentials of Physical Chemistry, B. S. Bahl, G. D. Tuli and Arun Bahl, S. Chand &Co.New Delhi
- Physical Chemistry, B. K. Sharma, Goel Publication House, Meerut.
- Organic Reaction Mechanism, including Reaction Intermediates, V.K. Ahluwalia, Ane's Chemistry active series.
- Organic Chemistry, Vol-1, by Sultanat, Ane's Student Edition, Ane Book Pvt Ltd
- Vogel's Textbook of Quantitative Chemical Analysis, John Wiley & Sons, 1989.
- Willard, H. H., Merritt, L.L., Dean, J. & Settle, F.A. Instrumental Methods of Analysis, 7thEd. Wadsworth Publishing Company Ltd., Belmont, California, USA, 1988.
- Christian, G.D; Analytical Chemistry, VI Ed. John Wiley & Sons, New York, 2004.
- Harris, D. C. Exploring Chemical Analysis, Ed. New York, W.H. Freeman, 2001.
- Skoog, D. A. Holler F.J. & Nieman, T.A. Principles of Instrumental Analysis, Cengage Learning India Ed, 2017.

Pedagogic tools:

- Chalk and Board
- Power point presentation
- Video
- As per facilitator's choice

Suggested MOOCs: Swayam-NPTEL



B.Sc. Honours/ Honours with Research in Chemistry
(NCrF Level- 4.5 First Year – Certificate in Chemistry)

Semester II

Course Category	MDC/IDC Practical -2 In addition to courses mentioned in SOP basket; Recommended for Physical Science, Mathematical Science, Life science Programs
Title of the Course	Introduction to Basic Chemistry Practical-2
Course Credit	01
Teaching Hours per Sem.	30
Total Marks	CCE- 25

Course Outcomes - COs

Course outcomes: This course will provide abroad foundation in chemistry that stresses scientific reasoning and analytical problem solving capability with a molecular perspective.

On completion of this course, the students will be able to perform/do independently:

- Determine various parameters of Water
- Determine the strength of various Redox titrants
- Determine the strength of commercial chemicals Volumetrically

1	Employability/Entrepreneurship/Skill Development પર કેન્દ્રિત થયેલ છે કે નહિ ?	Yes/No				
2	Value added Courses Imparting Transferable and Life Skillsનું ગુણો ધરાવે છે?	Yes/No				
3	Major	Yes/No	Minor	Yes/No		
	Skill Enhancement Courses	Yes/No	Ability Enhancement Courses	Yes/No		
	Value Added Courses	Yes/No	Exit/ Vocational Courses	Yes/No		
4	Holistic Education	Yes/No	Multidisciplinary	Yes/No	Interdisciplinary	Yes/No
5	દિવ્યાંગ માટે વિષય અંતર્ગત આનુસાંગિક જોગવાઈ કરાયેલ છે ?				Yes/No	
6	New India Literacy Programme (NILP) મુજબનો વિષય છે ?				Yes/No	
7	Swayam પ્લેટફોર્મ પરના MOOC વિષય પર આધારિત આ વિષય છે ?				Yes/No	
8	ઇન્ડિયન નોલેજ સીસ્ટમ (IKS) પર આધારિત વિષય છે ?				Yes/No	



MDC/IDC Practical-2
<p style="text-align: center;">Exercise-I: Water Analysis</p> <ul style="list-style-type: none">• pH & Conductivity• Acidity• Alkalinity• Temporary, Permanent and Total Hardness
<p style="text-align: center;">Exercise-II: Complexometric Analysis</p> <ul style="list-style-type: none">• Quantitative estimation of Cu^{2+} in a given $\text{CuCl}_2 \cdot 2\text{H}_2\text{O}$ solution using 0.01M EDTA solution• Quantitative estimation of Ni^{2+} in a given $\text{NiSO}_4 \cdot 7\text{H}_2\text{O}$ solution using 0.01M EDTA solution• Quantitative estimation of Zn^{2+} in a given ZnCl_2 solution using 0.01M EDTA solution• Quantitative estimation of Fe^{2+} by dichromate method (Internal indicator method)
<p style="text-align: center;">Exercise-III: Industrial analysis</p> <ul style="list-style-type: none">• Determination of acetic acid in a commercial vinegar using 0.1M NaOH solution• Determination of alkali in antacid using 0.1M HCl solution• To Estimate Vitamin C by titrimetric method.• To determine amount of bleach / bleaching powder by thiosulphate titrimetric method.• To determine sodium carbonate in soda ash

Reference Books:

- Vogel's Textbook of Quantitative Chemical Analysis, John Wiley & Sons, 1989.
- Willard, H. H., Merritt, L.L., Dean, J. & Settle, F.A. Instrumental Methods of Analysis, 7th Ed. Wadsworth Publishing Company Ltd., Belmont, California, USA, 1988.
- Christian, G.D; Analytical Chemistry, VI Ed. John Wiley & Sons, New York, 2004.
- Harris, D. C. Exploring Chemical Analysis, Ed. New York, W.H. Freeman, 2001.
- Skoog, D. A. Holler F.J. & Nieman, T.A. Principles of Instrumental Analysis, Cengage Learning India Ed, 2017.

Pedagogic tools:

- Chalk and Board
- Power point presentation
- Video
- As per facilitator's choice

Suggested MOOCs: SWAYAM-NPTEL

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