



भारत 2023 INDIA

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નં.એકે/વિજ્ઞાન/ ૮૪૩૫૧ /૨૦૨૩

તા. ૨૩/૦૮/૨૦૨૩

રસાયણશાસ્ત્ર

પરિપત્ર:-

સૌરાષ્ટ્ર યુનિવર્સિટીની વિજ્ઞાન વિદ્યાશાખા હેઠળની સ્નાતક કક્ષાના B.Sc.(રસાયણશાસ્ત્ર)ના અભ્યાસક્રમ ચલાવતી સર્વે સંલગ્ન કોલેજોના આચાર્યશ્રીઓને આથી જાણ કરવામાં આવે છે કે, NEP-2020 અંતર્ગતના રાજ્ય સરકારશ્રીના તા.૧૧/૦૭/૨૦૨૩ના ઠરાવ ત્યારબાદ તા.૨૭/૦૭/૨૦૨૩ના રોજ પ્રકાશિત થયેલ સ્ટાન્ડર્ડ ઓપરેટિંગ પ્રોસિજર(SOP) તેમજ ત્યારબાદ તેને આનુસંગિક તા.૨૮/૦૭/૨૦૨૩ના રોજ આવેલ સુધારા મુજબના અભ્યાસક્રમો ચેરમેનશ્રી, રસાયણશાસ્ત્ર વિષયની અભ્યાસ સમિતિ દ્વારા રજુ કરાયેલ B.Sc.(રસાયણશાસ્ત્ર) સેમેસ્ટર-૦૧ના અભ્યાસક્રમો આગામી શૈક્ષણિક સત્ર જુન-૨૦૨૩થી અમલમાં આવે તે રીતે રસાયણશાસ્ત્ર વિષયની અભ્યાસ સમિતિ, વિજ્ઞાન વિદ્યાશાખા, એકેડેમિક કાઉન્સિલ તથા સિન્ડિકેટની બહાલીની અપેક્ષાએ મંજૂર કરવા માન.કુલપતિશ્રીને ભલામણ કરેલ, જે માન.કુલપતિશ્રીએ મંજૂર કરેલ છે. જેથી સંબંધિત તમામે તે મુજબ તેની યુસ્તપણે અમલવારી કરવી.

(મુસદ્દો કુલસચિવશ્રીએ મંજૂર કરેલ છે.)

સહી/-

(ડૉ. એચ.પી.રૂપારેલીઆ)

કુલસચિવ

રવાના કર્યું

બિડાણ:- ઉક્ત અભ્યાસક્રમ (સોફ્ટ કોપી)

૨૩/૮/૨૩

એકેડેમિક ઓફીસર

પ્રતિ,

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

(૨) વિજ્ઞાન વિદ્યાશાખા હેઠળની રસાયણશાસ્ત્ર વિષયની અભ્યાસ સમિતિના સર્વે સભ્યશ્રીઓ

નકલ જાણ અર્થે રવાના:-

૧. માન.કુલપતિશ્રી/કુલસચિવશ્રીના અંગત સચિવ

નકલ રવાના (યોગ્ય કાર્યવાહી અર્થે):-

૧. ડીનશ્રી, વિજ્ઞાન વિદ્યાશાખા

૨. પરીક્ષા વિભાગ

૩. પી.જી.ટી.આર.વિભાગ

૪. 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)

Effective from June-2023 & onwards

(Submitted on 14/08/2023)



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 and Model curriculum 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 valuable college education and employment oriented carrier.
2. To frame the syllabus in accordance with the semester system, UGC- NEP 2020 and Standard Operating Procedure for Implementation of NEP-2020 for the State of Gujarat- HEIs of Gujarat, 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.

Prof. H. S. Joshi (Chairman),

Dr. K.D. Ladva (Other than Chairman)

Board of Studies, Chemistry

Dr. M.G. Borisagar,

Subject Expert, Board of Studies, Chemistry

Saurashtra University, Rajkot (Gujarat)ss

Date: 14th August 2023.



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 effectively communicate 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:**

PO₁	Foundational Knowledge	Understand major concepts, theoretical principles and experimental findings in chemistry.
PO₂		Conduct experiments, analyse data, and interpret results, while maintaining responsible and ethical scientific conduct.
PO₃	Scientific Aptitude	Employ critical thinking and efficient problem-solving skills in the four basic areas of chemistry - organic, inorganic, analytical, and physical.
PO₄		Exhibit awareness about safety and chemical hygiene regulations and good laboratory practices.
PO₅	Modern Tool Usage	Apply classical and minor instruments for chemical analysis and separation.
PO₆		Able to use computers and electronic resources for data management and retrieval.
PO₇		Communicate effectively in written and oral forms to transmit technical information in a clear and concise manner.
PO₈	Lifelong Learning	Comprehend and exhibit fundamental aspects of chemical sciences facilitating placement into PG programs, professional organizations, or other related job.
PO₉		Effectively work in diverse teams in all curricular, co-curricular and extra-curricular activities.
PO₁₀	Global Citizenship	Appraise and demonstrate Universal brotherhood

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

PSO₁	Acquire knowledge on the fundamentals aspects of chemistry leading to functional understanding of emerging concepts and technologies in chemical sciences.
PSO₂	Able to pursue higher education and research in the institutes of national and international repute.
PSO₃	Apply conceptual knowledge of Chemistry to identify practical & innovative solutions for socio-economically relevant issues.
PSO₄	Demonstrate ability to skilfully utilize the chemical literature to identify existing problems and employ tools & techniques of applied chemistry for finding sustainable & ethical solutions.
PSO₅	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 I

SN	Course Category As per GoG- NEP-SOP - July 2023& additional content 28/7/23	Course Title	Credit		SEE Dura tion Hrs.	Evaluation - Weightage CCE: SEE = 50:50		
			T	P		CCE Marks	SEE Marks	Total Marks
1	Major (Core) 1 (Chemistry)	Chemistry -1: Fundamental Chemistry-1	3	-	2½	75	75	150 To be converted for 75
2	Major(Core) 1 Practical (Chemistry)	Chemistry -1P: Fundamental Chemistry-1 Practical	-	1	2	25	25	50 To be converted for 25
3	Major (Core) 2 (Chemistry)	Chemistry -2: Fundamental Chemistry-2	3	-	2½	75	75	150 To be converted for 75
4	Major (Core) 2 Practical (Chemistry)	Chemistry -2P: Fundamental Chemistry-2 Practical	-	1	2	25	25	50 To be converted for 25
5	Minor(Elective)*-1	(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)	3	-	2½	75	75	150 To be converted for 75
6	Minor (Elective) * Practical-1	Practical of the Course selected as Minor	-	1	2	25	25	50 To be converted for 25
7	Multi/Inter -Disciplinary Course -1 (MDC/IDC-1) (Elective)** 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)	3		2½	75	75	150 To be converted for 75
8	Multi/Inter -Disciplinary Course Practical-1 (MDC/IDC-1) (Elective) ** Categories: Natural & Physical Science/	Practical of the Course selected as MDC/IDC-1	-	1	2	25	25	50 To be converted for 25



	Maths.,Stat.and Comp. Appl./Lib.,Info.and Media Sci./Comm. and Mgt./Huma., and Social Sci./ Sanskrit etc...							
9	Ability Enhancement Course -1(AEC-1)	(As per GoG- NEP-SOP July 2023& additional content 28/7/23 – Clause 3.3.4) English Language: Development of Functional English	2	-	2	50	50	100 To be converted for 50
10	Skill Enhancement Course-1 (SEC-1)	(As per GoG- NEP-SOP July 2023& additional content 28/7/23 – Clause 3.3.5) Skill based Practical Course-1: Common Adulterants Testing in Food	-	2	2	50	50	100 To be converted for 50
11	Common Value Added Course-1 (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	50	50	100 To be converted for 50
Total Credits and Marks (Semester-I)			14	8	NA	550	550	1150 To be converted for 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 will continue in the semester-II as well.

*** Common **Value Added Elective Courses (C-VAC-1)** common to all is to be selected from University Basket for semester 1, as per the expertise and resources available in the college.



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

SN	Course Category As per GoG- NEP- SOP - July 2023 & additional content 28/7/23	Course Title	Credit		SEE Durati on Hrs.	Evaluation - Weightage CCE: SEE = 50:50		
			T	P		CCE Marks	SEE Marks	Total Marks
1	Minor (Elective)-1 (Chemistry) (In addition to courses mentioned in SOP basket; Recommended for Physical Science, Mathematical Science, Life science Programs)	Chemistry-1: Fundamental Chemistry-1	3	-	2½	75	75	150 To be converted for 75
2	Minor (Elective) Practical-1 (Chemistry) (In addition to courses mentioned in SOP basket; Recommended for Physical Science, Mathematical Science, Life science Programs)	Chemistry-1P: Fundamental Chemistry-1 Practical	-	1	2	25	25	50 To be converted for 25
3	Multi/Inter - Disciplinary Course -1 (MDC/IDC-1) (Elective) (In addition to courses mentioned in SOP basket; Recommended for Physical Science, Mathematical Science, Life science Programs)	Chemistry: Introduction to Basic Chemistry-1	3	-	2½	75	75	150 To be converted for 75
4	Multi/Inter - Disciplinary Course Practical-1 (MDC/IDC Practical-1) (Elective) (In addition to courses mentioned in SOP basket; Recommended for Physical Science, Mathematical Science, Life science Programs)	Chemistry: Introduction to Basic Chemistry Practical-1	-	1	2	25	25	50 To be converted for 25



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	3 credit subjects (Marks)	2 credit subjects (Marks)
1	CCE (50%)		
	Classroom & Mid-Term Evaluation	75	50
2	SEE (50%)	75	50
	Total	150	100

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.

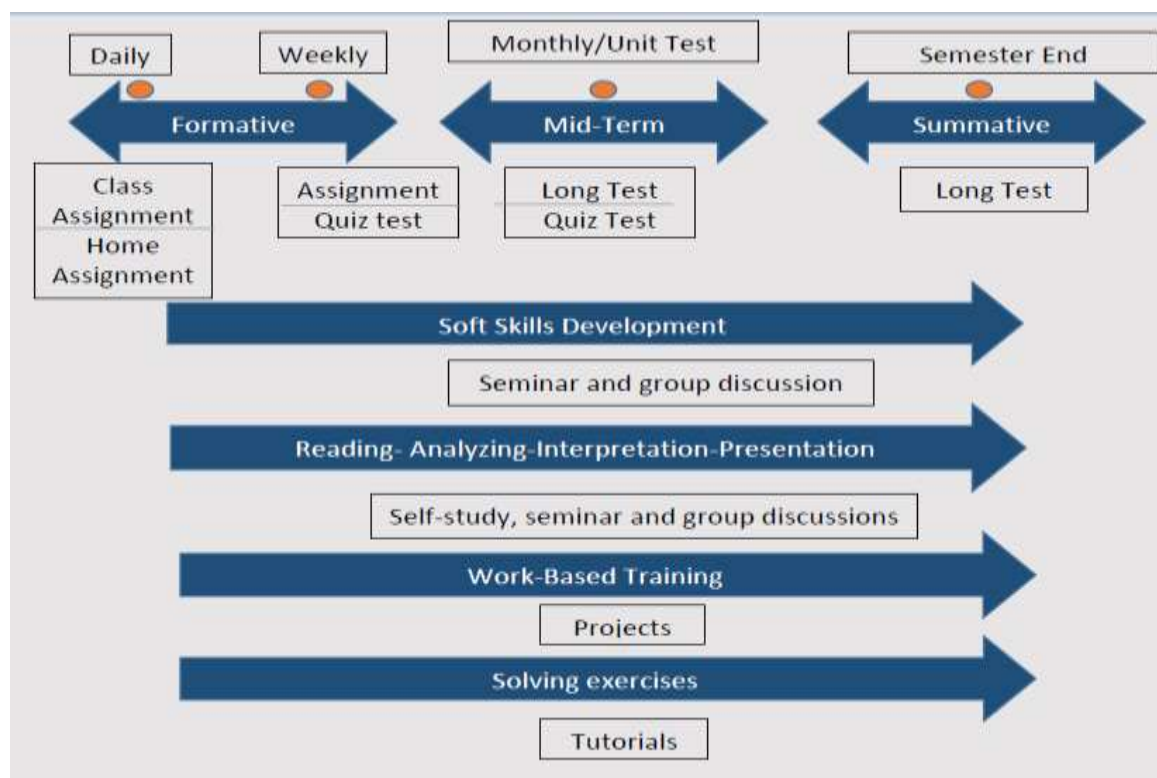
Eligibility Criteria to appear in SEE

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.



Model for Theory Courses- 3 Credit Course	
CCE-50% (75) SEE-50% (75)	
Exam Pattern	Marks
Class Test (Average of TWO tests)	15
Quiz (Average of TWO quiz)	15
Home Assignment	15
Active Learning- PBL/CSBL/Seminar/Flipped Class Room etc. OBE evaluation tools.	10
Class Assignment	10
Attendance	10
Continuous and Comprehensive Evaluation	75
Semester-End Evaluation	75

*Similarly Model for Theory 4 Credit Courses be formulated and can be implemented after discussion and approval.

Model for Practical Courses-1 Credit Course	
CCE-50% (25)SEE-50% (25)	
Exam Pattern	Marks
Lab work assessment	10
Viva voce/Lab quiz	10
Attendance	05
Continuous and Comprehensive Evaluation	25
Semester-End Evaluation	25

*Similarly Model for Practical2 Credit Courses be formulated and can be implemented after discussion and approval.

Model for Project/Self-study Courses-4 Credit Course	
CCE-50% (100)SEE-50% (100)	
Exam Pattern	Marks
Project Evaluation	80
Participation in discussion	10
Attendance	10
Continuous and Comprehensive Evaluation	100
Semester-End Evaluation	100

*Model for Project/Self-study Courses will be implemented from semester-6 after discussion and approval.

Model for Work Experience Courses-4 Credit Course	
CCE-50% (100)SEE-50% (100)	
Exam Pattern	Marks
Project Evaluation	80
Participation in discussion	10
Attendance	10
Continuous and Comprehensive Evaluation	100
Semester-End Evaluation	100

*Model for Work Experience Courses will be implemented from semester-6 after discussion and approval.



Model for Skill Enhancement Course - Skill based Practical Course -2 Credit Course	
CCE-50% (50)SEE-50% (50)	
Exam Pattern	Marks
Lab work assessment or Project based Assessment	20
Viva voce/Lab quiz	20
Attendance& Performance	10
Continuous and Comprehensive Evaluation	50
Semester-End Evaluation	50

Component	Credit	Marks	SEE Duration Hrs.	Evaluation - Weightage CCE: SEE = 50:50			
				CCE Marks	SEE Marks	Total Marks	Total Marks converted for
Theory	3	75	2$\frac{1}{2}$	75	75	150	75
Practical	1	25	2	25	25	50	25
Total	NA	100	NA	100	100	200	100

*Similarly Model for Theory 4 Credits Courses and Practical2 Credit Courses be formulated and can be implemented after discussion and approval.



Theory Question Paper Pattern

Semester End Examination (SEE)

Instructions:

- All Units/ Module carry equal weightage of 15 Marks each
- There must be One Question from each Unit/ Module
- Each Subtopic/ Chapter must be given due weightage in the Question paper
- Time duration: 2½Hours

The Theory Question Paper Skeleton is as follows

Question 1 (Unit/Module 1)		Marks
A	Answer All Three	03
B	Answer Any Two out of Three	06
C	Answer Any One out of Two	06
Total Marks Question 1		15
Question 2 (Unit/Module 2)		Marks
A	Answer All Three	03
B	Answer Any Two out of Three	06
C	Answer Any One out of Two	06
Total Marks Question 2		15
Question 3 (Unit/Module 3)		Marks
A	Answer All Three	03
B	Answer Any Two out of Three	06
C	Answer Any One out of Two	06
Total Marks Question 3		15
Question 4 (Unit/Module 4)		Marks
A	Answer All Three	03
B	Answer Any Two out of Three	06
C	Answer Any One out of Two	06
Total Marks Question 4		15
Question 5 (Unit/Module 5)		Marks
A	Answer All Three	03
B	Answer Any Two out of Three	06
C	Answer Any One out of Two	06
Total Marks Question 5		15



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

Semester I

Course Category	Major-1
Title of the Course	Chemistry -1: Fundamental Chemistry-1
Course Credit	03
Teaching Hours per Sem.	45
Total Marks	75

Course Outcomes - COs

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 understand;

- Atomic Structure and Periodic Properties in general and Characteristics of S & P block elements
- This course gives a broader theoretical picture in multiple stages in an overall chemical reaction
- Reactive intermediates, transition states and states of all the bonds broken and formed.
- Basic principles of Organic chemistry and functional group base reactivity.
- Stereochemistry concepts like Configuration, Fischer projection formula, homomers and enantiomers, geometrical isomerism: cis–trans, C.I.P rules with E/Z notations.
- Chemistry & characteristic of Hydrocarbons
- Basic concept of Analytical chemistry

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	Unit-I : Atomic Structure and Periodic Properties: Dual nature of electron: de-Broglie's equation, Heisenberg's Uncertainty Principle, quantum numbers, Aufbau Principle, Pauli's Exclusion Principle and Hund's Rule for electron configuration. Periodicity in atomic properties and its causes, explanation of general trends of Periodic Properties in detail: Atomic size, Covalent & van der Waals radius, Atomic & Ionic radii, Ionization Potential, Electronegativity and Electron Affinity.	9	15
2	Unit-II: Chemistry of s and p block elements: Electronic configuration of s and p block elements, Special characteristics such as Metallic character, Electropositive character, Oxidizing & Reducing property, Polarizing power, Hydration energy, Inert pair effect, Relative stability of different oxidation state. Diagonal relationship of (1) lithium with magnesium (2) boron with silicon and (3) beryllium with aluminium. Anomalous behaviour of Li, Be, Formation of complex compounds, catenation, allotropy (diamond and graphite-their structure, properties and its uses)	9	15
3	Unit-III: Basic Organic Chemistry and Aliphatic Hydrocarbons containing σ-bond: Nomenclature of organic compounds (Only Acyclic-IUPAC-1993) Electronic displacements: Inductive effect, electromeric effect, mesomeric effect and hyper-conjugation. Applications of inductive effect to bond length, dipole-moment, reactivity of alkyl halides, relative strength of acid, basicity of amines Homolytic and heterolytic fission, curly arrow rules. Reaction Intermediates: Carbocation, carbanion, free radical, carbenes and benzynes (Formation by cleavage type, structure, relative stabilities, generation) Types of organic reagents: Nucleophiles and electrophiles. Types of organic reactions: Substitution, addition, elimination and rearrangement. Nucleophilic substitution reaction mechanism (SN1&SN2) for alkyl halides Introduction to stereochemistry: Configuration, Fischer projection formula, homomers and enantiomers, geometrical isomerism: cis-trans, C.I.P rules with E/Z notations.	9	15



4	<p>Unit-IV: Aliphatic Acyclic Hydrocarbons:</p> <p>Hydrocarbons containing Carbon-Carbon π bonds: Formation of alkene by Elimination reactions, dehydration of alcohol, dehydro halogenation of alkyl halide, dehalogenation of vicinal and geminal dihalides Mechanism of E1, E2, E1cb reactions, Saytzeff and Hofmann eliminations.</p> <p>Electrophilic addition reaction and its mechanism (Markownikov/Anti Markownikov rule) Reactions of alkenes: Hydroboration oxidation, Ozonolysis, Reduction (catalytic), Syn and anti-hydroxylation (oxidation), 1, 2- and 1,4 -addition reactions in conjugated dienes, Diels-Alder reaction.</p> <p>Formation of alkynes: Dehydro halogenation of vicinal and geminal dihalides, Dehalogenation of tetra halides Reactions of alkynes: Acidity, electrophilic addition reactions like halogenation, hydro halogenation, hydration, hydroboration, addition of carbene and catalytic hydrogenation.</p> <p>Nucleophilic addition with hydrogen cyanide and alcohol, hydration to form carbonyl compounds, alkylation of terminal alkynes.</p>	9	15
5	<p>Unit-V: Basic concepts of Analytical Chemistry:</p> <p>Definitions of analysis, determination, measurement, techniques and methods. Classification of analytical techniques. Choice of an analytical method - accuracy, precision, sensitivity, selectivity, method validation. Figures of merit of analytical methods and limit of detection (LOD), Limit of quantification (LOQ), linear dynamic range (working range).</p> <p>Definitions of Errors and treatment of analytical data: Limitations of analytical methods -Errors: Determinate and indeterminate errors, absolute error, relative error, minimization of errors. Definition of Statistical treatment of finite samples -mean, median, and range, standard deviation variance. Numerical problems.</p> <p>Brief of Basic laboratory practices, Sampling (solids and liquids), weighing, drying, dissolving. Acid treatment, Rules of work in analytical laboratory, General rule for performing quantitative determinations (volumetric and gravimetric).</p> <p>Safety in Chemical laboratory, Rules of fire prevention and accidents, First aid. Precautions to be taken while handling toxic chemicals, concentrated/fuming acids and organic solvents.</p>	9	15



Reference Books:

- UGC Inorganic Chemistry–Volume-I H.C.Khera (Pragati Prakashan).
- Concise Inorganic Chemistry -J.D.Lee.
- Coordination Chemistry- Gurdeep Chatwal and M.S.Yadav.
- Advanced Inorganic Chemistry by S.K.Agarwal & KeemtiLal (A Pragati Edition)
- 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
- 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.
- Chemical Kinetics, G.R.Chatwal and Harish Mishra, Goel Publication House, Meerut.
- 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 I

Course Category	Major Practical -1
Title of the Course	Chemistry -1P: Fundamental Chemistry-1 Practical
Course Credit	01
Teaching Hours per Sem.	30
Total Marks	25

Course Outcomes - COs

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 perform/do independently**:

- Calibration of glass wares and preparation & standardization of Solutions
- Determine the strength of various Acids- Bases and Oxidants- Reductants

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	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-1

Exercise-I: Basic concepts of Volumetric Analysis

- Calibration of Glassware - Pipette, Burette, Measuring cylinder and Volumetric flask
- Preparation and Standardization of Solutions: Succinic acid, Oxalic acid, HCl, H₂SO₄, NaOH, KOH, Na₂CO₃, NaHCO₃, KMnO₄, K₂Cr₂O₇

Exercise-II: Volumetric Analysis - Acid-base titrations

- To prepare a solution by dissolving 'x' g NaHCO₃ /Na₂CO₃ in 100 ml solution and determine its concentration in terms of normality and molarity using 0.1 N HCl solution.
- To determine the normality, molarity and g/lit of NaOH and HCl using 0.1 N Na₂CO₃ solution.
- To determine the normality, molarity and g/lit of each component in a given mixture of NaHCO₃ and Na₂CO₃ using 0.1N HCl solution.
- To estimate Tartaric acid by Acid- base direct titration method.
- To estimate Salicylic acid by Acid- base direct titration method.

Exercise-III: Volumetric Analysis - Redox titrations

- To determine the normality, molarity and g/lit of each component in a mixture of H₂C₂O₄.2H₂O and H₂SO₄ using 0.1 N KMnO₄ and 0.1N NaOH solution.
- To determine the normality, molarity and g/lit of each component in a mixture of H₂C₂O₄.2H₂O and K₂C₂O₄.2H₂O using 0.1N NaOH and 0.1 N KMnO₄ solution
- To determine the normality, molarity and g/lit of KMnO₄ and FeSO₄.7H₂O solution using 0.1 N H₂C₂O₄.2H₂O solution.
- To determine the normality, molarity and g/lit of FeSO₄ (NH₄)₂SO₄.6H₂O and K₂Cr₂O₇ solutions using 0.1 N KMnO₄ solution.
- To determine Fe⁺² by K₂Cr₂O₇ method.

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, 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 I

Course Category	Major-2
Title of the Course	Chemistry -2: Fundamental Chemistry-2
Course Credit	03
Teaching Hours per Sem.	45
Total Marks	75

Course Outcomes - COs

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;

- Basic concepts of ionic compound and relevant equation and relationship between radius ratio, co-ordination number and crystal structure.
- VB & MO theory of chemical bonding and Stereo chemistry and Energy level diagrams of molecules
- Synthetic methods of preparation of alkanes and cycloalkanes. Chemical properties and conformational analysis of simple alkanes.
- Aromaticity and electrophilic aromatic substitution reactions with their mechanism.
- The course will also strengthen the problem solving capacity of students.
- Basic concept and application of adsorption and catalysis

1	Employability/Entrepreneurship/Skill Development પરકેન્દ્રિતથયેલછેકેનહિ ?	Yes/No				
2	Value added Courses Imparting Transferable and Life Skillsનાગુણોધરાવેછે?	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	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-I : Basics of Ionic Compounds: Introduction, characteristics of ionic solids, Born Haber cycle and its application, MaxBornequation, limiting radius ratio. Relation between radius ratio, co-ordination number and crystal structure Derivation of r^+/r^- ratio in triangular, planar, square planar, body centred and tetrahedral crystal lattices. Defects in ionic crystals (stoichiometric and non-stoichiometric), study of N & P types of semi-conductors	9	15
2	Unit-II: Chemical Bonding in Covalent Compounds: Covalent bond: Valence bond theory and its limitations, Concept of hybridization: sp ($BeCl_2$), sp^2 (BF_3), sp^3 (SiH_4), sp^3d (PCl_5) and sp^3d^2 (SF_6). Stereochemistry of Inorganic molecules: Sidgwick Powell rule and VSEPR theory, Structure of molecules: $SnCl_2$, SO_4^{2-} , CO_3^{2-} , Basic concept of MO theory, Bonding and Anti-bonding Molecular Orbitals, Gerade & Ungerade Molecular Orbitals, σ - Molecular Orbital and σ^* - Molecular Orbital, π -Molecular Orbital and π^* -Molecular Orbital, Conditions for effective combinations of atomic orbitals Energy level diagrams of B_2 , C_2 , N_2 , O_2 , F_2 , CO , NO , CO_2 (with s-p mixing and orbital interaction) with calculation of bond order and magnetic moment Comparison of MO theory and VB theory.	9	15
3	Unit-III: Alkanes and Cycloalkanes Chemistry of alkanes: Formation of alkanes: Wurtz reaction, Wurtz-Fittig reaction. Free radical substitutions: Halogenation- relative reactivity and selectivity. Introduction and classification of ring system (monocyclic and polycyclic, size, number of carbon atom common between the two rings) IUPAC nomenclature of cycloalkanes (including simple spiro compounds, fused ring and bridged ring systems-bicyclic only) Method of preparation of small ring cycloalkanes: Intra-molecular Wurtz's reaction, Simmons-Smith, Diels-Alder reaction Chemical Properties of Cycloalkanes: Substitution Reactions, Addition Reactions, Baeyer's Strain Theory and its limitations (puckering) Conformations, conformational analysis, conformation of ethane, propane and butane	9	15



4	Unit-IV: Aromatic Hydrocarbons Aromaticity: Criteria for (aromatic, non-aromatic and anti-aromatic), applications of Huckel's rule to simple annulene, cyclic carbocation/anion. Electrophilic aromatic substitution reactions of benzene with mechanisms, theory of effect of substituents on reactivity and orientation (with resonating structures for activating and deactivating groups) Electrophilic aromatic substitution reactions with mechanisms: Halogenation, Nitration, Sulphonation, Friedel-Crafts alkylation, Friedel-Crafts acylation	9	15
5	Unit-V: Adsorption and Catalysis Adsorption: Introduction, types of adsorption (physical and chemical), characteristics and factors affecting adsorption, Adsorption isotherm and Freundlich equation, Langmuir theory of adsorption: assumptions, derivation, modification in equation at very low and high pressure and applications of adsorption. Catalysis: Introduction, types of catalysis (homogeneous and heterogeneous), characteristics of catalysis, autocatalysis, negative catalysis (Inhibitor), promoters, and catalytic poisoning Activation energy and catalysis. Theories of catalysis: (1) Intermediate compound formation and (2) Adsorption theory, Active centers, Enzyme catalysis and its characteristics.	9	15

Reference Books:

- UGC Inorganic Chemistry– Volume-II H.C.Khera (Pragati Prakashan)
- Coordination Chemistry –Gurdeep Chatwal and M.S.Yadav
- 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.
- 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, 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 I

Course Category	Major Practical -2
Title of the Course	Chemistry -2P: Fundamental Chemistry-2 Practical
Course Credit	01
Teaching Hours per Sem.	30
Total Marks	25

Course Outcomes - COs

Upon completion of this course, the students will have the knowledge & skills to perform / do independently:

- Qualitatively analysis of mono functional Organic solid & liquid compounds.
- The Physical constants determination of the pure organic compounds
- 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-2

Exercise: Organic Qualitative Analysis (Minimum 12 / 15 compounds be given)

Organic **Mono Functional Group** Compounds such as Phenolic, Carboxylic acid, Amide, Nitro, Amines, Aldehyde, Ketone, Alcohol, Ester, Halogen, Anilide, Carbohydrate and Hydrocarbon.

Recommended Compounds:

Benzoic acid, Cinnamic acid, α -Naphthol, β -Naphthol, Acetone, Ethyl methyl ketone, Methyl acetate, Ethyl acetate, Naphthalene, Aniline, Nitrobenzene, Benzamide, Urea, Chloroform, MDC, Acetanilide, Carbon tetra chloride, Chlorobenzene, Bromobenzene etc.

Reference Books:

- Vogel's Textbook of Organic 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 I

Course Category	Skill Enhancement Course (SEC)-1 Skill based Practical Course-1; In addition to courses mentioned in SOP basket
Title of the Course	Common Adulterants Testing in Food
Course Credit	02
Teaching Hours per Sem.	60
Total Marks	50

Course Outcomes - COs

This course aims to provide an understanding of adulterants present in food and their effect on human health.

On completion of this course, the students will be **able to detect** the common adulterants present in:

- Milk & Milk Products
- Spices & Condiments and in Other Foods

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	



Evaluation of Skill Enhancement Course - Skill based Practical Course:

Model for Practical Courses-2 Credit Course	
CCE-50% (50)SEE-50% (50)	
Exam Pattern	Marks
Lab work assessment	20
Viva voce/Lab quiz	20
Attendance	10
Continuous and Comprehensive Evaluation	50
Semester-End Evaluation- THREE Exercise from Each Head – TWO hrs.	50

Skill Enhancement Course (SEC)-1 Skill based Practical Course-1
<p align="center">Exercise–I: Milk and Milk Products</p> <ol style="list-style-type: none"> Detection of Added Water / Added Starch and Cereal Flours/Cellulose/ Gelatin in Milk Detection of Added Cane Sugar (Sucrose)/Added Glucose Detection of Added Urea/Ammonium Salts in Milk/Sulphates in Milk Detection of Sodium Chloride/Vanaspati (Hydrogenated Fat) in Milk Detection of Detergents/ Pulverized Soap in Milk Test for Skimmed Milk Powder in Natural Milk Detection of Preservatives added to Milk <ul style="list-style-type: none"> ➤ Formalin ➤ Hydrogen peroxide ➤ Boric Acid and Borate ➤ Benzoic and Sodium benzoate ➤ Salicylic Acid ➤ Mercuric chloride Detection of Coloring Matter in Milk and Milk Products <ul style="list-style-type: none"> ➤ Metanil Yellow ➤ Annato in Milk ➤ Coal Tar Dyes (Azo) Dyes in Milk ➤ Coal Tar Dyes In Ghee, Butter, Khoa, Cheese, Condensed Milk, Milk Powder
<p align="center">Exercise–II: Spices & Condiments</p> <ol style="list-style-type: none"> Detection of Lead Salts/ Metanil Yellow/ Aniline Dyes / Chalk Powder in Turmeric Powder Detection of Added Starch in Powdered Spices other than Turmeric Powder Detection of Brick Powder/Oil Soluble Colour/ Sudan Dye III/ Rhodamine B in Chilli Powder Detection of Papaya Seeds in Black Pepper Detection of Common Salt in Coriander Powder Detection of Chalk/ Colophon Residue/ Foreign Resins in Asafoetida



Exercise–III: Detection of Adulterants in Other Foods

1. Detection of Chalk Powder & Washing Soda in Sugar, Bura Sugar/Wheat Flour/Ice Cream
2. Detection of Lead Chromate in Pulses/Other Foods
3. Detection of Sand/Dirt in Wheat and Other Flour
4. Detection of Iron Filing in Tea Leaves/Wheat Flour
5. Detection of Artificially Coloured Tea Dust Mixed with Genuine Tea or Used Tea Leave
6. Detection of Malachite Green in Green Vegetables
7. Detection of Artificial Invert Sugar Syrup in Honey (Fieh's Test)
8. Detection of Mineral Acid in Vinegar/Carbonated Beverages
9. Determination of Boric Acid in Maida/Rice Flour

Reference Manual:

1. FSSAI Manual of Simple Methods for Testing of common adulterants in Food
2. FSSAI DART Manual

Reference books:

1. FSSAI Manual of Methods of Analysis of Foods – Milk and Milk Products (2015) Food Safety and Standards Authority of India, Ministry of Health and Family Welfare Government of India New Delhi
2. Milk Testing and Payment Systems Resource Book – A Practical Guide to Assist Milk Producer Groups. FAO, Rome. Pp. 38-43.
3. Roy, N.K. and Sen, D.C. (1994). Rapid Analysis of Milk. In Textbook of Practical Dairy Chemistry. Kalyani Publishers. New Delhi. Pp. 85-118.
4. Darshan Lal, Raman Seth, Rajan Sharma and Arun Kumar (2005). Approaches for detection of Adulteration in Milk Fat – An Overview. Indian Dairyman, 57, 10. Pp. 31-43.
5. Gunnery, K.S. (1979). Additives in Milk and Their Detection. Indian Dairyman, 31, 9. Pp. 665-669.
6. BIS (1960). Indian Standard – Methods of Test for Dairy Industry. Part I Rapid Examination of Milk (IS 1479 (Part I): 1960)
7. BIS (1961). Indian Standard – Methods of Test for Dairy Industry. Part II Chemical Analysis of Milk (IS 1479 (Part II): 1961)
8. BIS (2006). Indian Standard: Quick methods for Detection of Adulterants/Contaminants in Common Food Products – Chemical methods (IS 15642 (Part 2): 2006)
9. Adulteration In Milk Fat A Review Indian J. Dairy Sci. 55: 319-330
10. Methods for detection of common adulterants in milk and milk products (2009), Technews, 83, 1-30 IS: 548 (Part II) 1976 Reaffirmed 2010 “Indian standard methods of sampling and test for oils and Fats Part II Purity Test (Third Revision) IS 15642 (Parts 1 and 2):2006 (Reaffirmed 2011) Quick Methods for Detection of Adulterants/Contaminants in Common Food Products.
11. Azadmard-Damirchi and Torbati, Adulterations in Some Edible Oils and Fats and Their Detection Methods, Journal of Food Quality and Hazards Control 2 (2015) 38-44
12. Shukla, AK, Dixit, AK and Singh, RP, Detection of Adulteration in Edible oils, Journal of Oleo Science (2005), 54, 317-324
13. Pearson's' Composition and Analysis of Food 9th Edition, FSSAI Manual of Methods of Analysis of



Foods – Spices and Condiments (2015)

14. Food Safety and Standards Authority of India, Ministry of Health and Family Welfare Government of India New Delhi IS 15642 (Parts 1 and 2) :2006 (Reaffirmed 2011)
15. Quick Methods for Detection of Adulterants/Contaminants in Common Food Products Purba MK, Agrawal, N and Shukla, SK, Detection of Non-Permitted Food Colors in Edibles (2015) Journal of Forensic Research S4:3
16. Punia, P, and Lokesh, T, Review on Common Adulterants in Food Apparatus, Journal of Biotechnology and Biosafety (2016) 4, 426-430.

Pedagogic tools:

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

Suggested MOOCs: Swayam-NPTEL



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

SN	Course Category As per GoG- NEP- SOP - July 2023& additional content 28/7/23	Course Title	Credit		SEE Durati on Hrs.	Evaluation - Weightage CCE: SEE = 50:50		
			T	P		CCE Marks	SEE Marks	Total Marks
1	Minor (Elective)-1 (Chemistry) (In addition to courses mentioned in SOP basket; Recommended for Physical Science, Mathematical Science, Life science Programs)	Chemistry-1: Fundamental Chemistry-1	3	-	2½	75	75	150 To be converted for 75
2	Minor (Elective) Practical-1 (Chemistry) (In addition to courses mentioned in SOP basket; Recommended for Physical Science, Mathematical Science, Life science Programs)	Chemistry-1P: Fundamental Chemistry-1 Practical	-	1	2	25	25	50 To be converted for 25
3	Multi/Inter - Disciplinary Course -1 (MDC/IDC-1) (Elective) (In addition to courses mentioned in SOP basket; Recommended for Physical Science, Mathematical Science, Life science Programs)	Chemistry: Introduction to Basic Chemistry-1	3	-	2½	75	75	150 To be converted for 75
4	Multi/Inter - Disciplinary Course Practical-1 (MDC/IDC Practical-1) (Elective) (In addition to courses mentioned in SOP basket; Recommended for Physical Science, Mathematical Science, Life science Programs)	Chemistry: Introduction to Basic Chemistry Practical-1	-	1	2	25	25	50 To be converted for 25



B.Sc. Honours/ Honours with Research in Chemistry

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

Semester I

Course Category	Minor-1 In addition to courses mentioned in SOP basket; Recommended for Physical Science, Mathematical Science, Life science Programs
Title of the Course	Chemistry -1: Fundamental Chemistry-1
Course Credit	03
Teaching Hours per Sem.	45
Total Marks	75

Course Outcomes - COs

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 understand;

- Atomic Structure and Periodic Properties in general and Characteristics of S & P block elements
- This course gives a broader theoretical picture in multiple stages in an overall chemical reaction
- Reactive intermediates, transition states and states of all the bonds broken and formed.
- Basic principles of Organic chemistry and functional group base reactivity.
- Stereochemistry concepts like Configuration, Fischer projection formula, homomers and enantiomers, geometrical isomerism: cis–trans, C.I.P rules with E/Z notations.
- Chemistry & characteristic of Hydrocarbons
- Basic concept of Analytical chemistry

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	Unit-I : Atomic Structure and Periodic Properties: Dual nature of electron: de-Broglie's equation, Heisenberg's Uncertainty Principle, quantum numbers, Aufbau Principle, Pauli's Exclusion Principle and Hund's Rule for electron configuration. Periodicity in atomic properties and its causes, explanation of general trends of Periodic Properties in detail: Atomic size, Covalent & van der Waals radius, Atomic & Ionic radii, Ionization Potential, Electro negativity and Electron Affinity.	9	15
2	Unit-II: Chemistry of s and p block elements: Electronic configuration of s and p block elements, Special characteristics such as Metallic character, Electropositive character, Oxidizing & Reducing property, Polarizing power, Hydration energy, Inert pair effect, Relative stability of different oxidation state. Diagonal relationship of (1) lithium with magnesium (2) boron with silicon and (3) beryllium with aluminium. Anomalous behaviour of Li, Be, Formation of complex compounds, catenation, allotropy (diamond and graphite-their structure, properties and its uses)	9	15
3	Unit-III: Basic Organic Chemistry and Aliphatic Hydrocarbons containing σ-bond: Nomenclature of organic compounds (Only Acyclic-IUPAC-1993) Electronic displacements: Inductive effect, electromeric effect, mesomeric effect and hyper-conjugation. Applications of inductive effect to bond length, dipole-moment, reactivity of alkyl halides, relative strength of acid, basicity of amines Homolytic and heterolytic fission, curly arrow rules. Reaction Intermediates: Carbocation, carbanion, free radical, carbenes and benzynes (Formation by cleavage type, structure, relative stabilities, generation) Types of organic reagents: Nucleophiles and electrophiles. Types of organic reactions: Substitution, addition, elimination and rearrangement. Nucleophilic substitution reaction mechanism (SN^1 & SN^2) for alkyl halides Introduction to stereochemistry: Configuration, Fischer projection formula, homomers and enantiomers, geometrical isomerism: cis-trans, C.I.P rules with E/Z notations.	9	15



4	<p>Unit-IV:Aliphatic Acyclic Hydrocarbons:</p> <p>Hydrocarbons containing Carbon-Carbon πbonds: Formation of alkene by Elimination reactions, dehydration of alcohol, dehydro halogenation of alkyl halide, dehalogenation of vicinal and geminal dihalides Mechanism of E1, E2, E1cb reactions, Saytzeff and Hofmann eliminations.</p> <p>Electrophilic addition reaction and its mechanism (Markownikov/Anti Markownikov rule)Reactions of alkenes: Hydroboration oxidation, Ozonolysis, Reduction (catalytic), Syn and anti-hydroxylation (oxidation), 1, 2- and 1,4 -addition reactions in conjugated dienes, Diels-Alderreaction.</p> <p>Formation of alkynes: Dehydro halogenation of vicinal and geminal dihalides, Dehalogenation of tetra halides Reactions of alkynes: Acidity, electrophilic addition reactions like halogenation, hydro halogenation, hydration, hydroboration, addition of carbene and catalytic hydrogenation.</p> <p>Nucleophilic addition with hydrogen cyanide and alcohol, hydration to form carbonyl compounds, alkylation of terminal alkynes.</p>	9	15
5	<p>Unit-V:Basic concepts of Analytical Chemistry:</p> <p>Definitions of analysis, determination, measurement, techniques and methods. Classification of analytical techniques. Choice of an analytical method - accuracy, precision, sensitivity, selectivity, method validation. Figures of merit of analytical methods and limit of detection (LOD), Limit of quantification (LOQ), linear dynamic range (working range).</p> <p>Definitions of Errors and treatment of analytical data: Limitations of analytical methods -Errors: Determinate and indeterminate errors, absolute error, relative error, minimization of errors. Definition of Statistical treatment of finite samples -mean, median, and range, standard deviation variance. Numerical problems.</p> <p>Brief of Basic laboratory practices, Sampling (solids and liquids), weighing, drying, dissolving. Acid treatment, Rules of work in analytical laboratory, General rule for performing quantitative determinations (volumetric and gravimetric).</p> <p>Safety in Chemical laboratory, Rules of fire prevention and accidents, First aid. Precautions to be taken while handling toxic chemicals, concentrated/fuming acids and organic solvents.</p>	9	15



Reference Books:

- UGC Inorganic Chemistry–Volume-I H.C.Khera (Pragati Prakashan).
- Concise Inorganic Chemistry -J.D.Lee.
- Coordination Chemistry-Gurdeep Chatwal and M.S.Yadav.
- Advanced Inorganic Chemistry by S.K.Agarwal & KeemtiLal(A Pragati Edition)
- 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
- 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.
- Chemical Kinetics, G.R. Chatwal and Harish Mishra, Goel Publication House, Meerut.
- 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 I

Course Category	Minor Practical -1 In addition to courses mentioned in SOP basket; Recommended for Physical Science, Mathematical Science, Life science Programs
Title of the Course	Chemistry -1P: Fundamental Chemistry-1 Practical
Course Credit	01
Teaching Hours per Sem.	30
Total Marks	25

Course Outcomes - COs

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 perform/do independently**:

- Calibration of glass wares and preparation & standardization of Solutions
- Determine the strength of various Acids- Bases and Oxidants- Reductants

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				



Minor Practical-1

Exercise-I: Basic concepts of Volumetric Analysis

- Calibration of Glassware - Pipette, Burette, Measuring cylinder and Volumetric flask
- Preparation and Standardization of Solutions: Succinic acid, Oxalic acid, HCl, H₂SO₄, NaOH, KOH, Na₂CO₃, NaHCO₃, KMnO₄, K₂Cr₂O₇

Exercise-II: Volumetric Analysis - Acid-base titrations

- To prepare a solution by dissolving 'x' g NaHCO₃ /Na₂CO₃ in 100 ml solution and determine its concentration in terms of normality and molarity using 0.1 N HCl solution.
- To determine the normality, molarity and g/lit of NaOH and HCl using 0.1 N Na₂CO₃ solution.
- To determine the normality, molarity and g/lit of each component in a given mixture of NaHCO₃ and Na₂CO₃ using 0.1N HCl solution.
- To estimate Tartaric acid by Acid- base direct titration method.
- To estimate Salicylic acid by Acid- base direct titration method.

Exercise-III: Volumetric Analysis - Redox titrations

- To determine the normality, molarity and g/lit of each component in a mixture of H₂C₂O₄.2H₂O and H₂SO₄ using 0.1 N KMnO₄ and 0.1N NaOH solution.
- To determine the normality, molarity and g/lit of each component in a mixture of H₂C₂O₄.2H₂O and K₂C₂O₄.2H₂O using 0.1N NaOH and 0.1 N KMnO₄ solution
- To determine the normality, molarity and g/lit of KMnO₄ and FeSO₄.7H₂O solution using 0.1 N H₂C₂O₄.2H₂O solution.
- To determine the normality, molarity and g/lit of FeSO₄ (NH₄)₂SO₄.6H₂O and K₂Cr₂O₇ solutions using 0.1 N KMnO₄ solution.
- To determine Fe⁺² by K₂Cr₂O₇ method.

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, 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 I

Course Category	MDC/IDC-1 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-1
Course Credit	03
Teaching Hours per Sem.	45
Total Marks	75

Course Outcomes - COs

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;

- Basic concepts of ionic compound and relevant equation and relationship between radius ratio, co-ordination number and crystal structure.
- VB & MO theory of chemical bonding and Stereo chemistry and Energy level diagrams of molecules
- Synthetic methods of preparation of alkanes and cycloalkanes. Chemical properties and conformational analysis of simple alkanes.
- Aromaticity and electrophilic aromatic substitution reactions with their mechanism.
- The course will also strengthen the problem solving capacity of students.
- Basic concept and application of adsorption and catalysis

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-I: Basic concepts of Analytical Chemistry:</p> <p>Definitions of analysis, determination, measurement, techniques and methods. Classification of analytical techniques. Choice of an analytical method - accuracy, precision, sensitivity, selectivity, method validation. Figures of merit of analytical methods and limit of detection (LOD), Limit of quantification (LOQ), linear dynamic range (working range).</p> <p>Definitions of Errors and treatment of analytical data: Limitations of analytical methods -Errors: Determinate and indeterminate errors, absolute error, relative error, minimization of errors. Definition of Statistical treatment of finite samples -mean, median, and range, standard deviation variance. Numerical problems.</p> <p>Brief of Basic laboratory practices, Sampling (solids and liquids), weighing, drying, dissolving. Acid treatment, Rules of work in analytical laboratory, General rule for performing quantitative determinations (volumetric and gravimetric).</p> <p>Safety in Chemical laboratory, Rules of fire prevention and accidents, First aid. Precautions to be taken while handling toxic chemicals, concentrated/fuming acids and organic solvents.</p>	9	15
2	<p>Unit-II: Chemical Bonding in Covalent Compounds:</p> <p>Covalent bond: Valence bond theory and its limitations, Concept of hybridization: sp ($BeCl_2$), sp^2 (BF_3), sp^3 (SiH_4), sp^3d (PCl_5) and sp^3d^2 (SF_6).</p> <p>Stereochemistry of Inorganic molecules: Sidgwick Powell rule and VSEPR theory,</p> <p>Basic concept of MO theory, Bonding and Anti-bonding Molecular Orbitals, Gerade & Ungerade Molecular Orbitals, σ- Molecular Orbital and σ^*- Molecular Orbital, π-Molecular Orbital and π^*-Molecular Orbital, Conditions for effective combinations of atomic orbitals</p> <p>Energy level diagrams of B_2, C_2, N_2, O_2, F_2, (with s-p mixing and orbital interaction) with calculation of bond order and magnetic moment Comparison of MO theory and VB theory.</p>	9	15



3	<p>Unit-III: Alkanes and Cycloalkanes</p> <p>Chemistry of alkanes: Formation of alkanes: Wurtz reaction, Wurtz-Fittig reaction. Free radical substitutions: Halogenation-relative reactivity and selectivity. Introduction and classification of ring system (monocyclic and polycyclic, size, number of carbon atom common between the two rings)</p> <p>IUPAC nomenclature of cycloalkanes (including simple spiro compounds, fused ring and bridged ring systems-bicyclic only) Method of preparation of small ring cycloalkanes: Intra-molecular Wurtz's reaction, Simmons-Smith, Diels-Alder reaction</p> <p>Chemical Properties of Cycloalkanes: Substitution Reactions, Addition Reactions, Baeyer's Strain Theory and its limitations (puckering)</p>	9	15
4	<p>Unit-IV: Aromatic Hydrocarbons</p> <p>Aromaticity: Criteria for (aromatic, non-aromatic and anti-aromatic), applications of Huckel's rule to simple annulene, cyclic carbocation/anion. Electrophilic aromatic substitution reactions of benzene with mechanisms, theory of effect of substituents on reactivity and orientation (with resonating structures for activating and deactivating groups) Electrophilic aromatic substitution reactions with Mechanisms: Halogenation, Nitration/Sulphonation, Friedel-Crafts alkylation/Friedel-Crafts acylation</p>	9	15
5	<p>Unit-V: Adsorption and Catalysis</p> <p>Adsorption: Introduction, types of adsorption (physical and chemical), characteristics and factors affecting adsorption, Adsorption isotherm and Freundlich equation, Langmuir theory of adsorption: assumptions, derivation, modification in equation at very low and high pressure and applications of adsorption.</p> <p>Catalysis: Introduction, types of catalysis (homogeneous and heterogeneous), characteristics of catalysis, autocatalysis, negative catalysis (Inhibitor), promoters, and catalytic poisoning Activation energy and catalysis. Theories of catalysis: (1) Intermediate compound formation and (2) Adsorption theory, Active centres, Enzyme catalysis and its characteristics.</p>	9	15



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 I

Course Category	MDC/IDC Practical -1 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-1
Course Credit	01
Teaching Hours per Sem.	30
Total Marks	25

Course Outcomes - COs

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 perform/do independently**:

- Calibration of glass wares and preparation & standardization of Solutions
- Determine the strength of various Acids- Bases and Oxidants- Reductants

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				



MDC/IDC Practical -1

Exercise–I: Basic concepts of Volumetric Analysis

- Calibration of Glassware - Pipette, Burette, Measuring cylinder and Volumetric flask
- Preparation and Standardization of relevant Solutions: Succinic acid, Oxalic acid, HCl, H₂SO₄, NaOH, KOH, Na₂CO₃, NaHCO₃, KMnO₄, K₂Cr₂O₇

Exercise–II: Volumetric Analysis - Acid-base titrations (Any 03)

- To prepare a solution by dissolving 'x' g NaHCO₃ /Na₂CO₃ in 100 ml solution and determine its concentration in terms of normality and molarity using 0.1 N HCl solution.
- To determine the normality, molarity and g/lit of NaOH and HCl using 0.1 N Na₂CO₃ solution.
- To determine the normality, molarity and g/lit of each component in a given mixture of NaHCO₃ and Na₂CO₃ using 0.1N HCl solution.
- To estimate Tartaric acid by Acid- base direct titration method.
- To estimate Salicylic acid by Acid- base direct titration method.

Exercise–III: Volumetric Analysis - Redox titrations (Any 03)

- To determine the normality, molarity and g/lit of each component in a mixture of H₂C₂O₄.2H₂O and H₂SO₄ using 0.1 N KMnO₄ and 0.1N NaOH solution.
- To determine the normality, molarity and g/lit of each component in a mixture of H₂C₂O₄.2H₂O and K₂C₂O₄.2H₂O using 0.1N NaOH and 0.1 N KMnO₄ solution
- To determine the normality, molarity and g/lit of KMnO₄ and FeSO₄.7H₂O solution using 0.1 N H₂C₂O₄.2H₂O solution.
- To determine the normality, molarity and g/lit of FeSO₄ (NH₄)₂SO₄.6H₂O and K₂Cr₂O₇ solutions using 0.1 N KMnO₄ solution.
- To determine Fe⁺² by K₂Cr₂O₇ method.

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, 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