MGM UNIVERSITY

Chhatrapati Sambhajinagar

SCHOOL OF BASIC AND APPLIED SCIENCES

DEPARTMENT OF CHEMISTRY

Under Graduate (UG) Degree Programme in Chemistry
(04 Year/08 Semesters)

B. Sc. (Hons)/B. Sc. (Honours/Research) Chemistry

Designed as per NEP-2020

Course Structure & Syllabus

Prepared By
BoardofStudies in Chemistry
MGM University,
Chhatrapati Sambhajinagar-431003

Effective from Academic Year-2023-2024

MGM University

Vision

- To ensure sustainable human development which encourages self-reliant and self-content society.
- To promote activities related to community services, social welfare and also Indian heritage and culture.
- To inculcate the culture of non-violence and truthfulness through vipassanna meditation and Gandhian Philosophy.
- To develop the culture of simple living and high thinking

Mission

- To impart state of art education and technical expertise to students and give necessary training to teachers to create self-reliant society for future.
- To encourage students to participate in Indian and International activities in sports, literature, etc. so that future generation becomes base for free and liberal society
- To educate students in areas like Management, Finance, Human relations to inculcate philosophy of simple living and high thinking value of simple economic society.
- To inculcate culture of non-violence and truthfulness through Vipassana.

  To sustain activities of Indian culture (viz. classical dance, music and fine arts) through establishing institutes like Mahagami, Naturopathy, etc.

विद्यापीठगीत

अत्तदिपभवभवप्रदिपभव,
स्वरूपरूपभवहो
ज्ञानसब्बविज्ञानसब्बभव ,
सब्बदिपभवहो
अत्ताहिअत्तनोनाथो ,
अत्ताहिअत्तनोगति
अत्तमार्गपरअप्रमादसेहैतुझेचलना
सब्बकाकल्याणहो ,
वोकार्यकुशलकरना
सब्बकाउत्तममंगल , पथप्रदर्शकहो
अत्तदिपभवभवप्रदिपभव ,
स्वरूपरूपभवहो
ज्ञानसब्बविज्ञानसब्बभव ,
सब्बदिपभवहो
बुद्धमंशरनंगच्छामि :
धम्मंशरनंगच्छामि :
संघंशरनंगच्छामि :

School of Basic and Applied Sciences (SBAS)

The School of Basic and Applied Sciences (SBAS) was established in the year May-2021. The School comprises of various department such as Physics, Chemistry, Mathematics& Statistics at the time of establishment of SBAS. The departments of Geology, Forensic Science, Home Science and Cosmetic Technology were established in 2022. School of Basic and Applied Science offers UG, PG and PhD programmes in various discipline of basic and applied science.

Vision

- The vision of the department is to provide high quality education and skills to undergraduate, postgraduate and doctorate students.
- Make the learning of basic sciences exciting through high class teaching with innovative ideas, curiosity and creativity.
- The department is committed to inculcate competence, critical, logical ethical thinking and communications skill amongst the students.

Mission

- To establish, build and sustain the department of the highest international standard by the excellent teaching, quality research, generating new knowledge and ideas in basic and applied sciences.
- To impart and nurture various skills, human values and social concerns that prepare students to built their carrier across the world in various areas.
- To collaborate with reputed academic and research institutes to strengthen the basic science education and research ecosystem.
- To enhance engagement with society and industry through various programs

Programs offered at SBAS

Undergraduate Programmes	Postgraduate Programmes	PhD Programmes	PG Diploma Programmes	Certificate Programmes
B. Sc (General) PCM				
B. Sc.(Hons/Research) Physics	M. Sc. Physics	Ph. D Physics		
B. Sc.(Hons/Research) Chemistry	M. Sc. Chemistry	Ph. D Chemistry		
B. Sc.(Hons/Research) Mathematics	M. Sc. Mathematics	Ph. D Mathematics		
B. Sc.(Hons/Research) Statistics	M. Sc. Statistics	Ph. D Statistics		
B. Sc.(Hons/Research) Geology	M. Sc. Applied Geology	Ph. D Geology		Ground water Surveying and rain water harvesting
B. Sc.(Hons/Research) Forensic Science	M. Sc. Forensic Science	Ph. D Forensic Science	Forensic Science and crime scene management	

Department of Chemistry

- Department of Chemistry was established in 2021 and works with dedication towards teaching, learning, evaluation, research, innovation, student placement and academic progression.
- Updated and advanced Outcome Based Curriculum Framework designed by experienced Academicians and Industry Experts integrating various ability enhancement, value education, skill, vocational and advanced laboratory courses which is required to build skills and competency for development of skilled and knowledgeable human recourse for institutions, industry, startups, and society.
- Continuous internal evaluation thorough unit test, tutorial, assignment, case study, project work, field work, student seminar for holistic development of students.
- Career guidance and mentoring to the students preparing for competitive examination such IIT-JAM, NET, SET, GATE, PET, MPSC, UPSC etc.
- Rigorous laboratory training and guidance to the students for nurturing chemistry with safety and responsibility for development of innovative research.
- The department offers four year **B. Sc. (Honours/Research) Chemistry,(UG)**programme which is designed as per NEP-2020. Beside this department offers minor course in Analytical Chemistry and open electives for students of within faculty and other faculty. In addition, this program is uniquely designed to increase the employability and to prepare students to work in a Multi-disciplinary work environment.
- The department offers **M. Sc. Chemistry (PG)**Programme with specializations in :
  1. Organic Chemistry
  2. Analytical Chemistry
  3. Physical Chemistry,
  4. Medicinal Chemistry,
  5. Polymer Chemistry
  6. Industrial Chemistry
- Students of M. Sc. Chemistry Programme can choose any one specialization for second year (III and IV semester) after completion of first year which is common for all specialization. Department of Chemistry also offers Ph. D programme in Chemistry**.**

Name of Program: B. Sc. (Honours/Research) Chemistry

Duration-Four Years

Eligibility-XIIth Science

1. Maharashtra State Candidate.

(i) The Candidate should be an Indian National and having domicile of Maharashtra state and/or born in Maharashtra state.

(ii) Passed HSC or its equivalent examination with at least 45% marks (at least 40% marks, in case of Backward class categories and Persons with Disability candidates belonging to Maharashtra State only) in Sciencestream candidate should have appeared in MGMU-CET 2023 and should obtain non zero score in MGMU-CET-2024.

2. All India Candidates –

(i) The Candidate should be an Indian National.

(ii) Passed HSC or its equivalent examination with sciences

B. Sc. (Hons)/ B. Sc. (Honours/Research) Chemistry

PROGRAME EDUCATIONAL OBJECTIVES (PEO)

The aim of B. Sc. (Hons) bachelor's degree programme in chemistry is intended to provide:

- To provide in depth knowledge and skills in the in chemistry subject.
- To develop students' ability and skill to acquire expertise over solving both theoretical and applied chemistry problems.
- To develop competent scholars and professionals for various industry such as pharmaceuticals, fine chemicals, polymer, cosmetics, food, fertilizers, paint and pigment etc.
- To provide knowledge and skill to the students' thus enabling them to undertake further studies in chemistry in related areas or multidisciplinary areas that can be helpful for self-employment/entrepreneurship.
- To provide an environment that ensures cognitive development of students in a holistic manner.
- To mould a responsible citizen who is aware of most basic domain-independent knowledge, including critical thinking and communication.
- To enable the graduate prepare for national as well as international competitive examinations, especially CSIR-NET, SET, GATE, MPSC, UPSC etc.
- To develop skilled and competent researcher, scientist, trained chemical analyst as an executive work force with strong fundamentals and advanced knowledge and skill in chemical science domain.
- To develop scholars who are capable of contributing towards strengthening of the scientific foundation of Chemical Industries. Besides this, such manpower would be scientifically multifaceted personalities able to pursue careers either in academics, pharmaceutical, fine chemical and material industries or as an entrepreneur.

PROGRAMME OUTCOMES (POs)

Science Graduates will be able to:

PO1: Disciplinary knowledge: Demonstrate comprehensive knowledge of the disciplines that form a part of a graduate program. Execute strong theoretical and practical understanding generated from the specific graduate program in the area of work.

PO2: Critical Thinking and Problem solving: Exhibit the skills of analysis, inference, interpretation and problem-solving by observing the situation closely and design the solutions.

PO3: Information/digital literacy: Capability to use ICT in a variety of learning situations, demonstrate ability to access, evaluate, and use a variety of relevant information sources; and use appropriate software for analysis of data.

PO4: Research-related skills: Develop the working knowledge and applications of instrumentation and laboratory techniques. Able to apply skills to design and conduct independent experiments, interpret, establish hypothesis and inquisitiveness towards research.

PO5: Moral and ethical awareness: Ability to embrace moral/ethical values in conducting one's life, formulate a position/argument about an ethical issue from multiple perspectives, and use ethical practices in all work.

PO6: Environment and sustainability: Understand the impact of the scientific solutions in societal and environmental contexts and demonstrate the knowledge of and need for sustainable development Understand

PO7: Self-directed and Life-long learning: Acquire the ability to engage in independent and life-long learning in the broadest context of socio-technological changes.

PROGRAME SPECIFIC OUTCOMES (PSOs)

Graduate in Chemistry will able to

PSO1: (i) Understandthe fundamental concepts in theoretical and experimental chemistry. (ii) Principle and use ofspectroscopic and chromatographic techniques for structural elucidation and purification of compounds

PSO2: Demonstrate (i) In-depth knowledge and understanding of various disciplines of Chemical Sciences (Inorganic Chemistry, Organic Chemistry, Physical Chemistry and Analytical Chemistry) (iii) Laboratory skills related to study of various physical and chemical properties of matter and Synthesis, isolation, purification and analysis of organic and inorganic compounds.

PSO3: (i) Correlate and apply the theoretical and experimental knowledge of chemistry in chemical analysis. (ii) Apply information related to material safety data sheets (MSDS) needed in various laboratory safety.

PSO4: Applyknowledge andskills to design solution for various research problems in the field of chemical sciences and other multidisciplinary subjects.

PSO5: (i)Recognize and appreciate the importance of the chemical sciences and its application in academic, industrial, economic, environmental and social context.

Appendix-11

Name of Faculty: Basic and Applied Sciences
Name of the College/Institute/Department/School: School of Basic and Applied Sciences
Name of the Programme: B. Sc. (Honours/Research) Chemistry
Programme Type (UG/PG): UG
Duration: 04 Year (08 Semester)

First Year – Semester-I: B. Sc. (Honours/Research) Chemistry

Course Category	Course Code	Course Title	Nature of Course	No. of Credits	Teaching (Contact hrs/ week)		Evaluation Scheme (Marks)			Minimum Passing (Marks)		
					L	P	Internal	External	Total	Internal	External	Total
MM	SCC43MML101	Basics of Analytical Chemistry	L	2	2	-	30	20	50	-	8	20
MM	SCC43MML102	Basics of Organic Chemistry	L	2	2	-	30	20	50	-	8	20
MM	SCC43MMP101	Chemistry Lab Course-I	P	2	-	4	30	20	50	-	8	20
OE	MGM43OEL10X	*Open Elective - I	L	2	2	-	30	20	50	-	8	20
OE	MGMXXOEL10X	*Open Elective - II	L	2	2	-	30	20	50	-	8	20
VSC	SCC43VSL101	$Vocational Skill course-I	L	2	2	-	30	20	50	-	8	20
SEC	SCC43SEP101	$ Skill Enhancement course-I (Lab)	P	2	-	4	30	20	50	-	8	20
AEC	MGM54AEL10X	*Ability Enhancement Course-I	L	2	2	-	30	20	50	-	8	20
VEC	MGMXXVEL10X	*Value Education course-I	L	2	2	-	30	20	50	-	8	20
IKS	SCC43IKL101	Development of science Ancient to Mordern	L	2	2	-	30	20	50	-	8	20
CC	MGMXXCCP10X	*Co-curricular course-I	P	2	-	4	50	-	50	20	-	20
Total				**22**	**16**	**12**	**350**	**200**	**550**	**20**	**80**	**220**

Note:
***To be chosen from university baskets**
$ To be chosen from department basket
Nature of Course: L- Lecture, P-Practical, S-Seminar, J-Project, I-Internship, D-Dissertation,
Course Category: MM-Major Mandatory, ME-Major Elective, MI-Minor, OE-Generic / Open electives, VSC-Vocational skill course, SEC-Skill Enhancement course, AEC-Ability Enhancement course, IKS-Indian Knowledge system, VEC-Value Education course, OJT-On Job Training / Internship / Apprenticeship, FP-Field project, CEP-Community engagement and service, CC-Co – curricular course, RM-Research methodology, RP-Research project.

First Year- Semester II: B. Sc. (Honours/Research) Chemistry												
Course Category	**Course Code**	**Course Title**	**Nature of Course**	**No. of Credits**	**Teaching (Contact hrs/ week)**		**Evaluation Scheme (Marks)**			**Minimum Passing (Marks)**		
					L	**P**	**Internal**	**External**	**Total**	**Internal**	**External**	**Total**
MM	SCC43MML103	Basics of Inorganic Chemistry	L	2	2	-	30	20	50	-	8	20
MM	SCC43MML104	Basics of Physical Chemistry	L	2	2	-	30	20	50	-	8	20
MM	SCC43MMP102	Chemistry Lab Course-II	P	2	-	4	30	20	50	-	8	20
MI		*Minor Course	L	2	2	-	30	20	50	-	8	20
OE	MGMXXOE10X	*Open Elective - III	L	2	2	-	30	20	50	-	8	20
OE	MGMXXOEL10X	*Open Elective - IV	L	2	2	-	30	20	50	-	8	20
VSC	SCC43VSL102	$Vocational Skill course-II	L	2	2	-	30	20	50	-	8	20
SEC	SCC43SEP102	$ Skill Enhancement course-II (Lab)	P	2	-	4	30	20	50	-	8	20
AEC	MGM54AEL10X	*Ability Enhancement Course-II	L	2	2	-	30	20	50	-	8	20
VEC	MGMXXVEL10X	*Value Education course-II	L	2	2	-	30	20	50	-	8	20
CC	MGMXXCCP10X	*Co-curricular course-II	P	2	-	4	50	-	50	20	-	20
Total				**22**	**16**	**12**	**350**	**200**	**550**	**20**	**80**	**220**

Note:
***To be chosen from university baskets**
$ To be chosen from department basket
Nature of Course:L- Lecture, P-Practical, S-Seminar, J-Project, I-Internship, D-Dissertation,
Course Category: MM-Major Mandatory, ME-Major Elective, MI-Minor, OE-Generic / Open electives, VSC-Vocational skill course, SEC-Skill Enhancement course, AEC-Ability Enhancement course, IKS-Indian Knowledge system, VEC-Value Education course, OJT-On Job Training / Internship / Apprenticeship, FP-Field project, CEP-Community engagement and service, CC-Co – curricular course, RM-Research methodology, RP-Research project
Level 4.5 Award of UG certificate with 44 credits and an additional 4-creditscoreNSQF course / internship OR continue with major and minor

List of Options to select from Bucket of Courses provided in various categories:

Major Chemistry		
Minor options Within Faculty of Basic and Applied Sciences	Computational Mathematics	Basic food Sciences and Processing
	Data Analytics	Nutraceutical Foods
	Cyber Security	
	Bioinformatics	

Minor options from Other Faculty					
Faculty of Engineering and Technology	**Faculty of Social Sciences & Humanities**	**Faculty of Design**	**Faculty of Management and Commerce**	**Interdisciplinary Faculty**	**Performing Arts**
Drone Technology	Filmmaking	Product Design	Financial Management	Officiating and Coaching	Theatre Arts
IoT	Photography	Visual Communication	E-Commerce	Sports Management	Dance
Remote Sensing	Psychology	Contemporary Arts	International Business Management	Sports Journalism	Music
EV Technology	Economics	Interior Design	Hospitality Mgmt	Sport Psychology	Folk Art
Drone Technology	English	Fashion Technology	Travel and Tourism		
Robotics Technology					
Chemical Technology					
AI&ML					

Second Year - Semester III: B. Sc. (Honours/Research) Chemistry												
Course Category	**Course Code**	**Course Title**	**Nature of Course**	**No. of Credits**	**Teaching (Contact hrs/ week)**		**Evaluation Scheme (Marks)**			**Minimum Passing (Marks)**		
					L	**P**	**Internal**	**External**	**Total**	**Internal**	**External**	**Total**
MM	SCC43MML205	Principles of Inorganic Chemistry-I	L	2	2	-	30	20	50	-	8	20
MM	SCC43MML206	Principles of Organic Chemistry-I	L	2	2	-	30	20	50	-	8	20
MM	SCC43MML207	Principles of Physical Chemistry-I	L	2	2	-	30	20	50	-	8	20
MM	SCC43MMP203	Chemistry Lab Course-III	P	2	-	4	30	20	50	-	8	20
MI		*Minor Course	L	3	3	-	60	40	100	-	16	40
		*Minor Course	P	1	-	2	30	20	50	-	8	20
OE	MGM43OE20X	*Open Elective - V	L	2	2	-	30	20	50	-	8	20
VSC	SCC43VEL203	$Vocational Skill course-III	L	2	2	-	30	20	50	-	8	20
AEC	MGM54AEL20X	*Modern Indian Language-II	L	2	2	-	30	20	50	-	8	20
FP	SCC43FPJ201	Field Project-I	J	2	-	4	50	-	50	20	-	20
CC	MGMXXCCP20X	*Co – curricular course-III	P	2	-	4	50	-	50	20	-	20
Total				**22**	**15**	**14**	**400**	**200**	**600**	**40**	**80**	**240**

Note:
***To be chosen from university baskets**
$ To be chosen from department basket
Nature of Course: L- Lecture, P-Practical, S-Seminar, J-Project, I-Internship, D-Dissertation,
Course Category: MM-Major Mandatory, ME-Major Elective, MI-Minor, OE-Generic / Open electives, VSC-Vocational skill course, SEC-Skill Enhancement course, AEC-Ability Enhancement course, IKS-Indian Knowledge system, VEC-Value Education course, OJT-On Job Training / Internship / Apprenticeship, FP-Field project, CEP-Community engagement and service, CC-Co – curricular course, RM-Research methodology, RP-Research project

Second Year - Semester IV: B. Sc. (Honours/Research) Chemistry												
Course Category	**Course Code**	**Course Title**	**Nature of Course**	**No. of Credits**	**Teaching (Contact hrs/ week)**		**Evaluation Scheme (Marks)**			**Minimum Passing (Marks)**		
					L	**P**	**Internal**	**External**	**Total**	**Internal**	**External**	**Total**
MM	SCC43MML208	Principles of Inorganic Chemistry-II	L	2	2	-	30	20	50	-	8	20
MM	SCC43MML209	Principles of Organic Chemistry-II	L	2	2	-	30	20	50	-	8	20
MM	SCC43MML210	Principles of Physical Chemistry-II	L	2	2	-	30	20	50	-	8	20
MM	SCC43MMP204	Chemistry Lab Course-IV	P	2	-	4	30	20	50	-	8	20
MI		*Minor Course	L	3	3	-	60	40	100	-	16	40
		*Minor Course	P	1	-	2	30	20	50	-	8	20
OE	MGM43OE20X	*Open Elective - VI	L	2	2	-	30	20	50	-	8	20
SEC	SCC43SEP203	$ Skill Enhancement course-III (Lab)	P	2	-	4	30	20	50	-	8	20
AEC	MGM54AEL20X	*Modern Indian Language-I	L	2	2	-	30	20	50	-	8	20
CEP	SCC43CEJ201	Community engagement and service	J	2	-	4	50	-	50	20	-	20
CC	MGMXXCCP20X	*Co – curricular course-IV	P	2	-	4	50	-	50	20	-	20
Total				**22**	**13**	**18**	**400**	**200**	**600**	**40**	**80**	**240**

Note:
***To be chosen from university baskets**
$ To be chosen from department basket
Nature of Course: L- Lecture, P-Practical, S-Seminar, J-Project, I-Internship, D-Dissertation,
Course Category: MM-Major Mandatory, ME-Major Elective, MI-Minor, OE-Generic / Open electives, VSC-Vocational skill course, SEC-Skill Enhancement course, AEC-Ability Enhancement course, IKS-Indian Knowledge system, VEC-Value Education course, OJT-On Job Training / Internship / Apprenticeship, FP-Field project, CEP-Community engagement and service, CC-Co – curricular course, RM-Research methodology, RP-Research project
Level 5.0 Award of UG Diploma with 88 credits and an additional 4-creditscoreNSQF course / internship OR continue with major and minor

Third Year-Semester-V B. Sc. (Honours/Research) Chemistry												
Course Category	**Course Code**	**Course Title**	**Nature of Course**	**No. of Credits**	**Teaching (Contact hrs/ week)**		**Evaluation Scheme (Marks)**			**Minimum Passing (Marks)**		
					L	**P**	**Internal**	**External**	**Total**	**Internal**	**External**	**Total**
MM	SCC43MML311	Fundamentals of Spectroscopy	L	3	3	-	60	40	100	-	16	40
MM	SCC43MML312	Organic Synthesis	L	3	3	-	60	40	100	-	16	40
MM	SCC43MMP305	Chemistry Lab Course-V	P	2	-	4	30	20	50	-	8	20
MM	SCC43MMP306	Chemistry Lab Course-VI	P	2	-	4	30	20	50	-	8	20
ME		Major Elective-I	L	3	3	-	60	40	100	-	16	40
	SCC43MEL301	Heterocyclic Chemistry										
	SCC43MEL302	Surface & Magneto Chemistry										
	SCC43MEL303	Bioinorganic Chemistry										
ME	SCC43MEP301	Chemistry Lab Course-VII (ME-I)	P	1	-	2	30	20	50	-	8	20
MI		*Minor Course	L	3	3	-	60	40	100	-	16	40
		*Minor Course	P	1	-	2	30	20	50	-	8	20
VSC	SCC43VSL304	$Vocational Skill course-IV	L	2	2	-	30	20	50	-	8	20
FP	SCC43FPJ302	Field Project-II	J	2	-	4	50	-	50	20	-	20
Total				**22**	**14**	**16**	**440**	**260**	**700**	**20**	**104**	**280**

Note:
***To be chosen from university baskets**
$ To be chosen from department basket
Nature of Course: L- Lecture, P-Practical, S-Seminar, J-Project, I-Internship, D-Dissertation,
Course Category: MM-Major Mandatory, ME-Major Elective, MI-Minor, OE-Generic / Open electives, VSC-Vocational skill course, SEC-Skill Enhancement course, AEC-Ability Enhancement course, IKS-Indian Knowledge system, VEC-Value Education course, OJT-On Job Training / Internship / Apprenticeship, FP-Field project, CEP-Community engagement and service, CC-Co – curricular course, RM-Research methodology, RP-Research project

Third Year – Semester-VI: B. Sc. (Honours/Research) Chemistry												
Course Category	**Course Code**	**Course Title**	**Nature of Course**	**No. of Credits**	**Teaching (Contact hrs/ week)**		**Evaluation Scheme (Marks)**			**Minimum Passing (Marks)**		
					L	**P**	**Internal**	**External**	**Total**	**Internal**	**External**	**Total**
MM	SCC43MML313	Coordination Chemistry	L	3	3	-	60	40	100	-	16	40
MM	SCC43MML314	Polymer Chemistry	L	3	3	-	60	40	100	-	16	40
MM	SCC43MMP307	Chemistry Lab Course-VIII	P	2	-	4	30	20	50	-	8	20
MM	SCC43MMP308	Chemistry Lab Course-IX	P	2	-	4	30	20	50	-	8	20
ME		Major Elective-II	L	3	3	-	60	40	100	-	16	40
	SCC43MEL304	Electroanalytical Techniques										
	SCC43MEL305	Material Chemistry										
	SCC43MEL306	Computational & Quantum Chemistry										
ME	SCC43MEP302	Chemistry Lab Course-X (ME-II)	P	1	-	2	30	20	50	-	8	20
MI		*Minor Course	L	3	3	-	60	40	100	-	16	40
		*Minor Course	P	1	-	2	30	20	50	-	8	20
OJT	SCC43JTI301	On Job Training/Internship	I	4	-	8	60	40	100	-	16	40
Total				**22**	**12**	**20**	**420**	**280**	**700**	**-**	**112**	**280**

Note:
***To be chosen from university baskets**
$ To be chosen from department basket
Nature of Course: L- Lecture, P-Practical, S-Seminar, J-Project, I-Internship, D-Dissertation,
Course Category: MM-Major Mandatory, ME-Major Elective, MI-Minor, OE-Generic / Open electives, VSC-Vocational skill course, SEC-Skill Enhancement course, AEC-Ability Enhancement course, IKS-Indian Knowledge system, VEC-Value Education course, OJT-On Job Training / Internship / Apprenticeship, FP-Field project, CEP-Community engagement and service, CC-Co – curricular course, RM-Research methodology, RP-Research project

Level 5.5 Award of UG Degree (B.Sc. Chemistry) with 132 credits and OR continues with major and minor

Appendix-11A

Fourth Year – Semester-VII B. Sc. (Honours) Chemistry												
Course Category	**Course Code**	**Course Title**	**Nature of Course**	**No. of Credits**	**Teaching (Contact hrs/ week)**		**Evaluation Scheme (Marks)**			**Minimum Passing (Marks)**		
					L	**P**	**Internal**	**External**	**Total**	**Internal**	**External**	**Total**
MM	SCC43MML415	Group Theory and Coordination Chemistry	L	3	3	-	60	40	100	-	16	40
MM	SCC43MML416	Organic Reaction Mechanism & Stereochemistry	L	3	3	-	60	40	100	-	16	40
MM	SCC43MML417	Thermodynamics and Electrochemistry	L	3	3	-	60	40	100	-	16	40
MM	SCC43MMP409	Chemistry Lab Course-XI	P	2	-	4	30	20	50	-	8	20
MM	SCC43MMP410	Chemistry Lab Course-XII	P	2	-	4	30	20	50	-	8	20
MM	SCC43MMP411	Chemistry Lab Course-XIII	P	1	-	2	30	20	50	-	8	20
ME		Major Elective-III	L	3	3	-	60	40	100	-	16	40
	SCC43MEL407	Chromatographic Methods of Analysis										
	SCC43MEL408	Material Chemistry										
	SCC43MEL409	Computational & Quantum Chemistry										
ME	SCC43MEP403	Chemistry Lab Course-XIV (ME-III)	P	1	-	2	30	20	50	-	8	20
RM	SCC43RML401	Research Methodology	L	4	4	-	60	40	100	-	16	40
Total				**22**	**16**	**12**	**420**	**280**	**700**	**-**	**112**	**280**

Note:

Nature of Course: L- Lecture, P-Practical, S-Seminar, J-Project, I-Internship, D-Dissertation,

Course Category: MM-Major Mandatory, ME-Major Elective, MI-Minor, OE-Generic / Open electives, VSC-Vocational skill course, SEC-Skill Enhancement course, AEC-Ability Enhancement course, IKS-Indian Knowledge system, VEC-Value Education course, OJT-On Job Training / Internship / Apprenticeship, FP-Field project, CEP-Community engagement and service, CC-Co – curricular course, RM-Research methodology, RP-Research project

Fourth Year -Semester-VIII B. Sc. (Honours) Chemistry												
Course Category	**Course Code**	**Course Title**	**Nature of Course**	**No. of Credits**	**Teaching (Contact hrs/ week)**		**Evaluation Scheme (Marks)**			**Minimum Passing (Marks)**		
					L	**P**	**Internal**	**External**	**Total**	**Internal**	**External**	**Total**
MM	SCC43MML418	Inorganic Reaction Mechanism & Organotransition Metal Chemistry	L	3	3	-	60	40	100	-	16	40
MM	SCC43MML419	Organic Reactions & Rearrangements	L	3	3	-	60	40	100	-	16	40
MM	SCC43MML420	Chemical Dynamics & Biophysical Chemistry	L	3	3	-	60	40	100	-	16	40
MM	SCC43MMP412	Chemistry Lab Course-XV	P	2	-	4	30	20	50	-	8	20
MM	SCC43MMP413	Chemistry Lab Course-XVI	P	2	-	4	30	20	50	-	8	20
MM	SCC43MMP414	Chemistry Lab Course-XVII	P	1	-	2	30	20	50	-	8	20
ME		Major Elective-IV	T	3	3	-	60	40	100	-	16	40
	SCC43MEL410	Spectroscopic Methods of Analysis										
	SCC43MEL411	Pharmaceutical and Forensic Analysis										
	SCC43MEL412	Food, Fertilizer & Pesticides Analysis										
ME	SCC43MEP404	Chemistry Lab Course-XVIII (ME-IV)	P	1	-	2	30	20	50	-	8	20
OJT	SCC43JTI402	On Job Training/Internship	I	4	-	8	60	40	100	-	16	40
Total				**22**	**12**	**20**	**420**	**280**	**700**	**-**	**112**	**280**

Note:

Nature of Course: L- Lecture, P-Practical, S-Seminar, J-Project, I-Internship, D-Dissertation,

Course Category: MM-Major Mandatory, ME-Major Elective, MI-Minor, OE-Generic / Open electives, VSC-Vocational skill course, SEC-Skill Enhancemenst course, AEC-Ability Enhancement course, IKS-Indian Knowledge system, VEC-Value Education course, OJT-On Job Training / Internship / Apprenticeship, FP-Field project, CEP-Community engagement and service, CC-Co – curricular course, RM-Research methodology, RP-Research project

Level 6.0 Award of UG Honours Degree (B.Sc. Hons. Chemistry) with 176 Credits

Appendix-11B

Fourth Year – Semester-VII (B. Sc. Honours with Research) Chemistry												
Course Category	**Course Code**	**Course Title**	**Nature of Course**	**No. of Credits**	**Teaching (Contact hrs/ week)**		**Evaluation Scheme (Marks)**			**Minimum Passing (Marks)**		
					L	**P**	**Internal**	**External**	**Total**	**Internal**	**External**	**Total**
MM	SCC43 MML415	Group Theory and Coordination Chemistry	L	3	3	-	60	40	100	-	16	40
MM	SCC43 MML416	Organic Reaction Mechanism and Stereochemistry	L	3	3	-	60	40	100	-	16	40
MM	SCC43 MMP409	Chemistry Lab Course-XI	P	2	-	4	30	20	50	-	8	20
MM	SCC43 MMP410	Chemistry Lab Course-XII	P	2	-	4	30	20	50	-	8	20
ME		**Major Elective-III**	L	3	3	-	60	40	100	-	16	40
	SCC43 MEL407	Chromatographic Methods of Analysis										
	SCC43 MEL408	Material Chemistry										
	SCC43 MEL409	Computational & Quantum Chemistry										
ME	SCC43 MEP403	Chemistry Lab Course-XIV (ME-III)	P	1	-	2	30	20	50	-	8	20
RM	SCC43 RML401	Research Methodology	L	4	4	-	60	40	100	-	16	40
RP	SCC43 RPJ401	Research Project-I	J	4	-	8	60	40	100	-	16	40
Total				**22**	**13**	**18**	**390**	**260**	**650**	**-**	**104**	**260**

Note: Nature of Course: L- Lecture, P-Practical, S-Seminar, J-Project, I-Internship, D-Dissertation,
Course Category: MM-Major Mandatory, ME-Major Elective, MI-Minor, OE-Generic / Open electives, VSC-Vocational skill course, SEC-Skill Enhancement course, AEC-Ability Enhancement course, IKS-Indian Knowledge system, VEC-Value Education course, OJT-On Job Training / Internship / Apprenticeship, FP-Field project, CEP-Community engagement and service, CC-Co – curricular course, RM-Research methodology, RP-Research project

Fourth Year – Semester-VIII(B. Sc. Honours with Research) Chemistry												
Course Category	**Course Code**	**Course Title**	**Nature of Course**	**No. of Credits**	**Teaching (Contact hrs/ week)**		**Evaluation Scheme (Marks)**			**Minimum Passing (Marks)**		
					L	**P**	**Internal**	**External**	**Total**	**Internal**	**External**	**Total**
MM	SCC43MML418	Inorganic Reaction Mechanism & Organotransition Metal Chemistry	L	3	3	-	60	40	100	-	16	40
MM	SCC43MML419	Organic Reactions & Rearrangements	L	3	3	-	60	40	100	-	16	40
MM	SCC43MMP412	Chemistry Lab Course-XV	P	2	-	4	30	20	50	-	8	20
MM	SCC43MMP413	Chemistry Lab Course-XVI	P	2	-	4	30	20	50	-	8	20
ME		**Major Elective-IV**	L	3	3	-	60	40	100	-	16	40
	SCC43MEL410	Spectroscopic Methods of Analysis										
	SCC43MEL411	Pharmaceutical & Forensic Analysis										
	SCC43MEL412	Food, Fertilizer & Pesticides Analysis										
ME	SCC43MEP404	Chemistry Lab Course-XVIII (ME-IV)	P	1	-	2	30	20	50	-	8	20
RP	SCC43RPJ402	Research Project-II	J	8	-	16	60	40	100	-	16	40
Total				**22**	**9**	**26**	**330**	**220**	**550**	**-**	**88**	**220**

Note:

Nature of Course: L- Lecture, P-Practical, S-Seminar, J-Project, I-Internship, D-Dissertation,

Course Category: MM-Major Mandatory, ME-Major Elective, MI-Minor, OE-Generic / Open electives, VSC-Vocational skill course, SEC-Skill Enhancemenst course, AEC-Ability Enhancement course, IKS-Indian Knowledge system, VEC-Value Education course, OJT-On Job Training / Internship / Apprenticeship, FP-Field project, CEP-Community engagement and service, CC-Co – curricular course, RM-Research methodology, RP-Research project

Level 6.0 Award of Four Year UG Honours Degree B.Sc. (Honours with Research) Chemistry with 176 Credits

MGM University,
School of Basic and Applied Science,
BOARD OF STUDIES IN CHEMISTRY

$Basket of Vocational Skill Course (VSC) offered in Chemistry:

(Three/Four Years UG Degree Program NEP-2020)

Effective from Academic Year-2023-2024

Sr. No	Course Category	Course Code	Course Title	Credits	Teaching (contact hrs/week)	
					L	P
1	VSC	SCC43VSL101	Chemical Methods of Analysis	2	2	-
2	VSC	SCC43VSL102	Chemistry of Materials	2	2	-
3	VSC	SCC43VSL103	Green Chemistry			
4	VSC	SCC43VSL201	Chromatographic Methods of Analysis	2	2	-
5	VSC	SCC43VSL202	Spectroscopic Methods of Analysis			
6	VSC	SCC43VSL301	Electroanalytical Techniques	2	2	-
Total				**8**	**8**	-

$Basket of Skill Enhancement Course (SEC) offered in Chemistry:

(Three/Four Years UG Degree Program NEP-2020)

Effective from Academic Year-2023-2024

Sr. No	Course Category	Course Code	Course Title	Credits	Teaching (contact hrs/week)	
					L	P
1	SEC	SCC43SEP101	Extraction, Isolation and Purification Methods	2	-	4
2	SEC	SCC43SEP102	Pharmaceutical Analysis	2	-	4
3	SEC	SCC43SEP103	Water and Soil Analysis			
4	SEC	SCC43SEP201	Ore, Alloy and Cosmetic Analysis	2	-	4
5	SEC	SCC43SEP202	Food, Fertilizer and Pesticide Analysis	2	-	4
6	SEC	SCC43SEP203	Green Techniques for Organic synthesis			
Total				**8**	**-**	**16**

MGM University,
School of Basic and Applied Science,
BOARD OF STUDIES IN CHEMISTRY
*** Minor offered in Chemistry: Title of Minor: Analytical Chemistry**

(Three/Four Years UG Degree Program NEP-2020)

Effective from Academic Year-2024-2025

Sr. No	Course Category	Course Code	Course Title	Credit	Teaching (contact Hrs/week)	
					L	P
1	MI	SCC43MIL101	Basics of Analytical Chemistry	2	2	-
2	MI	SCC43MIL201	Chromatographic Methods of Analysis	3	3	-
3	MI	SCC43MIP201	Analytical Chemistry Lab-I	1	-	2
4	MI	SCC43MIL202	Spectroscopic Methods of Analysis	3	3	-
5	MI	SCC43MIP202	Analytical Chemistry Lab-II	1	-	2
6	MI	SCC43MIL203	Electro Analytical Techniques	3	3	-
7	MI	SCC43MIP203	Analytical Chemistry Lab-III	1	-	2
8	MI	SCC43MIL204	Bioanalytical Techniques	3	3	-
9	MI	SCC43MIP204	Analytical Chemistry Lab-IV	1	-	2
Total				**18**	**14**	**08**

MGM University,
School of Basic and Applied Science,
BOARD OF STUDIES IN CHEMISTRY

*** Open Elective Courses offered in Chemistry:**

(Three/Four Years UG Degree Program NEP-2020)

Effective from Academic Year-2023-2024

Sr. No	Course Category	Course Code	Course Title	Credits	Teaching (contact hrs/week)	
					L	P
1	OE	MGM43OE109	Polymer Chemistry	2	2	-
2	OE	MGM43OE130	Chemistry of Nanomaterials	2	2	-
3	OE	MGM43OE208	Principles of Spectroscopy	2	2	-
4	OE	MGM43OE234	Green Chemistry and Biorefinery Techniques	2	2	-

Syllabus Semester-I

Course code: SCC43MML101	**Course name:**Basics of Analytical Chemistry
Course category: MM	
Credits:2 **Teaching scheme:** L-2	**Evaluation scheme:** CA-30, ESE–20
Pre-requisites: Basic understanding of chemistry and chemical stoichiometry	
Course Objectives:	
To understand analytical chemistry its scope and perspectives. To solve chemical stoichiometric numerical To understand fundaments of chromatography , purification and extraction techniques	
Course Outcomes: At the end of the course, the students will be able to –	
CO1: Understand Analytical Chemistry branch its scope and perspectives	
CO2: Express of solution concentration	
CO3: Solve stoichiometric numerical	
CO4 Understand fundamentals of Chromatography	

Unit	Content	Teaching hours
1	**IntroductiontoAnalyticalChemistry:** Introduction to analyticalChemistry: definition, scope and applications, CalculationsusedinAnalyticalChemistry, **Someimportantunitsofmeasurements:** SIunits,distinctionbetweenmassandweight,mole,millimoleandCalculations,significant figures	10
2	**Solutions:** Introduction, methods for expression of solution concentration**,** MolaranalyticalConcentrations,Molarequilibriumconcentration,percentConcentration, Normality, Molarity, Molality, partpermillion,partperbillion,partperthousand,Solution dilution, densityandspecificgravityofsolutions,problems based on calucation of solution concentration.	10
3	**ChemicalStoichiometry:** Limiting reagent, percent yield, chemical stoichiometry, stoichiometric numerical EmpiricalandMolecularFormulas,StoichiometricCalculations,Problems.	10
4	**Fundamentals of Chromatography** Introduction-Introductiontochromatography,IUPACdefinitionofchromatography. HistoryofChromatography-paperchromatography,ThinLayerChromatography,IonexchangeChromatography, Gas permeation Chromatography, affinity chromatography, Gas chromatography,SupercriticalfluidchromatographyHighPerformanceLiquidChromatography,Capillaryelectrophoresis,Classificationofchromatographicmethodsaccordingtoseparationmethods,accordingtodevelopmentprocedures.	10

Text Books:

1.DouglasASkoog,DonaldMWest,FJamesHoller,StainlyRCrounch,FundamentalsofAnalyticalChemistry, 9thedition (2013)
2. Vogel'sQuantitativeAnalysis, 7th edition (2008)
3. GurudeepRChatwal,ShamKAnand,InstrumentalMethodsofChemicalAnalysis,5th edition (2023)

Reference Books:

Online Resources: 1.NPTEL / SWAYAM lectures.

Semester-I

Course code: SCC43MML102	**Course name:**Basics of Organic Chemistry
Course category: MM	
Credits: 2 **Teaching scheme:** L-2	**Evaluation scheme:** CA-30, ESE-20
Pre-requisites: Basic understanding of carbon chemistry and IUPAC nomenclature	
Course Objectives: To understand the fundamentals, principles, and foundation of organic chemistry.	
Course Outcomes: At the end of the course, the students will be able to –	
CO1: Describe structure and bonding in organic molecules	
CO2: Identification of R and S and Cis and Trans isomerism	
CO3: Use of IUPAC Nomenclature and predication of reaction mechanism for synthesis and chemicalproperties of alkane, alkene and alkynes.	
CO4 Identify compounds in which resonance is important, predict the effect of resonance on the stability of compounds and reactive intermediates, and draw resonance structures.	

Unit	Content	Teaching hours
1	**Fundamentals of Organic Chemistry:** Classification of organic compounds, Nomenclature, ElectronicDisplacements:InductiveEffect,ElectrometricEffect,ResonanceandHyper conjugation. Cleavage of Bonds: Homolysis and Heterolysis. Structure, shape and reactivity oforganic molecules: Nucleophiles and electrophiles. Reactive Intermediates: Carbonations, Carbanionsand free radicals.	10
2	**Stereochemistry** Introduction, classification, Interconversion of Wedge Formula, Newmann, Sawhorse and Fischer representations. Conformations with respect to ethane, butane and cyclohexane. Configuration: Geometrical - cis – trans, and E / Z Nomenclature (for upto two C=C systems). Optical isomerism Enantiomerism, Diastereomerism and Meso compounds). Concept of chirality (upto two carbon atoms). Threo and erythro; D and L; nomenclature; CIP Rules: R/ S (for up to 2 chiral carbon atoms)	10
3	Alkanes: Functional groupapproach for the following reactions (preparations & reactions) to be studied incontexttotheir structure. **Alkanes:** (Up to 5 Carbons) *Preparation:* Catalytic hydrogenation, Wurtz reaction, Kolbe's synthesis,fromGrignardreagent.*Reactions:*FreeradicalSubstitution:Halogenation.	10
4	**Alkenes:** (Upto5Carbons)*Preparation:*Eliminationreactions:Dehydrationofalkenesanddehydrohalogenationof alkylhalides (Saytzeff's rule); cis alkenes (Partialcatalytichydrogenation)andtransalkenes(Birchreduction).*Reactions:*cis-addition(alk.KMnO4)andtrans-addition(bromine),AdditionofHX(Markownikoff'sandanti-Markownikoff'saddition),Hydration,Ozonolysis,oxymecuration-demercuration,Hydroboration-oxidation. **Alkynes**:(Up to 5 Carbons)*Preparation:*Acetylene from $CaC_2$and conversion into higher alkynes;bydehalogenationoftetrahalidesanddehydrohalogenationofvicinal-dihalide*Reactions:*formationof metal acetylides, addition of bromine and alkaline KMnO4, ozonolysis and oxidation with hot alk.KMnO4. Aromatic Hydrocarbon, Huckel rule.	10

Text Books:

1. Morrison, R.T. & Boyd, R.N. Organic Chemistry, Pearson, 2010.
2. Bahl, A. &Bahl, B.S. Advanced Organic Chemistry, S. Chand, 2010

Reference Books:

2. McMurry, J.E. Fundamentals of Organic Chemistry, 7th Ed. Cengage Learning India Edition, 2013.
2. Kes, P. A Guidebook to Mechanism in Organic Chemistry, Orient Longman, New Delhi (1988).
Online Resources: 1.NPTEL / SWAYAM

Syllabus

Semester-I

Course code: SCC43MMP101	**Course name:** Chemistry Lab Course-I
Course category: MM	
Credits: 2 **Teaching scheme:** P-4	**Evaluation scheme:** CA–30, ESE–20
Pre-requisites: Laboratory safety awareness	
Course Objectives: To provide hands on training of various practical techniques for estimation, synthesis and analysis	
Course Outcomes: At the end of the course the learners should have following skills	
LO1: Understand importance of chemical and laboratory safety practices	
LO2: Understand the volumetric analysis and Apply: principles of volumetric analysis for estimation	
LO3: Preparation and standardization of solutions	
LO4: Demonstrate the elemental and functional group analysis of organic compounds	
LO4: Demonstrate chromatographic techniques for separation of constituents of mixture	

List of Experiments

Section-A: Analytical Chemistry Experiments

1. To determine normality given sodium hydroxide solution by titrating against standard oxalic acid solution
2. To standardize KMnO4 solution by titrating it against standard oxalic acid solution.
3. To estimate amount of Fe(II) in given solution by titrating it against standard KMnO4 solution
4. EstimationofselectivelyCu (II)frombrassalloybyiodometrically
5. EstimationofCafromcalciumsupplementarytabletbycomplexometrictitration
6. Estimation zinc by EDTA solution using EBT indicator
7. Determination of active chlorine in the given sample of bleaching powder.
8. Determination of Mg^{++} from given sample of talcum powder
9. Determination of hardness of the water sample

Section-B: Organic Chemistry Experiments

1. To determine type, functional group and elemental (N, S, Cl, Br, I) analysis of given organic compounds (Analysis of four different organic compound)
2. SeparationofconstituentsofmixturesbyChromatography:MeasuretheRfvalueineachcase: Identify and separate the components of a given mixture of 2 amino acids (glycine, aspartic acid,glutamicacid,tyrosineoranyotheraminoacids)/pigmentsfromplantextract/2organiccompoundsbypaperchromatography
3. Identifyandseparatethesugarspresentinthegivenmixturebypaperchromatography
4. Preparations:Mechanismofvariousreactionsinvolvedtobediscussed.Recrystallization,determinationofmeltingpointandcalculationofquantitativeyieldstobedone.(AnyTwo) (i) BrominationofCinnamicacidusingsodiumbromideandSodiumbromate. (GreenChemistryApproach) (ii) BrominationofacetanilideusingKBrandCericammoniumnitrateinaqueousmedium.(GreenChemistryApproach)
5. Semicarbazonederivativesofaldehydesandketones
6. Oximeand2,4-dinitrophenylhydrazoneofaldehyde/ketone

Reference Book / Hand Books/ Lab Manual

1. Systematic Experimental Physical Chemistry, S. W. Rajbhoj, T. K. Chondekar, 3rd edition, 2013, Anjali Publication.
2. Advanced Practical Inorganic Chemistry, Gurudeep Raj, 20th edition, 2008 Goel Publishing House
3. Vogel's Qualitative Inorganic Anlysis, 7th edition, 2009, Person Education.

Syllabus

Semester-I

Course code: SCC43VSL101	**Course name:**Chemical Methods of Analysis
Course category:VSC	
Credits: 2**Teaching scheme:** L-2	**Evaluation scheme:** CA-30, ESE–20
Pre-requisites: Basic understanding of chemistry and chemical stoichiometry	
Course Objectives: To learn principles of volumetric analysis, gravimetric analysis, techniques in Chemical analysis.	
Course Outcomes: At the end of the course, the students will be able to –	
CO1: Understand the theory of acid base titration and role of inductor	
CO2 Depict the reactions involved in redox titration.	
CO3: Describe the role of precipitating and complexing agent in precipitation and complexometrictitrations	
CO4 Explain the theory of gravimetric analysis and stoichiometric correlations and analysis of organic compounds	

Unit	Content	Teaching hours
1	**Theory of volumetric Analysis** Introduction to the Standard solutions, Titration, types of titration, Equivalence Point, End Point, Indicator, expression of concentration of solution, concept of pH, pOH, pKa, pkb etc., buffer solution	10
2	**Acid Base and redox titrations** **Acid-Base titrations:** Indictors used in acid-base titration, titration curve, types of acid base titration, theory of indicator. **Oxidation Reduction Titrations**: Preparation and standardization of some redox titrants e.g. potassium permanganate, potassium dichromate, iodine, sodium thiosulphate, etc. Some exercises related to determination of oxidizing and reducing agents in the sample shall be covered. Exercises involving potassium iodate, potassium bromate, iodine solution etc.	10
3	**Precipitation and Complexometric Titrations** Theory of precipitation Preparation and standardization of titrants like silvernitrate and, ammonium thiocyanate. **Complexometric Titrations**:Lignad used in complexometirc titration, Preparations and standardization of EDTA solution and its application in compexometric titration. Indicators used in complexometric titration	10
4	**Gravimetric Analysis and purification and analysis of organic compounds**: Use of sintered glass crucible, Determination of water of hydration, Theory of gravimetric estimation, calculation of yield. Purificationoforganiccompounds-Introduction,recrystallization,distillation,sublimation, extractiontechniques. Typesoforganiccompounds,characteristictestsandclassifications,reactionsofdifferentfunctionalgroups,analysisofbinarymixtures. Analysis-Detectionofnitrogen,sulfur,halogenandphosphorousbyLassiagen'stest. Quantitative estimation of C, H, N, S, P& Halogens: Dumas method, Kjeldahl's method: Carius method.	10

Text Books:

1. DouglasASkoog,DonaldMWest,FJamesHoller,StainlyRCrounch,*Fundamentals*ofAnalyticalChemistry,9th edition (2013)
2. Vogel'sQuantitativeAnalysis, 7th edition (2008)
3. Puri, Sharma, Kalia, Principles of Inorganic Chemistry, 33rd edition 2021 ISBN:978-93-82956-96-9
4. Fundamental of Analytical Chemistry 8thEdn. Skoog, West Hollar, Couch.
5. Instrumental Method of Chemical Analysis, G.R. Chatwal&S.K.Anand.

Reference Books:

Online Resources: 1.NPTEL / SWAYAM lectures.

Syllabus

Semester-I

Course code: SCC43SEP101	**Course name:**Extraction, Isolation and Purification Methods
Course category:SEC	
Credits: 2 **Teaching scheme:** P-4	**Evaluation scheme:** CA–30, ESE–20
Pre-requisites: Laboratory safety awareness	
Course Objectives: To built skill of extraction, separation and purification of organic compounds and inorganic compounds and metal ions	
Course Outcomes: At the end of the course the learners should have following skills	
LO1 Demonstrate various laboratory skills such crystallization, solvent extraction, and purification by distillation process.	
LO2 Understand and apply Principles of dissolution, crystallization, and purification	
LO3 Skill of extraction and purification of organic and inorganic compounds	

List of Experiments

1. To crystallize impure sample of any one of the following: Alum, Copper Sulphate, Benzoic acid.
2. To separate of organic compounds by simple distillation.
3. To record melting point of Benzoic acid, Naphthalene, 4-Nitro-Aniline, β-Napththol.
4. To record boiling point of organic compounds: Acetophenone, Toulene, Xylene
5. To purify Naphthalene by sublimation
6. Liquid-Liquid extraction: Separation of acidic, neural and basic organic compounds.
7. Paper chromatographic separation of Fe (III), Al(III) and Cr(III) ions
8. Paper chromatographic separation of Ni (II), CO(II), Mn(II) and Zn(II) ions
9. Paper chromatographic separation of Ca (II), Sr (II) and Ba(II)
10. Paper chromatographic separation of Li (I), Na(I) and K(I)
11. Separation and estimation of Fe (III) and Cu(II)
12. Separation and estimation of Ni (III) and Zn (II)
13. Extraction of limonene for organic pill
14. Extraction of essential lemmon grass
15. Extraction of metal ions by solvent extraction

Reference Book / Hand Books/ Lab Manual

1. Systematic Experimental Physical Chemistry, S. W. Rajbhoj, T. K. Chondekar, 3rd edition, 2013, Anjali Publication.
2. Advanced Practical Inorganic Chemistry, Gurudeep Raj, 20th edition, 2008 Goel Publishing House
3. Vogel's Qualitative Inorganic Anlysis, 7th edition, 2009, Person Education.

Semester-I

Course code: SCC43IKL101 **Course name:**Development of Science Ancient to Modern
Course category: IKS
Credits: 2 **Teaching scheme:** L-2 **Evaluation scheme:** CA-30, ESE–20
Pre-requisites:-
Course Objective: The objective of this course is to provide students with a comprehensive understanding of the development and contributions of physics, chemistry, and mathematics in ancient, medieval, and modern India. The course aims to explore the rich heritage of scientific knowledge in India, analyse the advancements made by ancient and modern Indian scientists, and highlight the connections between these disciplines throughout history.
Course Outcomes: At the end of the course, the students will be able to –
CO1: Demonstrate knowledge of the historical development of physics, chemistry, and mathematics in India.
CO2• Identify and analyze the key concepts, theories, and discoveries in ancient, medieval, and modern Indian physics, chemistry, and mathematics.
CO3:• Evaluate the cultural, societal, and philosophical influences on scientific advancements in ancient and medieval India.
CO4 Explain Appreciate the contributions of ancient and modern Indian scientists to the global scientific community

Unit	Content	Teaching hours
1	**Ancient Indian Mathematics** Introduction to ancient Indian mathematical traditions and their historical significance,Study of ancient Indian numeral systems, place value system, and arithmetic operations, Exploration of mathematical texts such as the Sulba Sutras and the works of Aryabhata and Brahmagupta, Modern Indian Contributions to Mathematics,Overview of modern developments in mathematics in India.	10
2	**Ancient Indian Physics** Overview of ancient Indian physics and its connections with philosophical and religious traditions. Study of concepts related to matter, energy, and the nature of the universe in ancient Indian texts. Analysis of theories on light, sound, and motion proposed by ancient Indian scientists. Overview of modern developments in physicschemistryin India,	10
3	**Chemistry in Ancient and Medieval India** Introduction to the development of chemistry in ancient and medieval India.. Examination of the concepts of elements, compounds, and chemical reactions in ancient Indian texts. Analysis of chemical processes like distillation, metallurgy, and dyeing described in ancient Indian literature, Overview of modern developments in India.	10
4	**Introduction to Ancient to Modern Geology** Overview of the development of geology as a scientific discipline, Study of geological knowledge and practices in ancient India. Discussion on the influence of geological understanding on ancient	10

Text Books:

Recommended Books:

1. "A Concise History of Science in India" by D.M. Bose and S.N. Sen Edition: First Edition Year: 1988
2. "Mathematics in India" by Kim Plofker Edition: Third Edition Year: 2019
3. "The Crest of the Peacock: Non-European Roots of Mathematics" by George Gheverghese Joseph Edition: Second Edition Year: 2011
4. "Physics and Chemistry in India: Historical Essays and Biographies" edited by C.V. Raman and K. Venkataraman Edition: First Edition Year: 1986
5. "Indian Alchemy: Soma in the Veda" by David Gordon White Edition: Second Edition Year: 2012
6. "The History and Culture of the Indian People: The Vedic Age" edited by R.C. Majumdar Edition: Fourth Edition Year: 1977
7. "Indian Physics: Selected Papers of Sir C.V. Raman" edited by S. Ramaseshan Edition: First Edition Year: 1988
8. "Chemistry in India: Ancient and Modern" edited by S.K. Joshi and S. Bandyopadhyay Edition: First Edition Year: 2013

Reference Books:

Online Resources: 1.NPTEL / SWAYAM lectures.

Syllabus

Semester-II

Course code: SCC43MML103	**Course name:**Basics of Inorganic Chemistry
Course category: MM	
Credits: 2 **Teaching scheme:** L-2	**Evaluation scheme:** CA-30, ESE–20
Pre-requisites: Basic concepts in atomic structure and periodic properties	
Course Objectives: To Understand and learn the quantum atomic model and general periodic properties and comparative study of main group elements (S and P Group)	
Course Outcomes: At the end of the course, the students will be able to –	
CO 1 Explain Various theories and principles applied to revel atomic structure	
CO2 Understand the general periodic properties of elements of main group	
CO3: Understand the physical and chemical properties of main group elements	
CO4: Depict the structure of hydrides, oxides and halides of main group.	

Unit	Content	Teaching hours
1	**Origin of Quantum Mechanics:** Atomic models, Energy quantization- i) Black body radiation ii) The photoelectriceffect iii) Wave particle duality-a) The particle character of electromagnetic radiation b) the wavecharacter of particle, iv) diffraction by double slit v) atomic spectra,Review of-Bohr's theory and itslimitations,Heisenberg Uncertaintyprinciple.	10
2	**Periodic Table and Periodic Properties** Modern Periodic table & Periodic properties of elements**:** periodic table review. Rules for filling electrons in various orbitals, Electronic configurations of theatoms. Stability of half-filled and completely filled orbitals, concept of exchange energy. Relativeenergiesofatomicorbitals,Anomalouselectronicconfigurations, Longformofperiodictable-s,p,dandfblockelements,Detaileddiscussionoffollowingpropertiesofelementswithrefe rencetosandpblock, Effectivenuclearcharge,shieldingorscreeningeffect, Atomicandionicradii, Covalentradii, Ionizationenergies Electronegativity,Pauling's/electronegativityscale, Oxidationstatesofelements	10
3	**S-Block Elements** Occurrence, electronic configuration, general physical properties, periodic properties, Chemical Properties, biological role of alkali and alkaline earth metal ions, complexes of S-block elements and Uses.	10
4	**P-Block Elements** Group 13, 14, 15, 16, 17, 18, Elements, occurrence, general methods of extraction, electronic configuration, general periodic properties, comparative study on hydrias, oxides and halides	10

Text Books:

1. Concise Inorganic Chemistry: J. D. Lee, 5th Edition (2008)
2. Principles of Inorganic Chemistry : Puri, Sharma, Kalia, 33rd Edition (2022)
3. Inorganic Chemistry, James E. House, Academic Press (Elsevier), 2008

Reference Books:

Online Resources: 1.NPTEL / SWAYAM lectures.

Syllabus
Semester-II

Course code: SCC43MML104	**Course name:**Basics of Physical Chemistry
Course category: MM	
Credits: 2 **Teaching scheme:** L-2	**Evaluation scheme:** CA-30, ESE-20
Pre-requisites: Basic chemistry	
Course Objectives: To learn chemical thermodynamics and equilibrium	
Course Outcomes: At the end of the course, the students will be able to –	
CO1 Solve the numerical problems based on thermo chemistry	
CO2 Understand the equilibrium and equilibrium constant	
CO3 Understand the ionic equilibrium and salt hydrolysis	
CO4 Understand the buffer solution its properties and applications.	

Unit	Content	Teaching hours
1	**Thermodynamics-I** Term used in thermodynamic, types of process, work done, internal energy, enthalpy, heat capacity, first law of thermodynamics, numerical on calculation of work done, internal energy and enthalpy.	
2	**Thermodynamics-II** Important principles and definitions ofthermo chemistry.Conceptofstandardstateandstandardenthalpiesofformations,integralanddifferential enthalpies of solution and dilution, bond enthalpy effect of temperature – Kirchhoff'sequation.Second law of thermodynamics, Carnot cycle, entropy, Gibbsfree energy, ThirdLawofthermodynamics.	10
3	**Chemical Equilibrium** Concept of Equilibrium, types of equilibrium, Law of Mass Action, application of equilibrium constant, Le Chatelier's principle, reaction quotient.	10
4	**Ionic Equilibrium** Strong, and weak electrolytes, degree of ionization, factors affecting degree of ionization,ionization constant and ionic product of water. Ionization of weak acids and bases, pH scale, commonion effect. Salt hydrolysis-calculation of hydrolysis constant, degree of hydrolysis and pH for differentsalts. Buffer solutions. Solubility and solubility product of sparingly soluble salts applications ofsolubilityproductprinciple.	10

Text Books:

1. B S Bahl, G D Tuli, ArunBahl, Essentials of Physical Chemistry 28th Edition (2022)

Reference Books:

1. Peter Atkins and Julio de Paula, Elements of Physical Chemistry, Sixth edition (2013), Oxford press
2. Samuel H. Maron and Carl F. Prutton, Principal of physical Chemistry, 4th Edition, Collier Macmillan Ltd

Online Resources: 1.NPTEL / SWAYAM lectures.

Syllabus
Semester-II

Course code: SCC43MMP102	**Course name:** Chemistry Lab Course-II
Course category: MM	
Credits: 2 **Teaching scheme:** P-4	**Evaluation scheme:** CA–30, ESE–20
Pre-requisites: Solution Chemistry and basic Inorganic and Physical Chemistry	
Course Objectives: To provide skill in inorganic preparations, estimation and to study thermodynic properties and equilibrium practically.	
Course Outcomes: At the end of the course the learners should have following skills	
LO1 Demonstrate the synthesis of inorganic compounds and pigments	
LO2 Understand the thermo chemistry in the various reactions	
LO3 Measure the pH of various solutions and commercial samples	
LO4 Preparation of buffer solutions	

List of Experiments

Section-A: Inorganic Chemistry

Preparation of Inorganic Pigments (Any Four)

1. Lithopone, $ZnS+BaSO_4$
2. Prussian Blue, $Fe_4[Fe(CN)_6]_3$
3. Stronsium Yellow, $SrCrO_4$
4. Chrome Green, Cr_2O_3
5. Darkredinorganicpigment:Cu_2O

Inorganic Separation and estimation (Any Four)

1. Separation and estimation of Cu and Zn from given mixture
2. Separation and estimation of Cu and Ni from given mixture
3. Sepration and estimation of Fe and Cu form given mixture
5. Separation and estimation of Zn(II) and Mg(II) from given mixture using Amberlite IRA400 anion exchange resin

Section B: Physical Chemistry

1. Determination of enthalpy of neutralization of hydrochloric acid with sodium hydroxide.
2. Determination of enthalpy of ionization of acetic acid.
3. Determination of integral enthalpy of solution of salts (KNO3, NH4Cl).
4. Determination of enthalpy of hydration of copper sulphate.
5. Study of the solubility of benzoic acid in water and determination of ΔH.
6. Determine formula of the complex formed between cupric ion and ammonia by distribution method
7. Study the effect of addition of an electrolyte on solubility of monobasic organic acid at room temperature
8. Preparation of buffer solutions (Any One) (i) Sodium acetate-acetic acid and determine its buffer capacity (ii) Ammonium chloride-ammonium hydroxide and determine its buffer capacity

Reference Book / Hand Books/ Lab Manual

4. Systematic Experimental Physical Chemistry, S. W. Rajbhoj, T. K. Chondekar, 3rd edition, 2013, Anjali Publication.
5. Advanced Practical Inorganic Chemistry, Gurudeep Raj, 20th edition, 2008 Goel Publishing House
6. Vogel's Qualitative Inorganic Anlysis, 7th edition, 2009, Person Education.

Syllabus
Semester-II

Course code: SCC43VSL102	**Course name:**Chemistry of Materials
Course category: VSC	
Credits: 2 **Teaching scheme:** L-2	**Evaluation scheme:** CA-30, ESE–20
Pre-requisites: Basic of Physical Chemistry	
Course Objectives: To learn solid state chemistry and its applications	
Course Outcomes: At the end of the course, the students will be able to –	
CO1: Understand: Structure and properties of solid materials	
CO2: Describe: Bonding in solid state materials	
CO3: Describe: Magnetic properties of materials	
CO4: Understand: properties and applications of engineering materials	

Unit	Content	Teaching hours
1	**Defects in Solid materials** Introduction to types of Solids, Perfect & imperfect crystals, point defects, Line defect and plane defect (definition & explanation of meaning) order & disorder phenomena, thermodynamics of Schottky&frenkel defect formation, Determination of defect, Non stoichiometric defect (structural and thermodynamic aspects) incorporation of stoichiometric excess of defects, thermodynamics of Nonstiochiometric phases**.**	10
2	**Unit II: Bonding in Solid materials** Reactions in the solid state and phase transitions: General principles, kinetics of solid-state reactions-nucleation and diffusion rate, Wagner mechanism, Kirkendall effect. X-ray powder diffraction.	10
3	**Magnetic Materials** Introduction, Magnetization, Electron spin and magnetic moment, Theory of diamagnetism, langevins theory & paramagnetic susceptibility of solids, ferromagnetism, Domain theory. Hysteresis in magnetism, ferrimagnetisms (ferries) Applications of magnetic materials	10
4	**Unit IV: Engineering Materials (06 Hrs)** Glass, ceramics, Refractory materials Glassy states, Glass formers and glass modifiers, applications, ceramic structures, mechanical properties, clay products, refractory characterization, properties.	10

Text Books:

1. Material Chemistry by Bradley D. Fahlman, 3rd edition, Springer, Central Michigan University Mount Pleasant, MI, USA
2. Introduction to Materials Chemistry, Harry R. Allcock, 2nd Edition, Wiley publication.
3.C.N.R. Rao, Solid State Chemistry: Dekker
4. Wilcox: Preparation and Properties of Solid State Materials: Vol I & II, Dekker
5. LohnWulff, the Structure and Properties of Materials Vol. IV, Electronic Properties(Wily Eastern)
B S Bahl, G D Tuli, ArunBahl, Essentials of Physical Chemistry 28th Edition (2022)

Reference Books:

1. Peter Atkins and Julio de Paula, Elements of Physical Chemistry, Sixth edition (2013), Oxford press

Online Resources: 1.NPTEL / SWAYAM lectures.

Syllabus
Semester-II

Course code: SCC43VSL103	**Course name:**Green Chemistry
Course category: VSC	
Credits: 2 **Teaching scheme:** L-2	**Evaluation scheme:** CA-30, ESE–20
Pre-requisites:	
Course Objectives: To understand green chemistry and sustainability related to environmental aspects.	
Course Outcomes: At the end of the course, the students will be able to –	
CO1: Describe principles of Green chemistry.	
CO2: Describe: various green protocols via catalysis.	
CO3: Apply: green solvents in organic synthesis.	
CO4: Apply : principles of green chemistry for biomass transformation	

Unit	Content	Teaching hours
1	**Principles of Green Chemistry** Twelve principles of Green Chemistry, Green Chemistry aspects, Need of Green Chemistry for today's world, Atom economy and recovery of reagents.	10
2	**Green Catalysis** Basics of catalysis, Phase transfer catalysts (PTCs), Organocatalysts, Biocatalysts, heteropoly acids, nanocatalysts, natural catalysts etc.	10
3	**Green Solvents** Green Solvents-water, aqueous solvents, ionic liquids, deep eutectic solvents. Solid state reactions: solid phase synthesis, solid supported synthesis, Comparison of traditional processes versus green processes.	10
4	**Renewable Materials.** Renewable Feedstocks- Role of Biomass and Components, Production of Chemicals from Renewable Resources; Applications of Renewable Materials- The Case of Biodegradable Plastics, The Case of Compostable Chemicals, Production of Ethanol from Biomass, The Case of Flex-Fuel Vehicles, Production of Biodiesel.	10

Text Books:

1. Handbook of Green Chemistry And Technology (Hb 2014) By Clark J, Wiley India
3. Green Chemistry: Theory and Practice, Paul T. Anastas, John Charles Warner, Oxford University Press, 1998
4 Green Chemistry: Principles and Practice, Paul Anastas and Nicolas Eghbali, Chem. Soc. Rev., 2010, 39, 301–312

Reference Books:

1. Green Chemistry and Engineering: A Pathway to Sustainability, Anne E. Marteel-Parrish Martin A. Abraham, Published by John Wiley & Sons, Inc., Hoboken, New Jersey
2. Green Chemistry, 1st Edition BelaTorok Timothy Dransfield, 2017, Elsevier

Online Resources: 1.NPTEL / SWAYAM lectures.

Syllabus
Semester-II

Course code: SCC43SEP102	**Course name:** Pharmaceutical Analysis
Course category: SEC	
Credits: 2 **Teaching scheme:** P-4	**Evaluation scheme:** CA-30, ESE-20
Pre-requisites:-	
Course Objectives: To built skill of chemical instrumental testing of active pharmaceutical ingredient**Course Outcomes:** At the end of the course the learners should have following skills	
LO1 Demonstrate: Chemical testing of active pharmaceutical ingredients	
LO2 Understand and apply: Chemical testing and assay of drug molecules.	
LO3 Use the Skill of Chemical and instrumental testing of active pharmaceutical ingredients	

List of Experiments

1. Determination of following oil values (including standardization ofreagents) Acid value, Saponification value and Iodine value
2. Determine partition coefficient of aspirin
3. Determine partition coefficient of paracetamol
4. Assay of drugs 1. Isonicotinic acid hydrazide 2. Chloroquin
5. Determine the mixture composition of acetic acid and hydrochloric acid by conductometric titration.
6. To determine the degree of hydrolysis and hydrolysis constant of sodium acetate
7. To determine concentration of Fe(II) by titrating it with potassium dichromate solution conductometrically.
8. To determine pKa value of the given organic acid by pH measurements
9. To determine Hammentt constant of the given substituted benzoic acid by pH measurement
10. To determine absorption maximum for KMnO4 solution by colorimetric measurements.
11. To verify Beer's law by colorimetric measurements
12. To study inversion of cane sugar by polarimeter
13. To study the rate equation for mutaroation of D-glucose in water

Reference Book / Hand Books/ Lab Manual

1. Systematic Experimental Physical Chemistry, S. W. Rajbhoj, T. K. Chondekar, 3rd edition, 2013, Anjali Publication.
2. Advanced Practical Inorganic Chemistry, Gurudeep Raj, 20th edition, 2008 Goel Publishing House
3. Vogel's Qualitative Inorganic Anlysis, 7th edition, 2009, Person Education.

Syllabus
Semester-II

Course code: SCC43SEP103	**Course name:** Water and Soil Analysis
Course category: SEC	
Credits: 2 **Teaching scheme:** P-4	**Evaluation scheme:** CA-30, ESE-20
Pre-requisites: -	
Course Objectives: To built skill of physical and chemical parameters of water and soil for quality testing.	
Course Outcomes: At the end of the course the learners should have following skills	
LO1 Demonstrate: testing of various parameters of soil and water	
LO2 Understand and Apply: Quality parameters of soil and water	
LO3 Skill: Chemical and instrumental testing of soil and water	

List of Experiments

1. Determination of pH and Electrical Conductivity of water.
2. Determination of Alkalinity.
3. Determination of Hardness (Total, Permanent & Temporary)
4. Determination of calcium.
5. Determination of Magnesium.
6. Determination of Carbonates & Bi-carbonates.
7. Determination of Chemical Oxygen demand (C.O.D.)
8. Determination of Biochemical Oxygen Demand (B.O.D.)
9. Determination of Electrical Conductivity of given soil sample
10. Determination of pH of given soil sample
11. Determination of %$CaCo_3$ in given soil sample by acid neutralization method.
12. Estimation of potassium content (soil/fertilizer) by flame photometer.
13. Determination of pH and conductivity of soil sample.
14. Estimation of Phosphorous from soil by colorimetric method

Reference Book / Hand Books/ Lab Manual

Standard Methods for Examination of water & waste wate APHA- AWWA- WPCE

2. Manual of water & waste water analysis, NEERI, Nagpur.

3. Text book of water and waste water engineering by H. K. Hussen.

4. Water supply & sanitary engineering by Birdie.

5. Practical methods in ecology & Environmental science by R. K. Trivedi, P. K. Goel,

C. L. Trisal

Syllabus

Semester-III

Course code: SCC43MML205**Course name:**Principles of Inorganic Chemistry-I
Course category:MM
Credits:2 **Teaching scheme:** L-2**Evaluation scheme:**CA-30, ESE-20
Pre-requisites: Basic understanding of chemical bonding and bond parameters
Course Objectives: To understand nature and structure of chemical bonding in molecules and various types of acid base concepts
Course Outcomes: At the end of the course, the students will be able to -
CO1: Calculate bond energy, bond order, dipole moment, radius ratio.
CO2: Depict structure bonding, hybridization and geometry in of molecules, bond order, bond energy and dipole moment.
CO3: Metallic bonding and band theory
CO4: Describe theories ofacid and bases
Contents –

Unit	Content	Teaching hours
1	**Ionic bond:** General characteristics, types of ions, size effects, radius ratio rule and its limitations. Packing of ions in crystals. Born-Landé equation with derivation Born-Haber cycle and its application	10
2	**Covalent Bonding** Introduction to covalent and coordinate bonding. Lewis structure, Valence Bond Theory (VBT), Concept of hybridization, Molecular Orbital Theory (MOT). Liner combination of atomic orbital, Molecular orbital diagrams of diatomic and simple polyatomic molecules N_2, O_2, C_2, B_2, F_2, CO, NO, and their ions; HCl, BeF_2, CO_2 bond order and bond energy. Valence Shell Electron Pair Repulsion Theory (VSEPR) shapes of simple molecules and ions containing lone pairs and bond pairs of electrons. Covalent character in ionic compounds, polarizing power and polarizability. Fajan's rules and consequences of polarization. Ionic character in covalent compounds: dipole moment. Percentage ionic character from dipole moment and electronegativity difference..	10
3	**Metallic bonding** Metallic Bond: Qualitative idea of valence bond and band theories. Band theory, conductor, semiconductors and insulators, defects in crystalline solids. Weak Chemical Forces: van-der Waals forces, ion-dipole forces, dipole-dipole interactions, induced dipole interactions, Instantaneous dipole-induced dipole interactions. Repulsive forces, Hydrogen bonding (theories of hydrogen bonding, valence bond treatment) Effects of chemical force, melting and boiling points, solubility energetic of dissolution process	10
4	**Concepts of Acid and Base Theories**/Concept of Acid-Bases: Arrhenius concept, Lowry and Bronsted concept, Lux-Flood concept, Lewis concept of acid bases. Relative strength of acid and bases, effect of solvent, Hard and Soft Acids and Bases (HSAB), HSAB principle and its applications.	10

Text Books:

1. Concise inorganic chemistry, J. D. Lee, 5th Ed (1996), Blackwell Science
2. Inorganic Chemistry, James E. House, Academic Press (Elsevier), 2008
3. Principles of Inorganic Chemistry, Puri, Sharma, Kalia, 33rd Edition, Vishal publishing.

Reference Books:

Basic Inorganic Chemistry, F. A. Cotton, G. Wilkinson, P. Gaus, 3rd edition, 2007 Willy.
Principles of Inorganic Chemistry, Brian W. Pfennig, Wiley (2015)

Online Resources: 1.NPTEL / SWAYAM lectures.

Chemistry of main group Elements https://archive.nptel.ac.in/courses/104/101/104101090/

Syllabus
Semester-III

Course code: SCC43MML206**Course name:**Principles of Organic Chemistry-I
Course category:MM
Credits:2**Teaching scheme:** L-2**Evaluation scheme:** CA-30, ESE-20
Pre-requisites: Understanding of General Organic Chemistry (GOC)
Course Objectives: To understand various confirmers of cylohexane, aromaticity, preparation and reaction of alkyl and aryl halides and amines
Course Outcomes: At the end of the course, the students will be able to -
CO1 Demonstrate: Various confirmers of cyclohexane by ball and stick model
CO2Understand: Mechanism of various name reactions.
CO3 Depictsterochemical aspects in addition and elimination reaction
CO4 Depict the reaction mechanism of amines

Unit	Content	Teaching Hrs
1	**Cycloalkanes and Conformational Analysis** Types of cycloalkanes and their relative stability, Baeyer strain theory, Conformation analysis of alkanes: Relative stability: Energy diagrams of cyclohexane: Chair, Boat and Twist boat forms; Relative stability with energy diagrams.	10
2	**Aromatic Hydrocarbons** Aromaticity: Hückel's rule, aromatic character of arenes, cyclic carbocations/carbanions andheterocyclic compounds with suitable examples. Electrophilic aromatic substitution:halogenations, nitration, sulphonation and Friedel-Craft's alkylation/acylation with theirmechanism. Directing effects of the groups.	10
3	**Alkyl and Aryl Halides** Alkyl halides: Methods of preparation, nucleophilic substitution reactions-SN^1, SN^2 and Sn^i mechanisms with stereochemical aspects and effect of solvent etc.; nucleophilic substitution vs. elimination. Aryl halides: Preparation, including preparation from diazonium salts. Nucleophilic aromatic substitution; SNAr, Benzyne mechanism. Relative reactivity of alkyl, allyl/benzyl, vinyl and aryl halides towards nucleophilic substitution reactions	10
4	**Amines and Diazonium Salts:** Amines (Aliphatic and Aromatic): Introduction and IUPAC nomenclature, Preparation from alkyl halides, Gabriel's Phthalimide synthesis, Hofmann Bromamide reaction. Reactions: Hofmann vs. Saytzeff elimination, Electrophilic substitution (Case Aniline): nitration, bromination, sulphonation. Diazonium salts: Preparation from aromatic amines	10

Text Books:

1. Morrison, R.T. and Boyd, R.N. Organic Chemistry, Prentice Hall of India, Sixth Edition, 2002, 283-308.
2. Bahl, A. and Bahl, B.S. Advanced Organic Chemistry, S. Chand, 2010.
3. McMurry, J.E. Fundamentals of Organic Chemistry, 7th Ed. Cengage Learning India Edition, 2013

Reference Books: 1.Hughues- Hallett Gleason, Calculus Single and Multivariable, 4th edition, Wiley.

1. Jonathan Clayden, Nick Greeves, Stuart Warren, Peter Wothers, Organic Chemistry- Oxford University Press, USA, 2nd Ed.
2. Sykes, P. A Guidebook to Mechanism in Organic Chemistry, Orient Longman, New Delhi (1988)

Online Resources: 1.NPTEL / SWAYAM lectures.

Introductory Organic Chemistry Prof. NeerajaDashaputre, Prof. HarinathChakrapani | IISER Pune https://onlinecourses.nptel.ac.in/noc23_cy16/preview

Syllabus

Semester-III

Course code: SCC43MML207**Course name:**Principles of Physical Chemistry-I
Course category:MM
Credits: 4 **Teaching scheme:** L-2**Evaluation scheme:** CA-30, ESE-20
Pre-requisites: Basic understanding of physical chemistry and states of matter
Course Objectives:
Course Outcomes: At the end of the course, the students will be able to -
CO1: Describe gas laws, viscosity and surface tension of different liquids
CO2: UnderstandLaw of crystallography, crystal structure and defects in solids.
CO3: Describe preparation, properties and applications of sole and emulsion
CO4: Understand the physical properties of colloidal solutions and surface phenomenon

Unit	Content	Teaching Hrs
1	**Gaseous state** Postulates of kinetic theory of gases, kinetic gas equation, Deduction of Gas Laws : Boyles Law, Charles Law, Grahams Law of diffusion, Avogadro's hypothesis, deviation from ideal behavior, van der Waals equation of state. Critical Phenomena: PV isotherms of real gases. Numerical based on gas law and kinetic theory of gases	10
2	**Liquid state** Qualitative treatment of the structure of the liquid state; Radial distribution function; physical properties of liquids; vapour pressure, surface tension and coefficient of viscosity, and their determination. Effect of addition of various solutes on surface tension and viscosity. Liquid Crystals: Classification, structure of nematic and cholestric phases.	10
3	**Solid state** Nature of the solid state, law of constancy of interfacial angles, law of rational indices, Miller indices, elementary ideas of symmetry, symmetry elements and symmetry operations, qualitative idea of point and space groups, seven crystal systems and fourteen Bravais lattices; X-ray diffraction, Bragg's law, a simple account of rotating crystal method and powder pattern method. Analysis of powder diffraction patterns of NaCl, CsCl and KCl. Defects in crystals. Glasses and liquid	10
4	**Colloidal State** Concepts and examples of colloids, Classification of colloids. Types of sols: Lyophilic and Lyophobic sols, Micelle formation and mechanism of action. Hardy and Schulze rule Preparation of colloids : Chemical methods, Electrical disintegration methods and mechanical dispersion methods Purification of colloidal solution : Dialysis, Electro-dialysis and Ultra filtration Properties of Colloidal solution: Tyndall effect, Colour, Brownian motion, Electrokinetic potential, Electrophoresis. Emulsions: Types, Preparation and properties Application of Colloids.	10

Text Books:
1. Essentials of Physical chemistry by BahlTuli-Revised Multicolour Edition 2009, S. Chand Pub. 2. Atkins' Physical Chemistry by Peter Atkins, Julio de Paula, James Keeler -11th edition 3. Principles of Physical chemistry by B.R. Puri, L.R. Sharma, M.S. Pathania
Reference Books:.
Barrow, G.M. Physical Chemistry Tata McGraw-Hill (2007) 2. Physical-Chemistry-4th Edition - Gilbert W. Castellan Narosa (2004).
Online Resources: 1.NPTEL / SWAYAM lectures.
https://archive.nptel.ac.in/courses/104/105/104105093/

Syllabus

Semester-III

Course code: SCC43MMP203**Course name:**Chemistry Lab Course-III
Course category:MM
Credits: 2 **Teaching scheme:**P-4 **Evaluation scheme:** CA–30, ESE–20
Pre-requisites: Skills of handling of laboratory chemicals and glassware stoichiometric chemical calculations
Course Objectives: To provide hands on training of various practical techniques for estimation, synthesis and analysis
Course Outcomes: At the end of the course the learners should have following skills
LO1: Apply the separation and purification techniques
LO2: Demonstrate/Apply: principles of gravimetric and complexometric method of estimation
LO3: Demonstrate/Apply: measurement of viscosity, surface tension.

List of experiments

List of Experiments

Section-A: Inorganic Chemistry Experiments
Gravimetric analysis (Any Three) 10. Estimation of zinc gravimetrically as zinc ammonium phosphate 11. Estimation of manganese as manganese ammounium phosphate 12. Estimation of nickel gravimetricaaly as Ni-DMG 13. Estimation of barium gravimetrically as barium chromate Complexometric Titration (Any Three) 1. Estimation zinc by EDTA solution using EBT indicator 2. Estimation of nickel by EDTA using murexide indicator 3. Estimation of copper by EDTA using fast sulphonbalck F indicator 4. Estimation of lead by EDTA using xylenol orange indicator
Section-B: Organic Chemistry Experiments
Preparation, crystallization, TLC and physical constant of following organic derivatives (Any Five) 1. Acetyl derivative of aniline 2. Acetyl derivative of salicylic acid 3. Hydrolysis derivatives of ethyl benzoate 4. Hydrolysis derivatives of Aspirin 5. Reduction derivative of m-dinitrobenzene 6. Osazone derivatives of glucose 7. Osazone derivatives of sucrose
Section-C: Physical Chemistry Experiments
Section-III: Physical chemistry (Any Three) 1. To determine the surface tension by (i) drop number (ii) drop weight method. 2. To Study the variation of surface tension of detergent solutions with concentration. 3. Determine the molecular mass of polymer form visometry measurements 4. To Study the variation of viscosity of sucrose solution with the concentration of solute.
Reference Book / Hand Books/ Lab Manual
1. Systematic Experimental Physical Chemistry, S. W. Rajbhoj, T. K. Chondekar, 3rd edition, 2013, Anjali Publication. 2. Advanced Practical Inorganic Chemistry, Gurudeep Raj, 20th edition, 2008 Goel Publishing House 3. Vogel's Qualitative Inorganic Anlysis, 7th edition, 2009, Person Education.

Syllabus

Semester-III

Course code: SCC43VSL201 **Course name:**Chromatographic Methods of Analysis
Course category:VSC
Credits:2 **Teaching scheme:** L-2**Evaluation scheme:** CA–30, ESE–20
Pre-requisites: Fundamental Concepts of Analytical Chemistry
Course Objectives: To understand working principle, instrumentation and applications of various chromatographic methods of analysis**.**
Course Outcomes: At the end of the course, the students will be able to -
CO1: Understand: Principles of separation of organic compounds by chromatographic methods
CO2: Calculate: Height Equiliavent to Therotical Plate
CO3 Describe: Application of chomatogrhpy in qualitative analysis of compounds.
CO3 Summarize: Instrumentation and application of advanced chromatographic methods.

Contents –

Unit	Content	Teaching hours
1	**Fundamentals of chromatographic separation methods** Definition, Principles of chromatography, sorption mechanisms - differential migration, partition and adsorption phenomena; Classification of different chromatographic methods; Methods of development Elution development, Gradient elution development, displacement development and frontal analysis. Dynamics of chromatography-efficiency of chromatographic column, zone spreading, Height Equivalent to Theoretical plate (HETP).	10
2	**Thin Layer Chromatography** Principle, chromatographic media-coating materials, applications, activation of adsorbent, sample development, solvent systems, development of chromatoplate, types of development, visualization methods, documentation, applications in the separation, HPTLC principle, technique, applications.	10
3	**Column & Ion Exchange chromatography**: **Column Chromatography**: Principle, experimental details, theory of development, column efficiency, factors affecting column efficiency, and applications. Adsorption isotherms, chromatographic media, nature of forces between adsorbent and solutes, eluents, (mobile phase), column chromatography without detectors and liquid chromatography with detectors and applications. Advanced flash chromatography	10
4	**Unit-IV Advanced Chromatographic Techniques** **High Performance Liquid Chromatography (HPLC)**: Theory, Instrumentation - description of the different parts of the equipment, stationary phases (columns), mobile phase, detectors - UV detector, applications, advantages and disadvantages	10

Text Books:

Title, Author, Edition, year of publication, Publisher

1. Douglas A. Skoog, Donald M. West and F. James Holler, analytical chemistry an
2. introduction, saunders college publishing, New york, 1990.
3. J. Bassett, R.C. Denny, G. Jeffery and J. Mendham. Vogel's text book of inorganic
4. Quantitative analysis, 4th edition, Longman group Ltd, Harlow, 1985.

Reference Books:

Title, Author, Edition, year of publication, Publisher

1. Pietrazyk and Frank. Analytical chemistry, 1990.
2. Werner Funk, Vera Damman, GerhildDonnervert. Quality Assurance in Analytical.

E - resources:

Quantitative Methods in Chemistry By Prof. Aasheesh , Prof. BharathwajSathyamoorthy , IISER Bhopal, NPTEL Course, https://onlinecourses.nptel.ac.in/noc20_cy02/preview

Syllabus

Semester-III

Course code: SCC43VSL202**Course name:**Spectroscopic methods of analysis
Course category:VSC
Credits: 2 **Teaching scheme:** L-2**Evaluation scheme:** CA–30, ESE–20
Pre-requisites: Fundamental Concepts of atomic structure and chemical bonding
Course Objectives:
To understand working principle, instrumentation and applications of various chromatographic methods of analysis
Course Outcomes: At the end of the course, the students will be able to -
CO1: Describe and understand the basic profile of electromagnetic radiations.
CO2: Understand principles of vibrational spectroscopy
CO3: Describe vibronic transitions
CO4: Solve: problems based on calculation of absorption maximum for organic compounds.

Unit	Content	Teaching hours
I	**Fundamentals of Spectroscopy** Introduction, Electro Magnetic Radiation (EMR), calculation of wavelength, frequency, wavenumber of EMR, interaction of EMR with matter, emission and absorption spectra. Zeeman effect and Starck effect.	**10**
II	**Vibrational Spectroscopy** Infrared: Principle and applications of FT-IR, Review of harmonic oscillator, selection rules, vibrational energy of diatomic molecules, zero point energy, force constant and bond strength; finger-print region, functional group identification	**06**
III	**Molecular Spectroscopy** Molecular Spectroscopy: Energy levels, MO, vibronic transitions, Franck- Condon principle, Electronic spectra of polyatomic molecules. Emission spectra, radiative and non-radiative decay, internal conversion	**10**
IV	**Ultraviolet- Visible Spectroscopy** Principles of absorption spectroscopy, Electronic transitions, presentation of electronic spectra.chromophores, Auxochromers, Bathochromic and Hypochromic Shifts, Effect of solvent and conjugation on electronic transitions, calculation of absorption maximum(λ_{max}) on the basis of Woodward-Fieser rules for dienes, enones and aromatic compounds, study of UV spectra of some organic compounds. Applications of UV-Visible Spectroscopy	**04**

Text Books:
Title, Author, Edition, year of publication, Publisher
1. Fundamentals of Molecular Spectroscopy by C. N. Banwell and E. M. McCash, Tata McGraw Hill, 1994. 2. Introduction to Molecular Spectroscopy by G. M. Barrow, McGraw Hill 3. Introduction to Atomic Spectra by H. E. White, McGraw Hill, 1934. 4. P. S. Sindhu, "Elements of Molecular Spectroscopy", New Age International publisher, New Delhi (2010). 5. J. M. Hill, "Modern Spectroscopy", John Wiley & Sons Ltd, (2004). 6. Instrumental Methods of Chemical Analysis - Chatwal, Anand
Reference Books:
Title, Author, Edition, year of publication, Publisher
1. Pietrazyk and Frank. Analytical chemistry, 1990.
E - resources:

Syllabus
Semester-IV

Course code: SCC43MML208**Course name:**Principles of Inorganic Chemistry-II
Course category:MM
Credits:2 **Teaching scheme:** L-2**Evaluation scheme:** CA-30, ESE-20
Pre-requisites: Basic understanding of inorganic and solid state chemistry
Course Objectives:
To understand periodic and chemical properties of transition metals and its coordination compounds
Course Outcomes: At the end of the course, the students will be able to -
CO11. Describe periodic trends in periodic and chemical properties of first transition series elements.
2. Describe Werner's Coordination theory of complexes of transition elements and their properties.
3. Understand Chemistry of f-block elements
4. Solve problems based on redox reactions

Content-

Unit	Content	Teaching hours
I	**Unit-I Chemistry of Elements of First Transition Series:** General introduction to Periodic Table and introduction to Transition Elements. General characteristic features of d-block elements. Properties of the elements of the firsttransition series: Ionic Size, Atomic Size, Metallic properties, Ionization potential,magnetic properties, Oxidation State.	**06**
II	**Unit-II Co-ordination Compounds of transition elements. :** Werner's Co-ordination Theory and its experimental verification, Classification of ligands, Metal ligand bonding, Valance bond theory, effective atomic Number concept, chelates, nomenclature of co-ordination compounds, isomerism in Co-ordination compounds. Important applications of transition elements and their complexes	**10**
III	**Unit-III Chemistry of f-block elements** Lanthanide Series: Electronic configuration, Oxidation state, Ionic radii and Lanthanoid contraction, colour and magnetic properties, basic character, chemical reactivity, extraction of mixture of lanthanoids, separation of lanthanoids, Actinide Series: Electronic configuration, oxidation state, ionic radii, colour and complex formation, properties, comparison with lanthanides compounds of uranium and thorium.	**10**
IV	**Unit-IV Redox Reactions** Introduction, types of redox reactions, rules for calculation of oxidation number, balancing of redox reactions in acidic and basic medium, redox titration	**04**

Text Books:

1. Concise inorganic chemistry, J. D. Lee, 5th Ed (1996), Blackwell Science
2. Inorganic Chemistry, James E. House, Academic Press (Elsevier), 2008
3. Principles of Inorganic Chemistry, Puri, Sharma, Kalia, 33rd Edition, Vishal publishing Co.

Reference Books:

Title, Author, Edition, year of publication, Publisher

1. Advanced Inorganic Chemistry, 6th edition, 1999, F. A. Cotton, G. Wilkinson, C. A. Murillo, M. Bochmann, John Wiley and Sons, New York.
2. Inorganic Chemistry, 3rd Edition, 1999, D. F. Shriver, P. W. Atkins, Oxford University Press, Oxford.

E - resources:
https://archive.nptel.ac.in/courses/104/101/104101136/

Syllabus

Semester-IV

Course code: SCC43MML209**Course name:**Principles of Organic Chemistry-II
Course category: MM
Credits:2Teaching scheme: L-2**Evaluation scheme:** CA–30, ESE–20
Pre-requisites: Basic understanding of Organic Chemistry
Course Objectives: To understand preparation, reactivity, physicochemical properties and applications of Alcohol, Phenols, Aldehydes, Ketons and carboxylic acid derivatives
Course Outcomes: At the end of the course, the students will be able to -
CO1: Describe preparation methods, reactivity and physical and chemical properties of and of Alcohol, Phenols, Aldehydes, Ketons and carboxylic acid derivatives.
CO2: Predict: Reaction mechanism for reactions shown by Alcohol, Phenols, Aldehydes, Ketons and carboxylic acid derivatives.
CO3: Describe: application and uses of Alcohol, Phenols, Aldehydes, Ketons.
CO4: Describe: Preparation, properties and reactions of carboxylic acidContents –

Unit	Content	Teaching Hrs
I	**Alcohols** Defination: Monohydric Alcohols: Methods of Formation by reduction of Aldehydes, Ketones, Carboxylic Acids and Esters (One eg.each) Acidic Nature, Reactions of Alcohols. Dihydric Alcohols: Method of Formation of Ethylene Glycol-industrial method and From Alkene using OsO_4, Chemical Reactions of Ethylene Glycol-nitration, Acylation, Oxidation (Using $Pb(OAc)_4$ without Mechanism Pinacol-Pinacolone rearrangement, Trihydric Alcohols: Preparation of Glycerol from propane, Reactions of Glycerol.	**10**
II	**Phenols:** Preparation of Phenol from Chlorobenzene, Cumene and Benzene Sulphonic Acid, Physical properties, Acidic Nature of Phenol, Resonance stabilization of Phenoxide Ion. Reactions of Phenols- Electrophilic Aromatic Substitution, Acylation, Carboxylation (Without Mechanism) Reactions with Mechanism- intramolecular Fries Rearrangement, Claisen Rearrangement, Gatterman Synthesis and Reimer Tiemann Reaction.	**06**
III	**Aldehydes and Ketones** Aldehydes: Preparation of Aldehydes from Acid Chloride, Gattermann-Koch synthesis Ketones- Preparation from nitriles and from Carboxylic Acid, Physical Properties of Aldehydes and Ketones. Mechanism of Nucleophilic Additions to Carbonyl Group with particular emphasis on Benzoin, AldolKnoenenagel condensations, MannichReactions.Use of Acetals as Protecting Group.	**10**
IV	**Carboxylic Acids:** Acidity of Carboxylic Acids, Effects of substituents on Acid strength, preparation of Acetic Acid from CO2 from Nitriles, from Acid Chloride, Anhydride, Ester and Amide. Physical Properties and reactions.	**04**

Text Books:
1. Morrison, R.T. and Boyd, R.N. Organic Chemistry, Prentice Hall of India**,** Sixth Edition, 2002, 283-308. 2. Bahl, A. and Bahl, B.S. Advanced Organic Chemistry, S. Chand, 2010. **3.** McMurry, J.E. Fundamentals of Organic Chemistry, 7th Ed. Cengage Learning India Edition, 2013
Reference Books:
4. Jonathan Clayden, Nick Greeves, Stuart Warren, Peter Wothers, Organic Chemistry- Oxford University Press, USA, 2nd Ed. **5.** Sykes, P. A Guidebook to Mechanism in Organic Chemistry, Orient Longman, New Delhi (1988)
E - resources:
Introductory Organic Chemistry I, IISER Pune Prof. HarinathChakrapani, Prof. NeerajaDashaputre, NPTEL Course; https://nptel.ac.in/courses/104106119

Syllabus
Semester-III

Course code:SCC43MML210 **Course name:**Principles of Physical Chemistry-II
Course category:MM
Credits:2**Teaching scheme:** L-2**Evaluation scheme:** CA–30, ESE–20
Pre-requisites: Basic understanding of Physical Chemistry
Course Objectives: To understand basic concepts of electrochemistry in the elementary level and will be combined with some basic experiments to understand the theories
Course Outcomes: At the end of the course, the students will be able to -
CO1: Understand: Redox reactions as basis of electrochemistry
CO2: Construction of electrochemical cells, fuel cells and their applications, laws of electrolysis
CO3: Describe theory of conduction of electricity in solution and various electrochemical properties of solution.
CO4: Calculation of solution conductance, cell constant, ionic conductivity, transport number

Unit	Content	Teaching Hrs
I	**Redox Reactions:** Concept of oxidation and reduction, redox reactions, types of redox reactions, oxidation number, balancing redox reactions, in terms of loss and gain of electrons and change in oxidation number, Galvanic cell, standard electrode potential, electrochemical series, applications of redox reactions.	**06**
II	**Introduction to Electrochemistry :** Introduction to Electrochemistry, laws of electrochemistry and electrolysis : Faraday's laws of Electrolysis, Arrhenius theory of electrolytic dissociation, Electrochemical cells, Electrochemical potential, the Nernst equation, electrochemical cell, standard electrode potential and cell potential, reaction Gibbs energy and cell potential.	**04**
III	**Electrolytic solutions:** Migration of ions, the transport number, Hittorf's rule and determination of transport number. Conductance in solution, specific conductance, equivalent conductance, determination of conductance, equivalent conductance at infinite dilution. Kohlrausch's Law and ionic mobilities :Kohlrausch's Law, its applications, ionic mobilities, weak electrolytes, degree of dissociation, hydration of ions. Conductometric titrations: Theory and experiments on Conductometric titrations.	**10**
IV	**Electrochemical Cells:** Electrochemical Cell EMF and equilibrium constant, activity coefficient, construction of an electrochemical cell and calculation of cell EMF and electrochemical series Various electrodes (Glass, SHE, Calomel etc) and their applications, Liquid junction potential, concentration cell, polarization and overpotential. Applications of EMF measurement: Demonstration Experiments of EMF measurement	**10**

Text Books:
1. Essentials of Physical chemistry by BahlTuli-Revised Multicolour Edition 2009, S. Chand Pub. 2. Principles of Physical chemistry by B.R. Puri, L.R. Sharma, M.S. Pathania 3. Barrow, G.M. Physical Chemistry Tata McGraw-Hill (2007)
Reference Books:
1. The Elements of Physical Chemistry', P.W. Atkins & Julio de Paula, 8th edition, Oxford University Press, Oxford 2006. 2. S. Glasstone, An Introduction to Electrochemistry, Affiliated East West Press 1942.
E - resources:
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Syllabus

Semester-IV

Course code: SCC43MMP204**Course name:**Chemistry Lab Course-IV**Course category:**MM
Credits:2**Teaching scheme:**P-4**Evaluation scheme:** CA–30, ESE–20
Pre-requisites: Skills of handling of laboratory chemicals and glassware stoichiometric chemical calculations
Course Objectives: To provide hands on training of quantitative analysis and estimation of organic and inorganic compounds and to study physicochemical properties such conductance, pH, absorbance by instrumental methods.
Course Outcomes: At the end of the course, the students will be able to -
LO1:Understand: The difference between qualitative and quantitative analysis
LO2: Analyze: Chemical samples by various instrumental techniques.
LO3: Demonstrate/Apply: Estimation of metal ion by redox

List of Experiments

Section-A: Inorganic Chemistry Experiments

Acid-Base Titration (Any Three)

(i) To determine volumetrically the amounts of sodium carbonate and sodium hydroxide present together in the given solution provided 0.1 N HCl

(ii) To determine volumetrically the amounts of sodium hydroxide and sodium bicarbonate resent together in the given solution; provided 0.1 N HCl

(iii) Estimation of free alkali present in different soaps/detergents

(iv) To determine both temporary and permanent hardness of the given sample of water

Oxidation-Reduction Titrimetry (Any Three)

(i) Estimation of Fe(II) and oxalic acid using standardized KMnO4 solution.

(ii) Estimation of oxalic acid and sodium oxalate in a given mixture.

(iii) Estimation of Fe (II) with $K_2Cr_2O_7$ using internal (diphenylamine, anthranilic acid) and external indicator.

(iv) Estimation of iron content in protland cement.

Section-B: Organic Chemistry Experiments

(i) Determination of molecular weight: Determination of molecular weight of organic acid by titration against standardized NaOH - a) monobasic acid or b) dibasic acid

(ii) Estimation of amides: Determine the amount of acetamide in given solution by volumetric method. (Standardization of acid must be performed)

(iii) Estimation of Ethyl benzoate: To determine the amount of ethyl benzoate in given solution volumetrically. (Standardization of acid must be performed)

(iv) To estimate the amount of ester by hydrolysis method

Section-C: Physical Chemistry Experiments

(i) To determine normality and strength of HCl using 0.1 N NaOH solution conductometrycally

(ii) To determine normality and strength of acetic acid using 0.1 N NaOH solution conductometrycally

(iii) To determine normality and strength of acetic acidm and hydrochloric acid using 0.1 N NaOH solution conductometrycally

(iv) To verify Lambert's Beer's Law using potassium paramagnet solution.

(v) To determine the indicator constant of the given indicator colorimetrically

(vi) To determine normality and strength of HCl using 0.1 N NaOH solution pH metrically.

Reference Book / Hand Books/ Lab Manual

1. Systematic Experimental Physical Chemistry, S. W. Rajbhoj, T. K. Chondekar, 3rd edition, 2013, Anjali Publication.
2. Advanced Practical Inorganic Chemistry, Gurudeep Raj, 20th edition, 2008 Goel Publishing House
3. Vogel's Qualitative Inorganic Anlysis, 7th edition, 2009, Person Education.

Syllabus

Semester-IV

Course code: SCC43SEP202**Course name:**Food, Fertilizer and Pesticide analysis
Course category:SEC
Credits:2**Teaching scheme:** P-4**Evaluation scheme:** CA-30, ESE-20
Pre-requisites: Skills of handling of laboratory chemicals and glassware stoichiometric chemical calculations
Course Objectives:
To built skill of food, fertilizer and pesticide materials
Course Outcomes: At the end of the course, the students will be able to -
LO1: Demonstrate qualitative and quantitative analysis of food, fertilizer and pesticide materials
LO2: Apply skill of chemical analysis for moniting of quality of food, fertilizer and pesticide materials.

List of Experiments

Food Analysis

1. Qualitative tests for the presence of carbohydrates in food samples
2. Qualitative test for the presence of protein in food samples
3. Estimation of lactose in milk sample by titrimetric method
4. Determination of acid value of given oil or fat sample
5. Determination of saponification value and un-saponifiable matter
6. Determination of vitamin C in food sample.

Fertilizer Analysis

1. Estimation of total P2O5 content in fertilizer.
2. Estimation of nitrogen from ammonium sulphate
3. Estimation of potassium content in fertilizer by flame photometer

Pesticide Analysis

1. Estimation of copper from Copper oxy chloride.
2. Estimation of copper in copper sulphatepentahydrate
3. Estimation of Carbendazim in a given formulation.
4. Electrometric determination of acidity / alkalinity of WP.
5. Estimation of Phosphamidon/ Dicofol in a given sample.

Reference Book / Hand Books/ Lab Manual

1. Vogel's Qualitative Inorganic Anlysis, 7th edition, 2009, Person Education.
1. Methods of Pesticides analysis - U. S. SreeRamulu, Oxford-IBH
2. Pesticides, Plant Growth Regulators and Food Additives, Vol I to XI - Gunter Zweig Academic press
3. A textbook of Practical Organic Chemistry - A. I. Vogel- ELBS with Longman, 5th Ed., (1989)
4. Laboratory Manual of Organic Chemistry - R.K.Bansal- Wiley Eastern 3rd (1994) 5.

Syllabus

Semester-III

Course code: SCC43SEP201	**Course name:** Ore, Alloy and Cosmetic Analysis	
Course category: SEC		
Credits: 2	**Teaching scheme:** P-4	**Evaluation scheme:** CA30, ESE-20
Pre-requisites: Skills of handling of laboratory chemicals and glassware stoichiometric chemical calculations.		
Course Objectives:		
To built skill of separation, analysis and estimation of contents of ores, alloys and synthesis and analysis of cosmetic material		
Course Outcomes: At the end of the course, the students will be able to -		
LO1: Demonstrate separation and analysis of components of ores alloys and cosmetic materials		
LO2: Understand and Apply principles of dissolution, precipitation, gravimetric and volumetric analysis		
LO3: Skill of synthesis and analysis of cosmetic product.		

Contents –

List of Experiments

Analysis of Ores

16. To analyse the given sample of dolomite ore for its % loss on ignition, acid insoluble residue, calcium oxide and magnesium oxide content.
17. To analyse the given sample of haematite ore for its acid insoluble residue and ion by redox titration.
18. To analyse the given sample of pyrolusite ore for its acid insoluble residue, Iron using gravimetic method and Manganese by EDTA titration method.

Analysis of Alloys

1. To analyse the given sample of brass alloy for its Copper content by iodometric method and Zinc content by EDTA titration method.
2. To analyse the given sample of tin solder alloy for its Tin content by gravimetric method and Lead content by EDTA titration method
3. To analyse stainless steel alloy for its Iron content gravimetrically and Chromium contain volumetrically.

Cosmetic Preparation and analysis

Practical based on synthesis and analysis of cosmetic products.

1. Determination of saponification value of oil.
2. Determination of iodine value of oil.
3. Determination of iron by chloride extraction by solvent extraction process.
4. Determination of dissolved oxygen.
5. Determination of iron in iron tablets.
6. Simultaneous estimation of chromium (III) and iron (III) by EDTA titration.
7. Simultaneous estimation of calcium (II) and zinc (II) by EDTA titration.
8. Simultaneous estimation of lead (II) and magnesium (II) by EDTA titration.
9. Separation of amino acids/ dyes/ drugs by TLC

Reference Book / Hand Books/ Lab Manual

1. Systematic Experimental Physical Chemistry, S. W. Rajbhoj, T. K. Chondekar, 3rd edition, 2013, Anjali Publication.
2. Advanced Practical Inorganic Chemistry, Gurudeep Raj, 20th edition, 2008 Goel Publishing House
3. Vogel's Qualitative Inorganic Anlysis, 7th edition, 2009, Person Education.

Note: 1.For a subject having 2 credits, the syllabus contents should have 3 to 4 units.
2. For a subject having 3 credits, the syllabus contents should have 4 to 5 units.
3. For a subject having 4 credits, the syllabus contents should have 5 to 6 units.