

DR. BABASAHEB AMBEDKAR MARATHWADA UNIVERSITY,
CHHATRAPATI SAMBHAJINAGAR.



CIRCULAR NO.SU/PG/College./NEP/19/2024

It is hereby inform to all concerned that, the syllabi prepared by the Board of Studies/ Ad-hoc Boards & recommended by the Dean, Faculty of Science & Technology, **Academic Council at its meeting held on 08 April 2024 has accepted** the following Syllabi under the Faculty of Science & Technology as per Norms of National Education Policy -2020 run at the Affiliated Colleges, Dr.Babasaheb Ambedkar Marathwada University as appended herewith.

Sr.No.	Courses	Semester
1.	M.Sc.Microbiology	IIIrd & IVth semester
2.	M.Sc.Botany	IIIrd & IVth semester
3.	M.Sc.Environmental Science	IIIrd & IVth semester
4.	M.Sc.Industrial Chemistry	IIIrd & IVth semester
5.	M.Sc.Biochemistry	IIIrd & IVth semester
6.	M.Sc. Chemistry Specialization Analytical Chemistry, Organic Chemistry, Inorganic Chemistry, Physical Chemistry, Polymer Chemistry, Drug Chemistry.	IIIrd & IVth semester
7.	MCA(Science)	IIIrd & IVth semester
8.	M.Sc. Forensic Science	Ist to IVth semester
9.	M.Sc.Forensic Cyber	Ist to IVth semester

This is effective from the Academic Year 2024-25 and onwards.

All concerned are requested to note the contents of this circular and bring the notice to the students, teachers and staff for their information and necessary action.

University Campus,
Chhatrapati Sambhajinagar,
431 004.

REF.NO.SU/2024/ 2446-54 *****
Date:- 21.06.2024

DR
**Deputy Registrar,
Academic Section**

Copy forwarded with compliments to :-

- 1] **The Principal of all concerned Colleges,**
Dr. Babasaheb Ambedkar Marathwada University,
- 2] **The Director, University Network & Information Centre, UNIC, with a request to upload this Circular on University Website.**

Copy to :-

- 1] **The Director, Board of Examinations & Evaluation,** Dr.Babasaheb Ambedkar Marathwada University, Chhatrapati Sambhajinagar.
- 2] **The Section Officer,[M.Sc.Unit] Examination Branch,** Dr.Babasaheb Ambedkar Marathwada University, Chhatrapati Sambhajinagar.
- 3] **The Programmer [Computer Unit-1] Examinations,** Dr.Babasaheb Ambedkar Marathwada University, Chhatrapati Sambhajinagar.
- 4] **The Programmer [Computer Unit-2] Examinations,** Dr.Babasaheb Ambedkar Marathwada University, Chhatrapati Sambhajinagar.
- 5] **The In-charge,[E-Suvidha Kendra], Rajarshi Shahu Maharaj Pariksha Bhavan,** Dr.Babasaheb Ambedkar Marathwada University, Chhatrapati Sambhajinagar.
- 6] **The Public Relation Officer,** Dr.Babasaheb Ambedkar Marathwada University, Chhatrapati Sambhajinagar.
- 7] **The Record Keeper,** Dr.Babasaheb Ambedkar Marathwada University, Chhatrapati Sambhajinagar.

**DR. BABASAHEB AMBEDKAR MARATHWADA UNIVERSITY,
CHHATRAPATI SAMBHAJINAGAR**



NAAC Re-accredited 'A' Grade

National Education Policy-2020
Outcome Based Curriculum
For

AFFILIATED COLLEGES

Faculty of Science & Technology

Two Years Master of Science in Chemistry Programme

Subject : Chemistry

Specialization:

Analytical chemistry, Inorganic Chemistry, Physical Chemistry,
Organic Chemistry, Polymer chemistry, Drug Chemistry,

Effective from Academic Year 2023-24

Prof. Pathan Mohd Arif Ali Khan
Chairman
Board of Studies in Chemistry,
Dr. Babasaheb Ambedkar Marathwada

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Prof. Pathan Mehdi Arif Ali Khan
Chairman
Board of Studies in Chemistry,
Dr. Babasaheb Ambedkar Marathwada

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Prof. Pathan Mohd Arif Ali Khan
Chairman
Board of Studies in Chemistry,
Dr. Babasaheb Ambedkar Marathwada

PREFACE

National Education policy 2020 has been intensely debated policies come into existence. In January, 2020 UGC has given the guideline for Learning outcome based curriculum framework (LOCF) work towards more holistic experience for the students . while focussing not just on knowledge delivery in higher education but also on the application of knowledge through field and laboratory work and emphasis on application of knowledge to real life experiences, LOCF is student-centric education in the context of development of personal, social, professional and acquired knowledge requirements in their career and life building, which focuses on measuring student performance through outcomes. It includes the knowledge, skills and attitudes enhancement in the students.


The aspects of LOCF is all-round development of the students, skill acquisition outside chosen subjects and research were undetermined but NEP has changed all of these in one stroke. The prominent features of the NEP framework are:

- Student centric education
- Flexibility in postgraduate programmes
- Multiple entry and exit points
- Skill based & outcome base education
- Credit based evaluation system
- Academic bank credits

It also focuses on evaluation of outcomes of the program by considering the knowledge, skill and behaviour of a students after completion of two year program. The educational triangle of Teaching-Learning and Evaluation process is the unique features of the OBE approach. The curriculum practices such as Competency based curriculum, Tailor-made curriculum development, spades, curriculum principles, Blooms Taxonomy and further use of assessment methodologies like, Norm-reference testing and Criterion reference testing, etc is being practiced since decades. It is also interesting to know that, globally, different countries and universities adopts the curriculum development models /approaches such as, CDIO (Conceive-Design-Implement-Operate), Evidence based education systems approach, etc as the scientific and systematic approaches in curriculum design.

Maharashtra state government and the authorities of Dr. Babasaheb Ambedkar Marathwada University, Chhatrapati Sambhajinagar has decided to implement National Education policies -2020 from the academic year 2023-24 for postgraduate program with outcome-based education

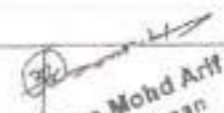
As per guideline of OBE the department has prepared curriculum for Master of science in chemistry with specialization Inorganic chemistry, Organic Chemistry, Physical Chemistry and self supported Analytical Chemistry . The OBE syllabus will help to improve the quality and employability of the Post-graduates of the university department.


Chairman Prof. Pathan Moid Arif Ali Khan
Chairman
Board of Studies in Chemistry
Dr. Babasaheb Ambedkar Marathwada University
Chhatrapati Sambhajinagar


1.	<p>Vision Statement: A Master of Science (M.Sc.) in Chemistry is a postgraduate degree that provide students with in-depth knowledge, research skills, and practical expertise in the field of chemistry. Some of key points of our M. Sc. Chemistry program are mentioned below:</p> <ol style="list-style-type: none">1. Comprehensive Core Curriculum: Our course having a strong core curriculum covering fundamental principles in organic, inorganic, physical, analytical, and drug chemistry. This foundational knowledge is crucial to build a solid understanding of the discipline.2. Specialization Options: To cater to the diverse interests of students, students have option to select different specialization. We are offering three specializations viz, Analytical Chemistry, Drug Chemistry and Organic Chemistry. By choosing a specialization, students can focus on topics that align with their career aspirations and research interests.3. Research Emphasis: Research is a crucial aspect of an M.Sc. Chemistry program. Students have opportunities to work on research projects under the guidance of experienced faculty members. This hands-on experience will enhance critical thinking, problem-solving skills, and laboratory techniques.4. Modern Analytical Techniques: The course will provide the training or interpretation in modern analytical techniques, such as spectroscopy, chromatography, mass spectrometry, and so on. Proficiency in these techniques is vital for conducting advanced research and for industry applications.5. Green Chemistry and Sustainability: Incorporation of principles of green chemistry and sustainability into the curriculum will promote awareness of environmental impact and encourage students to develop eco-friendly solutions. <p>Overall, the vision for M.Sc. Chemistry course is to produce well-rounded, skilled, and ethical chemists who can contribute meaningfully to scientific advancements and societal needs</p>
2.	<p>Mission Statement The mission of the M.Sc. Chemistry program is to provide advanced education and training in the field of chemistry. Student will get the understanding of chemical principles, analytical techniques, and specialized knowledge in various sub-disciplines. The program aims to foster critical thinking, research skills, and ethical practices among students, enabling them to contribute significantly to scientific advancement, innovation, and societal needs. Further, program focus is to encourage the students to stand in competitive examinations in the field of chemistry such as NET, SET and GATE and contribute to the academic field. To bring sustainable progress of society by nurturing chemistry with responsibilities. To create and maintain programs of excellence in the areas of research, education and public outreach. It will produce students who are knowledge in chemistry and can think critically. To develop the researcher and scientist in chemical science through post-graduate education and research programme. To develop the competent manpower with technology-based experimentation methodologies and value-</p>

Dr. Bha. P. ...
Chairman

	based practices for business and industries. To undertake projects to solve field base problems. To provide student centric learning facilities for the development of overall personality of learner.
3.	Eligibility Criteria : Candidate has passed Bachelor's Degree Examination with Chemistry as one of the major subject, eligible for M. Sc. (Chemistry) for all three specializations. Further, B.Sc. Forensic Science student is eligible only for Analytical Chemistry specialization
4.	Assessment and Evaluation: 40 % internal & 60% university exam
5.	Duration of Course Programme : Two years
6.	Credit Allotted for two year master programme in chemistry : 88 Credit Semester - I : 22 Semester -II : 22 Semester -III : 22 Semester -IV : 22
7.	Program Objectives: M. Sc. in Chemistry program aims to provide the following objectives: 1. Provide the Advanced Knowledge: The program aims to provide the core/basic concepts in chemistry, including organic, inorganic, physical, and analytical chemistry, while also exploring interdisciplinary areas. 2. Provide the Research Skills: Students will get the research-oriented environment in the department and learns the laboratory techniques and methodologies required in the research. 3. Create Analytical Thinking: We will encourage the students to create analytical thinking and encouraging to approach complex challenges with creativity and scientific reasoning. 4. Ability of Communication and Collaboration: In the program, students will work on their abilities to present and discuss scientific ideas clearly and work collaboratively with others
8.	Program Outcomes: The program outcomes (PO's) are the statement of competencies/ abilities. POs are the statement that describes the knowledge and the abilities the post-graduate will have by the end of program studies. i).In-depth and detailed functional knowledge of the fundamental theoretical concepts and experimental methods of chemistry.


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Dr. B. Ambedkar Marathwada

	<p>ii). Apply/implement interface between on the one hand, the history of chemistry and natural science and, on the other hand, issues pertaining to the areas of modern technology, health, and environment.</p> <p>iii). Skills in planning and conducting advanced chemical experiments and applying structural-chemical characterization techniques.</p> <p>iv). Skill in examining specific phenomena theoretically and/or experimentally.</p> <p>v). Generation of new scientific insights or to the innovation of new applications of chemical research.</p>
9.	<p>Course Program outcome</p> <p>Course Program Outcomes are developed through the curriculum (curricular/co-curricular-extra-curricular activities). The program outcomes are attained through the course implementation. As an educator, one must know, <u>"To which POs his/her course is contributing?"</u>. So that one can design the learning experiences, select teaching method and design the tool for assessment.</p>


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Dr. Babasaheb Ambedkar Marathwada

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CHHATRAPATI SAMBHAJINAGAR**



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National Education Policy-2020
Outcome Based Curriculum
For

AFFILIATED COLLEGES

Faculty of Science & Technology

Two Years Master of Science in Chemistry Programme

Subject : Chemistry

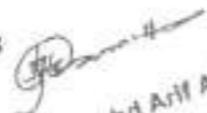
Specialization : Organic Chemistry,
Inorganic Chemistry, Physical Chemistry
Analytical Chemistry, Drug Chemistry
and Polymer Chemistry

(Semester I & II)

(Effective from 2023-24)

Illustrative Credit distribution structure for Two Years Programme with

Multiple Entry and Exit options


Pathan Mohd Arif Ali Khan
Chairman
Department of Chemistry,
Marathwada

**M.Sc. First Year Semester-I
Course Structure**

Course type	Course Code	Course Name	Teaching Scheme (Hrs./ week)		Credits Assigned			Marks		
			Theory	Practical	Theory	Practical	Total Credits	Conti. Inter. Assmen.	End. Sem Exam	Total Marks
Major Mandatory DSC	CHET/MJ/500	DSC-1 Anal. Chem	2	-	2	-	8T	20	30	50
	CHET/MJ/501	DSC-2 Inorg. Chem	2	-	2	-		20	30	50
	CHET/MJ/502	DSC-3 Org. Chem	2	-	2	-		20	30	50
	CHET/MJ/503	DSC-4 Phy. Chem	2	-	2	-		20	30	50
	CHEL/MJ/504	DSC-5 Inorg. Chem. Lab course	-	4	-	2	6L	20	30	50
	CHEL/MJ/505	DSC-6 Org. Chem. Lab course	-	4	-	2		20	30	50
	CHEL/MJ/506	DSC-7 Phy. Chem. Lab course	-	4	-	2		20	30	50
DSE (Choose one from your specialization and any one from remaining three)	CHETE/SE/507	DSE-1 Anal. Chem	2	-	2	-	4T	20	30	50
	CHETE/SE/508	DSE-2 Inorg. Chem	2	-	2	-		20	30	50
	CHETE/SE/509	DSE-3 Org. Chem	2	-	2	-		20	30	50
	CHETE/SE/510	DSE-4 Phy. Chem	2	-	2	-		20	30	50
	CHETE/SE/511	DSE-5 Drug Chem.	2	-	2	-		20	30	50
Research methodology	CHE/RM-512	Research methodology	4	-	4	-	4T	40	60	100
Total			16	12	16	06	22	220	330	550

Course Code Nomenclature :

DSC-Discipline Specific Core, DSE- Discipline Specific Elective, T-Theory, L- Laboratory course, CHET- Chemistry Theory Core, CHEL- Chemistry Laboratory Core, CHETE- Chemistry Theory Elective, CHERM- Chemistry Research Methodology

Prof. Pathan Mabd Arif Ali Khan
Chairman
Board of Studies in Chemistry,
Dr. Babasaheb Ambedkar Marathwada

**M.Sc. First Year Semester-II
Course Structure**

Course type	Course Code	Course Name	Teaching Scheme (Hrs./week)		Credits Assigned			Marks		
			Theory	Practical	Theory	Practical	Total Credits	Conti. Inter. Assme n.	End. Sem Exam	Total Marks
Major Mandatory DSC	CHET/ MJ/550	DSC-8 Anal. Chem	2	-	2	-	8T	20	30	50
	CHET/ MJ/551	DSC-9 Inorg. Chem	2	-	2	-		20	30	50
	CHET/ MJ/552	DSC-10 Org. Chem	2	-	2	-		20	30	50
	CHET/ MJ/553	DSC-11 Phy. Chem	2	-	2	-		20	30	50
	CHEL/ MJ/554	DSC-12 Inorg. Chem. Lab course	-	4	-	2	6L	20	30	50
	CHEL/ MJ/555	DSC-13 Org. Chem. Lab course	-	4	-	2		20	30	50
	CHEL/ MJ/556	DSC-14 Phy. Chem. Lab course	-	4	-	2		20	30	50
DSE (Choose one from your specialization and any one from remaining three)	CHETE/SE/557	DSE-6 Anal. Chem	2	-	2	-	4T	20	30	50
	CHETE/SE/558	DSE-7 Inorg. Chem	2	-	2	-		20	30	50
	CHETE/SE/559	DSE-8 Org. Chem	2	-	2	-		20	30	50
	CHETE/SE/560	DSE-9 Phy. Chem	2	-	2	-		20	30	50
	CHETE/SE/561	DSE-10 Drug Chem.	2	-	2	-		20	30	50
OJT/FP (Choose any one)	CHE OJT-562	On the Job Training	-	8	-	4	8L	40	60	100
	CHE FP-563	Field Project	-	8	-	4		40	60	100
Total			12	20	12	10	22	220	330	550

Course Code Nomenclature :

DSC-Discipline Specific Core, DSE- Discipline Specific Elective, T-Theory, L- Laboratory course, CHET- Chemistry Theory Core, CHEL- Chemistry Laboratory Core, CHETE- Chemistry Theory Elective, CHEO.IT- Chemistry On job training CHE FP Chemistry Field Project

Prof. Pathan Mohd Arif Ali Khan
Chairman
Board of Studies in Chemistry,
J. B. Ambedkar Marathwada

NEP-2020 BASED CURRICULUM FOR PG COURSE IN AFFILIATED COLLEGES OF DR. BAMU, CHHATRAPATI
SAMBHAJINAGAR

**R. BABASAHEB AMBEDKAR MARATHWADA UNIVERSITY,
CHHATRAPATI SAMBHAJINAGAR**



NAAC Re-accredited 'A' Grade

National Education Policy-2020
Outcome Based Curriculum
For

AFFILIATED COLLEGES

Faculty of Science & Technology

Two Years Master of Science in Chemistry Programme

Subject : Chemistry
Specialization : Organic Chemistry

(Semester III & IV)

(Effective from 2024-25)

Illustrative Credit distribution structure for Two Years Programme with
Multiple Entry and Exit options

Prof. Pathan Moad Arif Ali Khan
Prof. Pathan Moad Arif Ali Khan

M.Sc. Chemistry I & II Semester effective from 2023-24 & onwards

Dr. Babasaheb Ambedkar Marathwada
Dr. Bab

Class: M.Sc. Second Year Semester: IIIrd Specialization Subject: Organic Chemistry

Course type	Course Code	Course Name	Teaching Scheme (Hrs./ week)		Credits Assigned			Marks		
			Theory	Practical	Theory	Practical	Total Credits	Conti. Eval.	Uni. Exam.	Total Marks
Major Mandatory DSC	OCHET- 600	DSC-15 (org. Chem.)	4	-	4	-	10T	49	60	100
	OCHET- 601	DSC-16 (org. Chem.)	4	-	4	-		20	60	100
	OCHET- 602	DSC-17 (org. Chem.)	2	-	2	-		20	30	50
	OCHEL- 603	DSC-18 (org. Chem. Lab course)	-	4	-	2	4P	20	30	50
	OCHEL- 604	DSC-19 (org. Chem. Lab course)	-	4	-	2		20	30	50
DSE (Choose any Two from pool of courses)	OCHETE- 605	DSE-9 (org. Chem)	2	-	2	-	4T	20	30	50
	OCHETE- 606	DSE-10 (org. Chem)	2	-	2	-		20	30	50
	OCHETE- 607	DSE-11 (org. Chem)	2	-	2	-		20	30	50
	OCHETE- 608	DSE-12 (org. Chem)	2	-	2	-		20	30	50
Research Project	OCHE-RP- 649	Research Project -1	-	8	-	4	4P	40	60	100
Total			14	16	14	08	22	220	330	550

Course code Nomenclature :

DSC-Discipline Specific Core course, DSE- Discipline Specific Elective, T-Theory, L- Laboratory course, OCHET- Organic Chemistry Theory Core course, OCHEL- Organic Chemistry Laboratory Core course, OCHETE- Organic Chemistry Elective Course, OCHE-RP- Organic Chemistry Research Project


 Prof. Pathan Mohd Arif Ali Khen
 Chairman
 Board of Studies in Chemistry,
 Dr. B. A. M. U., Sambhajinagar, Maharashtra

Class: M.Sc. Second Year Semester: IVth Semester specialization Subject: Organic Chemistry

Course type	Course Code	Course Name	Teaching Scheme (Hrs./ week)		Credits Assigned			Marks		
			Theory	Practical	Theory	Practical	Total Credits	Cont. Eval.	Unl. Exam.	Total Marks
Major Mandatory DSC	OCHET-650	DSC-20 (org. Chem.)	4	-	4	-	10T	40	60	100
	OCHET-651	DSC-21 (org. Chem.)	4	-	4	-		40	60	100
	OCHET-652	DSC-22 (org. Chem.)	2	-	2	-		20	30	50
	OCHEL-653	DSC-23 (org. Chem. Lab course)	-	4	-	2	2P	20	30	50
DSE (Choose any Two from pool of courses)	OCHETE-654	DSE-13 (org. Chem)	2	-	2	-	4T	20	30	50
	OCHETE-655	DSE-14 (org. Chem)	2	-	2	-		20	30	50
	OCHETE-656	DSE-15 (org. Chem)	2	-	2	-		20	30	50
	OCHETE-657	DSE-16 (org. Chem)	2	-	2	-		20	30	50
Research Project	OCHETE-RP-699	Research Project-2	-	12	-	6	6P	60	90	150
Total			14	16	14	08	22	220	330	550

Course code Nomenclature :

DSC-Discipline Specific Core course, DSE- Discipline Specific Elective, T-Theory, L- Laboratory course, OCHET- Organic Chemistry Theory Core course, OCHEL- Organic Chemistry Laboratory Core course, OCHETE- Organic Chemistry Elective Course, OCHE-RP- Organic Chemistry Research Project,


 Prof. Pathan Mohd Arif Ali Khan
 Chairman
 Board of Studies in Chemistry,
 Dr. B. A. M. U., Warananagar Marathwad

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CHHATRAPATI SAMBHAJINAGAR**



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For

AFFILIATED COLLEGES

Faculty of Science & Technology

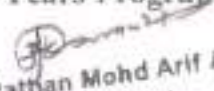
Two Years Master of Science in Chemistry Programme

Subject : Chemistry
Specialization : Analytical Chemistry

(Semester III & IV)

(Effective from 2024-25)

Illustrative Credit distribution structure for Two Years Programme with
Multiple Entry and Exit options


Prof. Pathan Mohd Arif Ali Khan
Chairman
Chemistry

Class: M.Sc. Second Year Semester: IIIrd Specialization Subject: Analytical Chemistry

Course type	Course Code	Course Name	Teaching Scheme (Hrs./ week)		Credits Assigned			Marks		
			Theory	Practical	Theory	Practical	Total Credits	Conti. Eval.	Uni. Exam.	Total Marks
Major Mandatory DSC	ACHET-600	DSC-15 (Ana. Chem.)	4	-	4	-	10T	40	60	100
	ACHET 601	DSC-16 (Ana. Chem.)	4	-	4	-		40	60	100
	ACHET 602	DSC-17 (Ana. Chem.)	2	-	2	-		20	30	50
	ACHEL 603	DSC-18 (Ana. Chem. Lab course)	-	4	-	2	4P	20	30	50
	ACHEL-604	DSC-19 (Ana. Chem. Lab course)	-	4	-	2		20	30	50
DSE (Choose any Two from pool of courses)	ACHETE 605	DSE-9 (Ana. Chem.)	2	-	2	-	4T	20	30	50
	ACHET 606	DSE-10 (Ana. Chem.)	2	-	2	-		20	30	50
	ACHET 607	DSE-11 (Ana. Chem.)	2	-	2	-		20	30	50
	ACHET 608	DSE-12 (Ana. Chem.)	2	-	2	-		20	30	50
Research Project	ACHE RP-649	Research Project -I	-	8	-	4	4P	40	60	100
Total			14	16	14	08	22	220	330	550

Course code Nomenclature :

DSC-Discipline Specific Core course, DSE- Discipline Specific Elective, T-Theory, L- Laboratory course, ACHTC- Analytical Chemistry Theory Core course, ACHLC- Analytical Chemistry Laboratory Core course, ACHEC- Analytical Chemistry Elective Course, ACHERP- Analytical Chemistry Research Project


 Prof. Pathan Mubd Arif Ali Khan
 Chairman
 Board of Studies in Chemistry,
 Chhatrapati Sambhajinagar Marathwada

Class: M.Sc. Second Year Semester: IVth Semester specialization Subject: Analytical
Chemistry

Course type	Course Code	Course Name	Teaching Scheme (Hrs./ week)		Credits Assigned			Marks		
			Theory	Practical	Theory	Practical	Total Credits	Conti. Eval.	Uni. Exam.	Total Marks
Major Mandatory DSC	ACHET 650	DSC-20 (Ana. Chem.)	4	-	4	-	10T	40	60	100
	ACHET 651	DSC-21 (Ana. Chem.)	4	-	4	-		40	60	100
	ACHET 652	DSC-22 (Ana. Chem.)	2	-	2	-		20	30	50
	ACHEL 653	DSC-23 (Ana. Chem. Lab course)	-	4	-	2	2P	20	30	50
DSE (Choose any Two from pool of courses)	ACHETE 654	DSE-13 (Ana. Chem.)	2	-	2	-	4T	20	30	50
	ACHETE 655	DSE-14 (Ana. Chem.)	2	-	2	-		20	30	50
	ACHETE 656	DSE-15 (Ana. Chem.)	2	-	2	-		20	30	50
	ACHETE 657	DSE-16 (Ana. Chem.)	2	-	2	-		20	30	50
Research Project	ACHERP-699	Research Project-2	-	12	-	6	6P	60	90	150
Total			14	16	14	08	22	220	330	550

Course code Nomenclature :

DSC-Discipline Specific Core course, DSE- Discipline Specific Elective, T-Theory, L- Laboratory course, ACHET- Analytical Chemistry Theory Core course, ACHEL- Analytical Chemistry Laboratory Core course, ACHETE- Analytical Chemistry Elective Course, ACHERP- Analytical Chemistry Research Project


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Chairman
Board of Studies in Chemistry,
Dr. Babasaheb Ambedkar Marathwada

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AFFILIATED COLLEGES

Faculty of Science & Technology


Two Years Master of Science in Chemistry Programme

Subject : Chemistry
Specialization : Polymer Chemistry

(Semester III & IV)

(Effective from 2024-25)

Illustrative Credit distribution structure for
Multiple Entry and Exit options


Prof. Pathan Mohd Arif Ali Khan
Chairman
Board of Studies in Chemistry
Dr. Babasaheb Ambedkar Marathwada University

Class: M.Sc. Second Year Semester: IIIrd Specialization Subject: Polymer Chemistry

Course type	Course Code	Course Name	Teaching Scheme (Hrs./week)		Credits Assigned			Marks		
			Theory	Practical	Theory	Practical	Total Credits	Conti. Eval.	Uni. Exam.	Total Marks
Major Mandatory DSC	PLCHET-600	DSC-15 (Polymer. Chem.)	4	-	4	-	10T	40	60	100
	PLCHET-601	DSC-16 (Polymer. Chem.)	4	-	4	-		40	60	100
	PLCHET-602	DSC-17 (Polymer. Chem.)	2	-	2	-		20	30	50
	PLCHEL-603	DSC-18 (Polymer. Chem.)	-	4	-	2	4P	20	30	50
	PLCHEL-604	DSC-19 (Polymer. Chem.)	-	4	-	2		20	30	50
DSE (Choose any Two from pool of courses)	PLCHETE-606	DSE-9 (Polymer. Chem.)	2	-	2	-	4T	20	30	50
	PLCHETE-607	DSE-10 (Polymer. Chem.)	2	-	2	-		20	30	50
	PLCHETE-608	DSE-11 (Polymer. Chem.)	2	-	2	-		20	30	50
	PLCHETE-609	DSE-12 (Polymer. Chem.)	2	-	2	-		20	30	50
Research Project	PLCHE-RP-649	Research Project -I	-	8	-	4	4P	40	60	100
Total			14	16	14	08	22	220	330	550

Course code Nomenclature :

DSC-Discipline Specific Core course, DSE- Discipline Specific Elective, T-Theory, L- Laboratory course, PLCHET- Polymer Chemistry Theory Core course, PLCHEL- Polymer Chemistry Laboratory Core course, PLCHETE- Polymer Chemistry Elective Course, PLCHE-RP- Polymer Chemistry Research Project

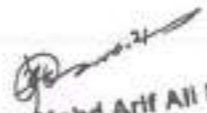

 Prof. Pathan Mohd Arif Ali Khan
 Chairman
 Board of Studies in Chemistry,
 Babasaheb Ambedkar Marathwada

Class: M.Sc. Second Year Semester: IVth Semester specialization Subject: Polymer Chemistry

Course type	Course Code	Course Name	Teaching Scheme (Hrs./ week)		Credits Assigned			Marks		
			Theory	Practical	Theory	Practical	Total Credits	Cont. i. Eval.	Uni. Exam.	Total Marks
Major Mandatory DSC	PLCHET-650	DSC-20 (Polymer. Chem.)	4	-	4	-	10T	40	60	100
	PLCHET-651	DSC-21 (Polymer. Chem.)	4	-	4	-		40	60	100
	PLCHET-652	DSC-22 (Polymer. Chem.)	2	-	2	-		20	30	50
	PLCHET-653	DSC-23 (Polymer. Chem. Lab course)	-	4	-	2	2P	20	30	50
DSE (Choose any Two from pool of courses)	PLCHETE-654	DSE-13 (Polymer. Chem.)	2	-	2	-	4T	20	30	50
	PLCHETE-655	DSE-14 (Polymer. Chem.)	2	-	2	-		20	30	50
	PLCHETE-656	DSE-15 (Polymer. Chem.)	2	-	2	-		20	30	50
	PLCHETE-657	DSE-16 (Ana. Chem.)	2	-	2	-		20	30	50
Research Project	PLCHE-RP-699	Research Project-2	-	12	-	6	6P	60	90	150
Total			14	16	14	08	22	220	330	550

Course code Nomenclature :

DSC-Discipline Specific Core course, DSE- Discipline Specific Elective, T-Theory, L- Laboratory course, PLCHTC- Polymer Chemistry Theory Core course, PLCHLC- Polymer Chemistry Laboratory Core course, PLCHEC- Polymer Chemistry Elective Course, PLCHRP- Polymer Chemistry Research Project


Prof. Pathan Mabd Arif Ali Khan
 Chairman
 Board of Studies in Chemistry,
 Dr. Babasaheb Ambedkar Marathwada

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CHHATRAPATI SAMBHAJINAGAR**



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For

AFFILIATED COLLEGES

Faculty of Science & Technology

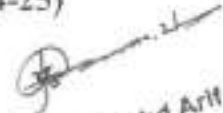
Two Years Master of Science in Chemistry Programme

Subject : Chemistry
Specialization : Drug Chemistry

(Semester III & IV)

(Effective from 2024-25)

Illustrative Credit distribution structure for Two Years Master of Science in Chemistry Programme with
Multiple Entry and Exit options



Prof. Pathan Mohd Arif Ali Khan
Chairman
Board of Studies in Chemistry,
Dr. Babasaheb Ambedkar Marathwada

Class: M.Sc. Second Year Semester: IIIrd Specialization Subject: Drug Chemistry

Course type	Course Code	Course Name	Teaching Scheme (Hrs./ week)		Credits Assigned			Marks		
			Theory	Practical	Theory	Practical	Total Credits	Cont. Eval.	Unl. Exam.	Total Marks
Major Mandatory DSC	DCHET- 600	DSC-15 (Drug Chem.)	4	-	4	-	10T	40	60	100
	DCHET 601	DSC-16 (Drug Chem.)	4	-	4	-		40	60	100
	DCHET 602	DSC-17 (Drug Chem.)	2	-	2	-		20	30	50
	DCHETL 603	DSC-18 (Drug Chem.)	-	4	-	2	4P	20	30	50
	DCHEL 604	DSC-19 (Drug Chem.)	-	4	-	2		20	30	50
DSE (Choose any Two from pool of courses)	DCHETE 605	DSE-9 (Drug Chem.)	2	-	2	-	4T	20	30	50
	DCHETE 606	DSE-10 (Drug Chem.)	2	-	2	-		20	30	50
	DCHETE 607	DSE-11 (Drug Chem.)	2	-	2	-		20	30	50
	DCHETE 608	DSE-12 (Drug Chem.)	2	-	2	-		20	30	50
Research Project	DCHE RP- 649	Research Project -I	-	8	-	4	4P	40	60	100
Total			14	16	14	08	22	220	330	550

Course code Nomenclature :

DSC-Discipline Specific Core course, DSE- Discipline Specific Elective, T-Theory, L- Laboratory course, DCHET- Drug Chemistry Theory Core course, DCHEL- Drug Chemistry Laboratory Core course, DCHETE- Drug Chemistry Elective Course, DCHE RP- Drug Chemistry Research Project


 Prof. Pathan Mubd Arif Ali Khan
 Chairman
 Board of Studies in Chemistry,
 Sambhajinagar, Maharashtra

Class: M.Sc. Second Year Semester: IVth Semester specialization Subject: Drug Chemistry

Course type	Course Code	Course Name	Teaching Scheme (Hrs./ week)		Credits Assigned			Marks		
			Theory	Practical	Theory	Practical	Total Credits	Cont. Eval.	Unl. Exam.	Total Marks
Major Mandatory DSC	DCHET 650	DSC-20 (Drug Chem.)	4	-	4	-	10T	40	60	100
	DCHET 651	DSC-21 (Drug Chem.)	4	-	4	-		40	60	100
	DCHET 652	DSC-22 (Drug Chem.)	2	-	2	-		20	30	50
	DCHEL 653	DSC-23 (Drug Chem. Lab course)	-	4	-	2	2P	20	30	50
DSE (Choose any Two from pool of courses)	DCHETE 654	DSE-13 (Drug Chem.)	2	-	2	-	4T	20	30	50
	DCHETE 655	DSE-14 (Drug Chem.)	2	-	2	-		20	30	50
	DCHETE 656	DSE-15 (Drug Chem.)	2	-	2	-		20	30	50
	DCHETE 657	DSE-16 (Drug Chem.)	2	-	2	-		20	30	50
Research Project	DCHE RP-699	Research Project-2	-	12	-	6	6P	60	90	150
Total			14	16	14	08	22	220	330	550

Course code Nomenclature :

DSC-Discipline Specific Core course, DSE- Discipline Specific Elective, T-Theory, L- Laboratory course, DCHET- Drug Chemistry Theory Core course, DCHEL- Drug Chemistry Laboratory Core course, DCHETE- Drug Chemistry Elective Course, DCHE RP- Drug Chemistry Research Project


 Prof. Pathan Mohd Arif Ali Khan
 Chairman
 Board of Studies in Chemistry,
 Dr. Babasaheb Ambedkar Marathwada

NEP-2020 BASED CURRICULAM FOR PG COURSE IN AFFILIATED COLLEGES OF DR. BAMU, CHHATRAPATI SAMBHAJINAGAR

**DR. BABASAHEB AMBEDKAR MARATHWADA UNIVERSITY,
CHHATRAPATI SAMBHAJINAGAR**



NAAC Re-accredited 'A' Grade

National Education Policy-2020
Outcome Based Curriculum
For

AFFILIATED COLLEGES

Faculty of Science & Technology

Two Years Master of Science in Chemistry Programme

Subject : Chemistry
Specialization : Inorganic Chemistry

(Semester III & IV)

(Effective from 2024-25)

Illustrative Credit distribution structure for Two Years Programme with
Multiple Entry and Exit options

Prof. Pathan Moud Arif All Khan

M.Sc. Chemistry I & II Semester effective from 2023-24 & onwards

Dr. Babasaheb Ambedkar Marathwada University

Class: M.Sc. Second Year Semester: IIIrd Specialization Subject: Inorganic Chemistry

Course type	Course Code	Course Name	Teaching Scheme (Hrs./week)		Credits Assigned			Marks		
			Theory	Practical	Theory	Practical	Total Credits	Conti. Eval.	Unl. Exam.	Total Marks
Major Mandatory DSC	ICHET-600	DSC-15 (Inorg. Chem.)	4	-	4	-	10T	40	60	100
	ICHET-601	DSC-16 (Inorg. Chem.)	4	-	4	-		40	60	100
	ICHET-602	DSC-17 (Inorg. Chem.)	2	-	2	-		20	30	50
	ICHEL-603	DSC-18 (Inorg. Chem. Lab course)	-	4	-	2	4P	20	30	50
	ICHEL-604	DSC-19 (Inorg. Chem. Lab course)	-	4	-	2		20	30	50
DSE (Choose any Two from pool of courses)	ICHETE-605	DSE-9 (Inorg. Chem)	2	-	2	-	4T	20	30	50
	ICHETE-606	DSE-10 (Inorg. Chem)	2	-	2	-		20	30	50
	ICHETE-607	DSE-11 (Inorg. Chem)	2	-	2	-		20	30	50
	ICHETE-608	DSE-12 (Inorg. Chem)	2	-	2	-		20	30	50
Research Project	ICHE-RP-649	Research Project -1	-	8	-	4	4P	40	60	100
Total			14	16	14	08	22	220	330	550

Course code Nomenclature :

DSC-Discipline Specific Core course, DSE- Discipline Specific Elective, T-Theory, L- Laboratory course, ICHET- Inorganic Chemistry Theory Core course, ICHEL- Inorganic Chemistry Laboratory Core course, ICHE-TE- Inorganic Chemistry Elective Course, ICHE-RP- Inorganic Chemistry Research Project



 Prof. Pathan Moad Arif Ali Khan
 Chairman
 Board of Studies in Chemistry,
 Dr. Babasaheb Ambedkar Marathwada

Class: M.Sc. Second Year Semester: IVth Semester specialization Subject: Inorganic Chemistry

Course type	Course Code	Course Name	Teaching Scheme (Hrs./ week)		Credits Assigned			Marks		
			Theory	Practical	Theory	Practical	Total Credits	Cont. Eval.	Uni. Exam.	Total Marks
Major Mandatory DSC	ICHET - 650	DSC-20 (Inorg. Chem.)	4	-	4	-	10T	40	60	100
	ICHET - 651	DSC-21 (Inorg. Chem.)	4	-	4	-		40	60	100
	ICHET - 652	DSC-22 (Inorg. Chem.)	2	-	2	-		20	30	50
	ICHEL - 653	DSC-23 (Inorg. Chem Lab course)	-	4	-	2	2P	20	30	50
DSE (Choose any Two from pool of courses)	ICHETE - 654	DSE-13 (Inorg. Chem)	2	-	2	-	4T	20	30	50
	ICHETE - 655	DSE-14 (Inorg. Chem)	2	-	2	-		20	30	50
	ICHETE - 656	DSE-15 (Inorg. Chem)	2	-	2	-		20	30	50
	ICHETE - 657	DSE-16 (Inorg. Chem)	2	-	2	-		20	30	50
Research Project	ICHE-RP-699	Research Project-2	-	12	-	6	6P	60	90	150
Total			14	16	14	08	22	220	330	550

Course code Nomenclature :

DSC-Discipline Specific Core course, DSE- Discipline Specific Elective, T-Theory, L- Laboratory course, ICHET- Inorganic Chemistry Theory Core course, ICHEL- Inorganic Chemistry Laboratory Core course, ICHETE- Inorganic Chemistry Elective Course, ICHE-RP- Inorganic Chemistry Research Project,


Prof. Pathan Mohd Arif Ali Khan
 Chairman
 Board of Studies in Chemistry,
 Dr. Babasaheb Ambedkar Marathwada

**DR. BABASAHEB AMBEDKAR MARATHWADA UNIVERSITY,
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National Education Policy-2020
Outcome Based Curriculum
For

AFFILIATED COLLEGES

Faculty of Science & Technology

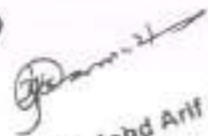
Two Years Master of Science in Chemistry Programme

Subject : Chemistry
Specialization : Physical Chemistry

(Semester III & IV)

(Effective from 2024-25)

Illustrative Credit distribution structure for Two Years Programme with
Multiple Entry and Exit options



Prof. Pathan Mohd Arif Ali Khan
Chairman
Studies in Chemistry,
Dr. Babasaheb Ambedkar Marathwada
University

Class: M.Sc. Second Year Semester: IIIrd Specialization Subject: Physical Chemistry

Course type	Course Code	Course Name	Teaching Scheme (Hrs./ week)		Credits Assigned			Marks		
			Theory	Practical	Theory	Practical	Total Credits	Cont. Eval.	Uni. Exam.	Total Marks
Major Mandatory DSC	PCHET- 600	DSC-15 (Phy. Chem.)	4	-	4	-	10T	40	60	100
	PCHET - 601	DSC-16 (Phy. Chem.)	4	-	4	-		40	60	100
	PCHET - 602	DSC-17 (Phy.Chem.)	2	-	2	-		20	30	50
	PCHET - 603	DSC-18 (Phy. Chem. Lab course)	-	4	-	2	4P	20	30	50
	PCHET - 604	DSC-19 (Phy. Chem. Lab course)	-	4	-	2		20	30	50
DSE (Choose any Two from pool of courses)	PCHET - 605	DSE-9 (Phy. Chem)	2	-	2	-	4T	20	30	50
	PCHET - 606	DSE-10 (Phy. Chem)	2	-	2	-		20	30	50
	PCHET - 607	DSE-11 (Phy. Chem)	2	-	2	-		20	30	50
	PCHET - 608	DSE-12 (Phy. Chem)	2	-	2	-		20	30	50
Research Project	PCHE RP- 649	Research Project -1	-	8	-	4	4P	40	60	100
Total			14	16	14	08	22	220	330	550

Course code Nomenclature :

DSC-Discipline Specific Core course, DSE- Discipline Specific Elective, T-Theory, L-Laboratory course, PCHET- Physical Chemistry Theory Core course, PCHEL- Physical Chemistry Laboratory Core course, PCHETE- Physical Chemistry Elective Course, PCHERP- Physical Chemistry Research Project


Prof. Pathan Mohd Arif Ali Khan
 Chairman
 Board of Studies in Chemistry,
 Dr. Babasaheb Ambedkar Marathwada

Class: M.Sc. Second Year Semester: IVth Semester specialization Subject: Physical Chemistry

Course type	Course Code	Course Name	Teaching Scheme (Hrs./ week)		Credits Assigned			Marks		
			Theory	Practical	Theory	Practical	Total Credits	Cont. Eval.	Uni. Exam.	Total Marks
Major Mandatory DSC	PCHET - 650	DSC-20 (Phy. Chem.)	4	-	4	-	10T	40	60	100
	PCHET 651	DSC-21 (Phy. Chem.)	4	-	4	-		40	60	100
	PCHET - 652	DSC-22 (Phy. Chem.)	2	-	2	-		20	30	50
	PCHET- 653	DSC-23 (Phy. Chem Lab course)	-	4	-	2	2P	20	30	50
DSE (Choose any Two from pool of courses)	PCHETE - 654	DSE-13 (Phy. Chem)	2	-	2	-	4T	20	30	50
	PCHETE - 655	DSE-14 (Phy. Chem)	2	-	2	-		20	30	50
	PCHETE - 656	DSE-15 (Phy. Chem)	2	-	2	-		20	30	50
	PCHETE - 657	DSE-16 (Phy. Chem)	2	-	2	-		20	30	50
Research Project	PCHE RP- 699	Research Project-2	-	12	-	6	6P	60	90	150
Total			14	16	14	08	22	220	330	550

Course code Nomenclature :

DSC-Discipline Specific Core course, DSE- Discipline Specific Elective, T-Theory, L- Laboratory course, PCHET- Physical Chemistry Theory Core course, PCHET- Physical Chemistry Laboratory Core course, PCHETE- Physical Chemistry Elective Course, PCHE-RP- Physical Chemistry Research Project.


 Prof. Pathan Mohd Arif Ali Khan
 Chairman
 Board of Studies in Chemistry,
 Babasaheb Ambedkar Marathwada

**DR. BABASAHEB AMBEDKAR MARATHWADA UNIVERSITY,
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National Education Policy-2020
Outcome Based Curriculum
For

AFFILIATED COLLEGES

Faculty of Science & Technology

Two Years Master of Science in Chemistry Programme

Subject : Chemistry

Specialization : Organic Chemistry,
Inorganic Chemistry, Physical Chemistry
Analytical Chemistry, Drug Chemistry
and Polymer Chemistry

(Semester I)

(Effective from 2023-24)

Illustrative Credit distribution structure for Two Years Programme with
Multiple Entry and Exit options

Board of Studies
Prof. Pathan Mehd Arif Ali Khan
Chairman

M.Sc. First Year Semester-I
Course Structure

Course type	Course Code	Course Name	Teaching Scheme (Hrs./ week)		Credits Assigned			Marks		
			Theory	Practical	Theory	Practical	Total Credits	Conti. Inter. Assmen.	End. Sem Exam	Total Marks
Major Mandatory DSC	CHET/MJ/500	DSC-1 Anal. Chem	2	-	2	-	8T	20	30	50
	CHET/MJ/501	DSC-2 Inorg. Chem	2	-	2	-		20	30	50
	CHET/MJ/502	DSC-3 Org. Chem	2	-	2	-		20	30	50
	CHET/MJ/503	DSC-4 Phy. Chem	2	-	2	-		20	30	50
	CHEL/MJ/504	DSC-5 Inorg. Chem. Lab course	-	4	-	2	6L	20	30	50
	CHEL/MJ/505	DSC-6 Org. Chem. Lab course	-	4	-	2		20	30	50
	CHEL/MJ/506	DSC-7 Phy. Chem. Lab course	-	4	-	2		20	30	50
DSE (Choose one from your specialization and any one from remaining three)	CHETE/SE/507	DSE-1 Anal. Chem	2	-	2	-	4T	20	30	50
	CHETE/SE/508	DSE-2 Inorg. Chem	2	-	2	-		20	30	50
	CHETE/SE/509	DSE-3 Org. Chem	2	-	2	-		20	30	50
	CHETE/SE/510	DSE-4 Phy. Chem	2	-	2	-		20	30	50
	CHETE/SE/511	DSE-5 Drug Chem.	2	-	2	-		20	30	50
Research methodology	CHE/RM-549	Research methodology	4	-	4	-	4T	40	60	100
Total			16	12	16	06	22	220	330	550

Course Code Nomenclature :

DSC-Discipline Specific Core, DSE- Discipline Specific Elective, T-Theory, L- Laboratory course, CHET- Chemistry Theory Core, CHEL- Chemistry Laboratory Core, CHETE- Chemistry Theory Elective, CHERM- Chemistry Research Methodology


Prof. Pathan Mohd Arif Ali Khan
Chairman
Department of Chemistry,
Dr. Babasaheb Ambedkar Marathwada

Semester : 1		
Course Name: Analytical Chemistry-I		Course Code: CHET/MJ/500
Course type : DSC-I		2 Hrs/ Week
Total contact hours : 30 Hrs	Theory Credit: 2	Marks : 50
Course outcomes: on completion of this course student will be able to :		
1.	Understand why analytical measurements need to be made.	
2.	Understand the importance of producing reliable results.	
3.	define what is meant by 'quality'.	
4.	understand the importance of sampling and able to identify different types of samples.	
5.	understand the basics in each separation techniques, viz. crystallization, sublimation, distillation, extraction.	
6.	understand the theory of liquid-liquid extraction.	
7.	understand the theory of solid-phase extraction.	
8.	understand basic of chromatographic Techniques for separation of constituents of mixtures	
9.	understand rate and plate theory of chromatography.	
Unit-I : Basic concepts of analytical chemistry		10Hrs
The role of analytical chemistry, The analytical perspectives, Common analytical problems, Purpose of analysis, Types of analysis, Qualitative and quantitative analysis, The analytical process, Steps in an analysis, Sampling: Types of samples and sampling, Introduction to the validation of a method		
Unit-II : Basic separation techniques		10Hrs
Precipitation, Recrystallization, Sublimation, Distillation: Simple, Fractional, Steam distillation, Distillation under vacuum, Theory of operation of distillation methods, Some practical considerations. Solvent and Solid Phase extraction: Phase equilibrium, The partition coefficient, The distribution ratio, Percent extracted, Theory of phase contact methods: Single equilibrations, Repeated equilibrations, Counter current distribution, Practical aspects and applications - Extraction of metals, Extraction of molecular species, Ion pair extractions, Accelerated and microwave assisted extraction, Solid phase extraction, Numericals		
Unit-III : Chromatography		10Hrs
Introduction, Elution, Eluent, Retention time, Retention volume, Retention ratio, Basic principles and theory of chromatographic techniques, Plate theory of chromatography, Rate theory of chromatography, Other factors in		

	zone broadening, Development of the chromatogram: Frontal analysis, elution analysis displacement analysis, Selection of chromatograph system. Qualitative and quantitative analysis by chromatography.	
References Books		
1.	Analytical Chemistry 6th Edition., Gary D. Christian	
2.	Fundamental of Analytical Chemistry 8th Ed ⁿ . Skoog, West Hollar, Crouch	
3.	Chemical Separations and Measurements, D.G. Peters, J.M. Hayes and G.M. Hieftie	
4.	Instrumental Method of Chemical Analysis, G.R. Chatwal & S. K. Anand	
5.	Introduction to instrumental analysis – Robert D. Braun	


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Chairman
Board of Studies in Chemistry,
Dr. Babasaheb Ambedkar Marathwada

-Semester : I		
Course Name: Inorganic Chemistry-I		Course Code: CHET/MJ/ - 501
Course type : DSC-2		2 Hrs/ Week
Total contact hours : 30 Hrs	Theory Credit: 2	Marks : 50
Course outcomes:		
On completion of this course, the students will be able:		
1.	To understand the stability constant of metal complex, stepwise and overall formation constant.	
2.	To describe the factors affecting for stability of metal complexes.	
3.	To identify and describe techniques for determination of formation constant of metal complexes.	
4.	To analyse the structural and stereoisomerism of metal complexes and their classifications.	
5.	To understand the mechanism in metal complexes.	
6.	To understand acid and base hydrolysis of metal complex and their mechanism.	
7.	To understand the role of trans effect in the synthesis of platinum complex.	
8.	To distinguish between the inner and outer sphere mechanism of electron transfer reaction of metal complexes.	
9.	To memorise the function of essential and trace elements in biological systems.	
10.	To describe the structure and function of metalloporphyrins, Hemoglobin, cytochrome and hemocyanine.	
11.	To understand the electron transfer, respiration and photosynthesis of biological system.	
12.	To know the diseases caused by deficiencies of Fe, Zn, Cu and Mn ions in biological system and remedies to them.	
Unit-I : Metal ligand equilibria in coordination compounds		10Hrs
	Definition of stability constant of metal complex , Step wise and overall formation constant, Factors affecting the stability of metal complexes with reference to the nature of metal ion and ligand. Determination of formation	

Mohd Arif Ali Khan

	constant for binary complexes using pH-metric technique. Isomerism in coordination compound, Types of isomerism.	
Unit-II : Reaction mechanism of transition metal complexes		10Hrs
	Ligand substitution reaction and their mechanisms of octahedral complexes. Acid hydrolysis, factors affecting the acid hydrolysis. Base hydrolysis, conjugate base mechanism. Trans effect in platinum complex, Theories of trans effect, reaction on platinum complex based on trans effect, Electron transfer reaction: mechanism of inner and outer sphere electron transfer reactions in octahedral complexes.	
Unit-III : Inorganic chemistry in biological systems		10Hrs
	Essential and trace elements in biological systems and their functions, structure and function of metalloporphyrins, Hemoglobin, cytochrome and hemocyanine. Electron transfer, Respiration and photosynthesis reaction, Metal ion deficiency diseases of Fe, Zn, Cu and Mn and their therapy.	
References Books		
1.	Principles of Inorganic chemistry- B.R. Puri, L. R. Sharma, K. C. Kalia	
2.	Concise Inorganic Chemistry- J.D. Lee.	
3.	Inorganic Chemistry- J.E. Huhey and Keiter R. L.	
4.	Inorganic Chemistry - Gary L. Miessler, Paul J. Fischer, Donald A. Tarr ; 5 th Edn	
5.	Mechanism of Inorganic Reaction- Fred Basolo and R.G. Pearsons.	
6.	Selected Topic in Inorganic Chemistry- Wahid U. Malik, G.D. Tuli and R. D. Madan.	
7.	Advanced Inorganic Chemistry- F. A. Cotton and Wilkinson.	
8.	Advanced Inorganic Chemistry- Satyaprakash, G.D. Tuli, S.K. Basu and R.D. Madan.	
9.	Advanced Inorganic Chemistry- Volume I and II Gurdeep Raj.	
10.	A Textbook of bioinorganic chemistry- A. K. Das	



 Prof. Pathan Mohd Arif Ali Khan
 Chairman
 Dept. of Chemistry,
 Sambhajinagar

Semester : I		
Course Name: Organic Chemistry-I		Course Code: CHET/MJ/-502
Course type : DSC-3		2 Hrs/ Week
Total contact hours : 30 Hrs	Theory Credit: 2	Marks : 50
Course outcomes		
Student will be able to		
1.	Understand the chemical and molecular processes in organic chemical reactions.	
2.	Study the concept of Alternant and non-alternant hydrocarbons	
3.	Study the energy levels of π -molecular orbitals	
4.	Explain the concept of aromaticity	
5.	Know the types of mechanism in organic reactions	
6.	Understand the correlation between the thermodynamic and kinetic parameters	
7.	Study the different intermediates involved in organic chemical reactions	
8.	Learn the various types of aliphatic nucleophilic substitution reactions	
Unit-I :Nature of Bonding in Organic Molecules		10 Hrs
Delocalized chemical bonding, conjugation, cross conjugation, resonance, hyperconjugation, tautomerism. Aromaticity in benzenoid and non-benzenoid compounds, alternant and non- alternant compounds, Huckel rule, energy level of π -molecular orbitals, annulenes, aromaticity, Bonds weaker than covalent - addition compounds, crown ether complexes and cryptands, inclusion compounds, cyclodextrins, catenanes and rotaxanes.		
Unit-II :Reaction Mechanism: Structure and Reactivity		10 Hrs
Types of Mechanisms, Types of reactions, Thermodynamic and Kinetic requirements, Kinetic and Thermodynamic control, Hammond's postulate, methods of determining mechanisms, isotope effects. Generation, structure, stability and reactivity of carbocations, Carbanions, free radicals, carbenes and Nitrenes. Effect of structure on reactivity, resonance and field effect, steric effect quantitative treatment, The Hammett equation, Linear free energy relationship, substituent and reaction constants, Taft equation.		
Unit-III :Aliphatic Nucleophilic Substitutions		10 Hrs
Nucleophilic: The S_N^2 , S_N^1 mixed S_N^1 and S_N^2 and SET mechanisms. The neighbouring group mechanism, Neighbouring group participation by π and σ -bonds, anchimeric assistance. Nucleophilic Substitution at an allylic aliphatic trigonal and a vinylic carbon. Reactivity: Effect of substrate structure, attacking nucleophile, leaving group, Reactivity and reaction medium. Phase transfer catalysis, Ambident nucleophiles, regioselectivity.		
Course Outcome :		
After completion of the course, students will be able to		
6.	Explore conceptual fact of chemical bonding and basis of reactivity	
7.	Apply the concept of aromaticity to various molecules	

8.	Explain the types of reactions and reaction intermediates	
9.	Compare the SN^1 , SN^2 and SN^3 with respect to mechanism, orientation and stereochemical outcome	
10.	Differentiate various nucleophilic substitution reactions	
11.	Explore conceptual fact of chemical bonding and basis of reactivity	
References Books		
1.	Advanced Organic Chemistry, IV Edition: J. March	
2.	Advanced organic Chemistry, Part-A and Part-B: F. A. Carey, & R. J. Sundburg	
3.	A Guide Book to Mechanism in Organic Chemistry: Peter Sykes	
4.	Synthetic Organic Chemistry: H. O. House	
5.	Principles of Organic Synthesis: R. O. C. Norman	
6.	Organic Chemistry (Second Edition): Clayden, Greeves and Warren	
7.	Mechanism and Structure in Organic Chemistry: E. S. Gould	

Semester: I		
Course Name: Physical Chemistry-I		Course Code: CHET/MJ/-503
Course Type: DSC-4		2 Hrs/ Week
Total Contact Hours: 30	Theory Credit: 2	Marks : 50
Course outcomes: student will be able		
1. To understand the fundamental principles of chemical kinetics.		
2. To learn different theories of chemical kinetics.		
3. To understand concept of fast and slow reactions based on their rate constant and reaction rates.		
4. To understand the concept of thermodynamics.		
5. To apply critical thinking and problem solving skills to solve problem related to thermodynamics and chemical kinetics.		
6. To understand the basic concept of micelles.		
Unit-I: Chemical Dynamics		10 Hrs
Collision theory, modified collision theory, weakness of the collision theory, Theory of absolute reaction rates, equilibrium hypothesis, Derivation of the rate equation, statistical mechanical derivation and thermodynamic formulation. Isotope effect on reaction rate. Primary salt effect, secondary salt effect. Dynamics of uni-molecular reactions, Lindmann and Hinshelwood theory, Kinetics of fast reactions, study of fast reactions by flow method, relaxation method, flash photolysis and NMR method. Reactions in solution: Reaction between ions, influence of solvent-double sphere model, single sphere model, influence of ionic strength, numericals.		
Unit-II: Classical Thermodynamics		10 Hrs
Nernst heat theorem, the third law of thermodynamics, determination of absolute entropies of solids, liquids and gases. Partial molar properties : Partial molar free energy, chemical potential, partial molar volume and partial molar heat content and their significance, determination of these quantities, concept of fugacity and determination of fugacity.		
Unit-III: Micelles		10 Hrs
Colloidal electrolytes, Types of micelles in colloidal electrolytes, Micellization, Thermodynamics of micellization, Mechanism of Micellization, critical micellar concentration, Determinations of critical micellar concentration, Surface active agents, Classifications of surface active agents, Reverse micelles, Solubilization		
Reference Books:		
1. Chemical Kinetics - Laidler (McGraw-Hill)		

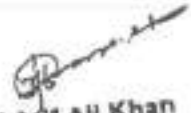
2.	Kinetic and Mechanism of Chemical Transformations - J. Rajuram and J.C. CURIACOSE (Macmillan India Ltd.)
3.	Physical Chemistry - Atkins (Oxford)
4.	Thermodynamics for Chemists - S. Glasstone (EWP, New Delhi)
5.	Physical Chemistry - G. M. Barrow
6.	Advanced Physical Chemistry - Gurdeep-Raj (Plenum)
7.	Micelles : Theoretical and Applied Aspects - V. Moroi (Plenum)
8.	Text Book of Physical Chemistry - S. Glasstone (McMillan)
9.	Physical chemistry – Robert A .Alberty ., Robert J .Silbey
10.	Statistical Thermodynamic – M. C. Gupta


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Semester : I		
Course Name: Inorganic Chemistry Laboratory Course-I		Course Code:CHEL/MJ/-504
Course type : DSC-5		4 Hrs/ Week
Total contact hours :60 Hrs	Lab. Work Credit: 2	Marks : 50
Course outcomes:		
On completion of this course, the students will be able:		
1.	To understand the difference between qualitative and quantitative analysis.	
2.	To understand the concept of qualitative and quantitative chemical analysis and their chemical reactions and constituents .	
3.	To understand the design and development of experimental setup and procedure, for volumetric and gravimetric analysis of chemical compound.	
4.	To identify constituents of chemicals qualitatively and quantitatively	
5.	To understand importance of accuracy and precision in measurement of chemical analysis	
6.	To apply grasped knowledge to solve chemical analysis related issues of stakeholder.	
7.	To understand importance of laboratory skills, precaution, accuracy and precision.	
8.	To separate and identify acidic & basic radicals from chemical sample.	
9.	To apply the grasped knowledge in chemical analysis of unknown sample.	
List of experiments		
Sr No	Group- I (Any 3)	
1.	Separation and Identification of three basic radicals from II group sample mixture by semimicro qualitative analysis method and their chemical reactions .	
2.	Separation and Identification of three basic radicals from III-A group sample mixture by semimicro qualitative analysis method and their chemical reactions .	
3.	Separation and Identification of three basic radicals from III-B group sample mixture by semimicro qualitative analysis method and their chemical reactions .	
4.	Separation and Identification of three basic radicals from IV group sample mixture by semimicro qualitative analysis method and their chemical reactions	

5.	Separation and Identification of three basic radicals from special group sample mixture by semimicro qualitative analysis method and their chemical reactions .
Group- II (Any 3)	
6.	Separation and Identification of three basic radicals from II, IIIA and IIIB groups sample mixture by semimicro qualitative analysis method and their chemical reactions .
7.	Separation and Identification of three basic radicals from IIIA , IIIB & IV groups sample mixture by semimicro qualitative analysis method and their chemical reactions.
8.	Separation and Identification of three basic radicals from IIIA , IIIB & V groups sample mixture by semimicro qualitative analysis method and their chemical reactions.
9.	Separation and Identification of three basic radicals from IIIA , IV & special groups sample mixture by semimicro qualitative analysis method and their chemical reactions .
Group- III (Any 3)	
10.	Identification of Carbonate, Chloride Iodide and Acetate ions from given mixture by semimicro qualitative analysis method along with chemical reaction of each radicals.
11.	Identification of Nitrate, Phosphate, Oxalate and Sulphate ions from given mixture by semimicro qualitative analysis method along with chemical reaction of each radicals.
12.	Identification of the Chloride , Bromide , Iodide and Acetate ions from given mixture along with chemical reaction of each radicals.
13.	Identification of Phosphate , Oxalate , thiosulphate and Acetate ions from given mixture by semimicro qualitative analysis method along with chemical reaction of each radicals.
14.	Identification of Carbonate , Nitrate , Oxalate and thiosulphate ions from given mixture by semimicro qualitative analysis method along with chemical reaction of each radicals.
Group- IV (Any 3)	
15.	Qualitative analysis of metal ions present in soil sample.
16.	Determine the temporary and permanent hardness of given sample of water
17.	To determine the percentage of phosphate as Phosphorous in chemical fertilizer Ammonium phosphomolybdate method.
18.	To determine the percentage of oxalate ion from sodium oxalate by volumetric method.
19.	To determine the percentage purity of Sodium chloride in commercial salt sample by Volhard's method.

References Books		
1.	A Text book of Micro and Semi micro Qualitative Inorganic Analysis- IV Edn, A. I. Vogel	
2.	A Text book of Quantitative Inorganic Analysis- A. I. Vogel	
3.	Practical Inorganic Chemistry- Pass Geoffrey and Haydn Sutcliffe	
4.	Advanced Practical Inorganic Chemistry- Gurudeep Raj	
5.	Vogel's Qualitative Inorganic Analysis- VII Edn. Orient Longman Ltd. D. Svehla	
6.	A Text book of Micro and Semi micro Qualitative Inorganic Analysis- IVedn, A. I. Vogel	
7.	A Text book of Quantitative Inorganic Analysis- A. I. Vogel	
8.	Practical Inorganic Chemistry- Pass Geoffrey and Haydn Sutcliffe	


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Semester : I		
Course Name: Organic Chemistry Laboratory Course-I		Course Code:CHEL/MJ/-505
Course type : DSC-6		4 Hrs/ Week
Total contact hours :60 Hrs	Lab. Work Credit: 2	Marks : 50
Learning Outcome : On completion of this course, the students will be able <ol style="list-style-type: none"> 1. Understand the separation and purification techniques 2. Understand various step involved in identification of organic compounds 3. Understand the handling of equipment required for the analysis of organic compounds. 4. Understand the stichometry of the reaction 5. To check the purity of compound using TLC 6. To check the Melting point 		
List of experiments		
1	Qualitative Organic Analysis Separation, purification and identification of binary (Solid-Solid) mixtures with one water soluble compound. The separation should be carried out using Chemical method/ physical method The two components are solid-solid mixtures. Student should submit the purified samples of the separated compounds and prepare a suitable derivative of the two compounds separated out. Note: Analysis of at least five mixtures should be carried out.	
2	Single Stage Preparations <ol style="list-style-type: none"> i) <i>p</i>-nitro acetanilide from acetanilide. ii) Dibenzylidene acetone from Benzaldehyde. iii) <i>p</i>-nitrobromobenzene from bromobenzene iv) salicylaldehyde from phenol (Reimer Tiemann reaction) v) <i>o</i> benzol propionic acid from succinic anhydride Note: i) The preparations should be carried out using (0.02 to 0.05 mole) of the starting material. ii) The yield, melting point and TLC of the recrystallised product should be recorded. Note: Student will not be allowed for practical examination if his/her record book is not completed and certified.	


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Semester: I		
Course Name: Physical Chemistry Laboratory Course-1		Course Code:CHEL/MJ/-506
Course Type: DSC-7		4 Hrs/ Week
Total contact hours :60 Hrs	Lab. Work Credit: 2	Marks: 50
Course Outcomes :		
On completion of this course, the students will be able:		
1.	To analyse sample by various instrumental techniques	
2.	To handling of electronic equipment	
3.	To understand laboratory skills, precaution, accuracy and precision.	
4.	To design experimental procedure for analysis important chemicals & samples	
5.	To understand the physical properties of chemicals	
6.	To distinguish accuracy of results in instrumental and non instrumental methods	
Unit-I: Instrumental		
1.	Determination of strengths of halides in a mixture potentiometrically.	
2.	Determination of the strength of strong and weak acid in a given mixture conductometrically.	
3.	Determination of solubility and solubility product of sparingly soluble salt BaSO ₄ .	
4.	Determine the pK ₁ and pK ₂ value of phosphoric acid by pH me try.	
5.	Determine the indicator constant of given indicator by colorimetric measurements.	
6.	Study of kinetics of inversion of cane sugar.	
7.	Synthesis and XRD characterization & indexing of bcc & fcc metal oxides & calculation of lattice parameters & particle sizes.	
8.	Synthesis and study of thermal decomposition patterns to investigate types of desorbed water, evolution of lattice oxygen and phase transition in a suitable compound.	
9.	Thermal analysis of any 5 well known polymers and interpretation of their glass transition temperatures.	

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Unit-II: Non-Instrumental	
1.	Determine the molecular refraction of methyl acetate, ethyl acetate, n-hexane and carbon tetrachloride and calculate the refraction of CH ₂ , C, H and O atoms.
2.	To study the effect of surfactants (sodium chloride) on surface tension of given liquid.
3.	To determine the radius of molecule by viscosity measurements.
4.	Determine the solubility of benzoic acid in water at different temperature and hence its heat of solution.
5.	Determine the formula of the complex formed between Cu(II) and ammonia by distribution method.
6.	Determine the velocity constant of hydrolysis of ester.
Reference Books:	
1.	Systematic experimental physical chemistry – T. K. Chondhekar & S.W. Rajbhoj
2.	Experiments in chemistry – D.V. Jahagirdar


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Semester : I		
Course Name: Analytical Chemistry-2		Course Code: CHETE/SE-507
Course type : DSE-1		2 Hrs/ Week
Total contact hours : 30 Hrs	Theory Credit: 2	Marks : 50
Course outcomes : after completion of course students will be able		
1.	to define the different regions of an electromagnetic radiation.	
2.	To understand the interaction/transition of the matter with different region of electromagnetic radiation.	
3.	to define basic elements of spectroscopic technique.	
4.	to calculate the wavelength at which a molecule show maximum absorption of UV-visible radiation.	
5.	To interpret the ultraviolet-visible spectrum	
6.	to define the bands in the IR spectrum due to fundamental frequency, and overtones, combination bands and Fermi resonance	
7.	to define the vibrational frequency of a particular bond	
8.	to calculate the vibrational frequency of a particular bond	
9.	To interpret the infrared spectrum	
10.	to predict the structure using UV-visible and IR spectrum.	
Unit-I : General introduction of spectral methods of analysis.		10Hrs
Characterization of electromagnetic radiations, Regions of the spectrum, Interaction of radiations with matter - absorption, emission, transmission, reflection, dispersion, polarization and representation of spectra, basic elements of practical spectroscopy, Resolving power, Signal to noise ratio. Uncertainty relation and natural line width, Natural line broadening, Intensity of spectral lines, Energy levels, Selection rules, Components of spectrometer and their functions.		
Unit-II : Ultraviolet- Visible Spectroscopy		10Hrs
Elementary ideas (Recapitulation), Instrumentation, Presentation of spectra, Effect of solvent on electronic transitions, The effect of conjugation, Woodward-Fieser rules for dienes, enones, aldehydes, acids, esters and aromatic compounds, Model compound studies, Visible spectra : color in compounds, Interpretation of an ultraviolet spectrum, Numericals		
Unit-III : : Infrared Spectroscopy		10Hrs
Elementary ideas (Recapitulation), Characteristic vibrational frequencies : hydrocarbons, aromatic rings, Alcohol, Phenols, Ethers, Carbonyl compounds, Amines, Nitriles, Isocyanates, Imines, Nitro compounds,		

	Carboxylate salts, Amine salts, Amino acids, Sulfur compounds, Phosphorus compounds, Alkyl halides, Arylhalides, and metal-ligand complexes. Factors affecting IR group frequencies, overtones, combination bands and Fermi resonance. Applications of IR. Problems based on combined applications of UV and IR spectroscopy.	
References Books		
1.	Analytical Chemistry 6th Edition., Gary D. Christian	
2.	Fundamental of Analytical Chemistry 8th Edn. Skoog, West Hollar, Couch	
3.	Chemical Separations and Measurements, D.G. Peters, J.M. Hayes and G.M. Hieftic	
4.	Instrumental Method of Chemical Analysis, G.R. Chatwal& S. K. Anand	
5.	Introduction to instrumental analysis – Robert D. Braun	
6.	Instrumental methods of analysis – Willard, Merritt, Dean, Settle	
7.	Principle of instrumental analysis Skoog, Holler, Nieman	
8.	Introduction to spectroscopy – Pavia, Lampman, Kriz, Vyvyan	
9.	Spectroscopic methods in organic chemistry – Dudley Williams, Ian Fleming	
10.	Spectrometric identification of organic compounds – Robert M. Silverstein, Francis X. Webster	
11.	Organic structure analysis – Phillip Crews, Jaime Rodriguez, Marcel Jaspars	
12.	Spectroscopy of organic compounds – P. S. Kalsi	

Semester : I		
Course Name: Inorganic Chemistry-2		Course Code:CHETE/SE/-508
Course type : DSE-2		2 Hrs/ Week
Total contact hours : 30 Hrs	Theory Credit: 2	Marks : 50
Learning outcomes:		
On completion of this course, the students will be able:		
1.	To understand how to perform symmetry operation to chemical molecules.	
2.	To identify the symmetry elements based on structure of molecules.	
3.	To apply the knowledge of concept of symmetry element and operations and centre, axis and planes symmetries possessed by an object / orbitals / molecule.	
4.	To identify & classify of point group of molecules	
5.	To apply knowledge of group theory to understand properties of molecules, character of matrix, product of symmetry operations, reducible and irreducible representations.	
6.	To use knowledge of character of representations to designate appropriate Mulliken symbols.	
7.	To calculate the appearance of irreducible representation by correlating relation between IRs, RRs and order of group.	
8.	To evaluation of predict the product of symmetric and asymmetric representations and evaluate new irreducible representation.	
9.	To identify modes of molecular vibrations of chemical compounds.	
Unit-I :Group theory and Symmetry concepts		10Hrs
Symmetry elements and symmetry operations, Centre of symmetry(i), Axis of symmetry(C_n), Plane of symmetry ($\sigma_v, \sigma_h, \sigma_d$), Rotation reflection axis of symmetry(S_n), Identity(E). Point groups, Classifications of point groups, Identification of point group of : $H_2O, NH_3, CO_2, BF_3, C_2H_4, PCl_3, PCl_5, [PtCl_4]^{2-}$, cis and trans $[PtCl_2(NH_3)_2]$, $[CoCl_2(NH_3)_4]$, $[FeF_6]$, $H_2, HCl, CO, BeF_2, C_2H_2Cl_2, C_6H_6$, and substituted benzene molecule. Application of point group with respect to dipole moment, polar and non polar molecules.		
Unit-II :Representations of groups		10Hrs

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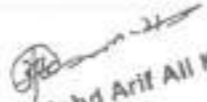
	Group, Properties of group, Group multiplication tables, Matrix representation of symmetry elements. Reducible representation, Generation of reducible representation for H ₂ O, NH ₃ , POCl ₃ , CH ₃ Cl Matrix representation for symmetry operations, Character of representation, Character of p, and d orbital representations.	
Unit-III : Application of character tables		10Hrs
	Character table, Rules for construction of character tables. Construction of character table for C _{2v} & C _{3v} point group. Mulliken symbolism rules for irreducible representations. Reduction formula, Reducing representations to Irreducible Representations with examples, Direct product of irreducible representation, Molecular vibrations, Modes of vibrations, calculation IR active modes of vibrations with examples.	
References Books		
12.	Symmetry and Spectroscopy of Molecules- K.Veera Reddy.	
13.	Group Theory and its Chemical Application- P.K. Bhattacharya	
14.	Inorganic Chemistry - Gary L. Miessler, Paul J. Fischer, Donald A. Tarr, 5 th Edn	
15.	Inorganic Chemistry- J.E.Huheey and Keiter R. L.	
16.	Principle of Inorganic chemistry-Brian W. Pfennig ,	
17.	Inorganic Chemistry – Shriver & Atkins	
18.	Symmetry and Group theory in Chemistry- R. Ameta	
19.	Group Theory and symmetry in Chemistry- Gurdeep Raj ,AjayBhagi and Vinod Jain.	


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Semester : I		
Course Name: Organic Chemistry-2		Course Code:CHETE/SE/-509
Course type : DSE-3		
Total contact hours : 30 h	Theory Credit: 2	Marks : 50
Course Objectives Student will be able to		
1	Understand the concept of Stereochemistry	
2	Know the stereochemical notations	
3	Know the difference between stereospecific and stereoselective reactions	
4	Study the stereochemistry of some Chiral molecules like Biphenyls, allenes and Spiranes.	
5	Acquire the knowledge of various methods of resolution	
6	Understand stereochemistry of the compounds containing Nitrogen, Sulphur and phosphorous	
7	Know about enantiomeric and diastereomeric excess	
Unit-I : Introduction to Stereochemistry		10L
Introduction and Significance of stereochemistry, Terminologies: Optical activity, Asymmetric atom, Stereogenic centre or Stereocentre, Conformation, Configuration, types of isomers, Essential criteria for a molecule to be chiral. Elements of symmetry: (A) Axis of symmetry (B) Plane of symmetry (C) Centre of symmetry, Problems based on elements of symmetry. R/S configuration and sequence rule, E/Z configuration. R/S Nomenclature in Fischer projection, Conversion of Fisher projection to Wedge and Newmann, Enantiomers, Properties of enantiomer, Diastereoisomers, Meso Compounds. Problems based on the above concepts.		
Unit-II : Stereochemistry-I		10L
Molecules with more than one chiral center, Epimers, Anomers, Threo and Erythro isomers, Prochiral relationships, stereospecific and stereoselective		

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	reactions. Optical activity in the absence of chiral carbon in (i) biphenyls, (ii) allenes (iii) spiranes and Essential criteria for chirality. Problems based on these molecules. Methods of resolution: Resolution through the formation of diastereomers, Resolution of racemic acids, bases and alcohols. Stereochemistry of the compounds containing Nitrogen, Sulphur and phosphorous.	
Unit-III : Conformational Analysis		10L
	Conformational analysis of cycloalkanes, Mono- and di-substituted cyclohexanes, decalins, effect of conformation on reactivity, Conformation in six membered rings containing hetero atoms, Specific Rotation, Enantiomeric Excess, Diastereomeric excess, Topocity, Homotopic, Homotopic ligands and Faces, Enantiotopic ligand and faces, Diastereotopic ligands and faces, Problems based on these concepts	
Reference Books		
1	Stereochemistry of Carbon Compounds: E. L. Eliel	
2	Stereochemistry of Organic Compounds: D. Nashipuri	
3	Organic Chemistry (Second edition): J. Clayden, N. Greeves, S. Warren	
4	Advanced organic Chemistry, Part-A and Part-B: F. A. Carey, & R. J. Sundburg	


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Semester: I		
Course Name: Physical Chemistry-2		Course Code:CHETE/SE/-510
Course Type: DSE-4		2 Hrs/ Week
Total Contact Hours: 30	Theory Credit: 2	Marks : 50
Course outcomes: after completion of the course Students will be able to		
1. To understand the concept of ionic equilibria, dissociation constant, buffer solution and solubility products.		
2. To calculate dissociation constant, pH, pOH, pKa, pKb of acidic and basic solutions.		
3. To understand the theories of electrolytes, electrocapillary phenomenon and its properties.		
4. To understand the concept of surface tension of liquid and curved surfaces.		
Unit-I: Ionic Equilibria and Biological Reactions		10 Hrs
Exact treatment of the dissociation of weak acids and bases, Dissociation constant of polyprotic acids, Statistical effects in polyprotic acids, Dissociation constant of complex ions, Logarithmic expression for pH and pOH, Calculations involving buffer solution, buffer capacity and buffer index, Salt effect and solubility product and its applications. Thermodynamics of biochemical reactions, Binding of oxygen by myoglobin and haemoglobin, Reaction between microscopic and macroscopic dissociation constant.		
Unit-II: Electrochemistry		10 Hrs
Debye-Huckel theory of strong electrolytes, Debye-Huckel-Onsager equation Testing of the equation, Debye-Falkenhagen effect, Wein effect, activity coefficient, mean ionic activity coefficient; Debye-Huckel limiting law ionic strength. Electrocapillary phenomena, and its measurements. Effect of anions, cations and molecules on electrocapillary curves. Electrocapillary properties of mercury-solution interface. Polarography: thellkovic equation and its derivation, concentration polarization, Instrumentation, advantages of DME, half wave potential. Applications of polarography, numerical.		
Unit-III: Surface Chemistry		10 Hrs
Surface tension, capillary action, pressure difference across curved surface (Laplace equation) vapour pressure of droplets (Kelvin equation) Gibbs adsorption isotherm, estimation of surface area (BET equation), surface films on liquids (Electro kinetic phenomenon), catalytic activity at surfaces, numericals.		
Reference Books:		
1. Chemical Kinetics - Laidler (McGraw-Hill)		

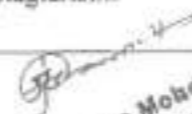
2.	Kinetic and Mechanism of Chemical Transformations - J. Rajaram and J.C. CURIAKOSE (Macmillan India Ltd.)
3.	Physical Chemistry - Atkins (Oxford)
4.	Thermodynamics for Chemists - S. Glasstone (EWP, New Delhi)
5.	Physical Chemistry - G. M. Barrow
6.	Advanced Physical Chemistry - Gurdeep-Raj (Pelenum)
7.	Micelles : Theoretical and Applied Aspects - V. Moroi (Plenum)
8.	Text Book of Physical Chemistry - S.Glasstone (McMillan)
9.	Physical chemistry – Robert A .Alberty ., Robert J .Silbey
10.	Statistical Thermodynamic – M. C. Gupta

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Semester: I		
Course Name: Drug Chemistry		Course Code: CHETE/SE/SE/-511
Course Type: DSE-5		2 Hrs/ Week
Total Contact Hours: 30	Theory Credit: 2	Marks : 50
Course Outcome: Students will be able to – <ol style="list-style-type: none"> 1. understand about oxidation reactions in organic chemistry using different reagents. 2. know about oxidative cleavage of carbon-carbon double bonds using different reagents. 3. know about catalytic reduction, reduction using hydride ion transfer reagents and so on. 4. predict the product by the action of different oxidizing and reducing agents. 		
Unit-I: Oxidation reactions-I		10 Hrs
Oxidation of alcohol to aldehyde, ketone or acid: Jones reagent, Swern oxidation, Collins reagents, Fetizon's reagents, PCC, PDC, PFC, IBX, Activation MnO ₂ , Chromyl chloride (Etard reaction), TEMPO, CAN, NMO, Moffatt oxidation.		
Unit-II: Reduction reactions -I		10 Hrs
Reduction reactions (a) Catalytic Hydrogenation; (b) Reduction of nitriles, oximes and nitro compounds; (c) Reduction of acids and esters; d) Reduction with metal hydride- Sodium cyanoborohydride, Diborane, L- and K-Selectrides, LiBH ₄ , DIBAL-H; Birch reduction and related reactions,		
Unit-III: Oxidation & reduction reactions II		10 Hrs
Oxidation reactions Oxidative cleavage of carbon-carbon double bonds: KMnO ₄ , Ozonolysis; Oxidations using SeO ₂ , PhSeBr Reduction reactions (h) Lucje reagent, Wolf-Kishner reduction, Clemmenson reduction, Wilkinson catalyst, TBTH		
Reference Books:		
1.	Advanced organic chemistry: F. A. Carey and R. J. Sundberg (Part A and B)	
2.	Principle of Organic Synthesis: R.O.C. Norman.	
3.	Modern Methods of Organic Synthesis: W. Carruthers	
4.	Organic Chemistry: Clayden, Greeves, Warren and Wothers	

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Semester : I		
Course Name: Research methodology		Course Code: CHE/RM/-512
Course type :- ---		4 Hrs/ Week
Total contact hours :60 Hrs	Theory Credit: 4	Marks :100
Course outcomes:		
On completion of this course, the students will be able to:		
1.	Understand the basic concepts of research methodology	
2.	know recent trends in chemical research.	
3.	Acquire the fundamental knowledge of various characterization techniques.	
4.	apply of characterization techniques viz.; XRD, SEM, TEM, UV, IR, NMR and Mass spectrometry in research	
Unit-I : Unit-I :Literature Survey		10Hrs
Print: Sources of information: Primary, secondary, tertiary sources; Journals: Journal abbreviations, abstracts, current titles, reviews, monographs, dictionaries, text-books, current contents, Introduction to Chemical Abstracts and Beilstein, Subject Index, Substance Index, Author Index, Formula Index, and other indices with examples. Digital: Web resources, E-journals, Journal access, TOC alerts, Hot articles, Citation index, Impact factor, H-index, E-consortium, UGC infonet, E-books, Internet discussion groups and communities, Blogs, Preprint servers		
Unit-II :Search Engines		10Hrs
Scirus, Google Scholar, Wiki- Databases, Chem Spider, Science Direct, Pub Med, Sci Finder, Mendeley, Scopus, Web of Science. Information Technology and Library Resources: The Internet and World Wide Web, Internet resources for chemistry, Finding and citing published information		
Unit-III : Methods of Scientific Research and Writing Scientific Papers		10Hrs
Reporting practical and project work. Writing literature surveys and reviews. Organizing a poster display. Giving an oral presentation. Writing scientific papers – justification for scientific contributions, bibliography, description of methods, conclusions, the need for illustration, style, publications of scientific work. Writing ethics. Avoiding plagiarism.		


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Unit-IV : Chemical Safety and Ethical Handling of Chemicals:		10Hrs
	Safe working procedure and protective environment, protective apparel, emergency procedure and first aid, laboratory ventilation. Safe storage and use of hazardous chemicals, procedure for working with substances that pose hazards, flammable or explosive hazards, procedures for working with gases at pressures above or below atmospheric – safe storage and disposal of waste chemicals, recovery, recycling and reuse of laboratory chemicals, procedure for laboratory disposal of explosives, identification, verification and segregation of laboratory waste, disposal of chemicals in the sanitary sewer system, incineration and transportation of hazardous chemicals.	
Unit-V : Data Analysis		10Hrs
	The Investigative Approach: Making and Recording Measurements. SI Units and their uses, Scientific method and design of experiments, Analysis and Presentation of Data: Descriptive statistics, Choosing and using statistical tests. Chemometrics. Analysis of variance (ANOVA), Correlation and regression, Curve fitting, fitting of linear equations, simple linear cases, weighted linear case, analysis of residuals, General polynomial fitting, linearizing transformations, exponential function fit, r and its abuse, basic aspects of the multiple linear regression analysis.	
Unit-VI : Fundamentals of Computers and Application		10Hrs
	a. Introduction to basic software i. MS Word, ii. Power Point, iii. Excel, b. Introduction to Chemistry related software i. Gaussian, ii. Gaussview, iii. ChemDraw / Chem Sketch	
References Books		
1.	Practical Skills in Chemistry, J. R. Dean, A. M. Jones, D. Holmes, R. Reed, J. Weyers and A Jones, Pearson Education Ltd. [Prentice Hall] (2002)	
2.	Research Methodology. Methods and Techniques: C. R. Kothari.	
3.	Research Methodology: Tools and Techniques by Dr. Prabhat Pandey, Dr.Meenu Mishra Pandey	


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**DR. BABASAHEB AMBEDKAR MARATHWADA UNIVERSITY,
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NAAC Re-accredited 'A' Grade

National Education Policy-2020
Outcome Based Curriculum
For

AFFILIATED COLLEGES

Faculty of Science & Technology

Two Years Master of Science in Chemistry Programme

Subject : Chemistry

Specialization : Organic Chemistry,
Inorganic Chemistry, Physical Chemistry
Analytical Chemistry, Drug Chemistry
and Polymer Chemistry

(Semester II)

(Effective from 2023-24)

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Illustrative Credit distribution structure for Two Years Programme with
Multiple Entry and Exit options

M.Sc. First Year Semester-II Course Structure

Course type	Course Code	Course Name	Teaching Scheme (Hrs./week)		Credits Assigned			Marks		
			Theory	Practical	Theory	Practical	Total Credits	Conti. Inter. Assm en.	End. Sem Exam	Total Marks
Major Mandatory DSC	CHET/MJ/-550	DSC-8 Anal. Chem	2	-	2	-	8T	20	30	50
	CHET/MJ/-551	DSC-9 Inorg. Chem	2	-	2	-		20	30	50
	CHET/MJ/-552	DSC-10 Org. Chem	2	-	2	-		20	30	50
	CHET/MJ/-553	DSC-11 Phy. Chem	2	-	2	-		20	30	50
	CHEL/MJ/-554	DSC-12 Inorg. Chem. Lab course	-	4	-	2	6L	20	30	50
	CHEL/MJ/-555	DSC-13 Org. Chem. Lab course	-	4	-	2		20	30	50
	CHEL/MJ/-556	DSC-14 Phy. Chem. Lab course	-	4	-	2		20	30	50
DSE (Choose one from your specialization and any one from remaining three)	CHETE -557	DSE-6 Anal. Chem	2	-	2	-	4T	20	30	50
	CHETE -558	DSE -7 Inorg. Chem	2	-	2	-		20	30	50
	CHETE -559	DSE -8 Org. Chem	2	-	2	-		20	30	50
	CHETE -560	DSE -9 Phy. Chem	2	-	2	-		20	30	50
	CHETE/SE/561	DSE -10 Drug. Chem	2	-	2	-		20	30	50
OJT/FP (Chose any one)	CHOJT-562	On the Job Training	-	8	-	4	4L	40	60	100
	CHFP-563	Field Project	-		-	40		60	100	
Total			12	20	12	10	22	220	330	550

Course code Nomenclature :

DSC-Discipline Specific Core ,DSE- Discipline Specific Elective, T-Theory, L- Laboratory course, CHTC- Chemistry Theory Core , CHLC- Chemistry Laboratory Core , CHTE-


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Chemistry Theory Elective , CHOJT- Chemistry On the Job Training, CHFP- Chemistry Field Project

Semester : II		
Course Name: Analytical Chemistry-3		Course Code: CHET/M.I/-550
Course type : DSC-8		2 Hrs/ Week
Total contact hours : 30 Hrs	Theory Credit: 2	Marks : 50
Course outcomes : after completion of the this course students will be able		
1.	To understand basic principle of different chromatographic Techniques for separation of constituents of mixtures	
2.	To understand theory, instrumentation, working procedure and application as well as limitations of TLC	
3.	To understand theory, instrumentation, working procedure and application as well as limitations of liquid- liquid partition chromatography	
4.	To understand theory, instrumentation, working procedure and application as well as limitations of column chromatography	
5.	To understand theory, instrumentation, working procedure and application as well as limitations of gel permeation chromatography	
6.	To understand theory, instrumentation, working procedure and application as well as limitations of ion exchange chromatography	
7.	To understand theory, instrumentation, working procedure and application as well as limitations of high performance liquid chromatography	
8.	To understand theory, instrumentation, working procedure and application as well as limitations of gas chromatography	
9.	To be able to select a particular chromatographic technique for separation of the constituents from a mixture.	
10	To be aware of the various problems associated with different chromatographic techniques.	
Unit-I : Chromatographic Techniques.		10Hrs
<p>Paper Chromatography: Elementary ideas (Recapitulation)</p> <p>Thin layer Chromatography: Elementary ideas (Recapitulation), Introduction, Principles, Superiority of TLC over other chromatographic technique, Experimental techniques, Solvent systems, Plate development, Detection of components, Evaluation of chromatogram by different methods, Applications. Limitation. High performance thin layer chromatography</p>		


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	<p>Liquid-Liquid partition chromatography: Introduction, theory, solid supports, selection of stationary and mobile phases, solvent systems, reverse phase chromatography, choice of adsorption or partition, applications of partition chromatography. Ultra performance liquid chromatography</p> <p>Column Chromatography: Principle, Experimental details, Theory of development, Column efficiency, Factors affecting column efficiency, and applications. Advanced flash chromatography</p> <p>Gel permeation Chromatography: Principle materials, Gel preparation, Column packing, Detectors and applications.</p> <p>Ion Exchange Chromatography: Ion Exchange resins, Ion exchange equilibria, Ion exchange capacity of resins and its determination, Applications of ion exchange resins to chromatography, Ion chromatography based on suppressors</p>	
Unit-II : Gas Chromatography		10Hrs
	Introduction, Branches of gas chromatography, principles of gas-liquid chromatography, instrumentation-Carrier gas, Sample introduction system, Columns, Detectors, substrates, Temperature control, Evaluation, Retention volume, Resolution, Applications, Numericals.	
Unit-III : : High Performance Liquid Chromatography		10Hrs
	Principle, instrumentation - Column, Column packing, Mobile phase, Pumping system, Detector system, Practical procedure, Applications, HPLC adsorption and partition chromatography	
References Books		
1.	Analytical Chemistry 6th Edition., Gary D. Christian	
2.	Fundamental of Analytical Chemistry 8th Ed ⁿ . Skoog, West Hollar, Crouch	
3.	Chemical Separations and Measurements, D.G. Peters, J.M. Hayes and G.M. Hieftic	
4.	Instrumental Method of Chemical Analysis, G.R. Chatwal & S. K. Anand	
5.	Introduction to instrumental analysis – Robert D. Braun	
6.	Principles of instrumental analysis – Skoog, Holler and Crouch	

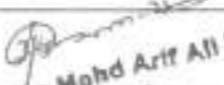

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Semester : II		
Course Name: Inorganic Chemistry-3		Course Code:CHET/MJ-551
Course type : DSC-9		2 Hrs/ Week
Total contact hours : 30 Hrs	Theory Credit: 2	Marks : 50
Course outcomes:		
On completion of this course, the students will be able:		
1.	To define and classify metal carbonyls	
2.	To design procedure to synthesize mononuclear and binuclear metal carbonyl	
3.	To understand the properties and structure metal carbonyl .	
4.	To apply the concept of effective atomic number for prediction of stability of metal carbonyls.	
5.	To synthesize the nitrosyl halides and their properties .	
6.	To understand the structure and properties and application of sodium nitroprusside.	
7.	To apply the knowledge of EAN and 18 electron rules metal nitrosyl compound of transition elements	
8.	To understand the d orbital splitting in different environment .	
9.	To understand factor affecting crystal field splitting energy	
10.	To describe Jahn Teller distortion and CFSE for high and low spin complexes	
Unit-I : Chemistry of Metal Carbonyls		10Hrs
Classification of metal carbonyls, structure carbonyl group, Preparation, properties, structures and bonding of Ni(CO) ₄ , Fe(CO) ₅ , Fe ₂ (CO) ₉ , Cr(CO) ₆ , Mn ₂ (CO) ₁₀ , Co ₂ (CO) ₈ , Mo(CO) ₆ and W(CO) ₆ , Co ₄ (CO) ₁₂ and V(CO) ₆ . EAN rule applied to metal carbonyls. Application of EAN rule to of mixed metal carbonyls. Preparations and properties of metal carbonyl halides.		
Unit-II : Metal nitrosyl compounds		10Hrs
Preparations and properties of Nitrosyl Fluoride, Nitrosyl chloride, and Nitrosyl bromide. Preparation and properties of Metal nitrosyl halides containing NO ⁻ anion and NO ⁺ cations, Preparation, structure and application of sodium nitroprusside. Application EAN and Eighteen electron rules to nitrosyl compounds of Cobalt, Iron and Manganese. Significance of NO for the life of living animal		

Unit-III : Crystal field theory		10Hrs
	Important feature of CFT, Crystal field splitting d orbital in octahedral , tetrahedral, square planer and tetragonal complexes, Factors affecting 10Dq. Spectrochemical series, Calculation of CFSE of high and low spin complex Jahn teller distortion , Limitation of CFT	
	References Books	
1.	Advance Inorganic chemistry- S.K. Agrawal, Keemti Lal	
2.	Principles of Inorganic chemistry, B.R. Puri, L. R. Shirma , K. C. Kalia	
3.	Concise Inorganic Chemistry - J. D. Lee.	
4.	Inorganic Chemistry - G.Y.Miessler and D.A. Tarr	
5.	Inorganic Chemistry – Shriver & Atkins	
6.	Principle of Inorganic chemistry- Brian W. Pfennig .	
7.	Advanced Inorganic Chemistry- Satyaprakash, G.D. Tuli, S.K. Basu and R.D. Madan.	
8.	Selected Topic in Inorganic Chemistry- Wahid U. Malik, G.D. Tuli and R. D. Madan.	
9.	Advanced Inorganic Chemistry- F. A . Cotton and Wilkinson.	


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Semester : II		
Course Name: Inorganic Chemistry Laboratory Course -II		Course Code:CHEL/MJ/-554
Course type : DSC-12		4 Hrs/ Week
Total contact hours :60 Hrs	Lab. Work Credit: 2	Marks : 50
Learning outcomes:		
On completion of this course, the students will be able:		
1.	To design experimental procedure for synthesis of metal complexes , calculation of conversion factors and characterization of synthesized coordination complexes compounds.	
2.	To understand, which skills are required in chemical laboratory .	
3.	To understand importance of accuracy and precision in chemical analysis.	
4.	To design the experimental procedure for separation and estimation of metals from mixture solution	
5.	To estimate the amount of constituents of chemicals by volumetric and gravimetric methods.	
6.	To apply grasped knowledge for finding purity of chemicals.	
List of experiments		
Group- I (Any 3)		
1.	Preparation of $[Mn(acac)_3]$ complex and its spectral analysis .	
2.	Preparation of $Hg[(Co(SCN)_4)]$ complex and its spectral analysis.	
3.	Preparation of $[Co(III)(NH_3)_6]Cl_3$ complexes and its spectral analysis.	
4.	Preparation of $[Ni(NH_3)_6]Cl_2$ complex and its spectral analysis.	
Group- II (Any 2)		
5.	Preparation of $Cis-K[Cr(C_2O_4)_2(H_2O)_2]$ complex and its thermogravimetric analysis.	
6.	Preparation of $VO(acac)_2$ complex and its thermogravimetric analysis.	


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7.	Preparation of $[\text{Cu}(\text{NH}_3)_4]\text{SO}_4 \cdot \text{H}_2\text{O}$ complex and its thermogravimetric analysis .	
Group- III (Any 3)		
8.	Preparation of $\text{K}_3[\text{Fe}(\text{C}_2\text{O}_4)_3]$ complex and estimate the amount Iron present in it.	
9.	Preparation of $[\text{Co}(\text{III})(\text{NO}_2)(\text{NH}_3)_5]\text{Cl}_2$ complex and estimate the amount cobalt present in it.	
10.	Preparation and estimation of percentage of copper from the $[\text{Cu}(\text{NH}_2\text{CSNH}_2)_5](\text{NO}_3)_2$ complexes	
Group- IV (Any 3)		
11.	Separation of Copper and Nickel from the given binary mixture sample and estimate the amount of Copper by volumetric and Nickel by gravimetric method.	
12.	Separation of Nickel & Zinc from given binary mixture sample and estimate the amount of Zinc by volumetric method and Nickel by gravimetric method.	
13.	Separation of Copper & Barium from given binary mixture sample and estimate the amount of Copper by volumetric method and Barium by gravimetric method.	
14.	Separation of Iron & Aluminium from given binary mixture sample and estimate the amount of Aluminium by volumetric method and Iron by gravimetric method .	
15.	Separation of Copper & Iron from given binary mixture sample and estimation of amount of Copper by volumetric method and Iron by gravimetric method.	
16.	Separation of Iron & Magnesium from given binary mixture sample and estimation of amount of Iron & Magnesium volumetric method .	
Group- V (Any 3)		
17.	Determination of percentage purity of concentrated hydrochloric acid by volumetric method.	
18.	Determination of chemical oxygen demand from given sample of water by volumetric method.	
19.	Determination of dissolved oxygen from given sample of water by volumetric method .	

Semester : II		
Course Name: Organic Chemistry-3		Course Code: CHET/MJ/-552
Course type : DSC-10		2 Hrs/ Week
Total contact hours : 30 Hrs	Theory Credit: 2	Marks : 50
Course Objectives Student will be able to		
1	Understand various reactions involved in addition to C-C and C-O double bond	
2	Acquire the stereochemical aspects in addition reaction	
3	Demonstrate/apply the concepts involved in elimination reaction	
4	Understand mechanism of various named reactions	
Unit-I : Addition to Carbon –Carbon multiple bond		10 Hrs
	Mechanism and stereochemical aspect of addition reaction involving electrophile, nucleophile and free radicals. Regioselectivity and chemoselectivity, orientation and reactivity, Michael addition, Sharpless asymmetric epoxidation.	
Unit-II: Addition to Carbon–Hetero Multiple bond		10 Hrs
	Mechanism of metal hydride reduction of saturated and unsaturated carbonyl compound s, acid, ester and nitriles. Addition of Grignard reagent, Organo zinc and organo lithium reagent to carbonyl and unsaturated carbonyl compounds. Wittig reaction. Mechanism of condensation reaction involving enolates, Aldol, Knoevenagel, Claisen, Mannich, Benzoin, Perkin, Stobbe reaction. Hydrolysis of esters.	
Unit-III : Elimination Reactions:		10 Hrs
	The E ₁ , E ₂ , and E ₁ CB mechanism, orientation of double bond. Reactivity: effect of substrate structure, attacking base, the leaving group and the medium, Hoffmann elimination, Saytzeff elimination, Chugaev elimination, pyrolytic syn elimination, Elimination vs Substitution	
References Books		
1	Advanced Organic Chemistry, IV Edition: J. March	
2	Advanced organic Chemistry, Part-A and Part-B: F. A. Carey, & R. J. Sundburg.	
3	A Guide Book to Mechanism in Organic Chemistry: Peter Sykes	
4	Synthetic Organic Chemistry: H. O. House	
5	Principles of Organic Synthesis: R. O. C. Norman	
6	Organic Chemistry: Clayden, Greeves and Warren	
7	Mechanism and Structure in Organic Chemistry: E. S. Gould	


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Semester: II		
Course Name: Physical Chemistry-3		Course Code: CHET/MJ/553
Course Type: DSC-11		2 Hrs/ Week
Total Contact Hours: 30	Theory Credit: 2	Marks : 50
Course Outcomes: student will be able		
1. To understand the fundamental principles of quantum mechanics.		
2. To solve the Schrodinger equations calculate wave function and energy levels.		
3. To understand the postulates of quantum mechanics.		
4. To understand the Huckel Molecular Theory of conjugated system and its applications.		
Unit-I: Quantum Chemistry-I		10 Hrs
The Schrodinger's equation for particle waves, Wave function ψ and its physical meaning, Wave particle duality, Uncertainty principle, The wave function ψ and its physical meaning, Eigen value and eigen functions. Postulates of quantum mechanics, Operators, Hermitian, Linear and Hamiltonian. Condition of Normalization, particle in one dimensional box particle in three dimensional box, numericals. Theory of Angular Momentum: Angular Momentum Operators, Ladder Operators,		
Unit-II: Quantum Chemistry II		10 Hrs
Unit-II :- Harmonic Oscillator, particle on a sphere, Schrodinger's equation for spherical coordinates rigid rotator, Variation theorem, The method of perturbation (Theory) and Applications to two electron systems, Term symbols and selection rules spin orbit coupling.		
Unit-III: Molecular Orbital Theory		10 Hrs
Huckel's Molecular Orbital theory of conjugated systems, Application to ethylene, butadiene, cyclopropenyl, and cyclobutadiene, Electron densities, Bond Order, Free valence indices.		
Reference Books:		
1.	Quantum Chemistry : Ira N. Levine	
2.	Quantum Chemistry : R.K. Prasad	
3.	Quantum Chemistry : B.K. Sen	
4.	Principles of Physical Chemistry : Puri, Sharma, Pathania	
5.	Advanced Physical Chemistry: Gurdeep - Raj, Plenum.	
6.	Physical Chemistry : Maron and Prutton	

20.	Determination of the percentage purity of copper sulphate from given commercial sample.	
21.	Determination of the amount of water content in commercial sample of copper sulphate .	
	References Books	
1.	Advanced Practical Inorganic Chemistry- GurudeepRaj;	
2.	Practical Inorganic Chemistry- Pass Geoffrey and Haydn Sutcliffe.	
3.	A Text book of Micro and Semi micro Qualitative Inorganic Analysis, 1Vedn, A. I. Vogel	
4.	A Text book of Quantitative Inorganic Analysis; A. I. Vogel	
5.	Vogel's Qualitative Inorganic Analysis, VII Edn. Orient Longman Ltd. D. Svehla	


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Semester : II		
Course Name: Organic Chemistry Laboratory Course-II		Course Code:CHEL/MJ/-555
Course type : DSC-13		4 Hrs/ Week
Total contact hours :60 Hrs	Lab. Work Credit: 2	Marks : 50
Course Outcomes 1. To Perform/demonstrate the techniques involved in organic binary mixture separation specially solid- liquid mixture. 2. To perform distillation techniques for purification of organic compounds. 3. To use/ apply the technique of separation, crystallization derivatization and function Group detection. 4. To use the methods for the preparation of useful compounds using named reaction		
List of experiments		
1	Qualitative Organic Analysis: Separation, purification and identification of binary (Solid-Liquid) mixtures. The separation should be carried out using Chemical method. The two components are solid-liquid mixtures. Student should submit the purified samples of the separated compounds and prepare a suitable derivative of the two compounds separated out. Note: Analysis of at least Five mixtures should be carried out.	
2	Single Stage Preparations: i) <i>p</i> -Bromo acetanilide from acetanilide. ii) 1,4-dichlorobenzene from <i>p</i> -chloroaniline iii) Benzophenone from benzene (Friedel Craft) iv) Cinnamic acid from Benzaldehyde (Perkins reaction) v) <i>o</i> -iodo benzoic acid from anthranilic acid Note: i) The preparations should be carried out using (0.02 to 0.05 mole) of the starting material. ii) The yield, melting point and TLC of the recrystallized product should be recorded. Note: Student will not be allowed for practical examination if his/her record book is not completed and certified.	



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Semester: II	
Course Name: Physical Chemistry Laboratory Course -II	Course Code: CHEL/MJ/556
Course Type: DSC-14	4 Hrs/ Week
Total contact Hours :60 Hrs	Lab. Work Credit: 2 Marks: 50
Course Outcome :	
1.	On completion of this course, the students will be able:
2.	To analyse sample by various instrumental techniques
3.	To handling of electronic equipment
4.	To understand laboratory skills, precaution, accuracy and precision.
5.	To design experimental procedure for analysis important chemicals & samples
6.	To understand the physical properties of chemicals
7.	To distinguish accuracy of results in instrumental and non instrumental methods
Unit-I: Instrumental	
1.	Determination of dissociation constants of phosphoric acid potentiometrically.
2.	Determination of dissociation constants of weak acid potentiometrically.
3.	Determination of acidic and basic dissociation constants of an amino acid and its isoelectric point.
4.	Determination of equilibrium quotient for the formation of monothiocynato iron (III) complex.
5.	To study the kinetics of mutarotation of glucose/fructose polarographically.
6.	Study of thermal analysis (TG/DTA/DSC) in atmosphere of evolved gases e.g decomposition of CaCO_3 , KClO_3 etc in environment of gases such as N_2 , O_2 , CO_2)
7.	Synthesis of various crystalline modifications of a hydrous transition metal oxide and their characterization by infra – red spectroscopy.
8.	Investigating esterification reaction by using solid acid catalyst and study of the reaction kinetics by IR spectroscopy.
9.	Study of kinetics of zeolite synthesis by infrared spectroscopy.
10.	Identification of acidic and basic sites of a catalyst by in situ infrared spectroscopy.
11.	Unit-II: Non-Instrumental
1.	To study the adsorption of acetic acid from aqueous solution by activated charcoal and examine the validity of Freundlich and Langmuir's isotherm.

2.	To construct the phase diagram for three component system (chloroform-acetic acid water).
3.	To study auto catalysis reaction between potassium permanganate and oxalic acid,
4.	Determine the rate constant of the reaction between potassium persulphate and potassium iodide having equal/unequal concentration of the reacting species.
5.	To study the variation of viscosity with the composition of mixtures (ethanol-water-HNO ₃ -chloroform) and to determine the formation of complex between two liquids.

Reference Books:


- | | |
|----|--|
| 1. | Systematic experimental physical chemistry – T. K. Chondhekar & S.W. Rajbhoj |
| 2. | Experiments in chemistry – D.V. Jahagirdar |


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Semester : II		
Course Name: Analytical Chemistry-4		Course Code: CHETE-557
Course type : DSE-6		2 Hrs/ Week
Total contact hours : 30 Hrs	Theory Credit: 2	Marks : 50
Course outcomes :		
1.	To be able to define the factors that determine chemical shift	
2.	To be able to locate chemical shift positions of ^1H attached to common functional groups.	
3.	To be able to define the characteristic chemical shifts for different protons.	
4.	To be able to predict the structure of a compound using NMR data/spectrum.	
5.	To be able to predict the structure of a compound using UV-visible, IR, and NMR data/spectrum.	
6.	To understand the principle, instrumentation and applications of mass spectrometry.	
7.	To be able to define different ionization techniques in mass spectrometry.	
8.	To understand the fragmentation processes in mass spectrometry.	
9.	To be able to define the molecular formula from molecular ion peaks.	
10.	To understand the principle, instrumentation and applications of atomic absorption spectroscopy, flame emission spectroscopy, electron spectroscopy for chemical analysis, Auger electron spectroscopy and ultraviolet photoelectron spectroscopy.	
Unit-I : Nuclear Magnetic Resonance Spectroscopy.		10Hrs
Elementary ideas (Recapitulation), Factors affecting chemical shifts, Spin-Spin couplings and coupling constants (J), ^1H - ^1H vicinal coupling, ^1H - ^1H germinal coupling, Long range coupling, The magnitude of ^1H - ^1H coupling constants, Integration. Problems based on combined applications of UV, IR and NMR spectroscopy..		
Unit-II : Mass Spectrometry		10Hrs
Sample flow in a mass spectrometer, Inlet sample system, Ionization methods, Mass analyzers, Ion-collection systems, Vacuum system, Data handling, Isotope-ratio spectrometry, Correlation of mass spectra with molecular structure, Applications of mass spectrometry, Quantitative analysis of mixtures, Fourier transform mass spectrometry.		
Unit-III : : Elemental methods of analysis		10Hrs
Flame emission spectroscopy: Principles, instrumentation, interferences, limitations, applications.		


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	<p>Atomic absorption spectroscopy: Introduction, principles, instrumentation, sources of EMR-hollow cathode lamps, temperature gradient lamps, cells, flames, furnaces, detectors, interferences, background corrections and use of AAS for qualitative and quantitative analysis.</p> <p>Electron Spectroscopy Photoelectron spectroscopy: Basic principles, ESCA- Introduction - ESCA - ESCA satellite peaks, spectral splitting, ESCA chemical shifts, Principle, instrumentation, applications, Auger electron spectroscopy, Ultraviolet photoelectron spectroscopy.</p>	
References Books		
1.	Analytical Chemistry 6th Edition., Gary D. Christian	
2.	Fundamental of Analytical Chemistry 8th Ed ⁿ , Skoog, West Hollar, Crouch	
3.	Chemical Separations and Measurements, D.G. Peters, J.M. Hayes and G.M. Hieftic	
4.	Instrumental Method of Chemical Analysis, G.R. Chatwal & S. K. Anand	
5.	Introduction to instrumental analysis – Robert D. Braun	
6.	Inrumental methods of analysis – Willard, Merritt, Dean, Settle	
7.	Principle of instrumental analysis - Skoog, Holler, Nieman	
8.	Introduction to spectroscopy – Pavia, Lampman, Kriz, Vyvyan	
9.	Spectroscopic methods in organic chemistry – Dudley Williams, Ian Fleming	
10.	Spectrometric identification of organic compounds – Robert M. Silverstein, Francis X. Webster	
11.	Organic structure analysis – Phillip Crews, Jaime Rodriguez, Marcel Jaspars	
12.	Spectroscopy of organic compounds – P. S. Kalsi	

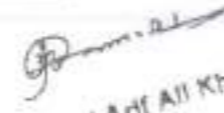

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Semester : II		
Course Name: Inorganic Chemistry-4		Course Code : CHETE/SE/-558
Course type : DSE-7		2 Hrs/ Week
Total contact hours : 30 Hrs	Theory Credit: 2	Marks : 50
Learning outcomes:		
On completion of this course, the students will be able:		
1.	To describe the generation of spectroscopic term symbols , ground state term & total term symbols, significance of spin multiplicities.	
2.	To use of microstates for representation electron representations	
3.	To sketch term energy level diagram.	
4.	To understand the designation of spin multiplicities to ligand field excited states of high and low spin complex.	
5.	To interpret A,E, T symmetric label for electronic configurations.	
6.	To construct correlation diagram of various electronic configurations	
7.	To analyse and interpretation Orgel diagram and Tanabe Sugano diagram.	
8.	To interpret electronic spectra of transition metal complexes.	
9.	To calculate the Dq , B and β parameters of complex.	
10.	To understand the Lewis and Bronsted Concept of Acids and Bases.	
11.	To apply knowledge of VBT & VSEPR theory for prediction structure of molecules .	
Unit-I : Spectroscopic term symbols and ligand field excited states		10Hrs
Spectroscopic terms symbols, Inter-electronics repulsion, Spin-orbit coupling, Ground state term, Microstates and its use, Rules for determination of total terms symbol of d^1 to d^9 configurations. Energy ordering of terms and their energy level diagram, Weak and stronger field approach, Calculation and labelling of spin multiplicities to ligand field excited states of low spin complex. Designation of A, E, T symmetric label to electronic configuration, Correlation diagram of d^1 , d^2 , d^8 and d^9 configuration in octahedral and tetrahedral environments, Non-crossing rule.		
Unit-II : Interpretation of electronic spectra of metal complexes		10Hrs
Orgel diagram of d^1 to d^9 configuration/ metal complex in an octahedral and tetrahedral environment, Selection rule for electronic transitions.		

	Tanabe Sugano diagram of d^2 and d^3 configurations. Measurement of the absorption spectra, Charge transfer transitions, Types of charge transfer transitions, Examples of charge transfer spectra, Band intensities, Intensity of d-d and charge transfer bands. Interpretation of electronic spectra of transition metal complex, Konig's method for calculation of D_0 , B and β parameters and numericals.	
Unit-III: Lewis and Bronsted Concept of Acids and Bases and Geometry of molecules		10Hrs
	Lewis and Bronsted Concept of Acids and Bases, examples of Lewis acid - Lewis base complex formation, Strong and weak acid, strength of acid factors affecting acid strength. Donor acceptor chemistry of NH_3 : BF_3 , BF_3 : $\text{O}(\text{C}_2\text{H}_5)_2$, Br_2 : CH_3OH adducts, HOMO -LUMO energy. Application of valence bond theory to identify structure of: H_2SO_4 , K_2CO_3 , HNO_3 , NH_4Cl , NaBH_4 , AlCl_3 , LiAlH_4 , SiCl_4 , SnCl_2 , SnCl_4 , H_3PO_2 , H_3PO_3 , H_3PO_4 , HClO_4 , K_2CrO_4 , $\text{K}_2\text{Cr}_2\text{O}_7$ and KMnO_4	
	References Books	
1.	Inorganic electronic spectroscopy - A.B.P. Lever.	
2.	Concise Inorganic Chemistry - J. D. Lee.	
3.	Principles of Inorganic chemistry, B.R. Puri, L. R. Sharma, K. C. Kalia	
4.	Symmetry and Spectroscopy of Molecules - K. Veera Reddy	
5.	Symmetry and Group theory in Chemistry, R. Ameta	
6.	Inorganic Chemistry - G.Y. Miessler and D.A. Tarr	
7.	Inorganic Chemistry – Shriver & Atkins	
8.	Principle of Inorganic chemistry- Brian W. Pfennig .	


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Semester : II		
Course Name: Organic Chemistry-4		Course Code: CHETE/SE/-559
Course type : DSE-8		2 Hrs/ Week
Total contact hours : 30 hrs	Theory Credit: 2	Marks : 50
Course Objectives		
Student will be able to		
1	Understand aromatic electrophilic substitution reactions	
2	Acquire the knowledge of directing nature of functional groups	
3	Know directing nature of attacking electrophiles on various aromatics	
4	Understand requirement for aromatic nucleophilic substitution reactions	
5	Describe the basic concepts in molecular rearrangement	
6	Acquire the knowledge of migratory aptitude	
Unit-I : Aromatic Electrophilic Substitutions		10 Hrs
The arenium ion mechanism, orientation and reactivity, energy profile diagram. Directing nature of various groups, Orientation of attacking electrophile on mono and di-substituted benzene, Five and six membered heterocycles. Electrophilic substitution on polycyclic aromatic hydrocarbons (Naphthalene, anthracene) The ortho/para ratio, IPSO substitution, orientation in other ring system, Recapitulation of halogenation, nitration, sulphonation and Fridel Craft's reaction (Alkylation and acylation), diazonium coupling		
Unit-II : Aromatic Nucleophilic Substitutions		10 Hrs
The S _N Ar, S _N 1, benzyne mechanism, Effect of substrate structure, leaving group and attacking nucleophile on reactivity, Chichibabin reaction (Pyridine, quinoline and isoquinoline)		
Unit-III : Rearrangements:		10 Hrs
General mechanistic consideration, nature of migration, migratory aptitude, memory effect, pinacol-pinacolone, Benzil-Bezilic acid, Beckmann, Hoffman and Fries rearrangements.		
References Books		
1	Advanced Organic Chemistry, IV Edition: J. March	
2	Advanced organic Chemistry, Part-A and Part-B: F. A. Carey, & R. J. Sundburg.	
3	A Guide Book to Mechanism in Organic Chemistry: Peter Sykes	
4	Synthetic Organic Chemistry: H. O. House	
5	Principles of Organic Synthesis: R. O. C. Norman	
6	Organic Chemistry: Clayden and Greeves	
7	Mechanism and Structure in Organic Chemistry: E. S. Gould	


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Semester: II		
Course Name: Physical Chemistry-4		Course Code: CHETE/SE/-560
Course Type: DSE-9		2 Hrs/ Week
Total Contact Hours: 30	Theory Credit: 2	Marks : 50
Course outcomes:		
1. To understand the basic concepts of phase rule		
2. To analyse and interpret phase diagrams for single and multicomponent systems.		
3. To understand the basic concept of crystallography.		
4. To understand the basic concepts of photochemistry, their different theories and possible applications.		
Unit-I: Phase Rule		10 Hrs
Recapitulation of phase rule and terms involved in it, one component system, two component systems (solid-solid, solid-liquid and liquid-liquid), reduced phase rule, three component systems, partially miscible three liquid systems : one partially miscible pair, two partially miscible pairs, three partially miscible pairs, systems composed of two solids and a liquid : crystallization of pure components only, formation of binary compounds, formation of ternary compounds, formation of solid solutions, partial miscibility of solid phases, numericals.		
Unit-II: Crystallography		10 Hrs
Classification of solids on the basis of shapes, and bonding, crystal lattice and unit cell, laws of crystallography crystal symmetry, symmetry elements, lattice planes and their designations, liquid crystals. Principle of crystal structure, close packing of atoms, packing of equal sized spheres in HCP, CCP, BCC structures, packing in ionic solids, atomic packing factor in crystal structures, ionic radius, radius ratio rule, (3, 4, 6, 8 coordinate structures). Octahedral and tetrahedral voids, isomorphism and polymorphism, numericals.		
Unit-III: Photochemistry		10 Hrs
Absorption of light and nature of absorption spectra, electronic transitions. Photo-dissociation and pre-dissociation, photo-oxidation, photo-reduction and photo-dimerization. photo-physical phenomenon. Jablonski diagram, photo-physical pathways of molecular deexcitation, difference between delayed fluorescence and phosphorescence, Stern-Volmer equation, deviations from Stern-Volmer equation, concentration dependence of quenching and excimer formation, quenching of fluorescence formation of excimer and exciplex.		
Reference Books:		
1.	Principles of Physical Chemistry : Puri, Sharma, Pathania	
2.	Advanced Physical Chemistry : Gurdeep - Raj, Plenum.	
3.	Physical Chemistry : Maron and Prutton	

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4.	Introduction to Molecular Photo-chemistry : C.H.J. Wells
5.	Fundamentals of Photo-chemistry : Rohatgi-Mukherjee.
6.	Photo-chemistry : J.G. Calvert & J.N. Pitts.
7.	Photo-luminescence of solutions : C.A. Parker.
8.	Photo-chemistry : A. Singh and R. Singh
9.	Atkin's Physical Chemistry : Peter Atkins
10.	Solid State Chemistry : D.K. Chakraborti
11.	Solid State Chemistry and its applications : A.R. West.
12.	The Determination of Molecular Structure : P.J. Wheatley.
13.	Solid State Chemistry : N.B. Hannary.
14.	Principles of Solid State : H.V. Keer.
15.	Physical Chemistry : G.K. Vemulapalli.


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Semester: II		
Course Name: Drug Chemistry-2		Course Code: CHETE/SE/-561
Course Type: DSE-10		2 Hrs/ Week
Total Contact Hours: 30	Theory Credit: 2	Marks : 50
Course Outcomes:		
1. To provide details about Drugs, their characterization and classification		
2. To know about sources of drugs, historical development and other parameters such as Lead discovery, lead development; Pharmacological / Microbiological / Biochemical evaluation; Clinical trials; and Pharmacokinetic		
3. To provide the information about dosage forms, drug toxicity and it's prevention		
Unit-I: Introduction to Drug		10 Hrs
What are Drugs? Definition, Characteristics of ideal drugs, Why do you need drugs? Classification of Drugs: i) Based on the chemical structures; examples of each class; ii) Based on the Pharmacological action; examples of each class, Physiological action, Pro-drug; mode of action		
Unit II: Sources and Development of Drugs		10 Hrs
a) Sources of Drugs: i) Plant sources; examples of methods of isolation; ii) Marine sources; examples of methods of isolation; iii) Micro-organism sources; examples of methods of isolation b) Historical development of Medicinal Chemistry, Genetic engineering c) Development of drugs: Lead discovery, lead development; Pharmacological / Microbiological / Biochemical evaluation of drugs; Clinical trials; Pharmacokinetic: i) Absorption, ii) Distribution, iii) Metabolism, iv) Elimination		
Unit-III: Dosage forms, Drug Toxicity and its prevention		10 Hrs
a) <u>Dosage forms</u> : Need and Benefits; Mode of administration of drugs; Types, Advantages; Disadvantages. b) <u>Drug Toxicity and its prevention</u> : Principles of toxicology, abnormal action of drugs such as tolerance, addiction, habituation, idiosyncrasy, allergy, hypersensitivity, antagonism, synergism, potentiation, tachyphylaxis. Adverse drug reactions and its monitoring.		
Reference Books:		
1.	Medicinal chemistry (Vol. I and II)-Burger.	
2.	The organic chemistry of drug design and drug action-R. B. Silverman (Academic Press)	
3.	Strategies for organic drug synthesis and designing - D. Lednicer Wiley.	
4.	Medicinal Chemistry- Ashutosh Kar	

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5.	Medicinal Chemistry- Balkishen Razdan	
Semester : II		
Course Name: On the Job Training		Course Code:CH101T-561
Course type :-		8 Hrs/ Week
Total contact hours :120 Hrs	Lab. Work Credit: 4	Marks :100
Course outcomes:		
On completion of this course, the students will be able:		
Able to get on the job training		
1.		
2.		
3.		


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 Dr. B. A. M. U. Chhatrapati Sambhajinagar, Marathwada

Semester : II		
Course Name: Field Project		Course Code:CHEP-562
Course type :- --		8 Hrs/ Week
Total contact hours :120 Hrs	Lab. Work Credit: 4	Marks :100
Learning outcomes: On completion of this course, the students will be able: Get experiential learning while field work		
1.		
2.		
3.		
4.		


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 Sambhajinagar

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NAAC Re-accredited 'A' Grade

National Education Policy-2020
Outcome Based Curriculum
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Faculty of Science & Technology

Two Years Master of Science in Chemistry Programme

Subject : Chemistry

Specialization:

Analytical Chemistry

Effective from Academic Year 2024-25


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PREFACE

National Education policy 2020 has been intensely debated policies come into existence. In January, 2020 UGC has given the guideline for Learning outcome based curriculum framework (LOCF) work towards more holistic experience for the students . while focussing not just on knowledge delivery in higher education but also on the application of knowledge through field and laboratory work and emphasis on application of knowledge to real life experiences, LOCF is student-centric education in the context of development of personal, social, professional and acquired knowledge requirements in their career and life building, which focuses on measuring student performance through outcomes. It includes the knowledge, skills and attitudes enhancement in the students .

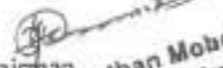
The aspects of LOCF is all-round development of the students, skill acquisition outside chosen subjects and research were undetermined but NEP has changed all of these in one stroke. The prominent features of the NEP framework are:

- Student centric education
- Flexibility in postgraduate programmes
- Multiple entry and exit points
- Skill based & outcome base education
- Credit based evaluation system
- Academic bank credits

It also focuses on evaluation of outcomes of the program by considering the knowledge, skill and behaviour of a students after completion of two year program. The educational triangle of Teaching-Learning and Evaluation process is the unique features of the OBE approach. The curriculum practices such as Competency based curriculum, Tailor-made curriculum development, spades, curriculum principles, Blooms Taxonomy and further use of assessment methodologies like, Norm-reference testing and Criterion reference testing, etc is being practiced since decades. It is also interesting to know that, globally, different countries and universities adopts the curriculum development models /approaches such as, CDIO (Conceive-Design-Implement-Operate), Evidence based education systems approach, etc as the scientific and systematic approaches in curriculum design.

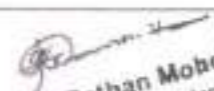
Maharashtra state government and the authorities of Dr. Babasaheb Ambedkar Marathwada University, Chhatrapati Sambhaji Nagar has decided to implement National Education policies -2020 from the academic year 2023-24 for postgraduate program with outcome based education

As per guideline of OBE the department has prepared curriculum for Master of science in chemistry with specialization Inorganic chemistry, Organic Chemistry, Physical Chemistry and self supported Analytical Chemistry . The OBE syllabus will help to improve the quality and employability of the Post-graduates of the university department.


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1.	<p>Vision Statement: A Master of Science (M.Sc.) in Chemistry is a postgraduate degree that provide students with in-depth knowledge, research skills, and practical expertise in the field of chemistry. Some of key points of our M. Sc. Chemistry program are mentioned below:</p> <ol style="list-style-type: none">1. Comprehensive Core Curriculum: Our course having a strong core curriculum covering fundamental principles in organic, inorganic, physical, analytical, and drug chemistry. This foundational knowledge is crucial to build a solid understanding of the discipline.2. Specialization Options: To cater to the diverse interests of students, students have option to select different specialization. We are offering three specializations viz, Analytical Chemistry, Drug Chemistry and Organic Chemistry. By choosing a specialization, students can focus on topics that align with their career aspirations and research interests.3. Research Emphasis: Research is a crucial aspect of an M.Sc. Chemistry program. Students have opportunities to work on research projects under the guidance of experienced faculty members. This hands-on experience will enhance critical thinking, problem-solving skills, and laboratory techniques.4. Modern Analytical Techniques: The course will provide the training or interpretation in modern analytical techniques, such as spectroscopy, chromatography, mass spectrometry, and so on. Proficiency in these techniques is vital for conducting advanced research and for industry applications.5. Green Chemistry and Sustainability: Incorporation of principles of green chemistry and sustainability into the curriculum will promote awareness of environmental impact and encourage students to develop eco-friendly solutions. <p>Overall, the vision for M.Sc. Chemistry course is to produce well-rounded, skilled, and ethical chemists who can contribute meaningfully to scientific advancements and societal needs</p>
2.	<p>Mission Statement The mission of the M.Sc. Chemistry program is to provide advanced education and training in the field of chemistry. Student will get the understanding of chemical principles, analytical techniques, and specialized knowledge in various sub-disciplines. The program aims to foster critical thinking, research skills, and ethical practices among students, enabling them to contribute significantly to scientific advancement, innovation, and societal needs. Further, program focus is to encourage the students to stand in competitive examinations in the field of chemistry such as NET, SET and GATE and contribute to the academic field. To bring sustainable progress of society by nurturing chemistry with responsibilities. To create and maintain programs of excellence in the areas of research, education and public outreach. It will produce students who are knowledge in chemistry and can think critically. To develop the researcher and scientist in chemical science through post-graduate education and research programme. To develop the competent manpower with technology-based experimentation methodologies and value-</p>

	based practices for business and industries. To undertake projects to solve field base problems. To provide student centric learning facilities for the development of overall personality of learner.
3.	Eligibility Criteria : Candidate has passed Bachelor's Degree Examination with Chemistry as one of the major subject, eligible for M. Sc. (Chemistry) for all three specializations. Further, B.Sc. Forensic Science student is eligible only for Analytical Chemistry specialization
4.	Assessment and Evaluation: 40 % internal & 60% university exam
5.	Duration of Course Programme : Two years
6.	Credit Allotted for two year master programme in chemistry : 88 Credit Semester - I : 22 Semester -II : 22 Semester -III : 22 Semester -IV : 22
7.	Program Objectives: M. Sc. in Chemistry program aims to provide the following objectives: 1. Provide the Advanced Knowledge: The program aims to provide the core/basic concepts in chemistry, including organic, inorganic, physical, and analytical chemistry, while also exploring interdisciplinary areas. 2. Provide the Research Skills: Students will get the research-oriented environment in the department and learns the laboratory techniques and methodologies required in the research. 3. Create Analytical Thinking: We will encourage the students to create analytical thinking and encouraging to approach complex challenges with creativity and scientific reasoning. 4. Ability of Communication and Collaboration: In the program, students will work on their abilities to present and discuss scientific ideas clearly and work collaboratively with others
8.	Program Outcomes: The program outcomes (PO's) are the statement of competencies/ abilities. POs are the statement that describes the knowledge and the abilities the post-graduate will have by the end of program studies. i).In-depth and detailed functional knowledge of the fundamental theoretical concepts and experimental methods of chemistry.


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	<p>ii). Apply/implement interface between on the one hand, the history of chemistry and natural science and, on the other hand, issues pertaining to the areas of modern technology, health, and environment.</p> <p>iii). Skills in planning and conducting advanced chemical experiments and applying structural-chemical characterization techniques.</p> <p>iv). Skill in examining specific phenomena theoretically and/or experimentally.</p> <p>v). Generation of new scientific insights or to the innovation of new applications of chemical research.</p>
9.	<p>Course Program outcome</p> <p>Course Program Outcomes are developed through the curriculum (curricular/co-curricular-extra-curricular activities). The program outcomes are attained through the course implementation. As an educator, one must know, <u>"To which POs his/her course is contributing?"</u>. So that one can design the learning experiences, select teaching method and design the tool for assessment.</p>


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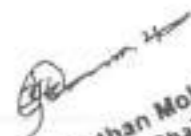
Faculty of Science & Technology

Two Years Master of Science in Chemistry Programme

Subject : Chemistry
Specialization : Analytical Chemistry

(Semester III & IV)

(Effective from 2024-25)


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Illustrative Credit distribution structure for Two Years Programme with
Multiple Entry and Exit options

Class: M.Sc. Second Year Semester: IIIrd Specialization Subject: Analytical Chemistry

Course type	Course Code	Course Name	Teaching Scheme (Hrs./ week)		Credits Assigned			Marks		
			Theory	Practical	Theory	Practical	Total Credits	Conti. Eval.	Unl. Exm.	Total Marks
Major Mandatory DSC	ACHET- 600	DSC-15 (Ana. Chem.)	4	-	4	-	10T	40	60	100
	ACHET 601	DSC-16 (Ana. Chem.)	4	-	4	-		40	60	100
	ACHET 602	DSC-17 (Ana. Chem.)	2	-	2	-		20	30	50
	ACHEL 603	DSC-18 (Ana. Chem. Lab course)	-	4	-	2	4P	20	30	50
	ACHEL-604	DSC-19 (Ana. Chem., Lab course)	-	4	-	2		20	30	50
DSE (Choose any Two from pool of courses)	ACHETE 605	DSE-9 (Ana. Chem.)	2	-	2	-	4T	20	30	50
	ACHET 606	DSE-10 (Ana. Chem.)	2	-	2	-		20	30	50
	ACHET 607	DSE-11 (Ana. Chem.)	2	-	2	-		20	30	50
	ACHET 608	DSE-12 (Ana. Chem.)	2	-	2	-		20	30	50
Research Project	ACHERP-649	Research Project -I	-	8	-	4	4P	40	60	100
Total			14	16	14	08	22	220	330	550

Course code Nomenclature :

DSC-Discipline Specific Core course, DSE- Discipline Specific Elective, T-Theory, L- Laboratory course, ACHTC- Analytical Chemistry Theory Core course, ACHLC- Analytical Chemistry Laboratory Core course, ACHEC- Analytical Chemistry Elective Course, ACHERP- Analytical Chemistry Research Project


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Class: M.Sc. Second Year Semester: IVth Semester specialization Subject: Analytical Chemistry

Course type	Course Code	Course Name	Teaching Scheme (Hrs./ week)		Credits Assigned			Marks		
			Theory	Practical	Theory	Practical	Total Credits	Cont. Eval.	Uni. Exam.	Total Marks
Major Mandatory DSC	ACHET 650	DSC-20 (Ana. Chem.)	4	-	4	-	10T	40	60	100
	ACHET 651	DSC-21 (Ana. Chem.)	4	-	4	-		40	60	100
	ACHET 652	DSC-22 (Ana. Chem.)	2	-	2	-		20	30	50
	ACHEL 653	DSC-23 (Ana. Chem. Lab course)	-	4	-	2	2P	20	30	50
DSE (Choose any Two from pool of courses)	ACHETE 654	DSE-13 (Ana. Chem.)	2	-	2	-	4T	20	30	50
	ACHETE 655	DSE-14 (Ana. Chem.)	2	-	2	-		20	30	50
	ACHETE 656	DSE-15 (Ana. Chem.)	2	-	2	-		20	30	50
	ACHETE 657	DSE-16 (Ana. Chem.)	2	-	2	-		20	30	50
Research Project	ACHERP-699	Research Project-2	-	12	-	6	6P	60	90	150
Total			14	16	14	08	22	220	330	550

Course code Nomenclature :

DSC-Discipline Specific Core course, DSE- Discipline Specific Elective, T-Theory, L- Laboratory course, ACHET- Analytical Chemistry Theory Core course, ACHEL- Analytical Chemistry Laboratory Core course, ACHETE- Analytical Chemistry Elective Course, ACHERP- Analytical Chemistry Research Project


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Semester : III

Course Name: Structural Elucidation by Spectral Methods Course Code:ACHET-600

Course type : DSC-15 4 Hrs/ Week

Total contact hours : 60 Hrs Theory Credit: 4 Marks : 100

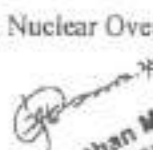
Learning outcomes:

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

1. Students will review elementary concepts of nuclear magnetic resonance spectroscopy and delve into spin-spin couplings, factors affecting coupling constants, and spin systems like AB, AX, and ABX.
2. They'll also explore techniques such as INEPT, INADEQUATE, and the Nuclear Overhauser effect.
3. Students will grasp elementary concepts of ^{13}C -nuclear magnetic resonance spectroscopy, including chemical shifts for various carbon types and the impact of substituents on these shifts.
4. They'll also address instrumental challenges associated with ^{13}C -NMR spectroscopy.
5. Students will understand the fundamentals of mass spectrometry, including ion production methods, ion analysis, factors affecting fragmentation, and the interpretation of mass spectra.
6. They'll explore fragmentation patterns for various functional groups and phenomena like the molecular ion peak and McLafferty rearrangement.
7. Students will grasp the principles of Mössbauer spectroscopy, understanding factors influencing line position and shape, including the isomer effect and quadrupole splitting.
8. They'll also delve into Electron Spin Resonance spectroscopy, analyzing hyperfine splitting, zero field splitting, and instrumentation in varied applications.
9. Students will integrate UV, IR, ^1H NMR, ^{13}C NMR, and Mass Spectroscopy data to solve complex problems in structural elucidation and compound identification.

Unit-I : Nuclear Magnetic Resonance Spectroscopy (^1H NMR) 12Hrs

Elementary ideas (Recapitulation); Spin-spin couplings, Different types of couplings, factors affecting on coupling constants, Karplus equation, Spin systems (AB, AX, ABX, AMX), Rate processes, spin decoupling, shift reagents, Nuclear Overhauser effect (NOE), INEPT and INADEQUATE.


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Unit-II : ^{13}C -Nuclear Magnetic Resonance Spectroscopy 12Hrs

Elementary ideas, instrumental problems, chemical shifts (aliphatic, olefinic, alkyne, aromatic, heteroaromatic and carbonyl carbons); Effect of substituents on chemical shifts.

Unit-III : Mass Spectroscopy 12Hrs

Introduction, ion production (EI, CI, FD and FAB), ion analysis, ion abundance, factors affecting on fragmentation, fragmentation of different functional groups, molecular ion peak, isotopic peaks, metastable peak, Nitrogen rule, McLafferty rearrangement, Retro-Diels-Alder reaction.

Unit-IV : 12Hrs

Problems based on joint applications of UV, IR, ^1H NMR, ^{13}C NMR and Mass spectroscopy.

Unit- V : Mossbauer Spectroscopy 12Hrs

Principle, factors affecting the line position and shape, isomer effect and Quadrupole splitting iron salt like compounds, complexes, carbonyl compounds (temperature dependence of isomer shift and Quadrupole splitting in simple compound and coordination, polynuclear complexes), Numericals. **Electron Spin Resonance Spectroscopy:** Introduction, principle of ESR spectroscopy, presentation of spectrum, hyperfine splitting in various structures, hyperfine splitting diagram of representative examples, factors affecting the magnitude of 'g' values, Zero field splitting, Kramer's degeneracy, Anisotropy in the hyperfine coupling constant, electron delocalization, instrumentation and applications.

References Books

1. Introduction to Spectroscopy: D. L. Pavia, G. M. Lampman, G. S. Kriz
2. Spectrometric Identification of Organic Compounds: R. M. Silverstein & F. X. Webster
3. ^{13}C NMR Spectroscopy: G. C. Levy, R. L. Lichter, G. L. Nelson
4. Spectroscopic Methods in Organic Chemistry: D. H. Williams & I. Fleming
5. Organic Structure Analysis: Phillips Crews
6. Structural Methods in Inorganic Chemistry: E. A. V. Ebsworth & D. W. H. Rankin
7. Physical Methods for Chemistry: R. S. Drago
8. Coordination Chemistry vol. I: E. Martell
9. Coordination Chemistry by Experimental Methods: K. Barger
10. Mass Spectrometry: K. G. Das & James


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11. Absorption Spectroscopy of Organic Compounds: V. M. Parikh

Semester : III

Course Name: Quality Assurance and Accreditation Course Code:ACHET-601

Course type : DSC-16 4 Hrs/ Week

Total contact hours : 60 Hrs Theory Credit: 4 Marks: 100

Learning outcomes:

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

1. Students will understand the concepts and significance of quality control and assurance, utilizing statistical techniques like quality control charts.
2. They will master calibration and maintenance of laboratory instruments.
3. They will gain proficiency in documentation for quality assurance, including handling raw data, sampling methods, and analytical reporting.
4. The course covers establishing a quality assurance program, writing standard operating procedures, and monitoring quality assurance data.
5. Students will explore laboratory accreditation, its international aspects, criteria, and benefits.
6. They will learn about ISO 9000 standards, their evolution, and implementation, including QMS documentation, quality policies, and the significance of ISO 9001, 9002, 9003, and 9004.

Unit-I :Quality Assurance: 12Hrs

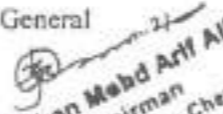
Introduction to Quality Control and quality assurance: Concepts and significance. Quality control and statistical techniques: Quality control charts, the X-quality control chart, the R-quality control chart and its interpretation, spiked sample control charts, use of blind samples in quality control, use of proficiency evaluations in quality control.

Unit-II : Calibration and maintenance of Instruments 12Hrs

Calibration and maintenance of Instruments : Instrument calibration – linear calibration curves, equipment calibration, frequency of calibration, calibration of common laboratory instrument and equipment (Analytical balances, volumetric glassware, ovens, furnaces, UV / Visible spectrophotometer, pH meter, conductivity meter, IR spectrophotometers, AAS, GC, HPLC etc.). Maintenance of instruments and equipment

Unit-III :Documentation for quality assurance and Raw Data: 12Hrs

Type of notebooks, control of notebook distribution and data entry. General Reagents and volumetric reagents.


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Sampling – sampling methods, sample labelling, and sample log-in/register. Sample analysis, reporting, recording and personal training. Instrument calibration and maintenance. Analytical report. Personnel, training, records - professional personnel, technician personnel. Filing quality assurance documentation. Good laboratory practices and personnel, Quality Programme, Instrument and Organisation calibration, Customer satisfaction.

Unit-IV : Computers and quality assurance

12Hrs

Computers and quality assurance: Sample handling. Data Acquisition. Quality control data and calculations. Computer generated analytical reports. Security considerations. Hardware and software. Establishing a Quality Assurance program: Management commitment. Define the quality assurance program. Writing standard operating procedures. Topics for standard operating procedures. Consolidating the programme. Monitoring the program – monitoring quality assurance data, reporting quality assurance problems. Writing the quality assurance manuals. AC(CB1)-4: Quality Accreditation

Unit-V : Quality Accreditation:

12Hrs

Laboratory Accreditation: Need for laboratory accreditation. International aspects of laboratory accreditation and in India. Criteria for laboratory accreditation. Benefits of laboratory accreditation, Evolution and significance of Quality Management, Background to ISO 9000, comparison between ISO-9001, ISO-9002 & ISO-9003., ISO 9000-2000 series of standards on quality management system, - evolution of series of standards, introduction to ISO organization, Registration / certification - benefits of QMS certification. Structure of ISO 9000-2000 family of standards. 124 Advantages of ISO 9000-2000. Requirements of ISO 9001-2000 QMS and applications, Steps for effective implementations. Significance of ISO - 9001, 9002, 9003& 9004. Requirements of ISO9000/IS14001. Concepts of OHSMS (BS 8800) Quality Management Principles in QMS, QMS documentation, Quality Manual, Quality policy, conformities and Non-conformities

References Books

1. Handbook of Quality Assurance for the analytical chemistry laboratory, James P. Dux, Van Nostrand Reinhold, New York, 1986.


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Shree Ambedkar Marathwada

2. Applying ISO-9000 Quality Management Systems, International Trade Centre Publishing, UNCTAD/WTO. Geneva, Switzerland, Indian Edition Printed by D.L.Shah Trust.
3. How to practice GLP, PP Sharma, Vandana Publications, 2000, New Delhi
4. Training manuals on ISO 9000 /2000 PQM, Girdhar J Gyani, Raj Publishing House, 2001
5. Quality Assurance in Analytical Chemistry, B.W. Wenclawiak, Springer,India, 2004.

Semester : III

Course Name: Advanced Analytical Techniques-I **Course Code:**ACHET-602

Course type : DSC-17 **2 Hrs/ Week**

Total contact hours : 30 Hrs **Theory Credit:** 2 **Marks :** 50

Learning outcomes:

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

They will understand Supercritical Fluids, hyphenated techniques like LC-MS and

1. GC-MS, Molecular Luminescence Spectrometry, and surface characterization techniques using spectroscopy and microscopy.
2. To understand the concept of fluorescence, phosphorescence and Chemiluminescence

Unit-I : Supercritical Fluids and Hyphenated Techniques **10Hrs**

Properties of Supercritical Fluids, Supercritical Fluid Chromatography, Supercritical Fluid Extraction.

Introduction, Need for hyphenation, possible hyphenation, Interfacing devices and applications of the following: LC-MS, GC-IR, GC-MS, ICP-MS, MS-MS.

Unit-II :Molecular Luminescence Spectrometry: **10Hrs**

Theory of fluorescence and phosphorescence, Instruments for measuring fluorescence and phosphorescence, Applications of photoluminescence methods, Chemiluminescence*

Unit-III :Surface Characterization by Spectroscopy and Microscopy **10Hrs**

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Dr. Babasaheb Patil
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Marathwada

Introduction to the study of surfaces, spectroscopic surface methods, Ion spectroscopic techniques, Surface photons spectroscopic methods, Electron stimulated microanalysis methods, Scanning probe microscopes.

References Books

1. Instrumental Methods of Analysis-Willard, Merritt, Dean & Settle.
2. Instrumental methods of analysis – B. K. Sharma.
3. Instrumental methods of analysis – Chatwal and Anand.
4. Fundamental of Analytical Chemistry,-D.A. Skoog, D.M.West and F.J. Holler.
5. Introduction to Instrumental Analysis-R.D. Braun, McGraw Hill.
6. Instrumental Analysis- Skoog, Holler, Crouch.6th edition
7. Analytical Chemistry – Gary D. Christian, 6th editio
8. Instrumental Methods of Chemical Analysis-Galen W. Ewing.

Semester : III

Course Name: Analytical Chemistry Laboratory Course	Course Code: ACHEL-603
Course type : DSC-18	4 Hrs/ Week
Total contact hours : 60 Hrs	Lab. Work Credit: 2
	Marks : 50


Learning outcomes:

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

1. Students will develop practical skills in various analytical techniques.
2. They will determine COD, BOD, and dissolved oxygen in wastewater, separate and estimate cadmium and zinc, and estimate nitrogen in fertilizers via the Kjeldahl method.
3. They will assess saponification, acid, and iodine values of oils, determine vitamin C in samples, and measure blood glucose levels.
4. Students will estimate APIs in pharmaceuticals, phenol/aniline, chloride in food, sodium carbonate, and moisture content.
5. They will measure hydrogen peroxide strength, pesticide residues by TLC, active chlorine in bleaching powder, magnesium in talcum powder, and alcohol content.
6. These skills prepare students for roles in environmental, pharmaceutical, and food chemistry sectors.

List of experiments

1. Determination of COD, BOD and dissolved oxygen from waste water sample.
2. Separate and estimate the amount of cadmium and zinc using ion exchange resin.
3. Estimation of Nitrogen from given sample of fertilizer by Kejalda method.


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4. Determination of saponification, acid and Iodine value of oil.
5. Determination Vitamin -C from given sample of Juice/ tablet using dichlorophenol indophenols by volumetric method.
6. Estimation of blood glucose by Folin Wu method.
7. Estimation of API in the pharmaceutical sample.
8. Estimation of phenol/aniline by bromination method.
9. Estimation of chloride from food sample by Volhard titration method.
10. Determination of sodium carbonate in washing soda.
11. Determination of volume strength of commercial hydrogen peroxide using KMnO_4
12. Moisture content in pharmaceutical/food sample by Karl-fisher titration method.
13. Estimation of pesticide residue by TLC method.
14. Estimation of active chlorine in the given sample of bleaching powder.
15. Estimation of mg from given sample of talcum powder.
16. Estimation of alcohol in the given sample by diffusion oxidation method

References Books

1. Quantitative Inorganic Analysis including Elementary Instrumental Analysis by A. I. Vogels.
2. Experiments in chemistry by D. V. Jahagirdar, Himalaya publication.
3. Practical Pharmaceutical Chemistry, 4th Ed. part-2, Beckett, Stenlake.
4. Indian Pharmacopeia volume -I, II III

Semester : III

Course Name: Analytical Chemistry Laboratory Course

Course Code: ACHEL-604

Course type : DSC-19

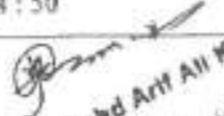
4 Hrs/ Week

Total contact hours : 60 Hrs Lab. Work Credit: 2

Marks : 50

Learning outcomes:

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


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1. Students will master the estimation of potassium, calcium, and sodium using flame photometry, and determine boric acid via conductometry.
They will analyze commercial vinegar by potentiometric and conductometric methods.
2. determine high polymer molecular weight by viscosity/turbidometry, and estimate phosphate in fertilizers/detergents spectrophotometrically.
3. They will estimate Cu (II) and Fe (III) using EDTA, reducing sugar in food by spectrophotometry, and protein by the biuret method.
They will determine mixture composition by refractometry, characterize samples by IR spectroscopy, and analyze alcohol mixtures and nitration monitoring by gas chromatography.
4. Students will determine lactose by HPLC, analyze binary mixtures, and determine Hammett constants by pH metrics.

List of experiments

1. Estimation of potassium, calcium and sodium from given sample using flame photometric method.
2. Determination of boric acid by conductometric method.
3. Determination of commercial vinegar by potentiometric titration and its confirmation by conductometric method.
4. Determination of molecular weight of high polymer by viscosity measurement /turbidometric method.
5. Determine the amount of phosphate from given sample of fertilizer/ detergent using spectrophotometric method.
6. Estimation of Cu (II) and Fe (III) by spectrophotometric method using EDTA.
7. Estimate the reducing sugar by 3, 5 dinitrosalicylic acid in the given food sample by Spectrophotometric method.
8. Determination of protein by biureate method using by Spectrophotometric method.
9. Determine the percentage composition of the mixture by refractometer.
10. Characterization of unknown sample by IR Spectroscopy.
11. Analysis of mixture of alcohols by Gas chromatography.
12. Monitoring of nitration of organic compound by gas chromatography.
13. Determination of petroleum hydrocarbons in burn-cases by GC method.
14. Determine the lactose sugar by HPLC method.
15. Analysis of binary mixture of simple organic compound by HPLC method.

16. Determine the Hammett constant of substituted benzoic acid by pH metric method.

References Books

1. Quantitative Inorganic Analysis including Elementary Instrumental Analysis by A. I. Vogels.
2. Experiments in chemistry by D. V. Jahagirdar, Himalaya publication.
3. Practical Pharmaceutical Chemistry, 4th Ed. part-2, Beckette, Stenlake.
4. Indian Pharmacopoeia volume -I, II& III

Semester : III

Course Name: Electroanalytical Techniques Course Code:ACHETE-605

Course type : DSE-9 2 Hrs/ Week

Total contact hours : 30 Hrs Theory Credit: 2 Marks : 50

Learning outcomes:

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

1. Students will comprehend electrode processes, including electrocapillary curve and exchange current, and various types of ion-selective electrodes.
2. They will explore potentiometry, its instrumentation, and different types of potentiometric titrations, understanding their variations and limitations.
3. Coulometry principles, techniques, and applications, along with high-frequency titration theory and instrumentation, will be covered.
4. Students will learn about cyclic voltammetry, its theory, instrumentation, and qualitative/quantitative analysis techniques.
5. Electrogravimetry principles, instrumentation, and applications, including constant applied voltage/current methods, will be studied.
6. Electrophoresis techniques, including paper, capillary, zone, and gel electrophoresis, will also be explored, along with their principles, experimental techniques, and applications.

Unit-I : General Introduction and Potentiometry 10Hrs

Electrode Processes, Electrocapillary curve and electrocapillary maximum potential, exchange current, Ion selective electrodes: Types and construction of electrode, Glass electrode, Solid state electrode and precipitate electrode, Liquid-liquid membrane electrodes, Enzyme and gas electrode, Applications

of ion selective electrodes, Reference electrodes, Mercury electrodes (DME, SME, HMDE).

Potentiometry: Instrumentation, Potentiometric titrations:- Types of potentiometric titrations, Variations in potentiometric titrations, Limitations.

Unit-II :Coulometry, High frequency titration and Cyclic Voltammetry 10Hrs

Coulometry: Principle, Technique, Coulometry at constant current and coulometry at controlled potential, Coulometric titration, Flowing stream coulometry, Stripping analysis, Applications.

High frequency titration: Theory and instrumentation, High frequency titrimetry, Types of cells, Advantages of high frequency methods, Applications.

Cyclic Voltammetry: Theory and origin of polarography, Interpretation of polarographic curves, Instrumentation of polarography, Differential pulse polarography, Factors affecting on polarographic wave. Introduction and beginning of cyclic voltammetry, Range of cyclic voltametric techniques. The acceptable sweep rate range. The shape of the peak in potential sweep curves, The role of non-aqueous solution in cyclic voltammetry, Criteria of reversibility of electrochemical reactions, Quasi reversible and irreversible processes, Qualitative and quantitative analysis by cyclic voltametric techniques, Linear sweep voltammetry for reactions that include simple adsorbed intermediates, Amperometric titrations, Chronoamperometry..

Unit-III : Electro-Gravimetry and Electrophoresis: 10Hrs

Electro-Gravimetry: Theory of electrogravimetry, Instrumentation, Electrogravimetric determination with constant applied voltage and constant current, Applications of electrogravimetry, Problems based on effect concentration on electrode potential, Calculation of theoretical potential, Effect of pH in electrolytic separation.

Electrophoresis: Paper electrophoresis Principle, Experimental techniques, Factors governing migration of ions, and Applications, Numericals. Capillary and zone electrophoresis: Electroosmotic flow, Migration in CE, Instrumentation, Control of separation, Application. Gel electrophoresis: Principle, technique, application.

References Books

1. Quantitative analysis - Alexeyev, V


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2. Instrumental methods of analysis – Chatwal and Anand.
3. Introduction to instrumental analysis – R. D. Braun.
4. Instrumental methods of analysis – Willard, Meritt, Dean and Settle.
5. Standard methods of chemical analysis – F. G. Welcher, Vol III, Part A & B.
6. Electroanalytical chemistry – H. W. Neurenberg.
7. Principles of electrochemistry – D. A. MacLines.
8. Ion selective electrodes – (John Wiley) Stulic. 126
9. Vogel's textbook of quantitative chemical analysis - Mendham, Denney, etc.
10. Modern Electrochemistry vol. I - John O'M Bockris
11. Modern Electrochemistry vol. II - John O'M Bockris
12. Analytical Chemistry – Gary D. Christian, 6th edition
13. Principles of Instrumental Analysis–Skoog, F. J. Holler & J. A. Nieman.
14. Instrumental Methods of Chemical Analysis–Galen W. Ewing, 5th edition

Semester : III

Course Name: Advanced Analytical Techniques-II	Course Code: ACHETE-606
Course type : DSE-10	2 Hrs/ Week
Total contact hours : 30 Hrs	Theory Credit: 2
	Marks : 50


Learning outcomes:

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

1. Students will master Atomic Mass and X-ray Spectrometry, including mass spectrometers and various methods such as inductive coupled plasma and electron microprobe.
2. They will understand Thermal Methods, encompassing thermogravimetry, differential thermal analysis, and thermometric titrations.
3. Students will gain proficiency in Diffraction Methods, learning about X-ray and electron diffraction techniques, Bragg's law, and structure determination.
4. They will explore applications in identifying unit cells, determining crystal structures, and understanding the differences between X-ray and neutron diffraction, particularly in magnetic scattering and transition metal oxides analysis.
5. These skills prepare students for advanced analytical roles in research and industry.

Unit-I :Atomic Mass and X-ray Spectrometry 10Hrs

Atomic Mass Spectrometry:Some general features of atomic mass spectrometry, Mass spectrometers, Inductive coupled plasma mass spectrometry, Spark source mass spectrometry, Glow discharge mass spectrometry, Other mass spectrometric methods.

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Atomic X-ray Spectrometry: Fundamental principles, Instrument components, X-ray fluorescence methods, X-ray absorption methods, The electron microprobe.

Unit-II : Thermal Methods

10Hrs

General introduction, classification of thermal methods of analysis thermogravimetry, principles, factors affecting thermal curve, thermogravimetric analysis, Derivative thermogravimetry, Differential thermal analysis - principles, factors affecting DTA curve, applications, differential scanning calorimetry - principles, instrumentation and applications, thermomechanical and dynamic mechanical analysis, thermometric titrations, numericals. Microthermal analysis.

Unit-III : Diffraction Methods

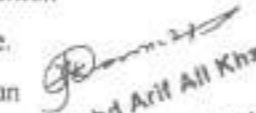
10Hrs

Generation of X-rays, interaction of X-rays with matter, scattering and diffraction, Bragg's law, Miller indices, General instrumentation, Laue Photograph method, Bragg's method, their principle and uses, single crystal method, Debye-Scherrer method, Identification of unit cells from systematic absences, X-ray intensities and structure determination, structure factor and its relation to electron density and intensity, Phase problem. Indexing of lattice planes in a cubic system, structure of NaCl and KCl, Avogadro's number from cubic lattice dimensions, applications of X-ray diffraction.

Electron diffraction: Scattering of electrons by gases, Weir equation, experimental methods: visual method, sector, method, radial distribution method, low energy electron diffraction, structure determination of SiF₄ and CF₃Cl, limitations. **Neutron diffraction:** Introduction, difference between neutron and X-ray diffraction measurement technique, magnetic scattering, applications, comparison of X-ray and neutron diffraction patterns for transition metal oxides.

References Books

1. Principles of Instrumental Analysis-Holler, Skoog&Crouch 6th edition
2. Instrumental Methods of Analysis-Willard, Merritt, Dean & Settle.
3. Principles of Instrumental Analysis-Skoog, F.J.Holler&J.A.Nieman


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Chhatrapati Sambhaji Maharajwada

4. Instrumental Methods of Chemical Analysis-Galen W. Ewing.
5. Analytical Chemistry –Gary D. Christian, 6 th edition
6. Handbook of Instrumental Techniques for Analytical Chemistry –Frank Settle,Editor.
7. Introduction to Instrumental Analysis-R.D. Braun, McGraw Hill.
8. Fundamental of Analytical Chemistry,-D.A. Skoog, D.M.West and F.J. Holler.
9. Instrumental methods of analysis – Chatwal and Anand.
10. Instrumental methods of analysis – B. K. Sharma.
11. Wilson and Wilson Compressive Analytical Chemistry. Ed. G. Svehla, A series of volumes.

Semester : III

Course Name: Polymer ,Paint and Pigment Analysis **Course Code:** ACHETE-607

Course type : DSE-II **2 Hrs/ Week**

Total contact hours : 30 Hrs **Theory Credit:** 2 **Marks :** 50

Learning outcomes:

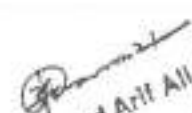
On completion of this course, the students will be able:

1. Students will comprehend the history and classification of polymers, along with their production methods.
They will analyze polymers chemically using techniques such as X-ray diffraction and thermal analysis, and assess physical properties including mechanical strength, impact resistance, and thermal behavior.
2. They will evaluate thermal, optical, electrical, and chemical properties, examining factors like flammability, transparency, and resistance to solvents.
3. Molecular weight and size measurement techniques will be explored, including osmometry and light scattering methods.
4. Students will also learn about the analysis of paints and pigments, including determination of components, pigment classification, and identification of binders.
5. These skills prepare students for roles in polymer research, development, and quality control.

Unit-I :Polymer Analysis

10Hrs

Brief history to polymer, classification of polymer,how polymer are made. Analysis and testing of polymer. Chemical analysis of polymer: X-ray diffraction analysis, thermal analysis, TGA, DTA. Physical testing of polymers: Mechanical properties, Fatigue testing, impact testing, tear resistance,hardness, abrasion resistance. Thermal properties: Softing temperature, flammability. Optical properties: Transmittance, color, gloss, haze and transparency. Electric properties: Dielectric constant and loss


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factor, resistivity, dielectric strength, electronic properties. Chemical properties: Resistance to solvents, vapour permeability, weathering.

Unit-II :Polymer analysis-molecular weight and size measurement 10Hrs

Kinetics of polymerization, Molecular mass, Number and mass average molecular mass, Molecular mass determination by osmometry, Viscometry, light scattering and Sedimentation methods, End group analysis, colligative properties measurements, solution viscosity and molecular size, Numericals

Unit-III : Analysis of Paints and Pigments 10Hrs

Introduction, Determination of non-volatile and volatile components, Flash point, Separation of pigments and thinner of solvent type coating, Pigment type, Identification of binders, Analysis of Vehicle and drying oils.

Analysis of pigments: Classification of organic and inorganic pigments, White tinted pigments.

References Books

1. Text Book of polymer science By F.W.Billmeyer, New York: Wiley
2. Physical polymer science by L.H.Sperlingwiley-Interscience New York
3. Fundamentals of polymer science & Engineering By A Kumar &S.K.Gupta,Tatamcgraw Hill
4. Introduction to polymer science, V.R.Gowarnikar, N.V. Vishwanathan& J.
5. Industrial Chemistry, B. K. Sharma, Goel publishing House Meerut.
6. Kent, Rieg's Industrial chemistry, Rain hold.
7. Handbook of Instrumental Techniques for analytical chemistry. Frank Settle, editor
8. Polymer science by VasantGovarikar, Wiley Earstewen. New York.
9. Principle of polymer science, Behadhar and Sastri, Narosa Publishing house.

Semester : III

Course Name: Petrochemical Analysis Course Code: ACHETE-608

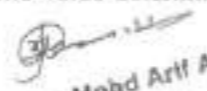
Course type : DSE-12 2 Hrs/ Week

Total contact hours : 30 Hrs Theory Credit: 2 Marks : 50

Learning outcomes:

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

1. Students will understand the concept of fuels, including calorific value determination and modern fuel classifications.


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2. They will explore solid fuels, such as coal, examining their formation, properties, and classification.
3. Students will learn about petroleum, including its occurrence, mining, and distillation processes.
4. They will analyze petroleum products, determining properties like flash point and aniline point, as well as octane and cetane numbers.
5. Additionally, students will study gas fuels, including natural gases and coal gas, analyzing their calorific values.
6. Petrochemical analysis techniques for naphtha and catalyst characterization for cracking processes will also be covered.
7. These skills prepare students for roles in the petrochemical industry and fuel analysis.

Unit-I :Fuels

10Hrs

Introduction, calorific value. Determination of calorific value. Modern concept of fuels. Classifications of fuels, criterion of selection of fuels, properties of fuels. Method of processing. Solids fuels, Natural solid fuels, Artificial solid fuels, Industrial solids fuels .Formation of coal properties of coal, Classification of coal, coking and non-coking coals. pulverised coal. Role of sulphur and ash in coal, approximate analysis, Ultimate analysis, Numerical.

Unit-II :Petroleum

10Hrs

Occurrence, mining of petroleum. Prospecting colour and consistency. Origin composition, classification, terms related to petroleum. Distillation of crude petroleum. Treatment of the residual liquid, Determination of flash point. Determination of aniline point, Knocking and Anti-knocking compounds. Octane number, Cetane number, Numericals.

Unit-III : Gases Fuels

10Hrs

Analysis of natural gases, liquefied petroleum gas, coal gas, water gas, producer gas, gobar gas, blast furnace gas and their calorific value determination. Petrochemical analysis: Analysis of naphtha and their feed stocks, characterization of the catalyst used for cracking.

References Books:

1. Industrial Chemistry, B. K. Sharma, Goel publishing House Meerut.

2. Handbook of Instrumental Techniques for analytical chemistry. Frank
Settle, editor

Semester : III

Course Name: Research project-I

Course Code:ACHERP-649

Course type : Research project

8 Hrs/ Week

Total contact hours : 120 Hrs Theory Credit: 4 Marks : 100

Learning outcomes:

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

At the end of the course, the student will be able to:

1. Know how to carry out literature survey by using various search engines and database
2. Handle various chemicals, solvents, instruments and others
3. Perform reactions, monitoring by Instruments reading
4. Purification techniques
5. Understand the structure of organic compounds by using spectral techniques

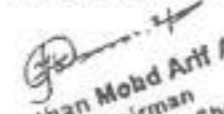

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M. Sc. Analytical Chemistry Semester IV Course Structure

Sr. No.	Course Code	Course Name	Teaching (Hr/W)	Credits Assigned	Conti. Inter. Assmen.	End. Sem Exam	Total Marks
Course Type :DSC-Major Mandatory:							
1.	ACHTC-650	Pharmaceutical and Forensic Analysis	4	4	40	60	100
2.	ACHTC-651	Environmental Analysis and Monitoring	4	4	40	60	100
3.	ACHTC-652	Analytical Method Development and Validation	2	2	20	30	50
4.	ACHLC-653	Analytical Chemistry Laboratory Course	4	2	20	30	50
Course Type : DSE (Choose any two from pool of the course)							
5.	ACHTE-654	Food Analysis	2	2	20	30	50
6.	ACHTE-655	Analysis of Oils, Soaps, Fertilizers, and Pesticides	2	2	20	30	50
7.	ACHTE-656	Analysis of Ores, Alloys & Cosmetics	2	2	20	30	50
8.	ACHTE -657	Microbial and Clinical Analysis	2	2	20	30	50
Course type :Research Project:							
9.	ACHRP -699	Research Project-2	12	6	60	90	150
Total			32	22	220	330	550

Course code Nomenclature :

DSC-Discipline Specific Core DSE- Discipline Specific Elective, T-Theory, L- Laboratory course, ACHTC- Analytical Chemistry Theory Core, ACHLC- Analytical Chemistry Laboratory Core, ACHTE- Analytical Chemistry Theory Elective, ACHRP- Analytical Chemistry Research Project


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Semester : IV

Course Name: Pharmaceutical, and Forensic Analysis Course Code:ACHET-650
 Course type : DSC-20 4 Hrs/ Week
 Total contact hours : 60 Hrs Theory Credit: 4 Marks : 100

Learning outcomes:

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

1. Students will gain an understanding of pharmaceutical analysis, covering drug classification, dosage forms, formulation sources, and impurities.
2. They will learn about pharmaceutical legislation, including drug acts, standards, and intellectual property rights.
3. Assay methods for various drug classes will be explored.
4. In forensic analysis, students will study toxicology, including poison classification and extraction methods for narcotics, stimulants, depressants, and hallucinogens.
5. They will analyze biological stains and materials, and investigate explosives, including their classification, analysis methods, and thermochemistry.
6. These skills prepare students for roles in pharmaceutical quality control and forensic investigation, ensuring product safety and legality.

Unit-I :Pharmaceutical Analysis-I 12Hrs

General idea regarding pharmaceutical industry, Definition and classification of drugs, types of dosage forms. Introduction to pharmaceutical formulations, Sources of impurities in pharmaceutical chemicals, raw materials & Products, Shelf life of pharmaceutical product and its determination, stability studies Standardization of finished products& their characteristics, Limit tests of As, Hg, Pb, Fe, Chlorides, and sulphates. Solubility tests, dissolution test, disintegration tests.

Unit-II :Pharmaceutical legislation 12Hrs

Introduction to drug acts, drug rules, FDA ISI, Agmark and other standard for pharmaceuticals& cosmetics particularly w.r.t. the testing of drugs, and raw material concerned. Pharmaceutical standards IP/BP/USP//EP. Cosmetic standards, Documentation, Record Keeping, Contents of labels, Types of packaging materials,

Intellectual property rights: Introduction, role of patents in the pharmaceutical industry, recent changes, some case studies.

Unit-III :Pharmaceutical Analysis-II 12Hrs

Assay of main classes of drugs as per IP with reference to Introduction, Type, Properties, Mode of action and Methods of Analysis.

Unit-IV :Forensic Analysis 12Hrs

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Introduction, Special features of forensic analysis, Sampling, Sample storage, Sample dissolution. Toxicology: Classification of poisons and poisoning, Lethal Dose, Significance of LD50 and LC50. Extraction methods in toxicology: Isolation, Identification and determinations of: Narcotics: Heroin, Morphine, Codeine. Stimulants: Caffeine, Cocaine, Amphetamines. Despressant: Benzodiazepines Diazepam, Oxazepam, Nitrazepam. Barbiturates- Phenobarbitone, Amylobarbitone, Pentobarbitone, Thiopentone. Hallucinogens: LSC and Cannabis. Analysis of biological stains and materials including blood, semen and saliva (qualitative and quantitative). Viscera, Stomach wash, Vomit and post mortem blood for poisons like cyanides, As, Hg, Insecticides and Pesticides.

Unit- V :Explosive:

12Hrs

Explosion, Detonation, Classification of explosives, Propellant, Fulminates, Detonators, Blasting-cap, Thermochemistry, Hygroscopicity of explosives, Moisture by KarlFisher titration, Isolation from debris, Qualitative test, Cation & anion analysis by capillary electrophoresis, EDXRF, Analysis by TLC, HPLC, IR, GC-TEA method.

References Books

1. Isolation and Identification of drug-n E. G. Clarke vol.- I
2. Laboratory procedure manual-Forensic Toxicology- Directorate of forensic science, MHA Govt. of India.
3. Analytical Biochemistry, D. J. Holme and H.Peck, Longman
4. BioanalyticalChemitry,S.R. Mikkelsen and E. Corton, John Wiley and Sons.
5. Immunoassay – a practical guide Eds,D.W.Chan and M.T.Perlstein, Academic Press.
6. Hawk's Physiological Chemistry, McGraw Hill.
7. Pharmaceutical Analysis Edited by David C. Lee, and Michael Webb.
8. Biochemical methods, S. Sadasivam, A .Manickam.
9. Standard Methods of Biochemical Analysis, S.R. Thimmaiah.

Semester : IV

Course Name: Environmental Analysis and Monitoring

Course Code:ACHET-651

Course type : DSC-21

4 Hrs/ Week

Total contact hours : 60 Hrs **Theory Credit:** 4

Marks : 100

Learning outcomes:

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

1. Students will understand air pollution, covering pollutants like CO, NO_x, SO_x, hydrocarbons, and particulates, along with monitoring techniques and control measures.

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2. In water pollution, they will study pollutants, water quality standards, and monitoring methods for oxygen-demanding wastes and trace metals.
3. Chemical toxicology topics include the impact of toxic chemicals on enzymes and biochemical effects of various pollutants.
4. Soil analysis techniques for determining nutrient content will be explored.
5. Industrial pollution sources and management strategies will be examined, including noise pollution.
6. Additionally, students will learn about Green Analytical Chemistry principles, focusing on sustainable development and eco-friendly analytical methods for sample treatment and instrumentation.
7. These skills prepare students for roles in environmental monitoring and sustainability efforts.

Unit-I :Air Pollution

12Hrs

General considerations: polluted air, Types of pollution and units of measurements. Air quality standards, Sampling, Monitoring, Analysis of CO, Sources and sinks of CO pollution, Effects of CO on plants and humans, Control of CO pollution, Analysis of oxides of nitrogen, NO_x sources and sinks of NO_x pollution, Control of NO_x pollution, Hydrocarbons and photochemical smog and its control, Analysis of hydrocarbon in exhaust gasses, Petrol and air, Sulphur di oxide sources, Analysis and control, Acid rain particulates and their effects on human and climate, Control of particulates.

Unit-II :Water Pollution

12Hrs

Aquatic environment, Water pollutants, Sampling of water and its preservation Trace metals in water, Chemical speciation with special reference to Copper, Lead, Mercury and Arsenic. Water quality standards Water quality parameters.

Oxygen Demanding Wastes: Dissolved oxygen, Biological oxygen demand, Monitoring techniques and methodology with special reference to ammonia, Nitrates, Nitrites, Fluorides, Cyanides, Total hardness, Lead, Cadmium and Mercury. Detection and control of Detergents, oils, Pesticides, Sewage treatment.

Unit-III : Chemical toxicology and Soil Analysis:

12Hrs

Chemical toxicology: Toxic chemicals in environment, Impact of toxic chemicals on enzymes, Biochemical effects of Arsenic, Cadmium, Lead, Mercury, Carbon monoxide, Sulphur dioxide, Pesticides and Carcinogens.

Soil analysis: Sampling of soil, Determination of water holding capacity, Determination of total nitrogen, Ammonia and nitrates. Determination of Na, Mg, Ca, K, phosphate and Sulphur in soil.

Unit-IV :Industrial pollution:

12Hrs

Pollution due to cement industry, Distillery, Pharmaceutical (Drug) industries, Sugar industry, Paper and pulp industries, Thermal power plants, Nuclear power plants, Metallurgical industries, Polymer industries. Recycle, reuse, recovery, disposal, and management of solid industrial waste. Noise pollution- Introduction, sources, measurement of noise level, differences between sound and noise pollution, reverberating of sound, effect and control.

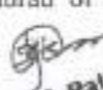
Unit-V :Green Analytical Chemistry:

12Hrs

Principle and concepts of Green Chemistry: Sustainable development and green chemistry. **Green analytical chemistry:** Concept and trends, 'Greening' **Sample treatment:** Reduced and solvent-free sample preparation methodologies, alternative solvents, energy saving procedures of analysis. **Green instrument analysis:** Assessment of analytical methods for 'Greenness', greening flow injection analysis, chemical sensors, liquid green chromatography.

References Books

1. A. K. De, Environmental Chemistry, Wiley Eastern Ltd. New Delhi.
2. S. L. Chopra and J. S. Kanwar, Analytical, Agricultural Chemistry, Kalyani Publishers.
3. R. K. Trivedy and P. K. God, Chemical and biological methods for water pollution studies, Environmental publications, co. New Delhi.
4. L. A. Richards, Diagnosis and improvement of saline and alkali soils. Oxford IBH publications co. New Delhi.
5. S. M. Khopkar, Environmental chemistry, Environmental pollution analysis Environmental chemistry-B.K. Sharma. Goel publishing house Meerut.
6. M. S. Creos and Morr, Environmental chemical analysis, American publications.
7. M. Sittig, Resources, Recovery and Recycling, Handbook of industrial waste.
8. Standard methods of water and waste water analysis, American public health association Washington D. C.
9. R. Gopalan and Amrutha Anand, "Environmental chemistry laboratory manual Emerald Publication.
10. Standards for water for drinking and other purposes, Beaurau of Indian Standards India.


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11. Guideline for drinking water quality recommendations of world health organization, Geneva.
12. B. K. Sharma and H. Kaur, Environmental Chemistry, Gool publishing house Meerut.
13. Thomas G. Spiro and Willian M. Stigliani, Chemistry of environment.
14. New Trends in green Chemistry, V.K.Ahluwalia and M. Kidwai, Anamaya Publishers New Delhi, (2004).

Semester : IV

Course Name: Analytical Method Development and Validation Course Code:ACHET-652

Course type : DSC-22 2 Hrs/ Week

Total contact hours : 30 Hrs Theory Credit: 2 Marks : 50

Learning outcomes:

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

1. Students will grasp assay validation principles and inter-laboratory transfer methods.
2. They will learn statistical analysis techniques and validation parameters such as accuracy, precision, calibration, selectivity, and limits of detection and quantification.
3. Special emphasis will be placed on understanding linear and non-linear response functions, internal standards, and analyse the stability in sample matrices.
4. Students will gain insights into world-wide regulations governing method validation.
5. Additionally, they will explore specific applications like dissolution studies, focusing on apparatus, sampling, calibration, and regulatory compliance.
6. These skills equip students to develop and validate analytical methods with precision, ensuring reliability and compliance with regulatory standards.

Unit-I :Assay Validation and Inter Laboratory Transfer: 10Hrs

Introduction, fundamental definitions, Essential principles of method transfer, method validation report, the inter-laboratory qualification (ILQ) process

Unit-II :Statistical Analysis and analytical Figure of Merit validation parameters: 10Hrs

Accuracy, precision, calibration, (linear response functions (linear regression-errors in slope and the intercept, error in the estimate of concentration, standard additions), non-linear response functions and weighted regression analysis, internal standards), selectivity and specificity (chromatographic methods), limits of detections (spectrophotometric methods, chromatographic methods and related techniques, receptor binding

assay), limit of quantification, sensitivity, ruggedness and robustness, analyte stability in the sample matrix, how to reduce systematic errors, mean and standard deviation, reliability of results, confidence interval, comparison of results, comparison of two means of two samples, experimental design.

Unit-III : Overview of World Wide Regulations

10Hrs

Specific methods and Applications: Dissolution Studies, Introduction, Dissolution test, Apparatus-USP type -I and II, Sampling and analytical instrumentation, Single point test vs. Dissolution profile, Calibration, regulatory guidelines, analytical validation, linearity, accuracy, precision, specificity.

References Books

1. Development and validation of Analytical Methods, Progress Pharmaceutical and Biomedical Analysis, Vol-3, Edited by Chitofer M. Riley and Tomas W. Rosanske (Elvier).
2. Vogel's Textbook of quantitative Chemical Analysis, sixth Ed., Mendham, Denney, Barnes, Thomas, Pub: Pearson Education.
3. Handbook of modern pharmaceutical analysis, edited by Satinder Ahuja and Stephen Scypinski, Academic Press, Separation science Series, Vol-3.
4. HPLC method Development for pharmaceuticals, Edited by Satinder Ahuja and Henrik Rasmussen, Academic Press, Separation science Series, Vol-8.
5. Practical HPLC method Development, Snyder, Kirkiand, Glajch, Wiley-India Pvt. Ltd.

Semester : IV

Course Name: Analytical Chemistry Laboratory Course

Course Code:ACHEL-653

Course type : DSC-23

4 Hrs/ Week

Total contact hours : 60 Hrs

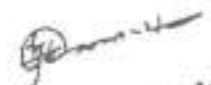
Lab. Work Credit: 2

Marks : 50

Learning outcomes:

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

1. Students will develop practical skills in various analytical techniques including determining COD, BOD, and dissolved oxygen in wastewater, and estimating cadmium, zinc, and nitrogen content.
2. They will also conduct analyses such as saponification, acid, and iodine value of oils, and determine Vitamin C levels in juice/tablet samples.
3. Additionally, students will perform assays like blood glucose estimation and API analysis in pharmaceutical samples.
4. They will learn to estimate phenol/aniline, chloride, sodium carbonate, and moisture content using various titration methods.


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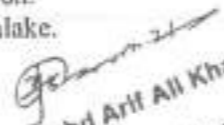
5. Other skills include pesticide residue estimation, active chlorine analysis, and alcohol content determination using different analytical methods.

List of Experiments:

- 1) Determination of COD, BOD and dissolved oxygen from waste water sample.
- 2) Separate and estimate the amount of cadmium and zinc using ion exchange resin.
- 3) Estimation of Nitrogen from given sample of fertilizer by Kjeldahl method.
- 4) Determination of saponification, acid and iodine value of oil.
- 5) Determination Vitamin -C from given sample of Juice/ tablet using dichlorophenol indophenols by volumetric method.
- 6) Estimation of blood glucose by Folin Wu method.
- 7) Estimation of API in the pharmaceutical sample.
- 8) Estimation of phenol/aniline by bromination method.
- 9) Estimation of chloride from food sample by Volhard titration method.
- 10) Determination of sodium carbonate in washing soda.
- 11) Determination of volume strength of commercial hydrogen peroxide using KMnO_4
- 12) Moisture content in pharmaceutical/food sample by Karl-fisher titration method.
- 13) Estimation of pesticide residue by TLC method.
- 14) Estimation of active chlorine in the given sample of bleaching powder.
- 15) Estimation of mg from given sample of talcum powder.
- 16) Estimation of alcohol in the given sample by diffusion oxidation method

References Books

1. Quantitative Inorganic Analysis including Elementary Instrumental Analysis by A. I. Vogels.
2. Experiments in chemistry by D. V. Jahagirdar, Himalaya publication.
3. Practical Pharmaceutical Chemistry, 4th Ed. part-2, Beckett, Stenlake.
4. Indian Pharmacopoeia volume -I, II III.


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Semester : IV

Course Name: Food Analysis

Course Code:ACHETE-654

Course type : DSE-13

2 Hrs/ Week

Total contact hours : 30 Hrs Theory Credit: 2

Marks : 50

Learning outcomes:

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

- 1) Students will comprehend the nutrient value, physical characteristics, and chemical constituents of food, along with proximate composition and relevant legislation.
- 2) They will explore food processing, preservation, contamination, spoilage, safety considerations, and adulteration types and control methods.
- 3) Analytical techniques for food preservatives, emulsifiers, stabilizers, and thickeners will be studied, along with standard composition and analysis of various foods like milk, tea, cereals, and beverages.
- 4) Students will also learn about the analysis of water and fat-soluble vitamins, including microbiological techniques, and understand human nutrition aspects such as biological values, enzyme estimation, and macronutrient analysis.
- 5) These skills prepare students for roles in food quality control and nutrition assessment.

Unit-I :General concepts of food analysis:

10Hrs

Nutrient value of food. Physical characteristics & chemical constituents
Proximate composition of food Legislation related to food and recent amendments, Standards and public health

- a) General idea regarding food processing and preservation
- b) Food contamination and spoilage
- c) Food safety considerations.
- d) Adulteration-Introduction, Types, Tests for adulterants, control

Unit-II :Analysis of food:

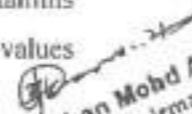
10Hrs

- a). Study of followings with their estimation methods : Food preservatives, Foodemulsifiers,Food stabilizers, Food thickener,
- b). Introduction, Standard composition and Analysis of the following foods:
Milk and milk products, Tea, Coffee, Cereals & Flour, Honey, Soft drinks & Alcoholic beverages.

Unit-III : Analysis of Vitamins:

10Hrs

Analytical techniques of determination of water and fat soluble vitamins including microbiological techniques. Human nutrition: Biological values


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and estimation of enzymes, Carbohydrates, essential amino acids, proteins and lipids.

References Books

1. Chemical analysis of food By Pearson.
2. Introductions to food science and technology, series by G.F.Stewart and M.A.Amerine Academic process.
3. Applied chemistry .AText book for Engineers and technologists by H.D.Gesser.
4. Food analysis by Nielson.
5. Food additives by S.N.Mahindry (APH) publication.
6. Jacob (M.B) chemical Analysis of food and food products (Van Nostrand co. New York).
7. Analytical chemistry of foods (C.S.James) Blackie Academic and professional.
8. Food Analysis principles and techniques D. W. Gruenwedel, J. R. Whitaker, Mercel-Dekker.
9. Food analysis Theory and practice Y. Pomeranz and C. E. Meloan, Chapman and Hill.
10. Food Analysis ,2nd edition S.S Nelsen, Aspen publishers
11. Food analysis, A. G. Woodman, McGraw Hill

Semester : IV

Course Name: Analysis of Oils, Soaps, Fertilizers, and Pesticides Course Code: ACHETE-655

Course type : DSE-14 2 Hrs/ Week

Total contact hours : 30 Hrs Theory Credit: 2 Marks : 50

Learning outcomes:

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

- 1) Students will gain proficiency in analyzing oils and fats, including determining various parameters like softening point, iodine value, and saponification value.
- 2) They will learn about soap analysis, including methods for assessing saponification and unsaponifiable matter.
- 3) Detergent analysis will cover active ingredient determination and estimation of critical micelle concentration.
- 4) In fertilizer analysis, students will understand fertilizer classification and assess NPK values and chemical composition.
- 5) Additionally, they will study pesticide legislation, chemical structures, application dosages, and specific pesticide analysis techniques.
- 6) These skills prepare students for roles in quality control and regulation compliance in industries related to oils, fats, detergents, fertilizers, and pesticides.

Unit-I :Analysis of Oils, Fats Soap and Detergents

10Hrs

Introduction to natural oils and fats, Analysis of oils and fats, Softing point, Congent point, Titer point, Cloud point, Iodine, Saponification, acid, Hydroxyl, R-M and polenske values, Elaiden test. Introduction to soaps; Analysis of soaps, for saponification, Unsaponifiable and unsaponified matter in soaps, Estimation of free alkali and phenol in soap, Classification of detergents (in Brief), Analysis of active ingredients from detergents (methylene blue and hyamine 1622 method), Estimation of CMC, Chlorides, Total phosphates

Unit-II :Analysis of fertilizers

10Hrs

Classification of fertilizer, NPK value, Chemical composition of superphosphate, Lime and Potash fertilizer, Analysis of commercially available fertilizers for N, P & K

Unit-III : Analysis of pesticides

10Hrs

Legislation and recent amendments with respect to pesticides materials. Names of pesticides and their chemical structures. , Application dosage of different pesticides. , Analysis of specific pesticides.

References Books

1. Chemical analysis of food By Pearson.
2. Introductions to food science and technology, series by G.F.Stewart and M.A.Amerine Academic process.
3. Applied chemistry .A Text book for Engineers and technologists by H.D.Gesser.
4. Food analysis by Nielson.
5. Food additives by S.N.Mahindry (APH) publication
6. Jacob (M.B) chemical Analysis of food and food products (Van Nostrand co. New York)
7. Analytical chemistry of foods (C.S.James) Blackie Academic and professional
8. Food Analysis principles and techniques D.W.Gruenwedel, J.R.Whitaker, MercelDekker
9. Food analysis Theory and practice Y.pomeranz and C.E.Meloan,Chapman and Hill
10. Food Analysis ,2nd edition S.S Nelsen, Aspen publishers
11. Food analysis, A. G. Woodman, McGraw Hill


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Semester : IV

Course Name: Analysis of Ores, Alloys & Cosmetics Course Code:ACHETE-656

Course type : DSE-15 2 Hrs/ Week

Total contact hours : 30 Hrs Theory Credit: 2 Marks : 50

Learning outcomes:

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

- 1) Students will learn to analyze various ores such as dolomite, bauxite, and zinc blend for their major constituents using standard methods.
- 2) They will also study the composition, properties, and analysis of alloys like brass, bronze, and stainless steel.
- 3) Analysis of building materials including cement and glass will be covered, focusing on major components and types.
- 4) In cosmetic analysis, students will evaluate raw materials, additives, and legislation related to cosmetics, and analyze physical and chemical constituents of skincare products, creams, lipsticks, and lotions.
- 5) Additionally, they will explore wood, pulp, and paper analysis, including methods for determining cellulose, moisture, and other key parameters.

Unit-I :Analysis of ores and Alloys: 10Hrs

Analysis of ores: Composition and analysis of Dolomite, Bauxite, Ilmenite, Zinc blend, hematite, pyrolusite and calcite for their major constituents using one of the standard methods of analysis.

Analysis of alloys: Composition, Properties, uses and analysis of : Brass, Bronze Solder, Stainless Steel, Monel-metal, gun-metal, Silver coin for their major constituents using one of the standard methods of analysis

Analysis of Cement and building materials: Types of cement, Sampling, Analysis of- Silicon dioxide, Aluminum oxides, Ferric oxides, Calcium oxide, Magnesium oxide, Sodium and potassium oxide. Analysis of Glass: Types of glasses, Determination of lead and lead glass.

Unit-II :Cosmetic Analysis: 10Hrs

Introduction to cosmetics. b) Evaluation of cosmetic materials-raw materials, additives, colours, perfumes. c) Legislation and recent amendments with respect to cosmetic materials. d) Analysis of Physical and chemical constituents of : Skin powder , Creams , Lipsticks , Lotions

Unit-III : Analysis of wood, pulp and paper:

10Hrs

Wood: sampling, determination of methoxy group in wood. A brief idea of analysis of moisture in wood chips and saw dust by toluene methods, cellulose in wood. Pulp: Introduction, sampling, determination of cellulose in pulp, permanganate number of pulp, copper number of pulp. Paper: Introduction, sampling, determination of reducible Sulphur in paper and paper boards, moisture in paper, ash in paper, starch in paper, cellulose in paper, copper number of paper, acid-soluble iron in paper

References Books

1. Hillenbrand Lhundel, Bright and Hoffman, Applied inorganic analysis, John Wiley.
2. P. G. Jeffery and, J. Hatchinson, Chemical methods of rock analysis.
3. Snell and Biffen, Commercial methods of analysis.
4. P. G. Jeffery, Chemical methods of rock analysis, pergamon.
5. Rieche, Outline of industrial organic chemistry, Butter worth.
6. Kent, Rieg's Industrial chemistry, Rain hold
7. F. J. Welcher Standard methods of chemical analysis, a series of volume Robert and Krieger Publishing Company.
8. Metallurgical analysis by S. K. Jain and K. K. Jain.

Semester : IV

Course Name: Microbial and Clinical Analysis

Course Code:ACHETE-657

Course type : DSE-16

2 Hrs/ Week

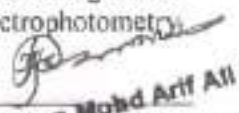
Total contact hours : 30 Hrs Theory Credit: 2

Marks : 50

Learning outcomes:

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

- 1) In Microbial Analysis, students will grasp microbiology fundamentals, including microorganism types and growth factors, and learn sterilization and disinfection techniques.
- 2) They will conduct sterility tests and learn about microbial isolation methods.
- 3) In Clinical Analysis, they will understand body fluid composition, collection, and preservation techniques.
- 4) They'll analyze constituents like pH, glucose, and urea in blood, and uric acid, albumin, and creatinine in serum.
- 5) Immunological methods for urine analysis will be covered.
- 6) Additionally, students will determine vitamin levels in body fluids, learning about vitamins' functions, deficiencies, and analytical methods, such as spectrophotometry and fluorometry.


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Unit-I :Microbial Analysis

10Hrs

a) Introduction to Microbiology, Application to pharmacy, Study of different types of micro-organisms (Bacteria, Viruses, and Fungi) w.r.t. morphology, cell characteristics, habits, nutrition, reproduction, and cultivation b) Isolation of important groups of bacteria by- Total viable count, Standard plate count. c) Microbial growth and factors affecting it: Temperature, pH, Heavy metals (media), Relative humidity, Molecular oxygen and Osmotic pressure. d) Sterilization-Principle, Methods used in general and as applied to Pharmaceutical products. e) Disinfectants-Classification, mode of action, efficiency. Antiseptic techniques: Sterility tests for typical Pharmaceutical products

Unit-II :Clinical Analysis

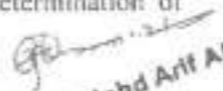
10Hrs

Introduction: Body fluids: Composition, Collection and Preservation of body fluids and detection of abnormal levels of certain constituents leading to diagnosis of diseases and disorders. Analysis of constituents of physiological fluids: 1.Blood -PH, Glucose, Urea. 2.Serum-uric acid, total protein, albumin, globulin& A/G ratio, barbiturates, alkaline phosphatase, acid phosphatase, bilirubin, cholesterol, amylase, creatinine carbohydrates. Urine- Immunological methods: General process of immune response, Antibody-Antigen ratio, Precipitation reactions, Enzyme linked immunosorbent assays ELISA

Unit-III : Determination of vitamins in body fluid

10Hrs

Classification of vitamins with example, Each vitamin must be explained with respect of functions, deficiency diseases, daily requirement, and analytical method i) Retinol (determination of retinol and serum carotene in serum using TFA), Vit D3 (cholecalciferol), Vitamin E (Tocopherols, Determination of serum tocopherol by spectrophotometry by dipyriddy method), Vitamin B1 (thiamine determination by flurometry), Vitamin B2 (riboflavin, Photofluorometric method), Vitamin B6 (Pyidoxine, Fluorometric determination of Xanthuric acid), Nicotinic acid and Niacin: determination by fluorometry, Ascorbic acid (vitamin -c) Volumetric method using 2,6 dichlorophenol method, colorimetric determination of leucocyte ascorbate.


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References Books

1. General Microbiology- R. V. Stainer 6th edition
2. Principle of microbiology- A. J. Salle
3. Microbiology- Pleczar
4. An Introduction to Practical Biochemistry, David Plummer.
5. Biochemical methods, S. Sadasivam, A .Manickam
6. Standard Methods of Biochemical Analysis, S.R. Thimmaiah

Semester : IV

Course Name: Research project-2

Course Code:ACHERP-699

Course type : Research project

12 Hrs/ Week

Total contact hours : 180Hrs

Theory Credit: 6

Marks : 150

Learning outcomes:

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

At the end of the course, the student will be able to:

6. Know how to carry out literature survey by using various search engines and database
7. Handle various chemicals, solvents, instruments and others
8. Perform reactions, monitoring by TLC
9. Purification techniques
10. Understand the structure of organic compounds by using spectral techniques


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PREFACE

National Education policy 2020 has been intensely debated policies come into existence. In January, 2020 UGC has given the guideline for Learning outcome based curriculum framework (LOCF) work towards more holistic experience for the students . while focussing not just on knowledge delivery in higher education but also on the application of knowledge through field and laboratory work and emphasis on application of knowledge to real life experiences, LOCF is student-centric education in the context of development of personal, social, professional and acquired knowledge requirements in their career and life building, which focuses on measuring student performance through outcomes. It includes the knowledge, skills and attitudes enhancement in the students .

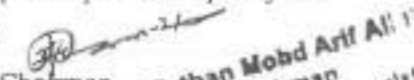
The aspects of LOCF is all-round development of the students, skill acquisition outside chosen subjects and research were undetermined but NEP has changed all of these in one stroke. The prominent features of the NEP framework are:

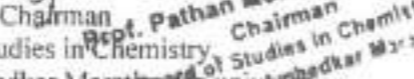
- Student centric education
- Flexibility in postgraduate programmes
- Multiple entry and exit points
- Skill based & outcome base education
- Credit based evaluation system
- Academic bank credits

It also focuses on evaluation of outcomes of the program by considering the knowledge, skill and behaviour of a students after completion of two year program. The educational triangle of Teaching-Learning and Evaluation process is the unique features of the OBE approach. The curriculum practices such as Competency based curriculum, Tailor-made curriculum development, spades, curriculum principles, Blooms Taxonomy and further use of assessment methodologies like, Norm-reference testing and Criterion reference testing, etc is being practiced since decades. It is also interesting to know that, globally, different countries and universities adopts the curriculum development models /approaches such as, CDIO (Conceive-Design-Implement-Operate), Evidence based education systems approach, etc as the scientific and systematic approaches in curriculum design.

Maharashtra state government and the authorities of Dr. Babasaheb Ambedkar Marathwada University, Chhatrapati Sambhaji Nagar has decided to implement National Education policies -2020 from the academic year 2023-24 for postgraduate program with outcome based education

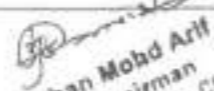
As per guideline of OBE the department has prepared curriculum for Master of science in chemistry with specialization Inorganic chemistry, Organic Chemistry, Physical Chemistry and self supported Analytical Chemistry . The OBE syllabus will help to improve the quality and employability of the Post-graduates of the university department.


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Board of Studies in Chemistry
Dr. Babasaheb Ambedkar Marathwada University
Chhatrapati Sambhaji Nagar


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Chhatrapati Sambhaji Nagar

1.	<p>Vision Statement: A Master of Science (M.Sc.) in Chemistry is a postgraduate degree that provide students with in-depth knowledge, research skills, and practical expertise in the field of chemistry. Some of key points of our M. Sc. Chemistry program are mentioned below:</p> <ol style="list-style-type: none">1. Comprehensive Core Curriculum: Our course having a strong core curriculum covering fundamental principles in organic, inorganic, physical, analytical, and drug chemistry. This foundational knowledge is crucial to build a solid understanding of the discipline.2. Specialization Options: To cater to the diverse interests of students, students have option to select different specialization. We are offering three specializations viz, Analytical Chemistry, Drug Chemistry and Organic Chemistry. By choosing a specialization, students can focus on topics that align with their career aspirations and research interests.3. Research Emphasis: Research is a crucial aspect of an M.Sc. Chemistry program. Students have opportunities to work on research projects under the guidance of experienced faculty members. This hands-on experience will enhance critical thinking, problem-solving skills, and laboratory techniques.4. Modern Analytical Techniques: The course will provide the training or interpretation in modern analytical techniques, such as spectroscopy, chromatography, mass spectrometry, and so on. Proficiency in these techniques is vital for conducting advanced research and for industry applications.5. Green Chemistry and Sustainability: Incorporation of principles of green chemistry and sustainability into the curriculum will promote awareness of environmental impact and encourage students to develop eco-friendly solutions. <p>Overall, the vision for M.Sc. Chemistry course is to produce well-rounded, skilled, and ethical chemists who can contribute meaningfully to scientific advancements and societal needs</p>
2.	<p>Mission Statement The mission of the M.Sc. Chemistry program is to provide advanced education and training in the field of chemistry. Student will get the understanding of chemical principles, analytical techniques, and specialized knowledge in various sub-disciplines. The program aims to foster critical thinking, research skills, and ethical practices among students, enabling them to contribute significantly to scientific advancement, innovation, and societal needs. Further, program focus is to encourage the students to stand in competitive examinations in the field of chemistry such as NET, SET and GATE and contribute to the academic field. To bring sustainable progress of society by nurturing chemistry with responsibilities. To create and maintain programs of excellence in the areas of research, education and public outreach. It will produce students who are knowledge in chemistry and can think critically. To develop the researcher and scientist in chemical science through post-graduate education and research programme. To develop the competent manpower with technology-based experimentation methodologies and value-</p>

	based practices for business and industries. To undertake projects to solve field base problems. To provide student centric learning facilities for the development of overall personality of learner.
3.	Eligibility Criteria : Candidate has passed Bachelor's Degree Examination with Chemistry as one of the major subject, eligible for M. Sc. (Chemistry) for all three specializations. Further, B.Sc. Forensic Science student is eligible only for Analytical Chemistry specialization
4.	Assessment and Evaluation: 40 % internal & 60% university exam
5.	Duration of Course Programme : Two years
6.	Credit Allotted for two year master programme in chemistry : 88 Credit Semester - I : 22 Semester -II : 22 Semester -III : 22 Semester -IV : 22
7.	Program Objectives: M. Sc. in Chemistry program aims to provide the following objectives: 1. Provide the Advanced Knowledge: The program aims to provide the core/basic concepts in chemistry, including organic, inorganic, physical, and analytical chemistry, while also exploring interdisciplinary areas. 2. Provide the Research Skills: Students will get the research-oriented environment in the department and learns the laboratory techniques and methodologies required in the research. 3. Create Analytical Thinking: We will encourage the students to create analytical thinking and encouraging to approach complex challenges with creativity and scientific reasoning. 4. Ability of Communication and Collaboration: In the program, students will work on their abilities to present and discuss scientific ideas clearly and work collaboratively with others
8.	Program Outcomes: The program outcomes (PO's) are the statement of competencies/ abilities. POs are the statement that describes the knowledge and the abilities the post-graduate will have by the end of program studies. i).In-depth and detailed functional knowledge of the fundamental theoretical concepts and experimental methods of chemistry.


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	<p>ii). Apply/implement interface between on the one hand, the history of chemistry and natural science and, on the other hand, issues pertaining to the areas of modern technology, health, and environment.</p> <p>iii). Skills in planning and conducting advanced chemical experiments and applying structural-chemical characterization techniques.</p> <p>iv). Skill in examining specific phenomena theoretically and/or experimentally.</p> <p>v). Generation of new scientific insights or to the innovation of new applications of chemical research.</p>
9.	<p>Course Program outcome</p> <p>Course Program Outcomes are developed through the curriculum (curricular/co-curricular-extra-curricular activities). The program outcomes are attained through the course implementation. As an educator, one must know, <u>"To which POs his/her course is contributing?"</u>. So that one can design the learning experiences, select teaching method and design the tool for assessment.</p>


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**DR. BABASAHEB AMBEDKAR MARATHWADA UNIVERSITY,
CHHATRAPATI SAMBHAJI NAGAR**



NAAC Re-accredited 'A' Grade

National Education Policy-2020
Outcome Based Curriculum
For

AFFILIATED COLLEGES

Faculty of Science & Technology

Two Years Master of Science in Chemistry Programme

Subject : Chemistry
Specialization : Organic Chemistry

(Semester III & IV)

(Effective from 2024-25)


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Dr. Babasaheb Ambedkar Marathwada University


Credit distribution structure for Two Years Programme with
Multiple Entry and Exit options

Class: M.Sc. Second Year Semester: IIIrd Specialization Subject: Organic Chemistry

Course type	Course Code	Course Name	Teaching Scheme (Hrs./ week)		Credits Assigned			Marks		
			Theory	Practical	Theory	Practical	Total Credits	Conti. Eval.	Uni. Exam.	Total Marks
Major Mandatory DSC	OCHET- 600	DSC-15 (org. Chem.)	4	-	4	-	10T	40	60	100
	OCHET- 601	DSC-16 (org. Chem.)	4	-	4	-		40	60	100
	OCHET- 602	DSC-17 (org. Chem.)	2	-	2	-		20	30	50
	OCHEL- 603	DSC-18 (org. Chem. Lab course)	-	4	-	2	4P	20	30	50
	OCHEL- 604	DSC-19 (org. Chem. Lab course)	-	4	-	2		20	30	50
DSE (Choose any Two from pool of courses)	OCHETE- 605	DSE-9 (org. Chem)	2	-	2	-	4T	20	30	50
	OCHETE- 606	DSE-10 (org. Chem)	2	-	2	-		20	30	50
	OCHETE- 607	DSE-11 (org. Chem)	2	-	2	-		20	30	50
	OCHETE- 608	DSE-12 (org. Chem)	2	-	2	-		20	30	50
Research Project	OCHE-RP- 649	Research Project -I	-	8	-	4	4P	40	60	100
Total			14	16	14	08	22	220	330	550

Course code Nomenclature :

DSC-Discipline Specific Core course, DSE- Discipline Specific Elective, T-Theory, L- Laboratory course, OCHET- Organic Chemistry Theory Core course, OCHEL- Organic Chemistry Laboratory Core course, OCHETE- Organic Chemistry Elective Course, OCHE-RP- Organic Chemistry Research Project


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Class: M.Sc. Second Year Semester: IVth Semester specialization Subject: Organic Chemistry

Course type	Course Code	Course Name	Teaching Scheme (Hrs./ week)		Credits Assigned			Marks		
			Theory	Practical	Theory	Practical	Total Credits	Cont. Eval.	Uni. Exam.	Total Marks
Major Mandatory DSC	OCHET-650	DSC-20 (org. Chem.)	4	-	4	-	10T	40	60	100
	OCHET-651	DSC-21 (org. Chem.)	4	-	4	-		40	60	100
	OCHET-652	DSC-22 (org. Chem.)	2	-	2	-		20	30	50
	OCHEL-653	DSC-23 (org. Chem. Lab course)	-	4	-	2	2P	20	30	50
DSE (Choose any Two from pool of courses)	OCHETE-654	DSE-13 (org. Chem)	2	-	2	-	4T	20	30	50
	OCHETE-655	DSE-14 (org. Chem)	2	-	2	-		20	30	50
	OCHETE-656	DSE-15 (org. Chem)	2	-	2	-		20	30	50
	OCHETE-657	DSE-16 (org. Chem)	2	-	2	-		20	30	50
Research Project	OCHETE-RP-699	Research Project-2	-	12	-	6	6P	60	90	150
Total			14	16	14	08	22	220	330	550

Course code Nomenclature :

DSC-Discipline Specific Core course, DSE- Discipline Specific Elective, T-Theory, L- Laboratory course, OCHET- Organic Chemistry Theory Core course, OCHEL- Organic Chemistry Laboratory Core course, OCHETE- Organic Chemistry Elective Course, OCHE-RP- Organic Chemistry Research Project.


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Semester-III

Course Name: Structural Elucidation by Spectral Methods

Course Code : OCHET-600

Course type: DSC-15

Total contact hours: 60 h (04 h/Week)

Credits: 04

Marks: 100

Course Outcomes:

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

1. Review elementary concepts of nuclear magnetic resonance spectroscopy and delve into spin-spin couplings, factors affecting coupling constants, and spin systems like AB, AX, and ABX.
2. Explore techniques such as INEPT, INADEQUATE, and the Nuclear Overhauser effect.
3. Grasp elementary concepts of ^{13}C NMR spectroscopy, including chemical shifts for various carbon types and the impact of substituents on these shifts.
4. Understand the fundamentals of mass spectrometry, including ion production methods, ion analysis, factors affecting fragmentation, and the interpretation of mass spectra.
5. Explore fragmentation patterns for various functional groups and phenomena like the molecular ion peak and McLafferty rearrangement.
6. Grasp the principles of Mössbauer spectroscopy, understanding factors influencing line position and shape, including the isomer effect and quadrupole splitting.
7. Integrate UV, IR, ^1H NMR, ^{13}C NMR and Mass data to solve complex and deduce the structure.

UNIT-I: Nuclear Magnetic Resonance Spectroscopy (^1H NMR) [12 h]

Elementary ideas (Recapitulation); Spin-spin couplings, Different types of couplings, factors affecting on coupling constants, Karplus equation, Spin systems (AB, AX, ABX, AMX), Rate processes, spin decoupling, shift reagents, Nuclear Overhauser effect (NOE), INEPT and INADEQUATE.

UNIT-II: ^{13}C Nuclear Magnetic Resonance Spectroscopy [12h]

Elementary ideas, instrumental problems, chemical shifts (aliphatic, olefinic, alkyne, aromatic, heteroaromatic and carbonyl carbons); Effect of substituents on chemical shifts.

UNIT-III: Mass Spectroscopy [12h]

Introduction, ion production (EI, CI, FD and FAB), ion analysis, ion abundance, factors affecting on fragmentation, fragmentation of different functional groups, molecular ion peak, isotopic peaks, metastable peak, Nitrogen rule, McLafferty rearrangement, Retro-Diels-Alder reaction.

Introduction, ion production (EI, CI, FD and FAB), ion analysis, ion abundance, factors affecting on fragmentation, fragmentation of different functional groups, molecular ion peak, isotopic peaks, metastable peak, Nitrogen rule, McLafferty rearrangement, Retro-Diels-Alder reaction.

UNIT-IV [12h]

Problems based on joint applications of UV, IR, ^1H NMR, ^{13}C NMR and Mass spectroscopy.

UNIT-V [12h]

Mossbauer spectroscopy: Principle, factors affecting the line position and shape, isomer effect and Quadrupole splitting iron salt like compounds, complexes, carbonyl compounds (temperature dependence of isomer shift and Quadrupole splitting in simple compound and coordination, polynuclear complexes), Numericals. **Electron Spin Resonance Spectroscopy:** Introduction, principle of ESR spectroscopy, presentation of spectrum, hyperfine splitting in various structures, hyperfine splitting diagram of representative examples, factors affecting the magnitude of 'g' values, Zero field splitting, Kramer's degeneracy, Anisotropy in the hyperfine coupling constant, electron delocalization, instrumentation and applications.

Reference Books:

1. Introduction to Spectroscopy: D. L. Pavia, G. M. Lampman, G. S. Kriz
2. Spectrometric Identification of Organic Compounds: R. M. Silverstein & F. X. Webster
3. ^{13}C NMR Spectroscopy: G. C. Levy, R. L. Lichter, G. L. Nelson
4. Spectroscopic Methods in Organic Chemistry: D. H. Williams & I. Fleming Absorption
5. Spectroscopy of Organic Compounds: V. M. Parikh
6. Mass Spectrometry: K. G. Das & James
7. Coordination Chemistry by Experimental Methods: K. Barger
8. Coordination Chemistry vol. I: E. Martell
9. Physical Methods for Chemistry: R. S. Drago
10. Structural Methods in Inorganic Chemistry: E. A. V. Ebsworth & D. W. H. Rankin
11. Organic Structure Analysis: Philips Crews

Semester-III

Course Name: Reagents in Organic Synthesis

Course Code: OCHET-601

Course type: DSC-16

Total contact hours: 60 h (04 h/Week)

Credits: 04

Marks: 100

Course Outcomes:

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

1. Explore metal and non-metal based oxidising agents for functional group transformations.

2. Understand the selectivity in the reagents for carrying oxidations
3. Learn the utility of the reagents
4. Explore the suitable methods to carry out oxidation and dihydroxylation
5. Explore the synthetic utility of various hydride transfer reagents for reduction of functional groups
6. Understand the preparation and applications of organic reagents for different types of reactions
7. Utilize the various organometallic reagents for carbon-carbon bond formations
8. Achieve the preparation of ylides and their synthetic utility]

UNIT-I Oxidation

[18 h]

- (a) Oxidation of alcohol to aldehyde, ketone or acid: Jones reagent, Collins reagent, Fetizon's reagent, PCC, PDC, PFC, Activated MnO_2 , Chromyl chloride (Etard reaction), TEMPO, CAN, NMO,
- (b) DMSO activated oxidation of alcohols to carbonyls: Kornblum oxidation, Moffatt-Pfitzner oxidation, Parikh-Doering oxidation, Albert-Goldman oxidation, Swern oxidation and Corey-Kim oxidation
- (c) Oxidative cleavage of Carbon-Carbon double bonds: $KMnO_4$, Ozonolysis.
- (d) Oxidations using SeO_2 , $PhSeBr$ and related applications of the reagents.
- (e) Selective cleavages at functional groups: Cleavage of glycols, IO_4^- , $Pb(OAc)_4$.
- (f) Dihydroxylation of alkenes: (i) OsO_4 ; Mitsunobu dihydroxylation, Upjohn dihydroxylation and Johnson-Leimux reaction (ii) Ruthenium tetroxide

UNIT-II Reductions

[12 h]

- (a) Catalytic Hydrogenation under homogeneous and heterogeneous conditions; Reduction of alkenes, alkynes, nitriles, oximes and nitro compounds; (b) Reduction of carbonyls, acids, amides, esters, lactones, lactams, cyanides, imines by boron and aluminium based reagents such as $LiAlH_4$, $LiBH_4$, $Li(OEt)_3AlH$, $NaBH_4$, $Ca(BH_4)_2$, $Zn(BH_4)_2$, DIBAL-H, $BH_3 \cdot THF$ complex, Catechol borane, Disiamylborane, Thexylborane, IP_2BH , IP_2CBH_2 (c) Reduction of carbonyls to hydrocarbons: Clemmensen reduction, Wolf-Kishner reduction (d) Birch reduction and related reactions

UNIT-III Organic Reagents

[12 h]

Preparation and synthetic applications of: DCC, EDC, DDQ, 1,3 Dithiane, LDA, DMSO, Iodoxybenzoic acid, Dess-Martin Periodinane, Diazomethane, Lawesson's reagent.

UNIT-IV

[06 h]

Ylides and Enamines

Ylides: Preparation and their synthetic applications along with their stereochemical aspects

- (i) Phosphorous ylides: Wittig, Wittig-Horner, Horner-Wadsworth-Emmons reactions
(ii) Sulphur ylides: Corey-Chaykovskyeoxidation, cyclopropanation and aziridination reactions
Enamines: Generation & application in organic synthesis with mechanistic pathways, stork enamine reaction.

UNIT-V Formation of Carbon-Carbon bonds via organometallic reagents [12 h]

Synthesis and applications of organo Lithium, Magnesium, Titanium, Cerium, Copper, Chromium, Zinc, Boron, Silicon, Cadmium, Palladium, Tin

Reference Books:

1. Organic Chemistry: Clayden, Greeves, Warren and Wothers
2. Stereochemistry of Organic Compounds (Principle and application): D. Nasipuri
3. Stereochemistry of Organic compounds: Ernest L. Eliel / Samuel H. Wilen
4. Organic Synthesis: W. Carruthers
5. Organic Reagents: Fieser&Fieser
6. Organic Synthesis: M. B. Smith
7. Advanced Organic Chemistry; Part A and B: F. A. Carey & R. J. Sundberg
8. Modern Organic Synthesis: An Introduction: G. S. Zweifel& M. H. Nantz
9. A Guidebook To Mechanism In Organic Chemistry: Peter Sykes
10. Organic Synthesis Concepts, Methods, Starting Materials: J. Fuhrhop, G. Perzlin
11. Organic Chemistry: An Intermediate Text: Robert V. Hoffmann
12. Advanced Organic Chemistry: Jerry March
13. Organic Synthesis: R. O. C. Norman and Coxon
14. Name Reactions: Jie Jack Li

Semester-III

Course Name: Pericyclic Reactions and Free Radicals

Course Code: OCHET-602

Course type: DSC-17

Total contact hours: 30 h (02 h/Week)

Credits: 02

Marks: 50

Course Outcomes:

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

1. Understand the photochemical and thermal reactions
2. Classify the various types of pericyclic reactions
3. Apply the orbital correlation and frontier molecular orbital methods for pericyclic reactions
4. Predict the stereochemical outcome of pericyclic reactions

5. Understand various free radical reactions

UNIT-I:Pericyclic Reactions-I

[10 h]

Features and classification of pericyclic reactions, Phases, nodes and symmetry properties of molecular orbital in ethylene, 1,3-butadiene, 1,3,5-hexatriene. Allylcation, allyl radical, pentadienylation and pentadienyl radical. Thermal and photochemical reactions.

Electrocyclic reactions: Woodward-Hoffmann selection rules for electrocyclic reactions. Explanation for the mechanism of electrocyclic reactions by: (i) Symmetry properties of HOMO of open chain partner; (ii) Conservation of orbital symmetry and orbital symmetry correlation diagram and (iii) Huckel-Mobius aromatic and antiaromatic transition state method.

UNIT-II:Pericyclic Reactions-II

[10 h]

Cycloaddition reactions: Diels-Alder reaction. Woodward-Hoffmann selection rules for cycloaddition reactions. Explanation for the mechanism of cycloaddition reactions by 1) Conservation of orbital symmetry and orbital symmetry correlation diagrams 2) Fukui Frontier Molecular Orbital (FMO) theory and (3) Huckel-Mobius aromatic and antiaromatic transition state method. Endo-exo selectivity in Diels-Alder reaction and it's explanation by FMO theory. Examples of cycloaddition reactions.

Sigmatropic reactions: Selection rules for [i,j] shifts. Cope, degenerate Cope and Claisen rearrangements. Explanation of sigmatropic reactions by (i) symmetry properties of HOMO (ii) Huckel-Mobius aromatic and antiaromatic transition state method. Introduction to chelotropic reactions and the explanation of mechanism by FMO theory.

UNIT-III:Free radical reactions

[10 h]

Introduction, generation, stability, reactivity, characteristics, structural and stereo chemical properties of free radicals, Persistent free radicals.

Reaction of free radicals: Addition, substitutions, fragmentations, Oxidations and reductions, Detection of free radicals, Homolysis and free radical displacement. Radical chain reactions, Addition and rearrangements, radical cyclization, reactivity of aliphatic and aromatic substrates at bridgehead, Coupling of alkynes and arylation of aromatic compound by diazonium salt, Sandmeyer reaction, Hunsdieker reaction, Allylic halogenations, McMurry reaction, Acyloin condensation, Birch reduction, Bouveault-Blank reduction.

Reference Books:

1. Advanced Organic Chemistry Part A & Part B: F. A. Carey & R. J. Sundberg

2. Advanced Organic Chemistry: Jerry March
3. Organic Chemistry: Clayden, Greeves, Warren &wother.
4. Organic Chemistry: Stanley H. Pine
5. Organic Synthesis: W. Carruthers
6. Organic Synthesis: Norman and Coxon

Semester-III

Course Name: Organic Chemistry Laboratory Course

Course Code:OCHEL-603

Course type: DSC-18

Total contact hours: 60 h (04 h/Week)

Credits: 02

Marks:50

Course Outcomes:

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

1. Understand the multistep organic synthesis
2. Explore the theoretical knowledge to predict the mechanism of reactions
3. Explore the purification techniques
4. Allow carry out various reactions.
5. Determine the overall yield of the reaction

Contents:

Preparations involving at least two stage based on name reactions, condensations, cyclo-condensations, reagents and rearrangements (as covered under the theory). Separation purification of the product is desired.

1. Preparation of sulphanilamide from acetanilide
2. Preparation of benzoic acid from benzoin
3. Preparation of acetanilide from acetophenone via Beckmann rearrangement
4. Preparation of Benzanilide from Benzophenone via Beckmann rearrangement
5. Preparation of para-nitroaniline from aniline
6. Preparation of para-bromoaniline from aniline
7. Preparation of epoxyketone from chalcone
8. Anthranilic acid to 2-Iodoxybenzoic acid


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Reference Book:

1. Practical Organic Chemistry: Vogel

Semester-III

Course Name: Organic Chemistry Laboratory Course

Course Code: OCHEL-604

Course type: DSC-19

Total contact hours: 60 h (04 h/Week)

Credits: 02

Marks: 50

Course Outcomes:

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

1. Understand the use of green chemistry principles
2. Explore the use of microwave and ultrasound irradiation technique for the synthesis
3. Explore the purification techniques
4. Carry out various reactions
5. Utilize the knowledge of spectroscopic techniques for structure elucidation

Part-A: Preparations involving one stage based upon the green synthetic protocols (as covered in theory syllabus). (Minimum 10 experiments)

Experiments will be based on use of Microwave and Ultrasound, Mild catalysts, Mechanochemistry, Water as solvent and solvent-free reactions.

1. Knoevenagel condensation
2. Hantzsch condensation
3. Biginelli condensation
4. Pechmann condensation
5. Preparation of 1, 1-bis-2-naphthol
6. Various Multicomponent reactions

Part-B Structure elucidation of organic compounds and drugs by spectral analyses

Use of UV, IR, ^1H NMR, ^{13}C NMR and Mass. A minimum of 40 representative examples should be discussed.

Reference Books:

1. Spectrometric Identification of Organic Compounds: R. M. Silverstein and others (8th Ed. Wiley)

2. Monograph on Green Chemistry Laboratory Experiments; Green Chemistry Task Force Committee, DST

Semester-III

Course Name: Organic Photochemistry and Green Chemistry

Course Code: OCHETE-605

Course type: DSE-9

Total contact hours: 30 h (02 h/Week)

Credits: 02

Marks: 50

Course Outcomes:

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

1. Understand the photochemical and thermal reactions
2. Classify the various types of photochemical reactions
3. Predict the stereochemical outcome of photochemical reactions
4. Understand the concept of green chemistry
5. Utilize the knowledge of Microwave and Ultrasound assisted reactions for bioactive molecules

UNIT-I: Photochemistry-I

[10 h]

Photochemistry of (π, π^*) transitions: Excited state of alkenes, cis-trans isomerisation, photochemistry state, electrocycloaddition and Sigmatropic rearrangements, di π -methane rearrangement.

Intermolecular reactions: photocycloadditions, photodimerisation. Photoaddition reactions. Excited states of aromatic compounds, photodimerisation of benzene, photosubstitution reactions of aromatic compounds and Photo-Fries rearrangement.

UNIT-II: Photochemistry-II

[10 h]

Photochemistry of (n, π^*) transitions: Excited state of carbonyl compounds, Norrish-I and Norrish-II

Addition to C-C multiple bonds: Paterno-Buchi reaction, photochemistry of alkyl peroxides, hypohalites and nitriles. Barton reaction. Photochemistry of azo compounds, diazo compounds,

azides and diazonium salts. Singlet oxygen-photo oxygenation reactions. Ene reaction, formation of dioxetanes and endoperoxides. Chemiluminescent reactions. Oxidative coupling.

UNIT-III:Green Chemistry [10 h]

Green chemistry, relevance and goals, Anastas' twelve principles of green chemistry-Tools of green chemistry: alternative starting materials, reagents, catalysts, solvents and processes with suitable examples.

Microwave and Ultrasound assisted organic synthesis

Activation and specific effects of microwave and ultrasound irradiations, Neat reactions, solid supports reactions, Functional group transformations, condensations reactions, oxidations, reductions reactions, multi-component reactions.

Use of Ionic liquids

General synthesis and properties of ionic liquids, applications in various organic transformations, multicomponent reactions.

Reference Books:

1. Green Chemistry-Designing Chemistry for the Environment. Paul T. Anastas& Tracy C. Williamson.
2. Green Chemistry-Frontiers in benign chemical synthesis and processes. Paul T. Anastas& Tracy C. Williamson
3. Advanced Organic Chemistry Part A & Part B: F. A. Carey & R. J. Sundberg.
4. Advanced Organic Chemistry: Jerry March
5. Organic Chemistry: Clayden, Greeves, Warren &wother.
6. Organic Chemistry: Stanley H. Pine
7. Organic Synthesis: W. Carruthers
8. Organic Synthesis: Norman and Coxon

Semester-III

Course Name: Synthetic Organic Chemistry

Course Code: OCHETE-606

Course type: DSE-10

Total contact hours: 30 h (02 h/Week)

Credits: 02

Marks: 50

CourseOutcomes:

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

1. Understand the types of reactions and rearrangements


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2. Predict the applications of named reactions and rearrangements in organic synthesis particularly natural products and drugs.
3. Allow to utilize the concept of carbon-carbon single and multiple bonds
4. Understand the concept of Multicomponent reactions and their utility

UNIT-I: Name Reactions-I

[10 h]

Arndt-Eistert, Hunsdiecker reaction, Baeyer-Villiger, Dakin, Gabriel synthesis, Michael, Darzen, Prins, Henry, Reimer-Tiemann, Hoffmann-Löffler-Freytag, Dieckmann cyclization, Chichibabin, Vilsmeier, Ene, Ullmann reaction, Mannich, Strecker amino acid synthesis. Bamford-Steven, Baylis-Hillmann, Corey-Fuchs Reaction, Julia olefination, Mukaiyamaaldol, Mitsunobu, Peterson olefination, Corey-Winter olefination,

UNIT-II: Name Reactions-II

[10 h]

Woodward and Prevost dihydroxylation, Shapiro, Ritter, Stille, Heck, Sonogashira, Suzuki, Duff, Chugaev, Petasis, McMurry reaction and Coupling. Ring closing metathesis (Grubb's metathesis), Aldol-Tishchenko (Evans-Tishchenko reaction), Ugi, Passerini, Biginelli, Hantzsch condensation.

UNIT-II: Name Rearrangements

[10 h]

Pummerer, Payne, Eschenmoser fragmentation, Brook, Wagner-Meerwein, Wolf, Semipinacol, Epoxide rearrangement with lewis acid, Dienone-Phenol rearrangement, Tiffeneau-Desmanov, Favorskii, von Richter, Wittig, Neber, Smiles, Fries, Curtius, Lossen, Schmidt, Steven, Hofmann, Iodolactonisation.

Reference Books

1. Organic Synthesis: M. B. Smith
2. Advanced Organic Chemistry; Part A and B: F. A. Carey & R. J. Sundberg
3. Modern Organic Synthesis: An Introduction: G. S. Zweifel & M. H. Nantz
4. A Guidebook To Mechanism In Organic Chemistry: Peter Sykes
5. Organic Synthesis Concepts, Methods, Starting Materials: J. Fuhrhop, G. Penzlin
6. Organic Chemistry: An Intermediate Text: Robert V. Hoffmann
7. Advanced Organic Chemistry: Jerry March
8. Organic Synthesis: R. O. C. Norman and Coxon
9. Name Reactions: Jie Jack Li
10. Name Reactions and Reagents in Organic Synthesis: B. P. Mundy, M. G. Eller, F. G. Favalaro


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Semester-III

Course Name: Bioorganic and Enzyme Chemistry

Course Code: OCHETE-607

Course type: DSE-11

Total contact hours: 30 h (02 h/Week)

Credits: 02

Marks: 50

Course Outcomes:

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

1. Understand the concept of bioorganic chemistry
2. Know about the types of enzymes, structures.
3. Understand the applicability of various enzymes

UNIT-I: Introduction to Bioorganic chemistry

[10 h]

Basic concepts, Proximity effects in organic chemistry, Molecular adaptation, Molecular recognition.

UNIT-II: Enzyme Chemistry

[10 h]

Introduction, Nomenclature, Classification and Extraction of enzymes, Introduction to catalysis and enzymes; Multifunctional catalysis, Intramolecular Catalysis, Mechanism of enzyme action, Factors responsible for enzyme specificity, Enzyme activity and kinetics (MichaelisMenten and Lineweaver-Burk plots), Enzyme Inhibitions (Reversible and irreversible), Structure, Mechanism of action and applications of α -Chymotrypsin, Ribonuclease, lysozyme and Carbopeptidase-A. Enzymes in synthetic organic chemistry. [Additions, eliminations, substitutions, condensations, cyclocondensations, oxidations, reductions and rearrangement reactions are to be covered]

UNIT-III: Co-Enzyme Chemistry

[10 h]

Chemical structures of co-enzymes and cofactors, Oxidoreduction (NAD^+ , NADP^+), Pyridoxal phosphate (PLP), Thiamine pyrophosphate (TPP), Biotin (CO_2 carrier), Haemoglobin (O_2 -carrier), Flavin (FMN, FAD, FADH_2) Oxene Reactions, Lipoic acid, Mechanisms of reactions catalyzed by co-factors.

Reference Books

1. Bioorganic chemistry (A chemical approach to enzyme action): Hermann Dugas
2. Biotransformation in Organic chemistry: K. Faber
3. Enzyme structure and Mechanism: Alan Fersht.
4. Enzyme catalysis in organic synthesis vol.I: KarlheinzDrauz and Herbert Waldmann.
5. Bioorganic, Bioinorganic and supramolecular chemistry: P. S. Kalsi and J. P. Kalsi.

Semester-III

Course Name: Emerging Topics in Organic Chemistry

Course Code: OCHETE-608

Course type: DSE-12

Total contact hours: 30 h (02 h/Week)

Credits: 02

Marks: 50

Course Outcomes:

At the end of the course, the student will be able to:

1. Understand the concepts of multicomponent reactions and their mechanisms.
2. Understand the tandem reactions in organic synthesis.
3. Apply the principles of click chemistry in drug discovery, biology and materials chemistry.
4. Discuss the flow chemistry, micro reactors, separation techniques and process chemistry in organic synthesis.

UNIT-I Advanced Multicomponent Reactions [10 h]

Recent Developments in the multicomponent reactions (MCRs): General Approaches of MCRs, Synthesis of different heterocyclic compounds using 3, 4 and 5 component reactions, MCRs using homogeneous and heterogeneous catalysts.

UNIT-II Click and Flow Chemistry [10 h]

Importance of Click chemistry, Applications of click chemistry in drug discovery, biology and materials chemistry.

Recent advances in Flow chemistry and Micro reactors,

UNIT-III Tandem Reactions [10 h]

Tandem (cascade/domino) reactions in Organic Synthesis, Metal Carbenes in Organic Synthesis, N-heterocyclic carbenes in organic synthesis, Hypervalent iodine reagents in organic synthesis.

Reference Books:

1. Multicomponent Reactions: Concepts and Applications for Design and Synthesis, Raquel P. Herrera, Eugenia Marqués-López, John Wiley & Sons, 2015, 1st Edition.
2. Click Reactions in Organic Synthesis, Srinivasan Chandrasekaran, John Wiley & Sons, 2016, 1st Edition.
3. Domino Reactions in Organic Synthesis, Lutz F. Tietze, Gordon Brasche, Kersten Gericke, John Wiley & Sons, 2006
4. Microreactors in Organic Synthesis and Catalysis, Ed. by Thomas Wirth Title, John Wiley & Sons, 2008

Semester-III

Course Name: Research Project-I

Course Code: OCHERP-649

Course type: Project

Total contact hours: 120 h (08 h/Week)

Credits: 04

Marks: 100

Course Outcomes:

At the end of the course, the student will be able to:

1. Know how to carry out literature survey by using various search engines and database
2. Handle various chemicals, solvents, instruments and others
3. Perform reactions, monitoring by TLC
4. Purification techniques
5. Understand the structure of organic compounds by using spectral techniques

Research project will be assigned to the students on the basis of theory components, such as Multicomponent reactions, use of ionic liquids/surfactants in organic synthesis, Microwave/ Ultrasound assisted synthesis of bioactive molecules etc.

Literature Survey, Studies of Reactions, Synthesis, Mechanism, Standardization of Reaction Conditions, New Synthetic Methods etc

Note: Student should attend the National/International Conference in this semester and present their project work (if possible)


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Class: M.Sc. Second Year Semester: IVth Semester specialization Subject: Organic Chemistry

Course type	Course Code	Course Name	Teaching Scheme (Hrs./ week)		Credits Assigned			Marks		
			Theory	Practical	Theory	Practical	Total Credits	Conti. Eval.	Unl. Exam.	Total Marks
Major Mandatory DSC	OCHET-650	DSC-20 (org. Chem.)	4	-	4	-	10T	40	60	100
	OCHET-651	DSC-21 (org. Chem.)	4	-	4	-		40	60	100
	OCHET-652	DSC-22 (org. Chem.)	2	-	2	-		20	30	50
	OCHEL-653	DSC-23 (org. Chem. Lab course)	-	4	-	2	2P	20	30	50
DSE (Choose any Two from pool of courses)	OCHETE-654	DSE-13 (org. Chem)	2	-	2	-	4T	20	30	50
	OCHETE-655	DSE-14 (org. Chem)	2	-	2	-		20	30	50
	OCHETE-656	DSE-15 (org. Chem)	2	-	2	-		20	30	50
	OCHETE-657	DSE-16 (org. Chem)	2	-	2	-		20	30	50
Research Project	OCHETE-RP-699	Research Project-2	-	12	-	6	6P	60	90	150
Total			14	16	14	08	22	220	330	550

Course code Nomenclature :

DSC-Discipline Specific Core course, DSE- Discipline Specific Elective, T-Theory, L- Laboratory course, OCHET- Organic Chemistry Theory Core course, OCHEL- Organic Chemistry Laboratory Core course, OCHETE- Organic Chemistry Elective Course, OCHE-RP- Organic Chemistry Research Project,


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 Dr. B. A. M. S. Marathwada

Semester-IV

Course Name: Organic synthesis: Retrosynthetic approach

Course Code: OCHET-650

Course type: DSC-20

Total contact hours: 60 h (04 h/Week)

Credits: 04

Marks: 100

Course Outcomes:

At the end of the course, the student will be able to:

1. Understand the basic concepts of retrosynthetic analysis
2. Describe disconnection approaches applied on synthetic strategies and mechanism prediction.
3. Understand the use of protecting groups
4. Allow to disconnect the molecules by using different strategies
5. Explore the various reactions for designing the synthesis of target molecules
6. Allow to construct the various rings
7. Utilize the knowledge of retro-synthetic analysis and synthesis for natural products, drugs and complex molecules

UNIT-I Disconnection Approach

[12 h]

An introduction to synthons, synthetic equivalents, disconnection approach, functional group interconversions, importance of order of events in organic synthesis, one and two group C-X disconnections, selective organic transformations: chemo-selectivity, regioselectivity, stereoselectivity, enantio-selectivity, Reversal of polarity, cyclization reactions, amine synthesis.

UNIT-II Protecting Groups

[12 h]

Protection and deprotection of hydroxyl, carbonyls in aldehydes and ketones, amines, carboxylic acids, alkenes and alkynes.

UNIT-III C-C Disconnections

[12 h]

(i) One group C-C Disconnections:

Alcohols (including stereo-selectivity), carbonyls (including regioselectivity), Alkene synthesis, use of acetylenes and aliphatic nitro compounds in organic synthesis.

(ii) Two group C-C Disconnections:

Diels-Alder reactions, 1,3difunctionalized compounds and α , β -unsaturated compounds, control in carbonyl condensations, 1,5 difunctionalized compounds, Michael addition and Robinson annelation.

UNIT-IV Ring Synthesis

[12 h]

Introduction to ring synthesis, saturated heterocycles, synthesis of 3, 4, 5 and 6 membered rings, rearrangements and photochemistry in synthesis, aromatic heterocycles.

UNIT-V Complex molecules

[12h]

Synthetic routes based on retrosynthetic analysis for following molecules: Longifoline, Reserpine, Juvabione, Aphidicoline, Taxol.

UNIT-IV Ring Synthesis [12 h]

Introduction to ring synthesis, saturated heterocycles, synthesis of 3, 4, 5 and 6 membered rings, rearrangements and photochemistry in synthesis, aromatic heterocycles.

UNIT-V Complex molecules [12h]

Synthetic routes based on retrosynthetic analysis for following molecules: Longifoline, Reserpine, Juvabione, Aphidicoline, Taxol.

Reference Books:

1. Organic Synthesis: The Disconnection Approach: Stuart Warren
2. Designing Organic Synthesis: Stuart Warren
3. Organic Synthesis: Strategy and Control: Paul Wyatt and Stuart Warren
4. The Logic of Chemical Synthesis: E. J. Corey and Xue-Min Chelg
5. Classics in Total Synthesis I, II and III: K. C. Nicolaou and others
6. Organic Synthesis Concepts, Methods, Starting Materials: J. Fuhrhop, G. Penzlin
7. Some Modern Methods of Organic Synthesis: W. Carruthers
8. Organic Synthesis: M. B. Smith
9. Principles of Organic Synthesis: R. Norman and J. M. Coxan.
10. Advanced Organic Chemistry: Jerry March
11. Organic Chemistry: Clayden, Greeves, Warren and Wothers

Semester-IV

Course Name: Chemistry of Natural Products and Asymmetric Synthesis

Course Code: OCHET-651

Course type: DSC-21

Total contact hours: 60 h (04 h/Week)

Credits: 04

Marks: 100

Course Outcomes:

At the end of the course, the student will be able to:

1. Understand the concept of structure elucidation of natural compounds
2. Build the synthetic schemes of natural products and bioactive molecules
3. Analyze the stereochemistry of drug molecules
4. Apply the knowledge of biosynthesis in total synthesis of organic molecules.
5. Design new synthetic methodologies
6. Understand the concepts involved in asymmetric synthesis


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UNIT-I:Terpenoids& Carotenoids

[12 h]

Classification, Nomenclature, occurrence, isolation, general methods of structure determination, isoprene rule, Structure determination, stereochemistry, and synthesis of the following representative molecules: Citral, Geraniol, α -Terpineol, Menthol, Farnesol, Zingiberene, Phytol, Abietic acid and β -Carotene.

UNIT-II:Alkaloids

[12 h]

Occurrence, isolation, general methods of structure elucidation, degradation, classification based on nitrogen heterocyclic ring, role of alkaloids in plants. Structure, stereochemistry and synthesis of the following: Ephedrine, (+)-coniine, nicotine, atropine, Quinine and Morphine.

UNIT-III:Steroids

[12 h]

Occurrence, nomenclature, basic skeleton, Diel's hydrocarbon and stereochemistry. Isolation, structure determination and synthesis of Bile acids, Androsterone, Testosterone, Estrone, Progesterone.

UNIT-IV:Asymmetric Synthesis-I

[12 h]

Chiral pool, Chiral auxiliary, Enantio- & Diastereoselective synthesis, Chiral reagent and chiral catalyst including CBS reagent, NADH, Asymmetric hydrogenation including BINAP.

UNIT-V:Asymmetric Synthesis-II

[12h]

Hydroboration- Ipc_2BH , IpcBH_2 , Asymmetric epoxidation- (+) DET & (-) DET, Sharpless, Jacobson, Asymmetric dihydroxylation- $(\text{DHQD})_2\text{PHAL}$ & $(\text{DHQ})_2\text{PHAL}$, Felkin-Anh model, Zimmermann-Traxler transition state model, Prolinecatalyzed asymmetric reactions.

Reference Books

1. The Organic Chemistry of Drug Design and Drug Action: R. B. Silverman, Academic press.
2. Natural Products: Chemistry and Biological Significance: J. Mann, R. S. Davidson, J. B. Hobbs, D. V. Banthorpe and J. B. Harborne, Longman, Essex.
3. Organic Chemistry: Vol. II, I. L. Finar, ELBS.
4. New Trends in Natural Product Chemistry: Atta-ur-Rahman and M. I. Choudhary, Harwood Academic publishers.
5. Stereochemistry of Organic Compounds (Principle and application): D. Nasipuri
6. Stereochemistry of Organic compounds: Ernest L. Eliel / Samuel H. Wilen
7. Advanced Organic Chemistry; Part A and B: F. A. Carey & R. J. Sundberg
8. Organic Chemistry: Clayden, Greeves, Warren and Wothers
9. Organic Synthesis: M. B. Smith


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Semester-IV

Course Name: Heterocyclic Chemistry

Course Code: OCHET-652

Course type: DSC-22

Total contact hours: 30 h (02 h/Week)

Credits: 02

Marks: 50

Course Outcomes:

At the end of the course, the student will be able to:

1. Classify heterocyclic compounds and their nomenclature
2. Understand the physical and chemical properties of simple and fused heterocyclic compounds
3. Apply the knowledge of heterocyclic chemistry to synthesize the natural products and drug molecules
4. Distinguish aromatic and homoaromatic compounds using spectral data

UNIT-I

[10 h]

Nomenclatures of all types of heterocycles, Classification of heterocycles: as aromatics based upon various membered ring systems.

UNIT-II

[10 h]

General synthetic routes based on name reactions, reactivities, utilities and wherever possible spectral analyses of the following class of heterocycles.

Four membered: Azetidines, including β - lactams.

Five membered: Thiazoles, Oxazoles, Pyrazoles and Imidazoles.

Six membered: Pyridines, Pyrimidines.


UNIT-III

[10 h]

Fused heterocycles: Flavones, Chromones, Coumarines, Indoles, Quinolines, Benzodiazepines, and Phenothiazines.

Reference Books:

1. Heterocyclic Chemistry: vol. I, II, III: R. R. Gupta, M. Kumar and M. Gupta
2. Heterocyclic Chemistry: Joules and Mills
3. Modern heterocyclic Chemistry: L. A. Paquette (Benjamin)
4. Organic Chemistry: Jonathan Clayden


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Semester-IV

Course Name: Organic Chemistry Laboratory Course

Course Code: OCHEL-653

Course type: DSC-23

Total contact hours: 60 h (04 h/Week)

Credits: 02

Marks: 50

Course Outcomes:

At the end of the course, the student will be able to:

1. Understand the principles involved in separation and purification techniques
2. Analyze the functional groups in organic molecules
3. Understand the principles involved in separation of ternary mixtures
4. Obtain practical experience in the separation and identification of individual compounds in the ternary mixtures
5. Develop the knowledge and skills in the synthetic organic chemistry useful for industrial applications

Qualitative analysis of ternary mixtures.

In a mixture at least one liquid one water soluble compound be given. (minimum 08 mixtures)

- (i) Separation of Ternary Mixture
- (ii) Identification of Two Components
- (iii) Element Detections
- (iv) Functional Groups
- (v) Physical Constant
- (vi) Derivatives


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Semester-IV

Course Name: Introduction to Medicinal Chemistry

Course Code: OCHETE-654

Course type: DSE-13

Total contact hours: 30 h (02 h/Week)

Credits: 02

Marks: 50

Course Outcomes:

At the end of the course, the student will be able to:

1. Understand basic concepts of drug discovery.
2. Apply the concepts in lead discovery.
3. Identify the importance of Lipinski rule and bioisosterism.
4. Understand the concept of Pharmacokinetics and Pharmacodynamics.

UNIT-I: Basic consideration of drug activity

[10 h]

Definition and Introduction of following terms-Drug, Prodrug, Hard and Soft drugs, agonists, antagonists, affinity, efficacy, potency, isosterism, bioisosterism, pharmacophores, lead molecule, lethal dose (LD50) and effective dose (ED50) (i) Factors affecting bioactivity, (ii) Theories of drug activity, (iii) Structure activity relationship (SAR), QSAR (2D and 3D method) and Hantzsch equation (iv) Drug receptor mechanism.

UNIT-II Pharmacokinetics

[10 h]

- (i) Drug absorption, Distribution and deposition of drugs.
- (ii) Excretion and elimination of drugs, Bioavailability.

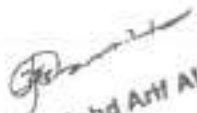
UNIT-III Pharmacodynamics

[10 h]

- (i) Mechanism of drug action: Enzyme stimulation and enzyme inhibition, antimetabolites, membrane active drugs, chelation; (ii) Drug metabolism and inactivation: Factors affecting drug metabolism, pathways of drug metabolism [Metabolism reaction (Phase I) and conjugation reaction (Phase II)].

Reference Books:

1. FOYE'S Principles of Medicinal Chemistry VIth Edition: Thomas L. Lemke, David A. Williams, Victoria F. Roche and S. William Zito.
2. Introduction of Medicinal Chemistry: A. Gringuage, Wiley-VCH.
3. Synthesis of Essential Drugs: R. S. Vardanyan and V. J. Hruby.
4. Volumes of Burger's Medicinal Chemistry: M. E. Wolf, John Wiley.
5. Medicinal Chemistry: David J. Triggle.
6. Essentials of Medicinal Chemistry IInd: Andrejus Korolkovas.


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Semester-IV

Course Name: Drug Synthesis

Course Code: OCHETE-655

Course type: DSE-14

Total contact hours: 30 h (02 h/Week)

Credits: 02

Marks: 50

Course Outcomes:

At the end of the course, the student will be able to:

1. Understand classification of drugs.
2. Explore the knowledge of pharmacokinetics and dynamics of the drugs.
3. Understand the mode of action of drugs.
4. Explore the knowledge of synthetic organic chemistry to drug synthesis

UNIT-I Classification of Drugs

[06 hrs]

The detail contents of the each class of the drugs.

UNIT-II Drug Synthesis-I

[12 hrs]

Synthesis and Utilities of the following drug molecules (at least one convenient synthetic route with possible mechanism) from following classes:

I. Anti-inflammatory Drugs: (a) Naproxen (b) Ibuprofen (c) Oxaprozin (d) Diclofenac Sodium (e) Rofecoxib (f) Celecoxib.

II. Anti-hypertensive Drugs: (a) Verapamil (b) Captopril (c) d-sotalol (d) Atenolol (e) Diltiazem (f) Semotiadilfumarate.

III. Drugs acting on CNS: (a) CNS Stimulant :Dextro-amphetamine

(b) Respiratory Stimulant :Doxapram

(c) CNS anti-depressant : (i) Chlorpromazine (Antipsychotic) (ii) Diazepam (Anxiolytic)

(iii) Phenobarbitol (Antiepileptic)

UNIT-III Drug Synthesis-II

[12 hrs]

I Anesthetic Drugs:

(a) General : Ketamine (b) Local : (i) Lidocaine (ii) Procaine

II. Antibiotics: (a) Chloramphenicol (b) Ampicillin (c) Amoxycillin (d) Cefepime (e) Cefpirome (f)

Antimycobacterial: Ethambutol (g) Antiviral: Acyclovir (h) Antimicrobial: Sulfamethoxazole

III. Antidiabetics : (a) Troglitazone (b) Chlorpropamide (c) Tolbutamide

IV. Antineoplastic Drugs: (a) Antagonist: Fluorouracil (b) Alkylating agents: i) Chlorambucil (ii)

Cis-Platin

Reference Books:

1. FOYE'S Principles of Medicinal Chemistry VIth Edition: Thomas L. Lemke, David A. Williams, Victoria F. Roche and S. William Zito.
1. Introduction of Medicinal Chemistry:A. Gringuage, Wiley-VCH.
2. Synthesis of Essential Drugs:R. S. Vardanyan and V. J. Hruby.
3. Volumes of Burger's Medicinal Chemistry: M. E. Wolf, JohnWiley.
4. Medicinal Chemistry: David J. Triggle.
5. Essentials of Medicinal Chemistry IInd: AndrejusKorolkovas,

Semester-IV

Course Name: Polymer Chemistry

Course Code: OCHETE-656

Course type: DSE-15

Total contact hours: 30 h (02 h/Week)

Credits: 02

Marks: 50

Course Outcomes:

At the end of the course, the student will be able to:

1. Understand the basic concepts in Polymer chemistry.
2. Learn the determination of molecular weight and properties of polymers.
3. Know about the polymer processing and polymerization techniques.
4. Explore synthesis and applications of commercial polymers and conducting polymers.

UNIT-I Basic Concepts

[10 h]

Hours) Monomers, repeat units, degree of polymerization, Linear, branched and network polymers, Addition polymerization, Condensation polymerization, Mechanism of free radical, cationic and anionic polymerization and co-ordination polymerization. Ziegler- Natta catalyst. Kinetics of free radical, cationic, anionic and co-polymerisation. Determination of Reactivity ratio, Reactivity ratio and co-polymerisation behavior.

UNIT-II Molecular Weight, Physical Properties, Polymer Processing & Techniques[10 h]

Concept of Average molecular weight, number- average, weight- average molecular weight and viscosity- average molecular weights. Determination of molecular weight - viscosity, light scattering, osmotic and ultracentrifugation methods.

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Polymers processing- Plastics, elastomers and fibres. Compounding, Processing techniques- calendaring, die casting, injection molding, thermofoaming and fibre spinning. Polymerization techniques- Bulk polymerization, solution polymerization, suspension polymerization, emulsion polymerization and melt polycondensation.

UNIT-III Commercial Polymers [10 h]

Synthesis and applications of polyethylene, polyvinyl chloride, polyamide, polyester, phenol resins, epoxy resins, silicone polymers, polybenoxazoles, polyimidazole, polyurethane, polymethylmethacrylate, poly(tetrafluoro ethylene) and polyacrylonitrile.

Reference Books:

1. Organic Polymer Chemistry: K. J. Saunders
2. Textbook of Polymer Science: F.W. Billmeyer, Wiley Student Edition, 3rd Edition.
3. Polymer Science: V.R. Gowariker, N. V. Viswanathan, J. Sreedhar

Semester-IV

Course Name: Advanced Spectroscopy

Course Code: OCHETE-657

Course type: DSE-16

Total contact hours: 30 h (02 h/Week)

Credits: 02

Marks: 50

Course Outcomes:

At the end of the course, the student will be able to:

1. Analyze the concepts of ^{19}F spectroscopy in determining the structures of molecules.
2. Apply the principles of 2D NMR spectroscopy in resolving the structures of organic molecules.
3. Discuss the principle of ^{31}P and mass spectrometry and their applications.
4. Solve the structures of organic compounds using spectral data.

UNIT-I 2D-NMR spectroscopy [10 h]

Principles of 2D NMR, Classification of 2D-experiments. Correlation spectroscopy (COSY) HOMOCOSY (^1H - ^1H COSY), TOCSY (Total Correlation Spectroscopy), Hetero COSY (^1H , ^{13}C COSY, HMQC), long range ^1H , ^{13}C COSY (HMBC), Homonuclear and Heteronuclear 2D-J-resolved spectroscopy, ROESY, NOESY and 2DINADEQUATE experiments and their applications.

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UNIT-II ^{19}F NMR spectroscopy: [10 h]

Introduction, ^{19}F chemical shifts, spin-spin coupling, coupling constants. Homonuclear couplings, Applications of ^{19}F NMR involving coupling with ^{19}F , ^1H and ^{31}P : 1, 2 dichloro-1, 1 difluoro ethane, BrF_3 , SF_4 , PF_5 , ClF_3 , IF_5 , $\text{CF}_3\text{CH}_2\text{OH}$.

UNIT-III ^{31}P NMR spectroscopy: [10 h]

^{31}P chemical shifts, coupling constants. Applications of ^{31}P NMR involving coupling with ^{31}P , ^{19}F , ^1H and ^{13}C : Simple molecules ^{31}P , P_4S_3 , H_3PO_4 , H_3PO_3 , H_3PO_2 and HPF_2 .

Reference Books:

1. Introduction to Spectroscopy, Donald Pavia, G. M. Lampman, George S. Kriz, Thomson/Brooks/Cole, 2001, 3rd Edition.
2. Organic Spectroscopy, William Kemp, Palgrave Publishers, 2007, 3rd Edition.
3. Spectrometric Identification of Organic Compounds, Robert M. Silverstein, Francis X. Webster, David J. Kiemle, David L. Bryce, Wiley, 2014, 8th Edition.

Semester-IV

Course Name: Research Project-II

Course Code: OCHERP-699

Course type: Project

Total contact hours: 120 h (12 h/Week)

Credits: 06

Marks: 150

Course Outcomes:

At the end of the course, the student will be able to:

1. Know how to carry out literature survey by using various search engines and database
2. Handle various chemicals, solvents, instruments and others
3. Perform reactions, monitoring by TLC
4. Purification techniques
5. Understand the structure of organic compounds by using spectral techniques

Research project will be assigned to the students on the basis of theory components, such as Multicomponent reactions, use of ionic liquids/surfactants in organic synthesis, Microwave/ Ultrasound assisted synthesis of bioactive molecules etc.

Literature Survey, Studies of Reactions, Synthesis, Mechanism, Standardization of Reaction Conditions, New Synthetic Methods etc

Note: Student should participate in National/International Conference and Present their project work.