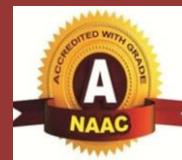




SCHOOL OF SCIENCES
(FORMERLY, SCHOOL OF ARCHITECTURE, SCIENCE AND TECHNOLOGY)
YASHWANTRAO CHAVAN MAHARASHTRA OPEN UNIVERSITY



Syllabus

V154: M.Sc. (Chemistry) {2023 Pattern} **(Semester 01 to 04)**

(Incorporating
NEP2020
Recommendations,
PG Credit and
Curriculum
Framework GR
dated 16-05-2023)

With effect from Academic
Year 2023-24, vide G.R. No.
NEP-2022/CR No. 09/VISHI-
3/शिकाना, dated 16 May,
2023.

2023

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NEP2020: Programme Structure with Syllabus of all Courses at Semester 01 to 04 were finalized in PAC meeting held on 26 July 2023


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Revised on 28 Aug 2023, 25 Nov 2023 for Evaluation Pattern

V154: M.Sc. (CHEMISTRY){2023 PATTERN}

ABOUT THE PROGRAMME

PROGRAMME CODE: V154

PROGRAMME NAME: M.Sc (CHEMISTRY)

This M.Sc. programme is uniquely designed to impart essential knowledge in all major areas of fundamental, pure or applied Chemistry. This programme offers an exciting opportunity for specialization in Chemistry to Chemical Industry, pharmaceutical companies, hospitals, medical schools, private clinics, research centres; they can pursue roles in research and development, quality control, and analytical laboratories. They can also explore opportunities in academia, where they can contribute to teaching and mentoring future chemists and so on. The course contents of total 04 semesters are a carefully selected blend of theory and practical which prepares students for specialist professional employment, research in academia, and various industries for broader applications. Learner centric curriculum is designed in adherence to the principles of National Education Policy (NEP 2020) to acquire knowledge and skills with valuable experiences through hands-on activities, projects and internships.

Programme Objective, Outcomes and Scope

This programme is designed to achieve following objectives, outcomes and scope.

Objectives: The objectives of this course are

- To study critical thinking and analytical skills to enable students to pursue higher studies and research in Chemistry. To expose students to current trends in research about Chemistry.
- To explore scientific reasoning and quantitative analysis. Our majors will be able to apply chemical concepts to solve qualitative and quantitative problems.
- To study provide a strong foundation for a better understanding of current advances in Chemistry and its practical significance. To perform statistical analysis of chemical data by developing analytical mind.
- To discuss Laboratory practice and safety. In order to learn the ways in which new scientific knowledge is created, our majors will experience how chemists interpret chemical and physical phenomena through experimental investigation.
- To study the Principles of mass spectroscopy, gas chromatography and HPLC. Apply the techniques for structure determination of organic molecules. To demonstrate the mechanism of various reactions.

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

- Inculcate critical thinking and analytical skills to enable students to pursue higher studies and research in Chemistry. Expose students to current trends in research about Chemistry.
- Use key concepts of inorganic and organometallic chemistry including those related to synthesis, reaction chemistry, and structure and bonding.

- Apply the knowledge to develop the sustainable and eco-friendly technology in Industrial Chemistry..
- Formulate the macroscopic and quantum laws of the absorption of light by molecules and solids. Describe the various deactivation processes of molecular excited states. Characterize the kinetics of deactivation processes and their role in the photochemical reactivity.
- Understand the Principles of mass spectroscopy, gas chromatography and HPLC. Apply the techniques for structure determination of organic molecules. Understand the mechanism of various reactions.

Scope of the Chemistry programmes: After successful completion of this programme, students may get opportunities in various fields/sectors to work as

- Career opportunities in both private and government sector/ in India and abroad
- Job opportunities in sectors like chemical, pharma & petroleum industries, Indian Forest Services, National Chemical Laboratories, Scientist, etc
- Inculcation of research attitude
- Inculcation of entrepreneurship
- Perceive higher education and research in the same or allied fields
- Candidates who have advanced qualifications can pursue either an academic career in institutions as **lecturers and professors or a scientific career** in various scientific positions
- They can also go and work as **Researchers and as administrators.**

Mode of Education

This Programme will be offered in Open and Distance Learning (ODL) Mode as defined in “UGC Open and Distance Learning Programmes and Online Programmes Regulations, 2020” published in the gazette notification by dated 4th Sept 2020 by the UGC as specified below.

“Open and Distance Learning Mode means a mode of providing flexible learning opportunities by overcoming separation of teacher and learner using a variety of media, including print, electronic, online and occasional interactive face-to-face meetings with the learners or Learner Support Services to deliver teaching-learning experiences, including practical or work experiences”

Mode of Examination

Continuous Assessment is conducted at recognized learner support centres/ study centres and End Examination for all type of courses is conducted at recognized Exam Centres of the University under supervision.

Basic Information

1. **Mode of Education:** ODL Mode.
2. **Minimum Programme Duration:** B.Sc. (PCM)/ B.Sc. with Chemistry at FY and SY or Equivalent pass

3. **Maximum Programme Duration:** 4 years from the date of admission to the PG programme, also referred as Valid Registration Period
4. **Learner Support Centers (LSC):** University approved/recognized Senior Science Colleges/ Institutes offering PG Mathematics programme
5. **Medium of Instruction:** English
6. **Attendance:** Minimum 80% attendance for all type of courses.
7. **Profile of Prospective Students:** In-Service Science Teachers from Schools/ Junior College and Equivalent pass students
8. **Teaching-Learning:** Total 12 + 3 = 15 working weeks in each semester, where 3-weeks' time duration in each semester for clearing face-to-face counseling session's backlog (if any).
9. **Total Teaching-Learning Support:** Total 2640 Hours including Self-Study during all 4 semesters. 660 Hours (including Self-Study) **during** each semester.
10. **Total Courses:** Total 23 courses (subjects) distributed over Semesters 01 to 04.
11. **Total Credits:** 88 Credits [As per UGC norms 1 Credit means 30 hours of study efforts required to gain learning of particular content of each credit].
12. **Total Courses and Credit Distribution Scheme:**

Sem	Mandatory Courses (DSC)			Elective Courses (DSE) (4 Credits)	Other Courses (4 Credits)/ (6 Credits)	Total Courses (Credits)
	Theory		Practical (4 Credits)			
	4 Credits	2 Credits				
1	2	1	1	1	1 – Research Methodology (4 Credits)	6 (22 Credits)
2	2	1	1	1	Any one - OJT/ Field Projects (4 Credits)	6 (22 Credits)
3	2	1	1	1	1- Research Project (4 Credits)	6 (22 Credits)
4	2	-	1	1	1- Research Project (6 Credits)	5 (22 Credits)
Total	8 x 4 = 32 (38 Credits)	3 x 2 = 06	4 x 4 = (16 Credits)	4 x 4 = (16 Credits)	3 x 4 + 1 x 6 = (18 Credits)	23 (88Credits)

13. **Multiple Entry and Multiple Exit:** The multiple entry and multiple exit features open up new opportunities for learners, even if they have stopped or discontinued their study in the middle for a variety of reasons. This feature provides entry options in order to promote flexible learning within the valid registration period (04 years from the date of admission to the PG programme). Learners only have the choice to leave the program at the end of even semester 02, and they have the option to reenter at the start of odd semester 03. Only one exit option and reentry is permissible for MSc programme during stipulated time period.

14. **Exit Option- PG Diploma Certificate:** The learner who passes all registered courses of first year (two semesters) of the programme successfully in the examinations and obtains required credits (44 Credits), shall be awarded with **Post Graduate Diploma PGD 12-CHE** if learner shall opt for exit. The aggregate performance (SGPA of Semester 01 and Semester 02) and Class in the programme shall be reported on the basis of performance.
15. **PG Degree Certificate:** After successful completion of all courses (semesters 01 to 04) at two year of the programme and obtaining required credits (88 Credits), learner shall be awarded with **Post Graduate Degree**. The aggregate performance (CGPA of Semester 01 to Semester 04) and Class in the programme shall be reported on the basis of performance.
16. **Approval/Equivalence Status:** UGC and DEB recognized and approved [AY 2023 and onwards] with UGC/DEB letter F.No. 1-2/2021 (DEB-I), Dated: 02.08.2021, available at [https://www.ugc.ac.in/pdfnews/4204139 HEI-Recognition-list-02-08-2021.pdf](https://www.ugc.ac.in/pdfnews/4204139_HEI-Recognition-list-02-08-2021.pdf)

Eligibility and Fees

Admission Eligibility	Certification Eligibility	Fees and Deposit / Year			
		UF is payable for “2 Semesters in an academic year” to the university at the time of online admission			
B.Sc.(PCM/PCB) /B.Sc.with Chemistry at FY and SY or Equivalent pass	V154: Min 40% or better marks in total 23 courses (subjects) of total 88 credits at Semesters 01 to 04. CGPA: Aggregate performance and Class in the programme shall be reported on the basis of semesters 01 to 04. For exit option PGD 12- CHE: Min 40% or better marks in total 12 courses (subjects) of total 44 credits at Semesters 01 to 02.	Description	INR ₹		
			1st Year	2nd Year	
		Mandatory Fees	608	858	
		Tuition Fee	USF	8000	8000
			LSCF	12000	12000
		End Exam Fees	2480	2370	
AAFA	23088	23228			

PROGRAMME STRUCTURE

V154: M.Sc (Chemistry) {2023 Pattern} as per NEP 2020

Year (2 Yr. PG)	Level	Sem	Major Courses				RM	OJT/FP	R P	Cu m. Cr.	
			Mandatory	CR	Elective	CR					
I	6.0	I	CHE501: Inorganic Chemistry-I(T)	4	CHE506: Physical Methods in Chemistry (T) OR CHE507: Polymer Chemistry (T)	4	RES505: Research Methodology (T) 4 CR	-	-	22	
			CHE502: Physical Chemistry-I(T)	4							
			CHE503: Organic Chemistry-I(T)	2							
			CHE504: Lab Activities on CHE501, CHE502 & CHE503	4							
		II	CHE509: Inorganic Chemistry-II(T)	4	CHE515: Analytical Chemistry (T) OR CHE516: Chemical Mathematics & Biostatistics (T)	4	-	CHE513: OJT (4 CR) OR CHE514: FP (4 CR)	-	-	22
			CHE510: Physical Chemistry-II(T)	4							
			CHE511: Organic Chemistry-II (T)	2							
			CHE512: Lab Activities on CHE509, CHE510 & CHE511 (P)	4							
Cum. Cr. For 1 Year PG Diploma			28	8	4	4	-	44			
Exit option: Post Graduate Diploma {PGD 12 –CHE (44 Credits)} after Three Year UG Degree											

Year (2 Yr. PG)	Level	Sem	Major Courses				RM	OJT / FP	RP	Cum. Cr.
			Mandatory	CR	Elective	CR				
II	6.5	III	CHE601: Organic Reaction Mechanism (T)	4	CHE606: Green Chemistry (T) OR CHE607: Drugs & Heterocyclic (T) OR CHE 608: Biotechnology (T)	4	-	-	CHE605: Research Project: (4 CR)	22
			CHE602: Stereochemistry (T)	4						
			CHE603: Advanced Synthetic Methods (T)	2						
			CHE604: : Lab Activities on CHE601, CHE602 & CHE603 (P)	4						
		IV	CHE609: Advanced Organic Chemistry (T)	4	CHE613: Natural Products (T) OR CHE614: Industrial Organic Chemistry(T) OR CHE615: Pharmaceutical Chemistry (T)	4	-	-	CHE612: Research Project: (6 CR)	22
			CHE610: Advanced Organic Spectroscopy (T)	4						
			CHE611: Lab Activities on CHE609 & CHE610 (P)	4						
Cum. Cr. For 2 Years PG Degree			54	16	4	4	10	88		
2 Years- 4 Semester PG Degree in Chemistry (88 credits) after Three Year UG Degree										

SEMESTERS AND COURSES

Abbreviations of the courses

Mandatory DSC	Discipline Specific Core Course	Elective DSE	Discipline Specific Elective Course
RM	Research Methodology	OJT	On Job Training: Internship/ Apprenticeship
FP	Field projects	RP	Research Project
OE	Open Elective (May be taken from MOOC or may be chosen from other domain of learning to get exposure to interdisciplinary domain) [OE will be available in phase manner]		

SN	Course Category	Code	Course Name	CA	EE	TM	Type	CR	Min %
[Level 6.0] Semester 01: 22 Credits									
01	Mandatory(DSC)	CHE501	Inorganic Chemistry-I	30	70	100	T	4	40%
02	Mandatory(DSC)	CHE502	Physical Chemistry-I	30	70	100	T	4	40%
03	Mandatory(DSC)	CHE503	Organic Chemistry-I	15	35	100	T	2	40%
04	Mandatory(DSC)	CHE504	Lab Activities on CHE501, CHE502 & CHE503	50	50	50	P	4	40%
05	RM	RES505	Research Methodology	30	70	100	T	4	40%
Elective (DSE) Courses (Select Any One)									
06	Elective (DSE)	CHE506	Physical Methods in Chemistry	30	70	100	T	4	40%
07	Elective (DSE)	CHE507	Polymer Chemistry	30	70	100	T	4	40%
[Level 6.0] Semester 02 : 22 Credits									
08	Mandatory(DSC)	CHE509	Inorganic Chemistry-II	30	70	100	T	4	40%
09	Mandatory(DSC)	CHE510	Physical Chemistry-II	30	70	100	T	4	40%
10	Mandatory(DSC)	CHE511	Organic Chemistry-II	15	35	100	T	2	40%
11	Mandatory(DSC)	CHE512	Lab Activities on CHE509, CHE510 & CHE511	50	50	50	P	4	40%
12	OJT/FP	CHE513 CHE514	Any one OJT or FP OJT FP	50	50	100	TW	4	40%
Elective (DSE) Courses (Select Any One)									
13	Elective (DSE)	CHE515	Analytical Chemistry	30	70	100	T	4	40%
14	Elective (DSE)	CHE516	Chemical mathematics & Biostatistics	30	70	100	T	4	40%
Exit option: PGD 14- CHE (44 Credits) after Three Year UG Degree									
[Level 6.5] Semester 03 : 22 Credits									
15	Mandatory(DSC)	CHE601	Organic Reaction Mechanism	30	70	100	T	4	40%

16	Mandatory(DSC)	CHE602	Stereochemistry	30	70	100	T	4	40%
17	Mandatory(DSC)	CHE603	Advanced Synthetic Methods	15	35	100	T	2	40%
18	Mandatory(DSC)	CHE604	Lab Activities on CHE601, CHE602 & CHE603	50	50	50	P	4	40%
19	RP	CHE605	Research Project	50	50	100	PW	4	40%
Elective (DSE) Courses (Select Any One)									
20	Elective (DSE)	CHE606	Green Chemistry	30	70	100	T	4	40%
21	Elective (DSE)	CHE607	Drugs & Heterocyclic	30	70	100	T	4	40%
22	Elective (DSE)	CHE608	Biotechnology	30	70	100	T	4	40%
[Level 6.5] Semester 04 : 22 Credits									
23	Mandatory(DSC)	CHE609	Advance Organic Chemistry	30	70	100	T	4	40%
24	Mandatory(DSC)	CHE610	Advanced Organic Spectroscopy	30	70	100	T	4	40%
25	Mandatory(DSC)	CHE611	Lab Activities on CHE609 & CHE610	30	70	100	T	4	40%
26	RP	CHE612	Research Project	75	75	150	PW	6	40%
Elective (DSE) Courses (Select Any One)									
27	Elective (DSE)	CHE613	Natural Products	30	70	100	T	4	40%
28	Elective (DSE)	CHE614	Industrial Organic Chemistry	30	70	100	T	4	40%
29	Elective (DSE)	CHE615	Pharmaceutical Chemistry	30	70	100	T	4	40%

GRADING SYSTEM

1. **“Absolute Grading”**: the marks are converted to grades based on pre-determined class intervals.
2. **“Letter Grade”**: It is an index of the performance of students in a said programme. Grades are denoted by letters O, A+, A, B+, B, C, P and F.
3. **“Grade Point”**: It is a numerical weight allotted to each letter grade on a 10-point scale. Grade Point shall be “0 (Zero)” for Letter Grade “Ab” and “F”. The marks scored by the examinee shall be converted into grade points by dividing the marks scored in the aggregate and dividing the resulting number by maximum marks, multiplying the result by ten, retaining the integer part (ignore the fractional part). Thus, if a person has secured 56 marks out of 100 marks in aggregate for a course, we get $(56/100) \times 10$ which is 5.6. Ignoring the fraction, we get 5 as the grade point.

Marks Obtained out of 100	Grade Point	Semester GPA / Programme CGPA Semester/ Programme	% of Marks	Alpha-Sign / Letter Grade Result
90 – 100	10	9.00 – 10.00	90.0 - 100	O (Outstanding)
80 – 89.99	9	8.00 - < 9.00	80.0 - < 90.0	A+ (Excellent)
70 – 79.99	8	7.00 - < 8.00	70.0 - < 80.0	A (Very Good)
60 – 69.99	7	6.00 - < 7.00	60.0 - < 70.0	B+ (Good)
55 – 59.99	6	5.50 - < 6.00	55.0 - < 60.0	B (Above Average)
50 – 54.99	5	5.00 - < 5.50	50.0 - < 55.0	C (Average)
40 – 49.99	4	4.00 - < 5.00	40.0 - < 50.0	P (Pass)
0 – 39.99	0	Below 4.00	Below 40	F (Fail)
		Ab (Absent)	-	Absent

4. **“Credit Point”**: It is the product of grade point and number of credits for a course.
5. **“Semester Grade Point Average (SGPA)”**: It is a measure of performance of work done in a semester. It is the ratio of sum of the product of the number of credits with the grade points scored by a student in all courses taken by a student and the sum of number of credits of all the courses undergone by a student:

$$SGPA (S_i) = \frac{\sum C_i G_i}{\sum C_i}$$

It shall be expressed up to two decimal places.

6. **“Cumulative Grade Point Average (CGPA)”**: It is a measure of overall cumulative performance of a student over all semesters. The CGPA is the ratio of total credit points secured by a student in various courses in all semesters and the sum of the total credits of all courses in all the semesters. The CGPA is also calculated in the same manner taking into account all the courses undergone by a student over all the semesters of a programme.

$$CGPA = \frac{\sum C_i S_i}{\sum C_i}$$

Where, S_i is the SGPA of the i^{th} semester & C_i is the total number of credits in that semester. It shall be expressed up to two decimal places.

7. **“Transcript or Grade Card or Certificate”**: Based on the grades earned, a grade certificate shall be issued to all the registered students after every semester. The grade certificate will display the course details (code, title, number of credits, grade secured) along with SGPA of that semester and CGPA **earned till that semester**.
8. **“Evaluation Pattern”**: As per NEP2020, the ‘Evaluation Pattern’ of the Post graduate Programme consists of the following components:

Course Type	Number of Credits	Continuous Assessment (CA)	End Examination (EE)	Total Marks ‘TM’ = (EE+CA)	Minimum Passing %
Theory(T)	4	30	70	100	minimum 40% in CA, EE and (CA + EE) shall be essential for each course to pass
Theory (T)	2	15	35	50	
Practical (P)	4	50	50	100	
OJT/Field Project (FP)	4	50	50	100	
Research Project (RP)	4	50	50	100	
Research Project(RP)	6	75	75	150	

EVALUATION PATTERN

[CA and EE Evaluation Pattern as per the Minutes of the Meeting of the NEP Cell Dated 21.11.2023]

SN	Type of Course	Continuous Assessment (CA)	End Examination (EE)
1	Theory (T) 4 Credit 100 Marks CA: 30% EE: 70%	<p>Each student is required to attempt total 02 (Two) "Continuous Assessments (CAs)" for each course of each Semester, as per the following details:</p> <ol style="list-style-type: none"> CA01: 'Continuous Assessment 01 (CA01)' on Credit 01 to Credit 04 of each course, consists of <ul style="list-style-type: none"> 2 (Two) 'Short Answer Questions (SAQs)', each carrying 05 Marks, on Credit 01 and Credit 02 and 1 (One) 'Long Answer Question (LAQ)' of 10 Marks, on Credit 03 and Credit 04. LAQ may consist of sub-questions. <p>CA01: On Credit 01 to Credit 04, of Marks = $(5 \times 2 + 10) = \mathbf{20}$ Marks</p> CA02: 'Continuous Assessment 02 (CA02)' on Credit 01 to Credit 04 of each course, consists of <ul style="list-style-type: none"> A test containing total 10 (Ten) 'Objective Type Questions,' 05 (Five) on Credit 01 and Credit 02, and 05 (Five) on Credit 03 and Credit 04. Each 'Objective Type Question' of 1 Mark. <p>CA02: On Credit 01 to Credit 04, of Marks = 10 Marks</p> Maximum number of attempts for CA, during each semester : Single attempt only Total Marks: 30 Marks 	<ol style="list-style-type: none"> Student is required to answer 05 'VSAQs' out of 06 'VSAQs', each carrying 03 Marks, on Credit 01 to 04, for total 15 Marks. One VSAQ will be on each Credit. Student is required to answer 05 'SAQs' out of 06 'SAQs', each carrying 05 Marks, on Credit 01 to 04, for total 25 Marks. One SAQ will be on each Credit. Student is required to answer 01 'LAQ' out of 2 LAQs, of 10 Marks on Credit 01 and Credit 02, for total 10 Marks. LAQ may consist of sub-questions. Student is required to answer 01 'LAQ' out of 2 LAQs, of 10 Marks on Credit 03 and Credit 04, for total 10 Marks. LAQ may consist of sub-questions. Student is required to answer 01 'LAQ' out of 2 LAQs, of 10 Marks on Credit 01 to Credit 04, for total 10 Marks. LAQ may consist of sub-questions. Number of attempts: Till Valid Registration Period (VRP) only Marks: 70 Marks Duration: 150 minutes

SN	Type of Course	Continuous Assessment (CA)		End Examination (EE)	
		SN	Description	Evaluation of End Examination(EE)	Marks
		1	Question Types	Very Short Answer Question (VSAQ) on each Credit	03 Marks
				Short Answer Question (SAQ) on each Credit	05 Marks
				On each Credit, either Single Long Answer Question (LAQ) or LAQ contains sub-questions (a), (b) and so on.	10 Marks
		2	Grand Total Marks	Total five Questions in EE Question paper based on: Credit 01 to 04 : 05 VSAQs out of 06 VSAQs (15 Marks) Credit 01 to 04 : 05 SAQs out of 06 SAQs (25 Marks) Credit 01 to 02 : 01 LAQ out of 02 LAQs (10 Marks) Credit 03 to 04 : 01 LAQ out of 02 LAQs (10 Marks) Credit 01 to 04 : 01 LAQ out of 02 LAQs (10 Marks) LAQ may contains sub-questions	70 Marks
2	Theory (T) 2 Credit 50 Marks CA: 30% EE: 70%	Each student is required to attempt total 01 (One) "Continuous Assessment (CA)" for each course of each Semester, as per the following details: 1. CA01: 1 (One) 'Continuous Assessment 01 (CA01)' on Credit 01 and Credit 02 of each course, consists of <ul style="list-style-type: none"> 1 (One) 'Short Answer Question (SAQ)' of 5 Marks and <ul style="list-style-type: none"> 1 (One) 'Long Answer Question (LAQ)' of 10 Marks, LAQ may consist of sub-questions. CA01: On Credit 01 and Credit 02 , of Marks = (5 + 10) = 15 Marks 2. Maximum number of attempts for CA , during each semester: Single attempt only 3. Total Marks: 15 Marks		1. Student is required to answer 05 'VSAQs' out of 06 'VSAQs' , each carrying 03 Marks, on Credit 01 to 02 , for total 15 Marks. One VSAQ will be on each Credit. 2. Student is required to answer 02 'SAQs' out of 03 'SAQs' , each carrying 05 Marks, on Credit 01 to 02 , for total 10 Marks. One SAQ will be on each Credit. 3. Student is required to answer 01 'LAQ' out of 2 LAQs , of 10 Marks on Credit 01 and Credit 02 , for total 10 Marks. LAQ may consist of sub-questions. 4. Number of attempts: Till Valid Registration Period (VRP) only 5. Marks: 35 Marks 6. Duration: 75 minutes	

SN	Type of Course	Continuous Assessment (CA)		End Examination (EE)	
		SN	Description	Evaluation of End Examination (EE)	Marks
		1	Question Types	Very Short Answer Question (VSAQ) on each Credit	03 Marks
				Short Answer Question (SAQ) on each Credit	05 Marks
				On each Credit, either Single Long Answer Question (LAQ) or LAQ contains sub-questions (a), (b) and so on.	10 Marks
		2	Grand Total Marks	Total three Questions in EE Question paper based on: Credit 01 to 02 : 05 VSAQs out of 06 VSAQs (15 Marks) Credit 01 to 02 : 02 SAQs out of 03 SAQs (10 Marks) Credit 01 to 02 : 01 LAQ out of 02 LAQs (10 Marks) LAQ may contains sub-questions	35 Marks

SN	Type of Course	Continuous Assessment (CA)				End Examination (EE)
3	Practical (P) 4 Credit 100 Marks CA: 50% EE: 50%	1. Student is required to submit "Activity Report in Work-Book Format" for each Credit in the prescribed format. 2. Maximum number of attempts for each CA, during each semester : Single attempt only 3. Marks: 50 Marks 4. Grading criteria:				External and internal examiners shall assess each student based on: 1. Workbook/Activity Report submission by the student (Only by External Examiner) [05 Marks] 2. Practical Activity performed by the student [12 Marks] 3. Result and Conclusion of the Practical Activity [13 Marks] 4. Viva-Voce on Practical Activities [20 Marks] 5. Number of attempts: Till Valid Registration Period (VRP) only 6. Marks: 50 Marks 7. Duration: 180 minutes
Lab Punctuality, Preparedness & Ethics	Irregular in lab. Copies the experiment from others (0 Points)	Consistently regular but unable to explain the concepts (06 Points)	Punctuality in lab. Follows the procedure and responds to questions asked (10 Points)			
Activity Report and Performance (Experiment No, Date, Objectives, Apparatus with specification, Observations, Graphs, software used if any)	Poor Documentation and copied the experiment from others. Couldn't perform the Activity /poor observation made (04 Points)	Average Documentation : Report is in format but some of the formatting guidelines are missed. Performed the Activity but observations made with some mistakes (12 Points)	Good Documentation: Lab activity writing is in proper format with all references, Grammar. Performed the Activity on time observations made with no mistakes (20 Points)			
Results and Conclusion	Unable to achieve the desired results but makes attempts to relate data to theory. Poor concluding statements (08 Points)	Average graphical and tabulated representation with misinterpret physical significance of theory. Achieve the desired results and but insufficient conclusion statement. (14 Points)	Analyses and interpret observed data carefully with good graphical and tabulated representation using appropriate theory/evidence. Achieve the results and reach to appropriate Conclusion (20 Points)			

SN	Type of Course	Continuous Assessment (CA)	End Examination (EE)																							
		Evaluation of Practical End Examination																								
		SN	Description	Internal Examiner	External Examiner																					
		1	Workbook/Activity Report	-	05 Marks																					
		2	Actual Conduct of one randomly selected Practical Activity	02 Marks	10 Marks																					
		3	Diagram, Synoptic Answers, Graph/Observation and Conclusion	03 Marks	10 Marks																					
		4	Viva-Voce/Oral	05 Marks	15 Marks																					
		5	Total	10 Marks	40 Marks																					
4	Field Project (TW) 4 Credit 100 Marks CA: 50% EE: 50%	<p>Students need to complete one month Field Project (Total Study hours 120 hrs including Activity Report). After completion of the field project, learners shall submit a report to the LSC - Programme Coordinator (PC) and Mentor/Guide.</p> <ol style="list-style-type: none"> Maximum number of attempts for each CA, during each semester: Single attempt only Duration: 1 Month or 4 Weeks duration -i) After end examination of semester 02 and before beginning of semester 03 or ii) Any one month during semester 02 duration Marks: 50 Marks Grading Criteria for Evaluation of FP (only by Mentor/Guide): <table border="1"> <thead> <tr> <th>SN</th> <th>Description</th> <th>Marks</th> </tr> </thead> <tbody> <tr> <td>1</td> <td>Key Definitions of Problem area and analysis of preliminary data</td> <td>15</td> </tr> <tr> <td>2</td> <td>Work related to formats, Correspondence, Interactions and liaising etc</td> <td>05</td> </tr> <tr> <td>3</td> <td>Field work and data collection</td> <td>15</td> </tr> <tr> <td>4</td> <td>Analysis and Report</td> <td>10</td> </tr> <tr> <td>5</td> <td>Feedback to community</td> <td>05</td> </tr> <tr> <td colspan="2" style="text-align: right;">Total</td> <td>50</td> </tr> </tbody> </table>		SN	Description	Marks	1	Key Definitions of Problem area and analysis of preliminary data	15	2	Work related to formats, Correspondence, Interactions and liaising etc	05	3	Field work and data collection	15	4	Analysis and Report	10	5	Feedback to community	05	Total		50	<ol style="list-style-type: none"> External and Internal examiners (Internal examiner - Programme Coordinator (PC) / Supervisor of LSC) shall assess each student based on: <ol style="list-style-type: none"> Activity Report submission by the student (Only by External Examiner) [10 Marks] Viva-Voce on Activity Report [40 Marks] Number of attempts: Till Valid Registration Period (VRP) only Marks: 50 Marks Duration: 180 minutes 	
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SN	Type of Course	Continuous Assessment (CA)	End Examination (EE)
		Evaluation of Field Project End Examination	
		SN	
		Description	Internal Examiner (Programme Coordinator (PC)/ Supervisor of LSC)
		External Examiner	
		1	Workbook/Report submission
			-
			10 Marks
		2	Viva-Voce /Oral
			10 Marks
			30 Marks
		3	Total
			10 Marks
			40 Marks

SN	Type of Course	Continuous Assessment (CA)	End Examination (EE)																																							
5	OJT or Internship (TW) 4 Credit 100 Marks CA: 50% EE: 50%	<p>1. Students need to complete one month On Job Training (OJT) or Internship (Total Study hours 120 hrs including Internship Report) in any Industry/Organization/Institute/ R&D Division /Any Micro/Small/Medium/enterprise/Govt/N GO/PSU/Online Internship related to major course.</p> <p>2. Maximum number of attempts for each CA, during each semester: Single attempt only</p> <p>3. Marks: 50 Marks</p> <p>4. Duration: 1 Month or 4 Weeks – i) After end examination of semester 02 and before beginning of semester 03. or ii) Any one month during semester 02 duration</p> <p>5. Grading Criteria for Evaluation of OJT (or Intern) only by Mentor where the Internship is proposed to be imparted:</p> <table border="1"> <thead> <tr> <th>S N</th> <th>Parameters</th> <th>Marks Out of</th> </tr> </thead> <tbody> <tr> <td>1</td> <td>Behaviors, Shows interest in assigned work, Willingness to learn</td> <td>10</td> </tr> <tr> <td>2</td> <td>Accepts responsibility, Cooperates with co-workers and supervisors, Demonstrates organizational skills</td> <td>10</td> </tr> <tr> <td>3</td> <td>Uses time, knowledge and expertise effectively, Analyzes problems effectively</td> <td>10</td> </tr> <tr> <td>4</td> <td>Demonstrates creativity/ originality / any innovative contribution, Professional ethics and accountability</td> <td>10</td> </tr> <tr> <td>5</td> <td>Writes effectively, Produces high quality work/Skill Proficiency</td> <td>10</td> </tr> <tr> <td colspan="2">Total</td> <td>50</td> </tr> </tbody> </table> <p>Document as Evidence: Activity report along with Certificate or Declaration, duly issued and signed by the concerned authority [To be assessed during EE] should be submitted during End Examination to the parent Learner support Centre (LSC).</p>	S N	Parameters	Marks Out of	1	Behaviors, Shows interest in assigned work, Willingness to learn	10	2	Accepts responsibility, Cooperates with co-workers and supervisors, Demonstrates organizational skills	10	3	Uses time, knowledge and expertise effectively, Analyzes problems effectively	10	4	Demonstrates creativity/ originality / any innovative contribution, Professional ethics and accountability	10	5	Writes effectively, Produces high quality work/Skill Proficiency	10	Total		50	<p>At the end of second semester, Programme Coordinator (PC)/ Supervisor of LSC and 1 (one) External Examiner will complete 'End Exam (EE)' for all allotted students as follows:</p> <ol style="list-style-type: none"> Duration of EE: After Theory EE of second Semester Programme Coordinator (PC)/ Supervisor of LSC and External Expert will have 20% and 80% weightage respectively in EE. Number of attempts: Till Valid Registration Period (VRP) only Marks for EE: 50 Marks <table border="1"> <thead> <tr> <th>Parameter</th> <th>PC /Supervisor of LSC</th> <th>External Expert</th> </tr> </thead> <tbody> <tr> <td>Professional Attitude</td> <td>-</td> <td>05 Marks</td> </tr> <tr> <td>Maintenance of Daily Diary</td> <td>-</td> <td>10 Marks</td> </tr> <tr> <td>Internship Report</td> <td>05 Marks</td> <td>10 Marks</td> </tr> <tr> <td>Viva/Oral</td> <td>05 Marks</td> <td>15 Marks</td> </tr> <tr> <td>Total</td> <td>10 Marks</td> <td>40 Marks</td> </tr> </tbody> </table>	Parameter	PC /Supervisor of LSC	External Expert	Professional Attitude	-	05 Marks	Maintenance of Daily Diary	-	10 Marks	Internship Report	05 Marks	10 Marks	Viva/Oral	05 Marks	15 Marks	Total	10 Marks	40 Marks
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SN	Type of Course	Continuous Assessment (CA)	End Examination (EE)																							
6	Project Work (PW) RP-I 4 Credit 100 Marks CA: 50% EE: 50%	1. Student is required to submit "Activity Report" based on Grading Criteria of the course in the prescribed format. 2. Maximum number of attempts for each CA, during each semester: Single attempt only 3. Marks: 50 Marks 4. Grading Criteria: <table border="1" style="margin-left: 20px;"> <thead> <tr> <th>SN</th> <th>Desc</th> <th>Marks</th> </tr> </thead> <tbody> <tr> <td>1</td> <td>Seminar*</td> <td>25</td> </tr> <tr> <td>2</td> <td>Research Proposal</td> <td>25</td> </tr> </tbody> </table> <p>*To be conducted in Online/Offline mode at LSC.</p>	SN	Desc	Marks	1	Seminar*	25	2	Research Proposal	25	1. External and internal examiners shall assess each student based on: <ol style="list-style-type: none"> Project Report submission by the student (Only by External Examiner) [10 Marks] Project Presentation by the student [20 Marks] Viva-Voce on Project Report [20 Marks] 2. Number of attempts: Till Valid Registration Period (VRP) only 3. Marks: 50 Marks 4. Duration: 180 minutes														
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S N	Evaluation of Project Work End Examination																									
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1	Project Report	-	10 Marks																							
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3	Viva-Voce /Oral	05 Marks	15 Marks																							
4	Total	10 Marks	40 Marks																							
7	Project Work (PW) RP-II 6 Credit 150 Marks CA: 50% EE: 50%	1. Student is required to submit "Activity Report" based on Grading Criteria of the course in the prescribed format. 2. Maximum number of attempts for each CA, during each semester: Single attempt only 3. Marks: 75 Marks 4. Grading Criteria: <table border="1" style="margin-left: 20px;"> <thead> <tr> <th>SN</th> <th>Desc</th> <th>Marks</th> </tr> </thead> <tbody> <tr> <td>1</td> <td>Seminar*</td> <td>30</td> </tr> <tr> <td>2</td> <td>Research Paper Presentation**</td> <td>30</td> </tr> <tr> <td>3</td> <td>Project Report</td> <td>15</td> </tr> </tbody> </table> <p>*To be conducted in Online/Off line mode at LSC. ** Journals/Conferences/ at LSC, in Online/Offline mode [This activity shall be organized by respective LSC in Online/Offline mode in case student didn't get an opportunity for presentation at Journals/Conferences]</p>	SN	Desc	Marks	1	Seminar*	30	2	Research Paper Presentation**	30	3	Project Report	15	1. External and internal examiners shall assess each student based on: <ol style="list-style-type: none"> Project Report submission by the student (Only by External Examiner) [20 Marks] Project Presentation by the student [25 Marks] Viva-Voce on Project Report [30 Marks] 2. Number of attempts: Till Valid Registration Period (VRP) only 3. Marks: 75 Marks 4. Duration: 180 minutes											
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SN	Type of Course	Continuous Assessment (CA)		End Examination (EE)	
		SN	Evaluation of Project Work End Examination		
			Description	Internal Examiner	External Examiner
		1	Project Report	-	20 Marks
		2	Project Presentation	05 Marks	20 Marks
		3	Viva-Voce /Oral	10 Marks	20 Marks
			Total	15 Marks	60 Marks

- Separate and independent passing @ 40% in CA, EE and (CA+EE) shall be essential for each course - Theory, Practical, OJT/FP and RP.** “CA, EE and Total marks” shall be separately reported for each course in the transcript or mark-statement. The minimum and maximum marks for “CA, EE and Total Marks” are shown in the table below. If student does not score a minimum of 40% marks in CA or in EE of a course then the result of such a course will be reported as FAIL.

Course Type	Number of Credits	Continuous Assessment (CA)		End Examination(EE)		Total Marks 'TM' = (CA +EE)	
		Min	Max	Min	Max	Min	Max
Theory	2	6	15	14	35	20	50
	4	12	30	28	70	40	100
Practical/ OJT/FP/RP	4	20	50	20	50	40	100
	6	30	75	30	75	60	150

- In each semester, **only 1 attempt**, for CA for each course and for EE for each course shall be allowed. Only **during valid registration period (VRP)**, students are allowed to appear for CA and EE for each course against the payment of the specified ‘Examination Fee’ for each attempt, for each course where he/she is admitted by the university. The ‘CA and/or EE’ attempts are counted for each examination option offered by the university to the student, irrespective of whether student actually chooses to appear in end exam or not.
- If a student does not successfully complete the continuous assessment (CA) or pass the End Examination of Practical/Term work/OJT/Field Project/Research Project courses, they may complete these requirements with the next semester at the respective Learning Support Center (LSC) **only** during the valid registration period (VRP).
- Duration for Practical/Term work/OJT/Field Project/Research Project type of Courses:** 180 Minutes for a batch of typically 15 ± 3 students
- Only best of past performance shall be reported in transcript or mark statement.**
- Total student evaluation for**
 - Each** semester shall be for **550** marks
 - Each** year shall be for **1100** marks
 - Each** regular PG degree shall be for **2200** marks
- Reporting Semesters** for certification:

- Min 40% or better marks in total 23 courses (subjects) of total 88 credit points at Semesters 01-04.

SUCCESSFUL COMPLETION OF COURSE OR PROGRAMME

1. "Successful Completion of the Course" means - either course is exempted or student gets minimum specified or better grade, either in end examination of that course or by credit transfer. A student obtaining grade "F" shall be considered failed and will be required to reappear in the examination. The student obtained minimum "P" (Pass) letter grade required for successful completion of each course.
2. "Successful Completion of the Programme" means – all courses at all semesters are successfully completed and the student obtained "P" (Pass) letter grade for all courses at all semesters along with minimum specified SGPA and CGPA.

SEMESTER 01

CHE501: INORGANIC CHEMISTRY-I

PROGRAMME INFORMATION

SN	Description	Details
1	University	Yashwantrao Chavan Maharashtra Open University Nasik - 422 222, Maharashtra, India Website: http://www.ycmou.ac.in/ and http://ycmou.digitaluniversity.ac/
2	School	School of Sciences
3	Discipline	Science
4	Level	PG
5	Course Used in	V154: M.Sc.(Chemistry){2023 Pattern} & V142 : M.Sc.(Chemistry){2022 Pattern}

COURSE INFORMATION

Sem	Major	Code	Course Name	CR	CST	ST	CA	EE	TM	Type
01	DSC	CHE501	Inorganic Chemistry-I	4	12	120	30	70	100	T

PRESUMED KNOWLEDGE AND LEARNING OBJECTIVES

Presumed Knowledge	Learning Objectives
<p>For successful completion of this course, student should have successfully complete:</p> <ul style="list-style-type: none">B.Sc. with Chemistry or equivalent from a recognized University/Board.	<p>The objectives of this course are</p> <ul style="list-style-type: none">To study the nuclear structure, stable and unstable atomic nuclei, and nuclear reactions.Analyse the various defects and its application on inorganic crystals. Explain the fundamentals of metallic clusters.Explain the chemistry of boranes and related compounds.To develop the ability to correlate the chemical and physical properties of elements and their compounds with their positions in the periodic table.To establish the link between theory and laboratory practice by conducting laboratory experiments. Describe the detection of radioactive rays and to measure the radiation.

UNITS

UN	Name of the Unit	CSs	Questions
01-01	Inorganic Clusters	CR 01 MLs 01-20	As per evaluation pattern, on Each Credit , Student is required to answer
01-02	Boranes, Boron Hydrides		
01-03	Isopoly and Heteropoly Acids		
01-04	Bioinorganic Chemistry		
02-01	Metallic State	CR 02 MLs 21-40	<ul style="list-style-type: none">Very Short Answer Question (VSAQ), of 03 marksShort Answer
02-02	Basic Organometallic Chemistry		
02-03	Basic Principles of Ligand-Field Theory		
02-04	Metal-Ligand Equilibria in Solution		

03-01	Homogeneous Catalytic Reactions	CR 03 MLs 41-60	Question (SAQ), of 05 marks • Long Answer Question (LAQ) of 10 Marks (LAQ may contain sub-questions (a), (b) and so on.)
03-02	Acid-Base Behavior		
03-03	Isomerisation of Alkenes		
03-04	Chemistry In Non-aqueous Solvents		
04-01	Nuclear Chemistry and Nuclear Reactions	CR 04 MLs 61-80	
04-02	N/P Ratios In Stable and Meta Stable Nuclei		
04-03	Nuclear Reactions		
04-04	Fertile Isotopes		

DETAILED SYLLABUS

UN	Detailed Syllabus of the Unit	CR
01-01	Inorganic Clusters: Introduction, Inorganic chains – rings - cages and clusters (definition and structure) – metal clusters -dinuclear clusters - trinuclear clusters - tetranuclear clusters – hexanuclearclusters -organometallic clusters. Silicates and siloxanes.	CR 01
01-02	Boranes, Boron Hydrides: Introduction, structure and properties of Boranes and boron hydrides, carboranes –metallo carboranes -Wade’s theory - closo-nido and arachno structures - borazines, phosphazenes -Sulphur-Nitrogen ring compounds.	
01-03	Isopoly and Heteropoly Acids: Introduction, Polymorphism of V, Cr, Mo and W, Heteropoly of Acids.	
01-04	Bioinorganic Chemistry: Introduction, Role of metal ions in biological processes, structure and properties of metallo proteins in electron transport processes, cytochromes, ferredoxins and iron sulphur proteins, ion transport across membranes, Biological nitrogen fixation, PSI, PS – II, Oxygen uptake proteins.	
02-01	Metallic State: Introduction, Free electron, band and zone theories - stoichiometry – point defects in solids - Schottky and Frenkel defects - linear effects - dislocation - effects due to dislocation - electrical properties of solids - insulators-intrinsic semiconductors -n and ptype and super conductors.	CR 02
02-02	Basic Organometallic Chemistry: Introduction, Common notation used in Organometallic chemistry-Metal-ligand interactions, Properties of organometallic compounds, Backbonding & CO vibration frequency, B-Hydride elimination, Associative Ligand Substitution, Dissociative Ligand Substitution.	
02-03	Basic Principles of Ligand-Field Theory: Introduction, Molecular orbital theory -18-electron rule - Common organometallic bonding modes – Introduction to Metal-centered organometallic reactions.	
02-04	Metal–Ligand Equilibria in Solution: Introduction, Stepwise and overall formation constants and their interaction, trends in stepwise constants, factors affecting the stability of metal complexes with reference to nature of metal ion and ligand, chelate effect and its thermodynamic origin, determination of formation constants by pH – metry, spectrophotometry methods.	
03-01	Homogeneous Catalytic Reactions: Introduction, Organometallic compounds in homogeneous catalytic reactions- Wilkinson’s Catalyst, Monsanto Process, Wacker Process, coordinativeunsaturation.	CR 03
03-02	Acid-Base Behavior: Introduction, Migration of atoms or groups from metal to ligand–insertion reaction–reactions of coordinated ligands–catalytic	

	reactions, Alkene Metathesis.	
03-03	Isomerisation of Alkenes: Introduction, hydroformylation and hydrosilation of alkenes – alkene polymerization and oligomerisation – fluxional molecules.	
03-04	Chemistry In Non-aqueous Solvents: Introduction, Classification of solvents, properties, leveling effect, type reactions in solvents, chemistry of liquid ammonia, liquid dinitrogen tetroxide and anhydrous sulphuric acid with respect to properties, solubilities and reactions.	
04-01	Nuclear Chemistry and Nuclear Reactions: Introduction, The nucleus - subatomic particles and their properties, binding energy.	CR 04
04-02	N/P Ratios In Stable and Meta Stable Nuclei: Introduction, Different type of nuclear forces - liquid model - shell model. Modes of radioactive decay - and decay radiation, electron capture, nuclear isomerism and internal conversion.	
04-03	Nuclear Reactions: Introduction, Nuclear reactions, Q-value, coulombic barrier, cross section, Different types of nuclear reactions - projectile capture - particle emission, spallation, fission, fusion, theories of fission, use of fission products, nuclear reactors.	
04-04	Fertile Isotopes: Introduction, U233, U235, Pu239, Th232, stellar energy, Synthetic elements - application of radio isotopes.	

LEARNING RESOURCE DETAILS

LR Code	Title Author	Edition Year	ISBN Publisher
Course Website Link for (1) Mobile and Online Lectures, (2) Discussion Forum for online interaction and (3) Self-Test for each CR Block, Continuous Assessment Test and End Examination			
Text-Books			
CHE501	Inorganic Chemistry-I -Dr. Pankaj D. Baviskar	2022	9789395855-13-6, YCMOU
Reference-Books: Explore additional details and reinforce learning, with this optional learning resource!			
CHE501- RB1	Advanced Inorganic Chemistry - F. Albert Cotton	6 th edition 1999	9780471199571
CHE501- RB2	Concise Inorganic chemistry - J D Lee	5 th edition 2008	9788126515547
CHE501- RB3	Inorganic Chemistry - Shriver Atkins/Gray L Miessler	5 th edition 2009	978-1429218207
CHE501- RB4	Introduction Of Co-ordination Chemistry - Geoffrey A. Lawrance	1 th edition 2010	9780470519318
CHE501- RB5	Inorganic Chemistry - James E. Huheey, Ellen A. Keiter, Richard L. Keiter, Okhil K. Medhi.	4 th edition 2000	9788178083858
CD / DVD: Explore additional details and reinforce learning, with this optional learning resource!			
CHE501 - CD1			

Web Links: Explore additional details and reinforce learning, with this optional learning resource!

CHE501- WL1			
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COURSE OUTCOMES

After successful completion of this course, student should be able to

1. Explain the nuclear structure, stable and unstable atomic nuclei, and nuclear reactions.
2. Analyse selected crystal structures explain what kind of parameters that affect the crystal structure of a compound and perform calculations of the lattice enthalpy of ionic compounds.
3. Analyse the various defects and its application on inorganic crystals. Explain the fundamentals of metallic clusters.
4. Understand the periodic properties of the different groups of compounds focusing on production methods and application of selected elements and compounds.
5. Evaluate the structure and bonding in molecules and predict the structure of molecules.

CHE502: PHYSICAL CHEMISTRY-I

PROGRAMME INFORMATION

SN	Description	Details
1	University	Yashwantrao Chavan Maharashtra Open University Nasik - 422 222, Maharashtra, India Website: http://www.ycmou.ac.in/ and http://ycmou.digitaluniversity.ac/
2	School	School of Sciences
3	Discipline	Science
4	Level	PG
5	Course Used in	V154: M.Sc.(Chemistry) {2023 Pattern} & V142: M.Sc.(Chemistry) {2022 Pattern}

COURSE INFORMATION

Sem	Major	Code	Course Name	CR	CST	ST	CA	EE	TM	Type
01	DSC	CHE502	Physical Chemistry-I	4	12	120	30	70	100	T

PRESUMED KNOWLEDGE AND LEARNING OBJECTIVES

Presumed Knowledge	Learning Objectives
<p>For successful completion of this course, student should have successfully complete:</p> <ul style="list-style-type: none">B.Sc. with Chemistry or equivalent from a recognized University/Board.	<p>The objectives of this course are</p> <ul style="list-style-type: none">To Describe the structure of an atom and different approximation methodsTo learn the concept of surface chemistry and their applications.To Apply the molecular phenomena and its model problemsAnalyses the probabilities, amplitudes, averages, expectation values and observables.To Evaluate the concept of group theory to predict the spectroscopic properties of amolecules

UNITS

UN	Name of the Unit	CSs	Questions
01-01	The Dawn of Quantum Theory	CR 01 MLs 01-20	As per evaluation pattern, on Each Credit , Student is required to answer
01-02	Formalism In Quantum Mechanics		
01-03	Particle In a Box		
01-04	Harmonic Oscillator & Rigid Rotator Model		
02-01	Schrodinger Equation For Hydrogen and Hydrogen Like Atoms	CR 02 MLs 21-40	<ul style="list-style-type: none">Very Short Answer Question (VSAQ), of 03 marksShort Answer Question (SAQ), of 05 marks
02-02	Orbital Shapes, Probability Density and Radial Distribution Function of H-atom		
02-03	Variation Method		
02-04	Perturbation Theory		

03-01	Theories of Reaction Rates The Arrhenius Parameters Elementary Reaction In Solution Kinetics of Complex Reactions	CR 03 MLs 41-60	• Long Answer Question (LAQ) of 10 Marks (LAQ may contain sub-questions (a), (b) and so on.)
03-02			
03-03			
03-04			
04-01	Surface Chemistry Role of Surface In Catalysis Enzyme Catalysis Heterogeneous Catalysis	CR 04 MLs 61-80	
04-02			
04-03			
04-04			

DETAILED SYLLABUS

UN	Detailed Syllabus of the Unit	CR
01-01	The Dawn of Quantum Theory: Introduction, Failure of classical mechanics, Quantum Theory of radiation, Black body radiation, Photoelectric effect. Wave Particle duality & uncertainty principle, the Schrodinger equation & the interpretation of the wave function.	CR 01
01-02	Formalism In Quantum Mechanics: Introduction, Time dependent Schrodinger equations & Born interpretation of the wave function (Condition of normalized wave function). Condition of Orthogonality, Operators- Eigen values and Eigen functions, Operators & Operand, Algebra of operators, Commutative & non-commutative operators, Line Operator. Operators in quantum mechanics- Kinetic Energy Operator, Hamiltonian operator or Total energy operator, angular momentum operator. Quantization of angular momentum and its spatial orientation- postulates of quantum mechanics.	
01-03	Particle In a Box: Introduction, Particle in a one-dimensional box, Quantization of energy -normalization of wave function- orthogonality of wave function & Illustration of the uncertainty principle in a one-dimensional box and correspondence Principle with reference to the particle in a one-dimensional box - particle in a three dimensional cubical, degeneracy.	
01-04	Harmonic Oscillator & Rigid Rotator Model: Introduction, Solving Schrodinger equation for Harmonic oscillator, energy of simple harmonic oscillator, Physical interpretation of ψ and ψ^2 for Simple Harmonic Oscillator, Harmonic Oscillator model of diatomic molecule, Illustration of the uncertainty principle and correspondence principle with reference to harmonic oscillator, Rigid rotator model of diatomic molecule (Spherical Polar Coordinates & The Rigid Rotator).	
02-01	Schrodinger Equation For Hydrogen and Hydrogen Like Atoms: Introduction, Schrodinger equation for hydrogen atom and separation of variables, Solution of Schrodinger equation for hydrogen atom, Solution of $\varphi(\phi)$ equation, Solution of θ (<i>theta</i>) equation, Solution of r equation (Radial equation) Radial Eigen functions, The complete wave function and eigenvalues of energy for hydrogen and hydrogen like atoms.	CR 02
02-02	Orbital Shapes, Probability Density and Radial Distribution Function of Hydrogen Atom: Introduction, Orbitals and orbital shapes. Probability density function or Probability distribution function, Radial Distribution Function and Need for Approximation Methods.	
02-03	Variation Method: Introduction, The Variation Theorem, Application of Variation Method to the Ground State of Simple Harmonic Oscillator, Application of Variation Method to the Ground State of Helium Atom.	
02-04	Perturbation Theory: Introduction of perturbation Theory, First order	

	perturbation theory, First Order Correction to Energy, First Order Correction to Wave Function, Application of time independent perturbation method, Application of Time Independent Perturbation Method to Particle in One Dimensional Box with Slanted Bottom, Application of Time Independent Perturbation Method to Helium Atom.	
03-01	Theories of Reaction Rates: Introduction, Rate of reaction, Rate laws and rate constants -reaction order determination of rate law– temperature dependence of reaction rates.	CR 03
03-02	The Arrhenius Parameters: Introduction to Arrhenius Parameters, Arrhenius Plot, Arrhenius Equation and the Pre-Exponential Factor (A) Theories of Reaction Rates, Collision theory - Lindmann's theory of unimolecular reaction.	
03-03	Elementary Reaction In Solution: Introduction of Activated Complex Theory, Brønsted-Bjerrum Equation, Primary Salt Effect, Secondary Salt Effect, Kinetic Isotope Effects, and Potential Energy Surfaces.	
03-04	Kinetics of Complex Reactions: Introduction, Consecutive Reactions & its examples, Reversible or Opposing Reactions, Chain Reactions & its examples.	
04-01	Surface Chemistry: Introduction, Adsorption, The Gibbs Adsorption Isotherm, and Adsorption at the solid-gas interface, Langmuir adsorption isotherm, and BET adsorption isotherm for Multilayer Adsorption.	CR 04
04-02	Role of Surface In Catalysis: Introduction, Semiconductor Catalysis, p-type & n-type semiconductor surfaces. Specific acid base catalysis, General Acid Base Catalysis, Bronsted catalysis law, The Hammett acidity functions.	
04-03	Enzyme Catalysis: Introduction, Michaelis Menten Law- Influence of pH and temperature on enzyme catalysis, Effect of pH, Effect of Temperature.	
04-04	Heterogeneous Catalysis: Introduction, Kinetics of bimolecular surface reactions-Langmuir-Hinshel-wood mechanism, Bimolecular Reactions, Reaction between a gas molecule and an adsorbed molecule (Langmuir Rideal mechanism and Rideal-Eley mechanism).	

LEARNING RESOURCE DETAILS

LR Code	Title Author	Edition Year	ISBN Publisher
Course Website Link for (1) Mobile and Online Lectures, (2) Discussion Forum for online interaction and (3) Self-Test for each CR Block, Continuous Assessment Test and End Examination			
Text-Books			
CHE502	Physical Chemistry-I -Mr. Dinesh S. Khairnar & Dr. Jamatsing Rajput	2022	978-93-95855-14-3 YCMOU
Reference-Books: Explore additional details and reinforce learning, with this optional learning resource!			
CHE502- RB1	Quantum Chemistry -Ira Levine	7 th edition 2014	9781-107-17986-8
CHE502- RB2	Physical Chemistry -Peter Atkins	3 th edition 1986	9780198551867

CHE502- RB3	Instrumental methods of chemical Analysis -Gurdeep Chatwal, Sham Anand.	1998	0-595-36551-5
CHE502- RB4	Basic Thermodynamics - P.B. Nagaraj D. Venkatesh	2005	9788122416138
CD / DVD: Explore additional details and reinforce learning, with this optional learning resource!			
CHE502 - CD1			
Web Links: Explore additional details and reinforce learning, with this optional learning resource!			
CHE502- WL1			

COURSE OUTCOMES

After successful completion of this course, student should be able to

1. Solve the problems related to 1D box.
2. Explore the role of operators in quantum.
3. Understand the solve questions basis on rates of different reactions.
4. Evaluate the concept of group theory to predict the spectroscopic properties of molecules
5. Use to differentiate between different theories of kinetics.

CHE503: ORGANIC CHEMISTRY-I

PROGRAMME INFORMATION

SN	Description	Details
1	University	Yashwantrao Chavan Maharashtra Open University Nasik - 422 222, Maharashtra, India Website: http://www.ycmou.ac.in/ and http://ycmou.digitaluniversity.ac/
2	School	School of Sciences
3	Discipline	Science
4	Level	PG
5	Course Used in	V154: M.Sc.(Chemistry){2023 Pattern} & V142 : M.Sc.(Chemistry){2022 Pattern}

COURSE INFORMATION

Sem	Major	Code	Course Name	CR	CST	ST	CA	EE	TM	Type
01	DSC	CHE503	Organic Chemistry-I	2	06	60	15	35	50	T

PRESUMED KNOWLEDGE AND LEARNING OBJECTIVES

Presumed Knowledge	Learning Objectives
For successful completion of this course, student should have successfully complete: <ul style="list-style-type: none">B.Sc. with Chemistry or equivalent from a recognized University/Board.	The objectives of this course are <ul style="list-style-type: none">Explain the aromaticity.Apply a versatile knowledge of different name reactions and their application in synthesis.Apply knowledge about reaction intermediates. Learn about familiar addition and elimination reactions.Explain the principles and reaction mechanisms involving various electrophilic and nucleophilic, addition and elimination reactions.Explain the different organic reaction mechanisms.

UNITS

UN	Name of the Unit	CSs	Questions
01-01	Reaction Mechanism	CR 01 MLs 01-20	As per evaluation pattern, on Each Credit , Student is required to answer <ul style="list-style-type: none">Very Short Answer Question (VSAQ), of 03 marksShort Answer Question (SAQ), of 05 marksLong Answer Question (LAQ) of 10 Marks (LAQ may contain sub-questions (a), (b) and so on.)
01-02	Aromaticity		
01-03	Bonding Properties of Systems		
01-04	Benzene, Annulenes, Spectroscopy & Mobius Aromaticity		
02-01	Addition Reactions	CR 02 MLs 21-40	
02-02	Addition Reactions To Carbonyl Compounds		
02-03	Concepts In Organic Synthesis		
02-04	Reagents In Organic Synthesis		

DETAILED SYLLABUS

UN	Detailed Syllabus of the Unit	CR
01-01	Reaction Mechanism: Introduction, Structure and Reactivity: Types of reactions, potential energy diagrams, transition states and intermediates. Hard and soft acids and bases, strength of acids and bases. Generation, structure, stability and reactivity of carbocations, carbanions, Free radicals, Carbene, Nitrene.	CR 01
01-02	Aromaticity: Introduction, Huckel's theory of aromaticity, antiaromaticity, Concept of homoaromaticity, Aromaticity of benzenoid, heterocyclic, and non-benzenoid compounds.	
01-03	Bonding Properties of Systems: Introduction, Bonding properties of systems with $(4n+2)$ π -electrons and $4n\pi$ -electrons, alternant and non-alternant hydrocarbons, azulene type -Aromaticity in heteroaromatic molecules - Sydnones and fullerenes.	
01-04	Benzene, Annulenes, Spectroscopy & Mobius Aromaticity: Introduction, Benzene (Preparation, Characteristics, Properties, Resonance & Uses), Aromaticity of Annulenes, Spectroscopy of Aromatic Compounds (Characteristics of ^1H NMR & ^{13}C NMR & Characteristics of IR And UV), Mobius Aromaticity, Huckel-Mobius Aromaticity.	
02-01	Addition Reactions: Introduction, Electrophilic, nucleophilic and free radical addition to double and triple bonds-hydration, hydroxylation, Michael addition, hydroboration and epoxidation.	CR 02
02-02	Addition Reactions To Carbonyl Compounds: Introduction, Mannich reaction, MeerweinPondroff- Verleyreduction, Grignard, Claisen, Dieckmann, Stobbe, Knoevenagel, Darzen, Wittig, T horpe andBenzoin reactions. Study of following reactions: Beckman, Fries, Benzilic acid, Hoffman, Schmidt, Curtius, Lossen & Benzilic acid, Neber, and Prins.	
02-03	Concepts In Organic Synthesis: Introduction to Reterosynthesis-Disconnections – Synthons- Synthetic equivalent Target molecules-Protection and deprotection of functional groups (R-OH,-CHO, C=O,-NH ₂ ,-COOH).	
02-04	Reagents In Organic Synthesis: Introduction, Preparations and synthetic applications of DDQ, DBU, Dimethyl sulfoxide, trimethyl silyl iodide, Osmium tetroxide, Selenium dioxide,Dicyclohexylcarbodiimide (DCC), LDA, DIBAL-H and Mercuric acetate.	

LEARNING RESOURCE DETAILS

LR Code	Title Author	Edition Year	ISBN Publisher
Course Website Link for (1) Mobile and Online Lectures, (2) Discussion Forum for online interaction and (3) Self-Test for each CR Block, Continuous Assessment Test and End Examination			
Text-Books			
CHE503	Organic Chemistry-I -Mr. Ghanshyam S. Patil & Dr. Atul A. Patil	2022	978-93-95855-08-2 YCMOU
Reference-Books: Explore additional details and reinforce learning, with this optional learning resource!			

CHE502- RB1	Advanced Organic Chemistry Part-A & B -Carey, Francis A, Sundberg, Richard J.	4 th edition 2017	9780306462450
CHE503- RB2	Advanced Organic Chemistry -Jerry March	8 th edition 2020	9781119371809
CHE503- RB3	Organic Chemistry -Gene Davis	2013	9789381714195
CHE503- RB4	Organic Chemistry -Clayden Greeves, Warren & wothers.	2012	9780199270293
CHE503- RB5	Organic Structures from Spectra -L D field, S Sternhell, J R Kalman	1986	9780471906445
CD / DVD: Explore additional details and reinforce learning, with this optional learning resource!			
CHE503 - CD1			
Web Links: Explore additional details and reinforce learning, with this optional learning resource!			
CHE503- WL1			

COURSE OUTCOMES

After successful completion of this course, student should be able to

1. Recognize either molecule is aromatic, non-aromatic or antiaromatic.
2. Describe mechanism of different aliphatic nucleophilic substitution reactions.
3. Understand the potential energy diagrams.
4. Apply a versatile knowledge of different name reactions and their application in synthesis.
5. Explore the different organic reaction mechanisms

CHE504: LAB ACTIVITIES ON CHE501, CHE 502 & CHE 503

PROGRAMME INFORMATION

SN	Description	Details
1	University	Yashwantrao Chavan Maharashtra Open University Nashik - 422 222, Maharashtra, India Website: http://www.ycmou.ac.in/ and http://ycmou.digitaluniversity.ac/
2	School	School of Sciences
3	Discipline	Science
4	Level	PG
5	Course Used in	V154: M.Sc.(Chemistry) {2023 Pattern} & V142: M.Sc.(Chemistry) {2022 Pattern}

COURSE INFORMATION

Sem	Major	Code	Course Name	CR	CST	ST	CA	EE	TM	Type
01	DSC	CHE504	Lab Activities on CHE501, CHE 502 & CHE 503	4	12	120	50	50	100	P

PRESUMED KNOWLEDGE AND LEARNING OBJECTIVES

Presumed Knowledge	Learning Objectives
<p>For successful completion of this course, student should have successfully complete:</p> <ul style="list-style-type: none"> B.Sc. / with Chemistry or equivalent from a recognized University/Board. 	<p>The objectives of this course are</p> <ul style="list-style-type: none"> To Develop technical skill To explain the qualitative analysis by semi micro-qualitative analysis method. Understand the basic concept and advantages of semi- micro qualitative analysis. To apply the techniques to prepare of inorganic complexes. To analyze the systematic separations of d-block elements. Evaluate the d-block elements with their special tests. To study the step wise procedure to predict the anions along with metals

UNITS/ACTIVITIES

UN	Name of the Unit	CSs
01-01	<u>Inorganic Chemistry:</u> Analysis of ore (Any 3)	CR 01
01-02	Analysis of binary mixtures by gravimetric and volumetric method (Any 3)	

02-01	<u>Inorganic Chemistry:</u> Preparation of the following complexes and determination of its purity: (Any 2)	CR 02
02-02	Drug Analysis (Any 1)	
02-03	<u>Organic Chemistry:</u> Qualitative analysis: (Any 2)	
02-04	Column chromatography (Any 1)	
03-01	<u>Organic Chemistry:</u> Preparation of Derivatives: (Each Derivative of at least one	CR 03
03-02	Compounds) (Any 2) Thin layer chromatography (TLC) (Any 1)	
03-03	<u>Physical Chemistry: Instrumental</u> Conductometry: (Any 3)	
04-01	<u>Physical Chemistry: Instrumental</u> Potentiometry:- (Any 2)	CR 04
04-02	pH-metry:- (Any 1)	
04-03	Colorimetry/ Spectrophotometry:- (Any 2)	
04-04	Polarimetry:- (Any 1)	

DETAILED PRACTICAL ACTIVITIES

No.	List of Practical Activities	Credits
1	<u>Inorganic Chemistry:</u> Analysis of ore (Any 3) a) Pyrolusite ore - Estimation of Silica gravimetrically and Manganese volumetrically. b) Chalcopyrite Ore - Estimation of Copper gravimetrically and Iron volumetrically. c) Haematite ore - Estimation of Silica gravimetrically and Iron volumetrically. d) Dolomite ore- Estimation of Calcium volumetrically and Magnesium gravimetrically.	CR 01
2	Analysis of binary mixtures by gravimetric and volumetric method (Any 3) a) Copper- Nickel b) Iron-Chromium c) Nickel-Zinc d) Tin-Lead	
3	Preparation of the following complexes and determination of its purity: (Any 2) a) Potassium trioxalatoaluminate (III) trihydrate b) Tris(thiourea) copper (I) Chloride c) Nitritopentaamminocobalt (III) Chloride d) Chloropenta-amminocobalt (III) chloride Drug Analysis (Any 1) a) Strength of medicinal H ₂ O ₂ b) Analysis of Calcium from milk powder	CR 02
4	<u>Organic Chemistry:</u> A) Qualitative analysis: (Any 2) Separation and identification of the two component/Binary mixtures using Chemical and physical methods.	

	B) Column chromatography (Any 1)	
5	<p>Organic Chemistry:</p> <p>A) Preparation of Derivatives: (Each Derivative of at least one Compounds) (Any 2)</p> <ol style="list-style-type: none"> 1. Oxime 2. 2, 4-DNP 3. Acetyl 4. Benzoyl 5. Semicarbazone 6. Anilide 7. Amide 8. Aryloxyacetic acid 9. Ester. <p>B) Thin layer chromatography (TLC) (Any 1)</p>	CR 03
6	<p>Physical Chemistry: Instrumental</p> <p>Conductometry: (Any 3)</p> <ol style="list-style-type: none"> 1) Determine the conductance of strong electrolyte (KCl/ NaCl/ AgNO₃/HCl) at various concentrations and verify the applicability of DHO equation. 2) Determination of degree of hydrolysis and hydrolysis constant of sodium acetate conductometrically. 3) Determine the amount of trichloroacetic acid, monochloroacetic acid and acetic acid in the given solution by conductometric titration against sodium hydroxide solution. 4) Study the second order velocity constant of hydrolysis of ethyl acetate by sodium hydroxide using conductance measurement. 5) Determination of critical micellar concentration (CMC) of sodium lauryl sulphate from the measurement of conductivities at different concentrations. 	
7	<p>A) Potentiometry:- (Any 2)</p> <ol style="list-style-type: none"> 1) To determine the stability constant of a complex ion [Ag₂(S₂O₃)]⁻³ potentiometrically. 2) To determine standard free energy change ΔG₀ and equilibrium constant for the reaction Cu + 2Ag⁺ = Cu⁺² + 2Ag Potentiometrically. 3) To determine the amount of each halide in a mixture of halides containing a) KI and KBr/KCl or b) KI/KBr and KCl Potentiometrically. 4) To titrate ferrous ammonium sulphate solution with potassium dichromate solution. Potentiometrically using bimetallic electrode pair. <p>B) pH -metry:- (Any 1)</p> <ol style="list-style-type: none"> 1) Determination of Hammett constant of a given substituted benzoic acid by pH measurements. 2) To determine the amount of aspirin in the given tablet. 3) To determine acidic and basic dissociation constants of an amino acid and hence the iso-electric point of the acid. 4) To determine the three dissociation constants of polybasic acid such as H₃PO₄ by pH measurements. 	CR 04
8	<p>A) Colorimetry/ Spectrophotometry:- (Any 2)</p> <ol style="list-style-type: none"> 1) To determine pK_a and K_a of given indicator by colorimetry/ spectrophotometry. 2) To determine the empirical formula of Ferric salicylate complex by Job's method and verify by slope ratio method. 3) Determination of iron in water using a colorimeter. 4) Simultaneous determination of Cr₂O₇²⁻ and MnO₄⁻ ions or Co²⁺ and Ni²⁺ in the solution by Spectrophotometry. 5) Record the UV spectrum of Benzene, Pyridine and Pyrimidine in methanol. 	

Compare and discuss the various transition involved in terms of MO theory. B) Polarimetry:- (Any 1) 1) Polarimetric determination of the specific rotation of camphor in benzene and carbon tetrachloride. 2) Determine the percentage of two optically active substances (d-glucose and d-tartaric acid) in a mixture polarimetrically.	
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LEARNING RESOURCE DETAILS

LR Code	Title Author	Edition Year	ISBN Publisher
Course Website Link for (1) Mobile and Online Lectures, (2) Discussion Forum for online interaction and (3) Self-Test for each CR Block, Continuous Assessment Test and End Examination			
Text-Books			
CHE504	Lab Activities on CHE501, CHE 502 & CHE 503 - Prof. Sham M. Golekar, Dr. Tukaram S. Topate, Prof. Rambhau Jadhav, Dr. Bharat P. More & Dr. A. V. Nagawade	2022	Publ. No.: 2506 YCMOU
Reference-Books: Explore additional details and reinforce learning, with this optional learning resource!			
CHE504-RB1	Vogel's qualitative organic analysis -G. Svehala Longman	7 th edition 1996	0582218667
CHE504-RB2	Practical Chemistry (VIII Edition) -Pandey, O. P, Bajpai, D. N. & Giri, S.	2001	New Delhi: S. Chand Pubs.
CHE504-RB3	Inorganic semi micro qualitative analysis 3rd edition. -V.V. Ramanujun	2014	National publication
CHE504-RB4	Advanced Physical Chemistry Practical Guide - Charu Arora, Sumantra Bhattacharya	2022	978-1-68108- 910-2
CHE504-RB5	Practical inorganic chemistry - G. Marr and BWrocket von. Nonstrand rteifold Co.	2015	978- 0442051310
.CD / DVD: Explore additional details and reinforce learning, with this optional learning resource!			
CHE512 - CD1			
Web Links: Explore additional details and reinforce learning, with this optional learning resource!			
CHE512- WL1			

COURSE OUTCOMES

<p>After successful completion of this course, student should be able to</p> <ul style="list-style-type: none"> • Build technical skill • Generalize the qualitative analysis by semi micro-qualitative analysis method. Understand the basic concept and advantages of semi- micro qualitative analysis. • Apply the techniques to prepare of inorganic complexes. • Analyze the systematic separations of d-block elements. Evaluate the d-block elements with their special tests. • Apply the step wise procedure to predict the anions along with metals
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RES505: RESEARCH METHODOLOGY

PROGRAMME INFORMATION

SN	Description	Details
1	University	Yashwantrao Chavan Maharashtra Open University Nasik - 422 222, Maharashtra, India Website: http://www.ycmou.ac.in/ and http://ycmou.digitaluniversity.ac/
2	School	School of Sciences
3	Discipline	Science
4	Level	PG
5	Course Used in	V154: M.Sc.(Chemistry){2023} & V142: M.Sc.(Chemistry) {2022}, V141: M.Sc.(Physics) {2022}, V142: M.Sc.(Chemistry) {2022}, V143: M.Sc.(Zoology) {2022}, V144: M.Sc.(Botany) {2022}

COURSE INFORMATION

Sem	Other	Code	Course Name	CR	CST	ST	CA	EE	TM	Type
01	RM	RES505	Research Methodology	4	12	120	50	50	100	T

PRESUMED KNOWLEDGE AND LEARNING OBJECTIVES

Presumed Knowledge	Learning Objectives
<p>For successful completion of this course, student should have successfully complete:</p> <ul style="list-style-type: none"> B.Sc. with Chemistry or equivalent from a recognized University/Board.s 	<p>The objectives of this course are–</p> <ul style="list-style-type: none"> Familiarizing with various research designs and their appropriate applications. Developing skills in formulating research questions and hypotheses. Learning to analyze and interpret data using appropriate statistical techniques. Enhancing critical thinking and problem-solving skills in the research process.

UNITS

UN	Name of the Unit	CSs	Questions
01-01	Research	CR 01 MLs 01-20	As per evaluation pattern, on Each Credit , Student is required to answer
01-02	Methods In Research		
01-03	Experimental Design		
01-04	Sampling Method		
02-01	Data Collections	CR 02 MLs 21-40	<ul style="list-style-type: none"> Very Short Answer Question (VSAQ), of 03 marks Short Answer Question (SAQ), of 05 marks Long Answer Question (LAQ) of 10 Marks (LAQ may contain sub-questions (a), (b) and so
02-02	Representation of Data		
02-03	Graphical Representation		
02-04	Analysis of Data		
03-01	Use of Inferential Statistical Tools In	CR 03 MLs 41-60	
03-02	Research		
03-03	Biostatistical Test		
03-04	Use of ANOVA		
	Application of Correlation of Data		

04-01	Literature Collection	CR 04 MLs 61-80	on.)
04-02	Intellectual Property Rights		
04-03	Research Databases		
04-04	Research Metrics		

Important Note: This course is common across all Postgraduate Programmes in the 'School of Sciences', the content within the Research Methodology course should incorporate illustrations and examples relevant to their respective domains or disciplines.

DETAILED SYLLABUS

UN	Detailed Syllabus of the Unit	CR
1-1	Research: Basic and applied research, essential steps in research, Research – definition, importance and application.	CR 01
1-2	Methods In Research: General methods in research – natural observation, field study, and experimentations.	
1-3	Experimental Design: Basic principles, hypothesis, one & two group experimental design. Matched pair data analysis, factorial design, randomized block design.	
1-4	Sampling Method: Concept of population, random sampling and non random sampling, variables – random, independent and intervening variables.	
2-1	Data Collections: Methods for primary data- observation, interview, questionnaire methods, and experiments, Methods for secondary data – scientific journals, books, reports, databases.	CR 02
2-2	Representation of Data: Tabular representations of quantitative data, frequency table – one way and two ways.	
2-3	Graphical Representation: Graphical representation of quantitative data – line graph, histogram, frequency polygon, frequency curve, Ogive, bar diagrams and pie diagrams.	
2-4	Analysis of Data – Tools of statistics and software applications.	
3-1	Use of Inferential Statistical Tools In Research: Use of different statistical estimations depending on the type of data, hypothesis testing, and test of significance.	CR 03
3-2	Biostatistical Test: Student's 't' test – applications and importance in research data And Application of Chi-square test for the experimental data	
3-3	Use of ANOVA: (one-way and two-way ANOVA) for the research data analysis.	
3-4	Application of Correlation of Data: Application of correlation and regression analysis for the data.	
4-1	Literature Collection: Need, review process, consulting source material, literature citation; Components of research report – Text, tables, figures, bibliography, Writing of dissertations, project proposals, project reports, research papers.	CR 04
4-2	Intellectual Property Rights: Basics of patent, Types of Patents (patents, copyrights, trademarks, Geographical Indications, Industrial Designs, and traditional knowledge, Patent application process (Searching a patent, Drafting a patent, Filing of patent, Types of patent applications), Patent documents (Specifications and Claims).	
4-3	Research Databases: Types of Databases - Indexing Databases and benefits	

	of Indexing, Citation Index Database; Major Citation Indexing Services - Web of Science /Web of Knowledge (WoS/WoK), Scopus/Science Direct, Google Scholar, CiteSeerX, WorldWideScience(WWS), IEEE Xplore, PubMed Central (PMC) Database, Directory of Open Access Journals (DOAJ), Indian Citation Index (ICI) Database, E-Theses Online Service (EThOS), Preprint site arXiv. [Refer Chapter 13 of Academic Integrity and Research Quality]
4-4	Research Metrics: Journal Metrics- Impact Factor (IF) or Journal Impact Factor(JIF), List of Impact Factor of Various Journals, Problems of the Impact Factor and the Editorial Ethics, Cite Score, Difference between Cite Score and Impact Factor, Impact Per Publication (IPP); Newly Emerged Indicators - Source Normalised Impact Per Paper (SNIP), Scimago Journal Rank (SJR), Eigen factor, Article Influence, SCImago Journal; Author level Metrics- H-Index with its Advantages and limitations, G-Index, i10/20 Index; Altmetrics with its Advantages and limitations; Unique ID for Research Contributors/Author. [Refer Chapter 13 and 14 of Academic Integrity and Research Quality]

LEARNING RESOURCE DETAILS

LRCODE	Title Author	Edition Year	ISBN Publisher
Course Website Link for (1) Mobile and Online Lectures, (2) Discussion Forum for online interaction and (3) Self-Test for each CR Block, Continuous Assessment Test and End Examination			
Text-Books			
RES505-T01	Research Methodology (Unit 01 to 14 only), Available here	2022	9789395855624 YCMOU, Nashik
Reference-Books: Explore additional details and reinforce learning, with this optional learning resource!			
RES505:RB1	Research Methods in Environmental Studies: A Social Science Approach – Ismael Vaccaro, Eric Alden Smith, and Shankar Aswani	1st Edition, 2010	978-0813344113 Routledge
RES505:RB2	Environmental Social Science: Human-Environment Interactions and Sustainability – Emilio F. Moran, Edward A. Rosa, and Anantha K. Duraiappah	1st Edition, 2010	978-1402090346 Springer
RES505:RB3	Handbook of Research Methods and Applications in Environmental Studies – Matthias Ruth and Brynhildur Davidsdottir	1st Edition, 2018	978-1785364327 Edward Elgar Publishing
RES505:RB4	Research Methods for Environmental Studies: A Social Science Approach – Mark L. Nichter and Mimi Nichter	1st Edition, 1991	978-0306438297 Springer
RES505- RB5	Academic Integrity and Research Quality (Chapter 13 and 14)	Dec 2021	e-Books , UGC web site
CD/DVD: Explore additional details and reinforce learning, with this optional learning resource!			
RES505:CD1			
WebLinks: Explore additional details and reinforce learning, with this optional learning resource!			
RES505-WL1	Academic Integrity and Research Quality	Dec 2021	UGC

RES505- WL2	Guidance Document: Good Academic Research Practices	Sept 2020	UGC
OER: Explore additional details and reinforce learning, with this optional learning resource!			
RES505- OER1			

COURSE OUTCOMES

After successful completion of this course, student should be able to –

- Select and apply appropriate research designs based on the research question or problem.
- Formulate clear and relevant research questions or hypotheses.
- Analyze and interpret data using appropriate statistical techniques.
- Identify and address ethical considerations in research, ensuring the protection of participants and data integrity.
- Develop critical thinking skills in evaluating research studies, identifying strengths and weaknesses, and proposing improvements

CHE506: PHYSICAL METHODS IN CHEMISTRY

PROGRAMME INFORMATION

SN	Description	Details
1	University	YashwantraoChavan Maharashtra Open University Nasik - 422 222, Maharashtra, India Website: http://www.ycmou.ac.in/ and http://ycmou.digitaluniversity.ac/
2	School	School of Sciences
3	Discipline	Science
4	Level	PG
5	Course Used in	V154: M.Sc.(Chemistry) {2023 Pattern} & V142: M.Sc.(Chemistry) {2022 Pattern}

COURSE INFORMATION

Sem	Major	Code	Course Name	CR	CST	ST	CA	EE	TM	Type
01	DSE	CHE506	Physical Methods in Chemistry	4	12	120	30	70	100	T

PRESUMED KNOWLEDGE AND LEARNING OBJECTIVES

Presumed Knowledge	Learning Objectives
<p>For successful completion of this course, student should have successfully complete:</p> <ul style="list-style-type: none"> B.Sc. with Chemistry or equivalent from a recognized University/Board. 	<p>The objectives of this course are</p> <ul style="list-style-type: none"> To describe about electron spectroscopy and thermal analysis. To learn Circular Dichroism and Optical Rotatory Dispersion To explain the Electron Spin Resonance spectroscopy To describe about flame emission spectroscopy. To apply the spectroscopic concepts for separation and identification of mixture compounds/complex/metals.

UNITS

UN	Name of the Unit	CSs	Questions
01-01	UV-Visible Spectroscopy	CR 01 MLs 01-20	As per evaluation pattern, on Each Credit , Student is required to answer
01-02	IR Spectroscopy		
01-03	Instrumentation and Application		
01-04	Principles and Applications of XRD		
02-01	Thermal Analysis	CR 02 MLs 21-40	<ul style="list-style-type: none"> Very Short Answer Question (VSAQ), of 03 marks Short Answer
02-02	Thermo Mechanical Analysis		
02-03	Description of ESCA Spectrometer		
02-04	Auger Electron Spectroscopy		

03-01	Diffraction Methods	CR 03 MLs 41-60	Question (SAQ), of 05 marks • Long Answer Question (LAQ) of 10 Marks (LAQ may contain sub-questions (a), (b) and so on.)
03-02	Raman Spectroscopy		
03-03	ESR Spectroscopy Theory		
03-04	Identification of Free Radicals		
04-01	Atomic Absorption Spectroscopy (AAS)	CR 04 MLs 61-80	
04-02	Plasma Sources & Applications of Flame Emission Spectrometry		
04-03	Instrumentation & Interference applications of (AAS)		
04-04	Inductively coupled Plasma Spectroscopy		

DETAILED SYLLABUS

UN	Detailed Syllabus of the Unit	CR
01-01	UV-Visible Spectroscopy: Principle-Instrumentation-Electronic excitation $\sigma\text{-}\sigma^*$, $n\text{-}\sigma^*$, $n\text{-}\pi$ and $\pi\text{-}\pi^*$ transitions.	CR 01
01-02	IR Spectroscopy: Principle - Instrumentation - Source of IR radiations, Monochromatization, Cell and Prim materials, measuring intensities of IR radiations.	
01-03	Intrumentation and Application: BET.	
01-04	Principles and Applications of XRD: Principles and Applications of powder and single crystal XRD.	
02-01	Thermal Analysis: Differential thermal analysis DTA and differential scanning calorimetry DSC - basic principles - thermo gravimetric analysis.	CR 02
02-02	Thermo Mechanical Analysis: Thermo mechanical analysis(TMA) and Dynamic mechanical analysis (DMA)-Instrumentation and applications Electron spectroscopy: ESCA XPS: Principle, chemical shifts-	
02-03	Description of ESCA Spectrometer: Description of ESCA spectrometer, X-ray sources, samples, analysis, detectors and recording devices-applications.	
02-04	Auger Electron Spectroscopy: AES and Ultra-Violet photo electron spectroscopy UPS/PES principles and applications.	
03-01	Diffraction Methods: Single crystal and Powder X-Ray Diffraction and their applications for Inorganic Compounds, Neutron Diffraction and Electron Diffraction.	CR 03
03-02	Raman Spectroscopy: Stokes and anti-Stokes lines. Polarizability ellipsoids. Rotational and vibrational. Selection rules. Rule of Mutual Exclusion. Polarization of Raman lines.	
03-03	ESR Spectroscopy Theory: derivative curves - g shift - hyperfine splitting- isotropic and anisotropic systems-zero field splitting and Kramer degeneracy.	
03-04	Identification of Free Radicals : Applications to copper complexes	
04-01	Atomic Absorption Spectroscopy (AAS): Absorption of characteristic radiation, instrumentation, Hollow cathode lamp – sampling- quantitative	

	measurements and interferences – atomic emission- instrumentation,	CR 04
04-02	Plasma Sources & Applications of Flame Emission Spectrometry: Plasma sources – instrumentation –inductively coupled plasma–mass spectrometry (ICP-MS) – principles & Instrumentation and applications of flame emission spectrometry – flame characteristics & processes – applications of flame photometry and flame atomic emission spectrometry.	
04-03	Instrumentation & Interference Applications of AAS: Advantages of AAS over FES, advantages and disadvantages of AAS.Instrumentation, Single and double beam AAS, detection limit and sensitivity, Interferences applications.	
04-04	Inductively Coupled Plasma Spectroscopy: Introduction, Nebulisation Torch, Plasma, Instrumentation, Interferences, and Applications.	

LEARNING RESOURCE DETAILS

LR Code	Title Author	Edition Year	ISBN Publisher
Course Website Link for (1) Mobile and Online Lectures, (2) Discussion Forum for online interaction and (3) Self-Test for each CR Block, Continuous Assessment Test and End Examination			
Text-Books			
CHE506	Physical Methods In Chemistry -Dr. Bharat P. More	2022	9789395855-07-5 YCMOU
Reference-Books: Explore additional details and reinforce learning, with this optional learning resource!			
CHE506 – RB1	Mathematics for Physical Chemistry - Robert G. Mortimer, S.M. Blinder	5 th edition 2023	9780443189456
CHE506 – RB2	Fundamentals for Molecular Spectroscopy - Banwell Colin	4 th edition 2017	9789352601738
CHE506 – RB3	Spectroscopy of Organic Compounds -P.S kalsi	1996	8122407196
CD / DVD: Explore additional details and reinforce learning, with this optional learning resource!			
CHE506 - CD1			
Web Links: Explore additional details and reinforce learning, with this optional learning resource!			
CHE506- WL1			

COURSE OUTCOMES

After successful completion of this course, student should be able to

1. Understand about electron spectroscopy and thermal analysis.
2. Analyze Circular Dichroism and Optical Rotatory Dispersion.
3. Explore the Electron Spin Resonance spectroscopy
4. Analyze about flame emission spectroscopy.
5. Apply the spectroscopic concepts for separation and identification of mixture compounds/ complex/ metals

CHE507: POLYMER CHEMISTRY

PROGRAMME INFORMATION

SN	Description	Details
1	University	Yashwantrao Chavan Maharashtra Open University Nasik - 422 222, Maharashtra, India Website: http://www.ycmou.ac.in/ and http://ycmou.digitaluniversity.ac/
2	School	School of Sciences
3	Discipline	Science
4	Level	PG
5	Course Used in	V154: M.Sc.(Chemistry) {2023 Pattern} & SV142: M.Sc.(Chemistry) {2022 Pattern}

COURSE INFORMATION

Sem	Major	Code	Course Name	CR	CST	ST	CA	EE	TM	Type
01	DSE	CHE507	Polymer Chemistry	4	12	120	30	70	100	T

PRESUMED KNOWLEDGE AND LEARNING OBJECTIVES

Presumed Knowledge	Learning Objectives
<p>For successful completion of this course, student should have successfully complete:</p> <ul style="list-style-type: none"> B.Sc. with Chemistry or equivalent from a recognized University/Board. 	<p>The objectives of this course are</p> <ul style="list-style-type: none"> To study the basic concepts of polymer. Techniques & Kinetics of polymer. To study of crystalline nature & degree of crystallinity To demonstrate polymer degradation & polymer reactions. To discuss stereochemistry of polymers & determination of molecular weight.

UNITS

UN	Name of the Unit	CSs	Questions
01-01	Terminology and Basic Concepts of Polymers	CR 01 MLs 01-20	As per evaluation pattern, on Each Credit , Student is required to answer <ul style="list-style-type: none"> Very Short Answer Question (VSAQ), of 03 marks Short Answer Question (SAQ), of 05 marks Long Answer Question (LAQ) of 10 Marks (LAQ may contain sub-questions (a), (b) and so
01-02	Types of Homopolymer & Copolymer		
01-03	Techniques of Polymerization		
01-04	Kinetics of Polymerization		
02-01	Crystalline Nature	CR 02 MLs 21-40	
02-02	Degree of Crystallinity		
02-03	Co-polymerization		
02-04	Commercial Polymers		
03-01	Polymer Degradation	CR 03 MLs 41-60	
03-02	Polymer Reactions		
03-03	Experimental Methods		
03-04	Elastomeric Materials		

04-01	Stereochemistry of Polymers	CR 04 MLs 61-80	on.)
04-02	Determination of Molecular Weight		
04-03	Thermal Characterization		
04-04	Structural Features Properties & Use of Commercial Polymers		

DETAILED SYLLABUS

UN	Detailed Syllabus of the Unit	CR
01-01	Terminology and Basic Concepts of Polymers: Monomers, Functionality, repeat units, degree of polymerization. General structure and naming of polymers. Average molecular weight and average chain dimension concept. Expressions for average molecular weights. Molecular weight distribution and Polydispersity. Classification based on various consideration source, preparation methods, thermal behavior, chain structure etc.	CR 01
01-02	Types of Homopolymer & Copolymer: Homopolymers and copolymers; linear, branched and network polymers.	
01-03	Techniques of Polymerization: Techniques of preparation of addition and condensation polymers.	
01-04	Kinetics of Polymerization: Kinetics and mechanism of addition and condensation polymerization. Kinetics of copolymerization-reactivity ratio and copolymer equation. Free radical chain polymerization –Cationic polymerization–Anionic polymerization – Polycondensation. Glass transition temperature: Glassy solids and Glass transition –associated properties –Factors influencing glass transition temperature – molecular weight –Plasticisers –melting point–importance of glass transition temperature.	
02-01	Crystalline Nature: Crystalline solids and their behaviour towards X-rays – Polymers and X-ray diffraction.	CR 02
02-02	Degree of Crystallinity: crystallites –factors affecting crystallinity, Helix structures.	
02-03	Co-polymerization: Free radical co-polymerization –Ionic copolymerization copolycondensation.	
02-04	Commercial Polymers: Polyethylene, polypropylene, polystyrene, polyacrylonitrile, polymethyl methacrylate, polyesters, polycarbonates, polyamides, polyurethanes, polyvinylacetate, polyvinylchloride, polyisoprene's, silicone polymers.	
03-01	Polymer Degradation: Types of degradation, thermal and mechanical–photo degradation–oxidative and hydrolytic degradation.	CR 03
03-02	Polymer Reactions: –Hydrolysis, acidolysis, aminolysis, hydrogenation, addition and substitution reactions – cyclisation, cross-linking reactions –Graft and Block copolymers.	
03-03	Experimental Methods: Polymer synthesis, isolation and purification of polymers– Fractional –Molecular weight determination–Molecular weight distribution curve –determination of glass transition temperature.	
03-04	Elastomeric Materials: Fibre forming materials–Plastic material Rheology of polymeric materials–compounding and processing techniques.	

04-01	Stereochemistry of Polymers: Geometric and optical isomerism in polymers. Structure, properties and preparation of stereoregular polymers.	CR 04
04-02	Determination of Molecular Weight: Osmometry and viscometry.	
04-03	Thermal Characterization: Glass Transition and melting-correlation with structure –Factors affecting T _g and T _m . Techniques of thermal characterization: DSC, DTA, DTG and TGA techniques.	
04-04	Structural Features Properties & Use of Commercial Polymers: Structural features, properties and uses of commercial polymers, Polyethylene, polystyrene, PVC, polyesters, polyamides, polyurethanes and polycarbonates. Conducting polymers, liquid crystal polymers and biomedical polymers.	

LEARNING RESOURCE DETAILS

LR Code	Title Author	Edition Year	ISBN Publisher
Course Website Link for (1) Mobile and Online Lectures, (2) Discussion Forum for online interaction and (3) Self-Test for each CR Block, Continuous Assessment Test and End Examination			
Text-Books			
CHE507	Polymer Chemistry -Prof. P. M. Jadhav	2022	978-81-19453-09-2
Reference-Books: Explore additional details and reinforce learning, with this optional learning resource!			
CHE507 -RB1	Organic Polymer Chemistry -K.J.Saunders, Chapman and Hall.	3 rd edition 2011	9789401070317
CHE507 -RB2	Advanced Polymer chemistry - Hari Mohan Kumar	2017	9789350848883
CHE507 -RB3	Contemporary Polymer Chemistry -H.R.Allcock and F.W.Lampe (PrenticeHall).	3 rd edition 2004	0-13-065056-0
CHE507 -RB4	Polymer Science -V.R.Gowariker, N.V.Viswanathan & T.Sreedhar	3 rd edition 2019	978-9387788640
CD / DVD: Explore additional details and reinforce learning, with this optional learning resource!			
CHE507 - CD1			
Web Links: Explore additional details and reinforce learning, with this optional learning resource!			
CHE507 -WL1			

COURSE OUTCOMES

After successful completion of this course, student should be able to

- Explaining the basic concepts of polymer. Techniques & Kinetics of polymer.
- Explore the Study of crystalline nature & degree of crystallinity.
- Understand polymer degradation & polymer reactions.
- Analyze stereochemistry of polymers & determination of molecular weight.

SEMESTER 02

CHE509: INORGANIC CHEMISTRY-II

PROGRAMME INFORMATION

SN	Description	Details
1	University	Yashwantrao Chavan Maharashtra Open University Nasik - 422 222, Maharashtra, India Website: http://www.ycmou.ac.in/ and http://ycmou.digitaluniversity.ac/
2	School	School of Sciences
3	Discipline	Science
4	Level	PG
5	Course Used in	V154: M.Sc.(Chemistry) {2023 Pattern} & V142: M.Sc.(Chemistry) {2022 Pattern}

COURSE INFORMATION

Sem	Major	Code	Course Name	CR	CST	ST	CA	EE	TM	Type
02	DSC	CHE509	Inorganic Chemistry-II	4	12	120	30	70	100	T

PRESUMED KNOWLEDGE AND LEARNING OBJECTIVES

Presumed Knowledge	Learning Objectives
For successful completion of this course, student should have successfully complete: <ul style="list-style-type: none">B.Sc. With Chemistry or equivalent from a recognized University/Board.	The objectives of this course are <ul style="list-style-type: none">To discuss the theories of bonding in coordination compounds.To Study the kinetics and mechanisms of reactions of complex compounds.To describe the magnetic properties of coordination compounds.To analyze the types of coordination compounds like metal carbonyls, carbocyclic p-complex in coordination compoundsTo evaluate the geometries of simple molecules.

UNITS

UN	Name of the Unit {Revised as per SLM book on 24 Feb 2024}	CSs	Questions
01-01 01-02 01-03 01-04	Coordination Chemistry Bonding Molecular Orbital Theory Octahedral & Square Planar Symmetries	CR 01 MLs 01-20	Student is required to answer 1 of 1 LAQ, of 10 marks.
02-01 02-02 02-03 02-04	Electronic Spectra Orgel Diagram and Tanabe-Sugano Energy Level Diagrams Metal Carbonyls Nitrosyl Complexes & Dinitrogen Complexes	CR 02 MLs 21-40	Student is required to answer 1 of 1 LAQ, of 10 marks.

03-01	Carbocyclic Pi Complexes and Reaction of Coordination Compounds	CR 03 MLs 41-60	Student is required to answer 2 of 2 LAQ's, each of 10 marks or 15 marks.
03-02	The Structure & Reactivity of Molecules		
03-03	Applications of VSEPR Theory		
03-04	Applications of MOT		
04-01	Symmetry Elements and Symmetry Operations	CR 04 MLs 61-80	Student is required to answer 2 of 2 LAQ's, each of 10 marks or 15 marks.
04-02	Principal Axis and Subsidiary Axes		
04-03	Ionic Compounds		
04-04	Lattice Energy of Ionic Solids		

DETAILED SYLLABUS

UN	Detailed Syllabus of the Unit	CR
01-01	Coordination Chemistry: Nomenclature, isomerism and methods of preparation of coordination complexes- types of ligands.	CR 01
01-02	Bonding: Valence bond theory- Crystal field theory – Crystal field effects in tetrahedral, Octahedral and square planar symmetries. Crystal field stabilization energy - weak and strong fields-spectro chemical series.	
01-03	Molecular Orbital Theory: based on group theoretical approach. M.O. diagram of Oh.	
01-04	Octahedral & Square Planar Symmetries: Involving pi bonding-experimental evidence for the presence of pi bonding. Magnetic behavior of the transition metal ions in crystal field and molecular orbital theories.	
02-01	Electronic Spectra: Term symbols for d configuration. Characteristics of d-d transition - selection rules for electronic spectra, charge transfer spectra. Weak and strong field limits.	CR 02
02-02	Orgel Diagram and Tanabe – Sugano Energy Level Diagrams: Spectrochemical series John-Teller distortion and spin orbit couplings. Nephelauxetic effect, Photoluminescence.	
02-03	Metal Carbonyls: Methods of preparation, structure, bonding and reactions. Carbonylate ions. Carbonyl hydrides–Vaska's compound, IR Spectroscopy of carbonyl complexes.	
02-04	Nitrosyl Complexes & Dinitrogen Complexes: Complexes of unsaturated hydrocarbons- Reactions and applications of nitrosyl complexes and dinitrogen complexes.	
03-01	Carbocyclic Pi Complexes and Reaction of Coordination Compounds: Cyclopentadienyl and related complexes synthesis, bonding, structure and reaction.	CR 03
03-02	The Structure and Reactivity of Molecules: VSEPR Theory, structures of molecules containing lone pair of electrons, Sulphur hexafluoride.	
03-03	Applications of VSEPR Theory Bromine trifluoride, dichloro iodate (I) anion, PCl ₅ , nitrogen dioxide, XeF ₆ , SiCl ₄ .	
03-04	Applications of MOT: Formation of O ₂ Molecule according to MOT, Formation of H ₂ O Molecule according to MOT, Formation of CO ₂ Molecule according to MOT, Formation of NH ₃ Molecule according to MOT.	
04-01	Symmetry Elements and Symmetry Operations: Centre of symmetry - Plane and its types of Symmetry order of axis.	CR 04

04-02	Principal Axis and Subsidiary Axes: The concept of groups - Assigning Pointgroups with illustrative examples, Proper and Improper axis of Symmetry.	
04-03	Ionic Compounds: Properties of ionic compounds, radius ratio rules, calculation of some limiting radius ratio values, close packing Structures of ionic solid NaCl.	
04-04	Lattice Energy of Ionic Solids: The Born - Haber cycle, Concept of formal charge, Hydrogen bonding concept and structure of water.	

LEARNING RESOURCE DETAILS

LR Code	Title Author	Edition Year	ISBN Publisher
Course Website Link for (1) Mobile and Online Lectures, (2) Discussion Forum for online interaction and (3) Self-Test for each CR Block, Continuous Assessment Test and End Examination			
Text-Books			
CHE509	Inorganic Chemistry-II -Dr. Pankaj D. Baviskar	2023	978-93-95855-72-3
Reference-Books: Explore additional details and reinforce learning, with this optional learning resource!			
CHE509-RB1	Advanced Inorganic Chemistry - F.Albert Cotton	6 th edition 1999	9780471199571
CHE509-RB2	Concise Inorganic chemistry - J D Lee	5 th edition 2008	9788126515547
CHE509-RB3	Inorganic Chemistry - Shriver Atkins/Gray L Miessler	5 th edition 2009	978-1429218207
CHE509-RB4	Introduction Of Co-ordination Chemistry - Geoffrey A.Lawrance	1 th edition 2010	9780470519318
CHE509-RB5	Inorganic Chemistry - James E. Huheey, Ellen A. Keiter, Rechar L. Keiter, Okhil K. Medhi.	4 th edition 2000	9788178083858
CD / DVD: Explore additional details and reinforce learning, with this optional learning resource!			
CHE509 - CD1			
Web Links: Explore additional details and reinforce learning, with this optional learning resource!			
CHE509-WL1			

COURSE OUTCOMES

After successful completion of this course, student should be able to

- Explain the theories of bonding in coordination compounds.
- Comprehend the kinetics and mechanisms of reactions of complex compounds.

- Explore the magnetic properties of coordination compounds.
- Analyze the types of coordination compounds like metal carbonyls, carbocyclic picomplex in coordination compounds
- Evaluate the geometries of simple molecules.

CHE510: PHYSICAL CHEMISTRY-II

PROGRAMME INFORMATION

SN	Description	Details
1	University	Yashwantrao Chavan Maharashtra Open University Nasik - 422 222, Maharashtra, India Website: http://www.ycmou.ac.in/ and http://ycmou.digitaluniversity.ac/
2	School	School of Sciences
3	Discipline	Science
4	Level	PG
5	Course Used in	V154: M.Sc.(Chemistry) {2023 Pattern} & V142: M.Sc.(Chemistry){2022 Pattern}

COURSE INFORMATION

Sem	Major	Code	Course Name	CR	CST	ST	CA	EE	TM	Type
02	DSC	CHE510	Physical Chemistry -II	4	12	120	30	70	100	T

PRESUMED KNOWLEDGE AND LEARNING OBJECTIVES

Presumed Knowledge	Learning Objectives
<p>For successful completion of this course, student should have successfully complete:</p> <ul style="list-style-type: none">B.Sc. with chemistry or equivalent from a recognized University/Board.	<p>The objectives of this course are</p> <ul style="list-style-type: none">To study the thermodynamics and Non-ideal systemsTo discuss about the third law of thermodynamicsTo evaluate the classical Maxwell-Boltzman and quantum statisticsTo know about partition functions and determining thermodynamic properties. Comprehend heat capacity of solids.To explore the thermodynamic factors in various organic synthesis processes (how the reaction condition and reaction rate various depend on the thermodynamic factors).

UNITS

UN	Name of the Unit	CSs	Questions
01-01	Thermodynamics	CR 01 MLs 01-20	As per evaluation pattern, on Each Credit , Student is required to answer
01-02	Maxwell Relations and Its Applications		
01-03	Duhem-Margules Equation and Its Applications		
01-04	Henry's Law		
02-01	Statistical Thermodynamics	CR 02 MLs 21-40	• Very Short Answer Question (VSAQ), of 03 marks • Short Answer Question (SAQ), of 05
02-02	Partition Function and Its Significance		
02-03	Thermodynamic Probability and Entropy		
02-04	Applications to Monoatomic Gases		

03-01	Spectroscopy Rotational (Microwave) Spectroscopy Fundamental Vibrational Frequencies Raman Spectroscopy	CR 03 MLs 41-60	marks • Long Answer Question (LAQ) of 10 Marks (LAQ may contain sub-questions (a), (b) and so on.)
03-02			
03-03			
03-04			
04-01	Macromolecules Degree of Polymerization and Molecular Weight Chemistry of Polymerization Electronically Conducting Polymers, Thermodynamics of Polymer Solutions:	CR 04 MLs 61-80	
04-02			
04-03			
04-04			

DETAILED SYLLABUS

UN	Detailed Syllabus of the Unit	CR
01-01	Thermodynamics: Introduction, revision of basic concepts: Entropy and third law of thermodynamics. Methods of determining the practical absolute entropies. Entropies of phase transition.	CR 01
01-02	Maxwell Relations and Its applications: Thermodynamic equation of state. Ideal and non-ideal solutions, Thermodynamics of nonelectrolyte solutions. Raoult's law.	
01-03	Duhem-Margules Equation and Its Applications: To vapor pressure curves (Binary liquid mixture). Gibbs-Duhem equation and its applications to study of partial molar quantities. Chemical potential, variation of chemical potential with temperature pressure.	
01-04	Henry's Law: Excess and mixing thermodynamic properties. Equilibrium constants and general conditions of equilibrium in terms of thermodynamic potentials. Numerical Problems.	
02-01	Statistical Thermodynamics: Probability and distribution, Stirling Approximation, Weights and configurations, the most probable configuration, Ensembles, ensemble average and time average of property. Statistical equilibrium & thermodynamic probability, Maxwell-Boltzmann (MB) distribution law.	CR 02
02-02	Partition Function and Its Significance: Rotational, translational, vibrational and electronic partition functions. Relationship between partition function and thermodynamic properties.	
02-03	Thermodynamic Probability and Entropy: Boltzmann – Planck equation, Partition function and third law of thermodynamics,	
02-04	Applications To Monoatomic Gases: Sackur tetrode equation, applications to diatomic molecules, Statistical expression for equilibrium constant, Limitations of Maxwell-Boltzmann statistics, Numerical Problems.	
03-01	Spectroscopy: Electromagnetic spectrum, Interaction of emr with matter, Natural line width and Broadening- Intensity of spectral transitions. Selection rules.	CR 03
03-02	Rotational (Microwave) Spectroscopy: Classification of molecules according to their moments of inertia, rotational energy levels of HCl, Selection rule for Microwave spectra, intensity, effect of substitution in Microwave spectra. Stark effect, spectra of symmetric top and asymmetric top type molecules.	

03-03	Fundamental Vibrational Frequencies: Selection rules and vibrational energy for harmonic and anharmonic oscillators, vibration rotational spectra of diatomic molecules, Fundamental, overtone and combination bands, P, Q and R branches, hot bands, group frequencies, normal modes of vibrations, symmetry of vibrations.	
03-04	Raman Spectroscopy: Selection rules, mutual exclusion principle, vibrationrotation Raman spectra. Intensity of Raman lines. Electronic spectroscopy: Electronic transitions and selection rules, Frank Condon principle and electronic spectra of polyatomic molecules, Fluorescence and phosphorescence, solvent effects, absorption and intensity shifts, Calculation of absorption maxima by Woodward-Fieser Rules.	
04-01	Macromolecules: Mechanism of polymerization, molecular weight of a polymer (Number and mass average) viscosity average molecular weight, numerical problems.	
04-02	Degree of Polymerization and Molecular Weight: Degree of polymerization and molecular weight, practical significance of polymermolecular weight, methods of determiningmolecular weights (Osmometry, viscometry, light scattering, diffusion and ultracentrifugation)	CR 04
04-03	Chemistry of Polymerization: Ceiling temperature, Free radical polymerization (Initiation, propagation andtermination), kinetics of free radicalpolymerization, step growth polymerization (Polycondensation), molecular weight distribution, kinetics of steppolymerization, cationic and anionicpolymerization.	
04-04	Electronically Conducting Polymers, Thermodynamics of Polymer Solutions: Flory-HugginsTheory. Glass transition temperature andmolecular weight, factors influencing Glass transition temperature, determination of glass transitiontemperature.	

LEARNING RESOURCE DETAILS

LR Code	Title Author	Edition Year	ISBN Publisher
Course Website Link for (1) Mobile and Online Lectures, (2) Discussion Forum for online interaction and (3) Self-Test for each CR Block, Continuous Assessment Test and End Examination			
Text-Books			
CHE510	Physical Chemistry-II -Dr. Ashok Borhade	2023	978-81-19453-26-9, YCMOU
Reference-Books: Explore additional details and reinforce learning, with this optional learning resource!			
CHE510-RB1	Thermodynamics for Chemists - Glasstone, S.	2008	978-8176710145
CHE510-RB2	Atkins Physical Chemistry -Atkins, P., & De Paula, J.	11 th edition 2017	978-0198769866
CHE510-RB3	Text Book Physical Chemistry Vol. V. - Kapoor, K. L.	1 th edition 2004	9781403922779
CHE510-RB-4	Physical Chemistry - Lavin, I. N.	4 th edition 1994	978-0070375284

CHE510- RB-5	Fundamentals of Molecular Spectroscopy -C.N. Banwell and E.M. McCash, Tata McGraw Hill.	4 th edition 2017	978-9352601738
CD / DVD: Explore additional details and reinforce learning, with this optional learning resource!			
CHE510- CD1			
Web Links: Explore additional details and reinforce learning, with this optional learning resource!			
CHE510- WL1			

COURSE OUTCOMES

After successful completion of this course, student should be able to

- Explain the thermodynamics and Non-ideal systems
- Describe about the third law of thermodynamics
- Understand the classical Maxwell-Boltzman and quantum statistics
- Know about partition functions and determining thermodynamic properties
- Understand heat capacity of solids.
- Use the thermodynamic factors in various organic synthesis processes (how the reaction condition and reaction rate various depend on the thermodynamic factors).

CHE511: ORGANIC CHEMISTRY-II

PROGRAMME INFORMATION

SN	Description	Details
1	University	Yashwantrao Chavan Maharashtra Open University Nasik - 422 222, Maharashtra, India Website: http://www.ycmou.ac.in/ and http://ycmou.digitaluniversity.ac/
2	School	School of Sciences
3	Discipline	Science
4	Level	PG
5	Course Used in	V154: M.Sc.(Chemistry){2023 Pattern} & V142 : M.Sc.(Chemistry){2022 Pattern}

COURSE INFORMATION

Sem	Major	Code	Course Name	CR	CST	ST	CA	EE	TM	Type
01	DSC	CHE511	Organic Chemistry-II	2	06	60	15	35	50	T

PRESUMED KNOWLEDGE AND LEARNING OBJECTIVES

Presumed Knowledge	Learning Objectives
For successful completion of this course, student should have successfully complete: <ul style="list-style-type: none">B.Sc. with Chemistry or equivalent from a recognized University/Board.	The objectives of this course are <ul style="list-style-type: none">Explain the aromaticity.Apply a versatile knowledge of different name reactions and their application in synthesis.Apply knowledge about reaction intermediates. Learn about familiar addition and elimination reactions.Explain the principles and reaction mechanisms involving various electrophilic and nucleophilic, addition and elimination reactions.Explain the different organic reaction mechanisms.

UNITS

UN	Name of the Unit	CSs	Questions
01-01	Aromatic Electrophilic Substitution-I	CR 01 MLs 1-20	As per evaluation pattern, on Each Credit , Student is required to answer <ul style="list-style-type: none">Very Short Answer Question (VSAQ), of 03 marksShort Answer Question (SAQ), of 05 marksLong Answer Question (LAQ) of 10 Marks (LAQ may contain sub-questions (a), (b) and so on.)
01-02	Aromatic Electrophilic Substitution-II		
01-03	Aliphatic Electrophilic Substitution		
01-04	Typical Electrophilic Substitution		
02-01	Aliphatic Nucleophilic Substitution-I	CR 02 MLs 21-40	
02-02	Aliphatic Nucleophilic Substitution-II		
02-03	Aromatic Nucleophilic Substitution		
02-04	Elimination Reactions		

DETAILED SYLLABUS

UN	Detailed Syllabus of the Unit	CR
01-01	Aromatic Electrophilic Substitution-I: Introduction, Aromatic electrophilic substitution reactions-formylations–Gattermann, Gattermann Koch, Riemer Tiemann and Vilsmeier-Haack reactions.	CR 01
01-02	Aromatic Electrophilic Substitution-II: Introduction, Kolbes Reaction, Bischler-Napieralski and Hofmann-Martius reactions. Friedel crafts alkylation and acylations.	
01-03	Aliphatic Electrophilic Substitution: Introduction, Mechanisms- SE1, SE2 and SEi –structure, reactivity relationship, Electrophilic Substitution accompanied by double bond shifts, Effect of factors on Aliphatic Electrophilic Substitution.	
01-04	Typical Electrophilic Substitution: Introduction, Friedel crafts acylation at olefinic carbon, Stork enamine reaction and decarboxylation of aliphatic acids, Barton decarboxylation reaction.	
02-01	Aliphatic Nucleophilic Substitution-I: Introduction, Aliphatic nucleophilic substitution reactions- mechanisms - SN1, SN2, SNi & SET structure, reactivity relationship.	CR 02
02-02	Aliphatic Nucleophilic Substitution-II: Introduction, Factors Influencing SN1 & SN2 (Effect of substrate structure - solvent effects - leaving group effect – nucleophilicity), ambident nucleophiles and ambident substrates- neighbouring group participation.	
02-03	Aromatic Nucleophilic Substitution: Introduction, Benzyne mechanism, intermediate complex, Mechanism and SN1 mechanism, structure reactivity relationship. Ziegler alkylation and Chichibabin reaction.	
02-04	Elimination Reactions: Introduction, E1, E2, Ei and E1cB mechanisms - stereochemistry of eliminations. Hofmann rule-Saytzeff rule-Bredts rule–Substitution versus Elimination. Typical elimination reaction - Chugaev reaction, Hofmann elimination and Cope elimination.	

LEARNING RESOURCE DETAILS

LR Code	Title Author	Edition Year	ISBN Publisher
Course Website Link for (1) Mobile and Online Lectures, (2) Discussion Forum for online interaction and (3) Self-Test for each CR Block, Continuous Assessment Test and End Examination			
Text-Books			
CHE511	Organic Chemistry-I -Mr. Ghanshyam S. Patil & Dr. Atul A. Patil	2022	978-93-95855-08-2, YCMOU
Reference-Books: Explore additional details and reinforce learning, with this optional learning resource!			
CHE511-RB1	Advanced Organic Chemistry Part-A & B -Carey, Francis A, Sundberg, Richard J.	4 th edition 2017	9780306462450
CHE511-RB2	Advanced Organic Chemistry	8 th	9781119371809

	-Jerry March	edition 2020	
CHE511-RB3	Organic Chemistry -Gene Davis	2013	9789381714195
CHE511-RB4	Organic Chemistry -Clayden Greeves, Warren & wothers.	2012	9780199270293
CHE511-RB5	Organic Structures from Spectra -L D field, S Sternhell, J R Kalman	1986	9780471906445
CD / DVD: Explore additional details and reinforce learning, with this optional learning resource!			
CHE511 -CD1			
Web Links: Explore additional details and reinforce learning, with this optional learning resource!			
CHE511-WL1			

COURSE OUTCOMES

After successful completion of this course, student should be able to

1. Recognize either molecule is aromatic, non-aromatic or antiaromatic.
2. Describe mechanism of different aliphatic nucleophilic substitution reactions.
3. Understand the potential energy diagrams.
4. Apply a versatile knowledge of different name reactions and their application in synthesis.
5. Explore the different organic reaction mechanisms

CHE512: LAB ACTIVITIES ON CHE 509, CHE 510 & CHE 511

PROGRAMME INFORMATION

SN	Description	Details
1	University	Yashwantrao Chavan Maharashtra Open University Nashik - 422 222, Maharashtra, India Website: http://www.ycmou.ac.in/ and http://ycmou.digitaluniversity.ac/
2	School	School of Sciences
3	Discipline	Science
4	Level	PG
5	Course Used in	V154: M.Sc.(Chemistry){2023 Pattern} & V142: M.Sc.(Chemistry){2022 Pattern}

COURSE INFORMATION

Sem	Major	Code	Course Name	CR	CST	ST	CA	EE	TM	Type
01	DSC	CHE512	Lab Activities on CHE509, CHE 510 & CHE 511	4	12	120	50	50	100	P

PRESUMED KNOWLEDGE AND LEARNING OBJECTIVES

Presumed Knowledge	Learning Objectives
<p>For successful completion of this course, student should have successfully complete:</p> <ul style="list-style-type: none"> B.Sc. / with Chemistry or equivalent from a recognized University/Board. 	<p>The objectives of this course are</p> <ul style="list-style-type: none"> To Develop technical skill To explain the qualitative analysis by semi micro-qualitative analysis method. Understand the basic concept and advantages of semi- micro qualitative analysis. To apply the techniques to prepare of inorganic complexes. To analyze the systematic separations of d-block elements. Evaluate the d-block elements with their special tests. To study the step wise procedure to predict the anions along with metals

UNITS/ACTIVITIES

UN	Name of the Unit	CSs
01-01 01-02	Inorganic Chemistry: Thermo chemistry (Any 2) Instrumental method of Analysis (Any 4)	CR 01

02-01	<u>Inorganic Chemistry:</u> Chromatography (Any 1)	CR 02
02-02	Colorimetric analysis (Any 2)	
02-03	<u>Organic Chemistry:</u>	
02-04	A) Single Stage Preparation Monitored by TLC (Any 2) B) Steam distillation techniques. (one)	
03-01	<u>Organic Chemistry:</u> A) Organic Estimations (Any 2)	CR 03
03-02	B) Two Stage Preparation Monitored by TLC (Any 1)	
03-03	<u>Physical Chemistry: Non- Instrumental</u>	
03-04	A) Chemical kinetics: (Any 2) B) Surface Chemistry: (one)	
04-01	Non- Instrumental (Any 3)	CR 04
04-02	Analysis: (Any 3)	

DETAILED PRACTICAL ACTIVITIES

No.	List of Practical Activities	Credits
1	<u>Inorganic Chemistry</u> A) Thermo chemistry (Any 2) To determine the lattice energy of binary salts (NaCl, KCl, CaCl ₂).	CR 01
2	B) Instrumental method of Analysis (Any 4) a) To determine the strength of given mixture of carbonate and bicarbonate by pH metric method b) To determine Ca in the given solution by flame photometrically, by calibration curve Method. c) Spectrophotometry (any one experiments) i) Estimation of phosphate from waste water by calibration curve method ii) Estimation of Manganese from steel. d) To determine the amount of copper present by iodometric method (potentiometrically) e) Estimation of Boric acid using NH ₄ OH by conductometric method.	
3	A) Chromatography (Any 1) a) Determination of the R _f value of Pb, Cu, Cd ions by using paperchromatographic technique. b) Determination of the R _f value of Fe, Al, Cr ions by using paper chromatographic technique. c) Determination of the R _f value of Ba, Sr, Ca ions by using paper chromatographic technique. B) Colorimetric analysis (Any 2) Estimation of copper, nickel, zinc, lead, chromium, Iron	CR 02
4	<u>Organic Chemistry:</u> A) Single Stage Preparation Monitored by TLC (Any 2) 1. Acetophenone to Benzalacetophenone. 2. Resorcinol to 7-hydroxy, 4-methyl coumarin. 3. Camphor to Borneol. 4. Benzophenone to Benzhydrol.	

	<p>5. Acetoacetic ester to Pyrazolone. 6. Paramino Benzoic Acid to Parachloro Benzoic Acid. 7. 2-methoxy naphthalene to 1-formyl-2-methoxy naphthalene. 8. Glycine to Benzoylglycine. 9. Cyclohexanone to Adipic acid 10. Cyclohexanone to Oxime 11. P-nitrotoluene to p-nitrobenzoic acid B) Steam distillation techniques. (one)</p>	
5	<p>Organic Chemistry: A) Organic Estimations (Any 2) 1. Estimation of Phenol. 2. Estimation of ethyl methyl ketone. 3. Estimation of glucose. 4. Estimation of nitro compound. 5. Estimation of amino compound. 6. Estimation of methoxy groups. 7. Unsaturation of an organic compound. B) Two Stage Preparation Monitored by TLC (Any 1) 1. Phthalic acid - phthalic anhydride - phthalimide. 2. Chlorobenzene - 2,4-dinitrochlorobenzene - 2,4-dinitrophenol</p>	
6	<p>Physical Chemistry: Non-Instrumental A) Chemical kinetics: (Any 2) 1) To determine the rate constant for depolymerization of diacetone alcohol catalyzed by sodium hydroxide using dilatometer. 2) To determine the order of the reaction between potassium persulphate and potassium iodide by fractional change method. 3) To investigate the kinetics of iodination of acetone. 4) To determine energy of activation of the hydrolysis of methyl acetate in presence of hydrochloric acid (Calculations and graphs expected from excel programming). B) Surface Chemistry: (one) 1) To determine the critical micelle concentration of soap by surface tension by drop number method.</p>	CR 03
7	<p>Non-Instrumental (Any 3) 1) Determine the transport number of H⁺ and Cl⁻ ions by moving boundary method. 2) To obtain solubility curve for liquid say water-acetic acid-chloroform system 3) Investigate the adsorption of acetic acid in aqueous solution by using activated charcoal and verify Freundlich's adsorption isotherm. 4) Determination of partial molar volume of ethanol in dilute aqueous solutions. 5) To study the effect of addition of an electrolyte (KCl /NaCl /NH₄Cl / Na₂SO₄/ K₂SO₄) on solubility of an organic acid (benzoic acid or salicylic acid).</p>	CR 04
8	<p>Analysis: (Any 3) 1. To verify Beer-Lambert's Law for potassium permanganate solution and hence to determine the molar extinction coefficient and unknown concentration of given sample Spectrophotometrically 2. To determine the iron potentiometrically by titrating with potassium dichromate 3. To determine the solubility of Calcium oxalate in presence of different concentration of KCl</p>	

4. To determine the solubility of Calcium oxalate in presence of different concentration of HCl	
5. Analysis of pharmaceutical tablets for ibuprofen content	
6. To verify the Beer-Lamberts Law and determine the concentration of given organic dye solution calorimetrically/spectrophotometrically.	

LEARNING RESOURCE DETAILS

LR Code	Title Author	Edition Year	ISBN Publisher
Course Website Link for (1) Mobile and Online Lectures, (2) Discussion Forum for online interaction and (3) Self-Test for each CR Block, Continuous Assessment Test and End Examination			
Text-Books			
CHE512	Lab Activities on CHE509, CHE 510 & CHE 511 - Prof. Sham M. Golekar, Dr. Tukaram S. Topate, Prof. Rambhau Jadhav, Dr. Bharat P. More & Dr. A. V. Nagawade	2022	Publ. No: 2573 , 2502, 2506, YCMOU
Reference-Books: Explore additional details and reinforce learning, with this optional learning resource!			
CHE512- RB1	Vogel's qualitative organic analysis -G. Svehala Longman	7 th edition 1996	0582218667
CHE512- RB2	Practical Chemistry (VIII Edition) -Pandey, O. P, Bajpai, D. N. & Giri, S.	2001	New Delhi: S. Chand Pubs.
CHE512- RB3	Inorganic semi micro qualitative analysis -V.V. Ramanujun	3 rd edition 2014	National publication
CHE512- RB4	Advanced Physical Chemistry Practical Guide - Charu Arora, Sumantra Bhattacharya	2022	978-1-68108- 910-2
CHE512- RB5	Practical inorganic chemistry -G.Marr and BWrocket von. Nonstrand reilfold Co.	2015	978-0442051310
.CD / DVD: Explore additional details and reinforce learning, with this optional learning resource!			
CHE512 - CD1			
Web Links: Explore additional details and reinforce learning, with this optional learning resource!			
CHE512- WL1			

COURSE OUTCOMES

<p>After successful completion of this course, student should be able to</p> <ul style="list-style-type: none"> • Get knowledge about the heat of solution, determination of molecular weight and Distribution coefficient. • Apply the basic concepts of conductometric titrations to determine the ionic strength. • Explain the various laws in electrochemistry. • Apply the conductometric method for the solutions and measure its conductivity. Give practice to handle the conductivity meter, spectrophotometer. • Evaluate distribution co-efficient influence the solubility of various systems.
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CHE513: ON JOB TRAINING (OJT)

PROGRAMME INFORMATION

SN	Description	Details
1	University	YashwantraoChavan Maharashtra Open University Nasik - 422 222, Maharashtra, India Website: http://www.ycmou.ac.in/ and http://ycmou.digitaluniversity.ac/
2	School	School of Sciences
3	Discipline	Science
4	Level	PG
5	Course Used in	V154: M.Sc.(Chemistry){2023 Pattern}

COURSE INFORMATION

Sem	Other	Code	Course Name	CR	CST	ST	CA	EE	TM	Type
02	OJT	CHE513	On Job Training (OJT)	4	12	120	50	50	100	TW

PRESUMED KNOWLEDGE AND LEARNING OBJECTIVES

Presumed Knowledge	Learning Objectives
For successful completion of this course, student should have successfully complete: <ul style="list-style-type: none">B.Sc. with Chemistry or equivalent from a recognized University/Board.	The objectives of this course are <ul style="list-style-type: none">To provide hands-on experiencesTo provide an effective training environment to studentsTo provide opportunities for students to apply theories and principles learned in class to real job settings.To bridge the gap between academia and the professional worldTo promote research and innovation

DETAILS ABOUT ON-JOB-TRAINING (OJT)/INTERNSHIPS

Internships offer valuable opportunities for postgraduate students to bridge the gap between academia and the professional world, promote research and innovation.

By engaging in hands-on experiences and collaborating with experts, students can develop practical skills, expand their network, and gain insights into potential career paths.

Guidelines: [In process]

A. General:

- 1) It is mandatory for a student to successfully complete the OJT (Internship) for the award of the PG Diploma / PG Degree. This internship could be the research internship or any normal industry, Organization/Institute, Start-up/ ATAL Innovation/Incubation centers, Micro/Small/Medium/Enterprise, Govt/NGO/PSU/, Online/offline academic activities at School/Regional Centers/ University Head Quarters, Online Internship related to major courses.
- 2) In case of working students if his/her job nature is related to major courses or in allied domain then he/she will be permitted for the internship at workplace provided; a declaration by an employer is submitted directly to the LSC head and School. Both,

declaration by an employer and the training completion certificate will be attached along with Internship report.

- 3) Internship is of four credits with a period of 4 weeks and carries a weightage of 50-50% in 'Continuous Assessment (CA)' and 'End examination (EE)'. The internship time period does not extend beyond end examination of OJT.
 - Total Study efforts (including Self-Study) in Hours: Total 120 Hours
 - On-Job-Training/Internship (@during 22working days) in a month: minimum 110Hours
 - Preparation of Internship Report: 10 Hours
 - Duration– i) After end examination of semester 02 and before beginning of semester 03 or ii) Any one month within semester 02 of the programme
- 4) At the end of the internship, each student is required to provide a printed copy of their consolidated diary/journal and internship report for the evaluation of internship. The report must express exactly what was learned and accomplished during the internship.
- 5) The Intern will be assessed by
 - a) Continuous Assessment (CA) - Mentor of the Industry/NGO/organization/Institute
Etcwhere student is selected for Internship
 - b) End Examination (EE) - LSC Supervisor/PC and External Examiner.

B. Monitoring and Evaluation:

Monitoring: During internship period as part of 'Continuous assessment (CA)', the mentor should evaluate the interns using the following points and should issue a recommendation letter that whether Intern/student meets the expectations of the internship or not:

1	Behaviors, Shows interest in assigned work, Willingness to learn
2	Accepts responsibility, Cooperates with co-workers and supervisors, Demonstrates organizational skills
3	Uses time, knowledge and expertise effectively, Analyzes problems effectively
4	Demonstrates creativity/ originality / any innovative contribution, Professional ethics and accountability
5	Writes effectively, Produces high quality work/Skill Proficiency

Evaluation: At internship, the intern will be evaluated in the end examination (EE), by duly constituted expert committee of internal and external, on the following suggestive aspects:

- Professional Attitude
- Maintenance of Daily Diary
- Internship Report
- Viva voce/Oral

Reference-Link: Explore additional details!	
CHE 513 –RL 1	UGC Internship Guidelines https://www.ugc.gov.in/pdfnews/1887287_Rsearch-Internship-Guidelines-120522.pdf
CHE 513 –RL 2	AICTE Internship Portal https://internship.aicte-india.org/
CHE 513 –RL 3	NITI Aayog Internship Scheme https://www.niti.gov.in/internship

COURSE OUTCOMES

After successful completion of this course, student should be able to –

- Students will demonstrate proficiency in applying theoretical knowledge and academic concepts to real-world professional situations.
- Students will possess job-specific skills that are relevant to their chosen field of study, enabling them to perform tasks and responsibilities effectively and efficiently.
- Students will acquire a comprehensive understanding of industry practices, trends, and challenges, contributing to their overall knowledge and expertise in the field.
- Students will establish professional networks and relationships, expanding their professional connections and opportunities for future collaborations and career advancement.
- Students will develop problem-solving and critical thinking abilities, demonstrating the ability to analyze complex situations, make informed decisions, and propose effective solutions.
- Students will demonstrate professionalism, adaptability, and effective communication skills in a professional work environment.

CHE514: FIELD PROJECT (FP)

PROGRAMME INFORMATION

SN	Description	Details
1	University	YashwantraoChavan Maharashtra Open University Nasik - 422 222, Maharashtra, India Website: http://www.ycmou.ac.in/ and http://ycmou.digitaluniversity.ac/
2	School	School of Sciences
3	Discipline	Science
4	Level	PG
5	Course Used in	V154: M.Sc.(Chemistry){2023 Pattern}

COURSE INFORMATION

Sem	Other	Code	Course Name	CR	CST	ST	CA	EE	TM	Type
02	FP	CHE514	Field Project (FP)	4	12	120	50	50	100	TW

PRESUMED KNOWLEDGE AND LEARNING OBJECTIVES

Presumed Knowledge	Learning Objectives
For successful completion of this course, student should have successfully complete: <ul style="list-style-type: none">B.Sc. with Chemistry or equivalent from a recognized University/Board.	The objectives of this course are– <ul style="list-style-type: none">Applying theoretical knowledge in real-world settings.Developing research and investigative skills.Conducting independent researchCollaborating and communicating effectively.Developing problem-solving and critical thinking abilities.

DETAILS ABOUT FIELD PROJECT [In process]

Domains

Maharashtra is a diverse state with various ecosystems, environmental and chemical challenges, and research opportunities. Choose a domain that aligns with your interests, the expertise of your faculty, and the resources available in your region. Field projects offer an opportunity to apply theoretical knowledge to real-world situations and contribute to addressing environmental and chemical challenges in the region. Some potential domains of field work for Chemistry students are listed as follows. Learner may find this helpful while choosing topic of the field work, but not limited to -

- Green Solvents and Sustainable Processes:** Investigate the use of environmentally friendly solvents and processes in chemical reactions, reducing the environmental impact.
- Catalysis and Reaction Optimization:** Develop and optimize catalytic processes for efficient and selective chemical transformations, relevant to Maharashtra's industrial needs.

- **Metal-Organic Frameworks (MOFs):** Study the synthesis and applications of MOFs in gas storage, separation, and catalysis, addressing environmental and energy challenges.
- **Biosynthesis of Nanoparticles:** Explore the use of biological entities for the synthesis of nanoparticles with specific sizes and shapes for various applications.
- **Chemical Imaging and Spectroscopy:** Apply advanced spectroscopic and imaging techniques to analyze the chemical composition and spatial distribution of materials.
- **Chemical Education and Outreach:** Design and implement chemistry education programs or workshops for schools and communities in Maharashtra.
- **Chemical Speciation Analysis:** Study the different chemical forms of elements in environmental samples, understanding their mobility and toxicity.
- **Microplastics Analysis:** Investigate the presence and distribution of microplastics in water bodies and sediments within Maharashtra.
- **Photocatalysis:** Explore the use of photocatalysts to initiate chemical reactions under light irradiation for applications in degradation of pollutants and hydrogen generation.
- **Chemical Sensors and Nanotechnology:** Develop nanoscale sensors for detecting specific analytes, such as gases, heavy metals, or biomolecules, in various matrices.
- **Chemical Informatics:** Use computational tools to analyze chemical data, predict properties, and aid in drug design or materials discovery.
- **Chemical Exposure Assessment:** Study the exposure of individuals in Maharashtra to chemicals through air, water, food, and occupational settings.
- **Analytical Method Validation:** Validate and optimize analytical methods for accuracy, precision, sensitivity, and specificity in various samples from Maharashtra.
- **Chemical Modification of Biomolecules:** Investigate the chemical modification of biomolecules like proteins, nucleic acids, and carbohydrates for biotechnological applications.
- **Chemical Ecology:** Study the chemical interactions between organisms and their environments, including chemical signaling and defense mechanisms.
- **Biocatalysis and Enzyme Engineering:** Explore the use of enzymes as biocatalysts for sustainable chemical transformations in Maharashtra's industries.
- **Chemical Safety and Hazard Assessment:** Evaluate the safety risks associated with chemical processes and propose measures for safe handling and disposal.

- **Quantum Chemistry:** Apply quantum chemical calculations to study molecular properties, electronic structure, and reaction mechanisms.
- **Chemical Process Intensification:** Develop innovative approaches to intensify chemical processes, improving efficiency and reducing resource consumption.
- **Chemical Synthesis of Nanomaterials:** Synthesize nanoparticles with controlled properties for applications in catalysis, electronics, and medicine.
- **Chemical Aspects of Renewable Energy:** Investigate chemical processes and materials involved in renewable energy technologies, such as solar cells and fuel cells.
- **Molecular Modeling and Drug Design:** Use computational modeling to design and predict the interactions between drugs and biological targets.
- **Analytical Chemistry in Food Safety:** Analyze food samples for contaminants, additives, and authenticity to ensure food safety in Maharashtra.
- **Molecular Spectroscopy:** Study molecular structure and dynamics using various spectroscopic techniques, such as NMR, IR, and UV-Vis.
- **Chemical Reaction Mechanisms:** Investigate the detailed mechanisms of complex chemical reactions and intermediates.
- **Chiral Chemistry:** Study asymmetric synthesis and chirality in molecules for pharmaceutical and agrochemical applications.
- **Chemical Kinetics and Thermodynamics:** Explore reaction rates, rate laws, and energy changes in chemical reactions.
- **Forensic Chemistry:** Analyze physical evidence from crime scenes using chemical methods for legal investigations.
- **Materials Characterization:** Study the properties and applications of materials through techniques like X-ray diffraction and microscopy.
- **Chemical Education Technology:** Develop digital tools and simulations to enhance chemistry education and learning experiences.
- **Chemical Oceanography:** Study the chemical composition and processes in oceanic systems, addressing marine pollution and biogeochemistry.
- **Analytical Quality Control:** Implement quality control procedures to ensure accuracy and reliability of analytical results.
- **Supramolecular Chemistry:** Investigate non-covalent interactions and self-assembly of molecules for designing functional materials.
- **Analytical Chemistry in Environmental Monitoring:** Monitor pollutants and contaminants in air, water, and soil samples from different regions of Maharashtra.

- **Chemical Communication in Insects:** Study the chemical signals and pheromones used by insects for communication and behavior.
- **Chemical Analysis of Archaeological Artifacts:** Analyze historical artifacts using chemical techniques to determine their composition and authenticity.
- **Chemical Evolution and Origins of Life:** Investigate the chemical processes that might have led to the emergence of life on Earth.
- **Chemical Imaging of Biological Systems:** Apply imaging techniques to study chemical processes within living organisms or biological tissues.
- **Chemical Analysis of Air Pollutants:** Measure and analyze air pollutants, including volatile organic compounds and particulate matter, in different locations within Maharashtra.
- **Chemistry of Traditional Medicines:** Investigate the chemical composition and bioactivity of traditional medicinal plants used in Maharashtra.

Guidelines: [In process]

Topic Selection and Proposal:

- Choose a well-defined and feasible topic that aligns with your interests, available resources, and the expertise of your mentors.
- Develop a clear and comprehensive project proposal that outlines the research objectives, significance, methodology, and expected outcomes.

Research Planning:

- Define your research question and objectives precisely. Identify the scope of your study, study area within Maharashtra, and the timeline for fieldwork.
- Conduct a thorough literature review to understand the existing knowledge and identify gaps in the chosen area of study.

Methodology:

- Determine the appropriate research methods and techniques based on your research objectives. These might include field surveys, sample collection, laboratory analysis, interviews, or experiments.
- Detail the step-by-step procedures you will follow during fieldwork, ensuring they are well-structured and repeatable.

Ethics and Permissions:

- If your research involves human subjects, ensure you obtain necessary ethical approvals from your academic institution.
- If conducting research/field work in protected areas or involving sensitive species, obtain required permits or approvals from relevant authorities.

Data Collection:

- Collect data systematically and accurately according to your defined methodology. Maintain organized records of observations, samples, measurements, and any other relevant information.

Data Analysis:

- Organize and manage your collected data in a format suitable for analysis.
- Apply appropriate statistical or analytical techniques to interpret your data and draw meaningful conclusions.

Results and Interpretation:

- Present your findings using tables, graphs, charts, and descriptive text.
- Interpret your results in the context of your research question and compare them with existing literature.

Discussion and Conclusion:

- Discuss the implications of your findings, considering how they contribute to the existing knowledge in your field and address the research gaps you identified.
- Reflect on any limitations of your study and suggest potential avenues for further research.

Reporting and Documentation:

- Create a well-structured report that includes an introduction, objectives, methods, results, discussion, and conclusion sections.
- Include proper citations for references to literature.
- Visual aids such as photographs, maps, and diagrams can enhance the clarity of your report.

Presentation and Communication:

- Present your findings to your academic institution, peers, and mentors through a seminar, presentation, or poster session.

- Practice clear and concise communication to effectively convey your research process and outcomes.

Time Management:

- Plan your fieldwork, data collection, and analysis schedule to ensure efficient use of time and resources.

Mentorship and Feedback:

- Collaborate closely with mentors or advisors who can provide guidance, feedback, and support throughout the project.

Flexibility and Adaptability:

- Be prepared to adjust your plans if you encounter unexpected challenges during fieldwork or analysis.

LEARNING RESOURCE DETAILS

LR Code	Title Author	Edition Year	ISBN Publisher
Course Website Link for (1) Mobile and Online Lectures, (2) Discussion Forum for online interaction and (3) Self-Test for each CR Block, Continuous Assessment Test and End Examination			
Text-Books			
CHE514	Field Project (FP)		
Reference-Books: Explore additional details and reinforce learning, with this optional learning resource!			
CD / DVD: Explore additional details and reinforce learning, with this optional learning resource!			
CHE514:CD1			
Web Links: Explore additional details and reinforce learning, with this optional learning resource!			
CHE514:WL1	https://sdgs.un.org/goals		
CHE514:WL2	https://cpcb.nic.in/standards/		
CHE514:WL3	www.ipcc.org ; https://www.ipcc.ch/report/sixth-assessment-report-cycle/		
OER: Explore additional details and reinforce learning, with this optional learning resource!			

COURSE OUTCOMES

After successful completion of this course, student should be able to –

- Students will demonstrate the ability to apply theoretical knowledge and concepts to

real-world situations, effectively bridging the gap between academia and practical applications.

- Students will develop advanced research and investigative skills, including the ability to design and execute research projects, collect and analyze data, and draw well-founded conclusions.
- Students will conduct independent research, demonstrating the ability to formulate research questions, design appropriate methodologies, and independently execute fieldwork or data collection.
- Students will exhibit effective collaboration and communication skills, demonstrating the ability to work collaboratively with others, engage in professional dialogue, and effectively communicate their research findings to diverse audiences.
- Students will showcase advanced problem-solving and critical thinking abilities, demonstrating the capacity to identify and address challenges encountered during fieldwork, analyze complex data, and propose innovative solutions.
- Students will demonstrate a thorough understanding of ethical considerations, field safety protocols, and best practices in their chosen field of study.

CHE515: ANALYTICAL CHEMISTRY

PROGRAMME INFORMATION

SN	Description	Details
1	University	Yashwantrao Chavan Maharashtra Open University Nasik - 422 222, Maharashtra, India Website: http://www.ycmou.ac.in/ and http://ycmou.digitaluniversity.ac/
2	School	School of Sciences
3	Discipline	Science
4	Level	PG
5	Course Used in	V154: M.Sc.(Chemistry){2023 Pattern} & V142: M.Sc.(Chemistry){2022 Pattern}

COURSE INFORMATION

Sem	Major	Code	Course Name	CR	CST	ST	CA	EE	TM	Type
02	DSE	CHE515	Analytical Chemistry	4	12	120	30	70	100	T

PRESUMED KNOWLEDGE AND LEARNING OBJECTIVES

Presumed Knowledge	Learning Objectives
<p>For successful completion of this course, student should have successfully complete:</p> <ul style="list-style-type: none"> B.Sc. with chemistry or equivalent from a recognized University/Board. 	<p>After successful completion of this course, student should be able to</p> <ul style="list-style-type: none"> To study the impart knowledge on the instrumentation of UV-Visible spectrometry and FT-IR To discuss the basic principles of Thermal methods, Polarography, powder and single crystal XRD techniques. To explore the applications of these instrumental techniques in studying various physical and chemical phenomena.

UNITS

UN	Name of the Unit	CSs	Questions
01-01	Basics of Analytical Chemistry	CR 01 MLs 01-20	As per evaluation pattern, on Each Credit , Student is required to answer <ul style="list-style-type: none"> Very Short Answer Question (VSAQ), of 03 marks Short Answer Question (SAQ), of 05 marks Long Answer Question
01-02	Classification of Analytical Techniques		
01-03	Types and Sources of Error		
01-04	Sampling		
02-01	Quantitative Analysis	CR 02 MLs 21-40	
02-02	Complexometric Titrations - Stability of Complexes		
02-03	Redox Equibria		
02-04	Gravimetric Analysis		

03-01	Chromatography Column Chromatography Gas Chromatography HPLC	CR 03 MLs 41-60	(LAQ) of 10 Marks
03-02			(LAQ may contain sub-questions
03-03			(a), (b) and so on.)
03-04			
04-01	Electro Analytical Techniques - Polarography	CR 04 MLs 61-80	
04-02	Electro Analytical Techniques - Amperometry		
04-03	Electro Analytical Techniques - Voltametry		
04-04	Voltametry - Quantitative and Qualitative aspects		

DETAILED SYLLABUS

UN	Detailed Syllabus of the Unit	CR
01-01	Basics of Analytical Chemistry: Analytical Chemistry, Errors, treatments and statistics, Chemical analysis, instrumental methods, Analytical methods, Techniques of analysis, classification of analytical techniques,	CR 01
01-02	Classification of Analytical Techniques: Classification of instrumental methods, factors affecting choice of analytical methods, interferences.	
01-03	Types and Sources of Error: determinate and indeterminate errors, accuracy and precision Absolute and relative errors, Minimisation of errors, Significant figures, Mean, median and standard deviation, Least square method.	
01-04	Sampling: Types of sampling, Techniques of sampling of gases, fluids, solids, and particulates. Good Laboratory Practices Problems.	
02-01	Quantitative Analysis: Fundamentals of quantitative analysis, Introduction, general terms in volumetric analysis, indicators, indicator theory, choice of indicators. Acid-base titrations, titration curves with example, Buffer solutions, acid-base equilibria in- polyprotic acids, amino acids, carbonates, bicarbonates, mixture of two acids.	CR 02
02-02	Complexometric Titrations-Stability of Complexes: Metal-ion buffer, titrations involving unidentate and multidentate ligands. Precipitation titrations and solubility equilibria, indicators, factors affecting solubility, applications of precipitation titrations.	
02-03	Redox Equilibria: Oxidation-reduction equilibria and applications, Nernst equation, titration curves, redox indicators, applications with respect to KMnO_4 , $\text{K}_2\text{Cr}_2\text{O}_7$, Iodine, and Potassium bromate.	
02-04	Gravimetric Analysis: Introduction, general terms used in gravimetry, steps in gravimetric analysis, conditions for precipitation, purity of the precipitate – Co-precipitation and Post-precipitation, precipitation from homogeneous solution, organic precipitants. Advantages and disadvantages of gravimetric analysis. Determination of iron gravimetrically from iron ore, determination of lead gravimetrically from Galena ore, determination of Pb gravimetrically from type metal alloy.	
03-01	Chromatography: General principle, classification of chromatographic methods, migration rates of solutes, chromatographic behaviour of solutes, band broadening, column efficiency and resolution. Thin layer chromatography, basic principle, coating materials, solvent-solvent system,	CR 03

	analytical and preparative TLC, methods of detection, applications and advances in TLC including modern TLC techniques.	
03-02	Column Chromatography: Principle and theory, adsorption and partition methods, stationary and mobile phase, columns and preparation of the columns, solvent systems, normal phase, reverse phase, detection methods and applications. Possible hyphenations- Advantages and limitations.	
03-03	Gas Chromatography: Basic Principle, Instrumentation, detectors, Applications, Advantage and disadvantages.	
03-04	HPLC: Basic Principle, Instrumentation, detectors, applications, advantage and disadvantages. Ion exchange chromatography: Introduction and basic principles, instrumentation, types of exchangers, synthesis of ion exchangers, mechanism of ion, exchange, exchange theories, methodology, and applications.	
04-01	Electro Analytical Techniques - Polarography: Introduction, Instrumentation, Ilkovic equation and its verification. Polarographic measurements, Dropping mercury electrode, Determination of half wave potential, qualitative and quantitative applications.	CR 04
04-02	Electro Analytical Techniques - Amperometry: Basic principles, instrumentation, Amperometric titration curves, Amperometric indicators, procedure for Amperometric titrations, Evaluation of amperometry in research and analytical applications.	
04-03	Electro Analytical Techniques - Voltammetry: Voltammetric methods of analysis, basic principles, instrumentation, voltammetric measurements, voltammetric techniques, current in voltammetry, shape of voltammograms	
04-04	Voltammetry - Quantitative and Qualitative Aspects: quantitative applications, characterization applications, Evaluation of CV in research and analytical applications.	

LEARNING RESOURCE DETAILS

LR Code	Title Author	Edition Year	ISBN Publisher
Course Website Link for (1) Mobile and Online Lectures, (2) Discussion Forum for online interaction and (3) Self-Test for each CR Block, Continuous Assessment Test and End Examination			
Text-Books			
CHE515	Analytical Chemistry -Dr A. V. Nagawade	2023	978-81-19453-27-6, YCMOU
Reference-Books: Explore additional details and reinforce learning, with this optional learning resource!			
CHE515 – RB1	Instrumental Methods of Chemical Analysis (V Edition) - Gurdeep. R. Chatwal, & Sham K Anand.	5 th edition 2023	9789351420880.
CHE515- RB2	Fundamentals of Analytical Chemistry (VIII Edition) - Skoog, D. A., & West, D. M.	2004	Singapore: Thomson Book Store.
CHE515- RB3	Instrumental Methods of Chemical Analysis -H.Kaur.	12 th edition 2016	9789386104250
CHE515- RB4	Elements of Analytical Chemistry - Gopalan, V., Subramanian, P. S., & Rangarajan, K.	2003	New Delhi: S. Chand and Sons.

CHE515- RB5	Physical Methods in Inorganic Chemistry - Drago, R .S.	2 th edition 2012	9780030751769
CD / DVD: Explore additional details and reinforce learning, with this optional learning resource!			
CHE515- - CD1			
Web Links: Explore additional details and reinforce learning, with this optional learning resource!			
CHE515- WL1			

COURSE OUTCOMES
<p>After successful completion of this course, student should be able to</p> <ul style="list-style-type: none"> • Impart knowledge on the instrumentation of UV-Visible spectrometry and FT-IR • Comprehend the basic principles of Thermal methods, Polarography, powder and single crystal XRD techniques. • Understand the applications of these instrumental techniques in studying various physical and chemical phenomena.

CHE516: CHEMICAL MATHEMATICS & BIOSTATISTICS

PROGRAMME INFORMATION

SN	Description	Details
1	University	Yashwantrao Chavan Maharashtra Open University Nasik - 422 222, Maharashtra, India Website: http://www.ycmou.ac.in/ and http://ycmou.digitaluniversity.ac/
2	School	School of Sciences
3	Discipline	Science
4	Level	PG
5	Course Used in	V154: M.Sc.(chemistry){2023 Pattern}

COURSE INFORMATION

Sem	Major	Code	Course Name	CR	CST	ST	CA	EE	TM	Type
02	DSE	CHE516	Chemical Mathematics & Biostatistics	4	12	120	30	70	100	T

PRESUMED KNOWLEDGE AND LEARNING OBJECTIVES

Presumed Knowledge	Learning Objectives
For successful completion of this course, student should have successfully complete: <ul style="list-style-type: none">B.Sc. with Chemistry or equivalent from a recognized University/Board.	The objectives of this course are <ul style="list-style-type: none">To study the functions, differential & integral.To explore the partial differentiationTo explain the Vectors, Matrices & DeterminantsTo study the statistics, probability & sampling.To explore the statistical techniques in pharmaceuticals.

UNITS

UN	Name of the Unit	CSs	Questions
01-01	Functions, Differential and Integral Calculus	CR 01 MLs 01-20	As per evaluation pattern, on Each Credit , Student is required to answer <ul style="list-style-type: none">Very Short Answer Question (VSAQ), of 03 marks
01-02	Applications In Chemistry		
01-03	Partial Differentiation		
01-04	Rules of Integration		
02-01	Differential Equations	CR 02 MLs 21-40	• Short Answer Question (SAQ), of 05 marks • Long Answer Question (LAQ) of 10 Marks (LAQ may contain sub-questions (a), (b) and so on.)
02-02	Probability and Theory of Errors		
02-03	Vectors, Matrices and Determinants		
02-04	Introduction to Matrix Algebra		
03-01	Statistics	CR 03 MLs 41-60	
03-02	Probability		
03-03	Sampling		
03-04	Estimation and Hypothesis Testing		

04-01	Experimental Design and Analysis of Variance Correlation and Regression Non-parametric Tests Statistical Techniques In Pharmaceutics	CR 04 MLs 61-80	
04-02			
04-03			
04-04			

DETAILED SYLLABUS

UN	Detailed Syllabus of the Unit	CR
01-01	Functions, Differential and Integral Calculus: Functions, Limits, Derivative, physical significance, basic rules of differentiation, Maxima and Minima.	CR 01
01-02	Applications In Chemistry: Exact and inexact differential, Taylor and Mc Laurin series, Curve sketching.	
01-03	Partial Differentiation: Partial differentiation, maxima and minima of functions of several variables, chemical applications.	
01-04	Rules of Integration: Rules of Integration, definite and indefinite integrals, geometrical meaning of integration, Applications in Chemistry	
02-01	Differential Equations: Separation of variables, homogeneous, exact, linear equations, Equations of Second order, Series solution method	CR 02
02-02	Probability and Theory of Errors: Permutations and Combinations, probability and probability theorems, Probability curves, Errors and Deviations, thermodynamic probability. Methods of Averages and Least Squares.	
02-03	Vectors, Matrices and Determinants: Vectors, dot, cross and triple products.	
02-04	Introduction to Matrix Algebra: Addition and Multiplication of Matrices, inverse, adjoint and transpose of matrices, unit, diagonal matrices, matrix eigenvalues and eigenvectors, diagonalization, determinants and their evaluation.	
03-01	Statistics: Introduction, its role and uses. Collection; Organization; Graphics and pictorial representation of data; Measures of central tendencies and dispersion. Coefficient of variation.	CR 03
03-02	Probability: Basic concepts; Common probability distributions and probability distributions related to normal distribution.	
03-03	Sampling: Simple random and other sampling procedures. Distribution of sample mean and proportion.	
03-04	Estimation and Hypothesis Testing: Point and interval estimation including fiducial limits. Concepts of hypothesis testing and types of errors. Student- t and Chi square tests. Sample size and power.	
04-01	Experimental Design and Analysis of Variance: Completely randomized, randomized blocks. Latin square and factorial designs. Post- hoc procedures.	
04-02	Correlation and Regression: Graphical presentation of two continuous variables; Pearson's product moment correlation coefficient, its statistical significance. Multiple and partial correlations. Linear regression; Regression line, coefficient of determination, interval estimation and hypothesis testing for population slope. Introduction to multiple linear regression models. Probit and logit transformations.	

04-03	Non-parametric Tests: Sign; Mann-Whitney U; Wilcoxon matched pair; Kruskal wallis and Friedman two way ANOVA tests. Spearman rank correlation.	CR 04
04-04	Statistical Techniques In Pharmaceuticals: Experimental design in clinical trials; Parallel and crossover designs. Statistical test for bioequivalence. Dose response studies; Statistical quality control.	

LEARNING RESOURCE DETAILS

LR Code	Title Author	Edition Year	ISBN Publisher
Course Website Link for (1) Mobile and Online Lectures, (2) Discussion Forum for online interaction and (3) Self-Test for each CR Block, Continuous Assessment Test and End Examination			
Text-Books			
CHE516	Chemical Mathematics & Biostatistics		
Reference-Books: Explore additional details and reinforce learning, with this optional learning resource!			
CHE516-RB1	Mathematical Preparation for Physical Chemistry -F. Daniels, McGraw Hill, NY	1959	9780070153011
CHE516-RB2	Introduction to Biostatistics - F James Rohlf , Robert R Sokal	2 nd edition 2009	978-0486469614
CHE516-RB3	Introduction to Quantum Mechanics- with Applications to Quantum Chemistry -L. Pauling and E. Bright Wilson, Dover Publishers, NY	1985	9780486648712
CHE516-RB4			
CHE516-RB5			
CD / DVD: Explore additional details and reinforce learning, with this optional learning resource!			
CHE516 - CD1			
Web Links: Explore additional details and reinforce learning, with this optional learning resource!			
CHE516- WL1			

COURSE OUTCOMES

After successful completion of this course, student should be able to

- Understand the functions, differential & integral.
- Explore the partial differentiation
- Explain the Vectors, Matrices & Determinants
- Analyze the statistics, probability & sampling.
- Use the knowledge of basic statistical methods to solve problems. Students are taught to operate. Use the statistical techniques in pharmaceuticals

SEMESTER 03

CHE601: ORGANIC REACTION MECHANISM

PROGRAMME INFORMATION

SN	Description	Details
1	University	Yashwantrao Chavan Maharashtra Open University Nashik - 422 222, Maharashtra, India Website: http://www.ycmou.ac.in/ and http://ycmou.digitaluniversity.ac/
2	School	School of Sciences
3	Discipline	Science
4	Level	PG
5	Course Used in	V154: M.Sc.(Chemistry){2023 Pattern} & V142: M.Sc.(Chemistry){2022 Pattern}

COURSE INFORMATION

Sem	Major	Code	Course Name	CR	CST	ST	CA	EE	TM	Type
03	DSC	CHE601	Organic Reaction Mechanism	4	12	120	30	70	100	T

PRESUMED KNOWLEDGE AND LEARNING OBJECTIVES

Presumed Knowledge	Learning Objectives
For successful completion of this course, student should have successfully complete: <ul style="list-style-type: none">B.Sc. with Chemistry or equivalent from a recognized University/Board.	The objectives of this course are <ul style="list-style-type: none">To Explain the Molecularity.To study provide a versatile knowledge of different name reactions and their application in synthesis.To learn about familiar Oxidation and Reduction reactions. Gain knowledge about reaction intermediates.To describe the principles and reaction mechanisms involving various Free radical reactions.To analyse the different organic reaction mechanisms.

UNITS

UN	Name of the Unit	CSs	Questions
01-01	Methods of Determining Reaction Mechanisms	CR 01 MLs 01-20	As per evaluation pattern, on Each Credit , Student is required to answer <ul style="list-style-type: none">Very Short Answer Question (VSAQ), of 03 marks
01-02	Types of Reactions		
01-03	Energy of Activation		
01-04	Non-Kinetic Methods		
02-01	Oxidation Methods	CR 02 MLs 21-40	• Short Answer Question (SAQ), of 05 marks <ul style="list-style-type: none">Long Answer Question
02-02	Oxidation Involving		
02-03	Reduction Methods		
02-04	Reductions of Conjugated Systems		

03-01	Reactive Intermediates: Carbenes & Nitrenes	CR 03 MLs 41-60	(LAQ) of 10 Marks (LAQ may contain sub-questions (a), (b) and so on.)
03-02	Study of Reactions		
03-03	Molecular Recognition		
03-04	Supramolecular Reactivity and Catalysis		
04-01	Types of Free Radical Reactions	CR 04 MLs 61-80	
04-02	Neighbouring Group Assistance		
04-03	Allylic Hydrogenation (NBS)		
04-04	Coupling of Alkynes & Arylation		

DETAILED SYLLABUS

UN	Detailed Syllabus of the Unit	CR
01-01	Methods of Determining Reaction Mechanisms: Introduction, Kinetics Methods, Order and Molecularity, Methods of following reaction rates (Pseudo-Molecular Reactions).	CR 01
01-02	Types of Reactions: Introduction, 1st, 2nd and 3rd order reactions; Reversible, Consecutive and Parallel reactions.	
01-03	Energy of Activation: Introduction, Activation Energy, Conclusions Drawn From Energy Profile Diagram, Thermodynamic or Mathematical Treatment of Transition.	
01-04	Non-Kinetic Methods: Introduction, Product Analysis, Determination of The Presence of Intermediates, Trapping of Reaction Intermediates, Isotopic Labelling And Isotope Effects, Cross-over Experiments, Stereochemical Evidence, Kinetic Evidence, Study Of Catalysis And Kinetic And Thermodynamic Control, Linear Free Energy Relationship.	
02-01	Oxidation Methods: Introduction, (metal, nonmetal based and organic oxidation methods) CrO ₃ (Jones reagent), PDC, PCC, , KMnO ₄ , MnO ₂ , NaIO ₄ , HIO ₄ Pb(OAc) ₄ OsO ₄ , RuO ₄ , mCPBA, Sharpless epoxidation , H ₂ O ₂ - NaOH, ozonolysis,	CR 02
02-02	Oxidation Involving: Introduction, Oxidation Involving Alkoxy sulphonium salts, Swern oxidation, SeO ₂ , Oppenauer oxidation, palladium catalyzed oxidation, Woodward Prevost reaction, Dess-Martin oxidation, IBX oxidation.	
02-03	Reduction Methods: Introduction, (hydrogenations, complex metal hydride reductions, dissolving metal reductions, other metal & nonmetal based reductions, organic reagents based reduction methods) Catalytic hydrogenation, Pd/C, PtO ₂ , H ₂ /catalyst, Selectivity of Reduction, Stereochemistry and mechanism, Wilkinson's catalyst, Boranes and Hydroboration reactions , NaBH ₄ , NaCNBH ₃ , Na(OAc) ₃ BH , LAH, DIBAL, superhydrides, Reductions with trialkylsilanes (R ₃ SiH), Reductions With Tributyltin Hydride (Bu ₃ SnH), MPV reduction, Wolf-Kishner Reduction NH ₂ -NH ₂ etc.	
02-04	Reductions of Conjugated Systems: Introduction, Birch reduction, reductive fission of alcohols, Pinacol coupling/McMurry coupling, Deoxygenation of carbonyl compounds, Shapiro reaction.	
03-01	Reactive Intermediates: Carbenes & Nitrenes: Introduction of Carbenes, Structure, Reactivity Of Carbenes, Generation Of Carbenes Reactions Involving	

	Carbenes, Behaviour Of Methylene (CH ₂), Introduction of Nitrenes, Curtius Reaction, Hoffman Reaction	
03-02	Study of Reactions: Alkyne metathesis reaction, Weinreb-Nahm ketone synthesis, Petasis reaction, Henry reaction, Corey Kim oxidation.	CR 03
03-03	Molecular Recognition: Introduction, Principles of molecular associations and organizations, Molecular receptors for different types of molecules substrates, Supramolecular reactivity and catalysis. Supramolecular devices: Crypts And Crown Ethers, Structure of Crown Ethers and Crypts, Novelcrownethers and important Properties, Synthesis Of Crown Ethers And Cryptands, Application and Uses of Crown Ethers And Crypts, Caged Molecules, Catenanes and Rotaxanes, Calixarenes.	
03-04	Supramolecular Reactivity and Catalysis: Introduction, Self-Assembly and Self-Organisation, Self assembly of inorganic architectures, Self assembly of organic supramolecular structures, Supramolecules devices, Molecular Recognition, Information and Signals Semiochemistry, Supramolecular Photochemistry, Light Conversion and Energy Transfer Devices, Photoinduced Electron Transfer in Photoactive Devices, Molecular and Supramolecular Electronic Devices, Supramolecular Electrochemistry, Electron conducting devices- Molecular Wires, Molecular and Supramolecular Devices.	
04-01	Types of Free Radical Reactions: Introduction, Types of Free radicals reactions, free radical substitution mechanism, Allylic Halogenation, Detection and Characterization of Radicals.	CR 04
04-02	Neighbouring Group Assistance: Introduction, Mechanism Of Anchimeric Assistance, Reactions With Oxygen As Neighboring Group Donor, Neighbouring Group Participation By Heteroatom Lone Pairs, Neighbouring Group Participation On SN ² Reactions, Neighbouring Group Participation On SN ¹ Reactions, Neighbouring Groups And Rearrangements,	
04-03	Allylic Hydrogenation (NBS): Introduction, Catalysts For Hydrogenation, Selectivity Of Hydrogenation, Halogenation Of Alkenes: Aspects Of Carbon-Carbon Double Bond Hydrogenations, Mechanism Of Hydrogenation And Stereochemical Aspects.	
04-04	Coupling Reaction of Alkynes & Arylation: Diazo Compounds & Diazonium Salt: Coupling Reaction, Sandmeyers reaction, Synthetic Applications, Hunsdiecker reaction.	

LEARNING RESOURCE DETAILS

LR Code	Title Author	Edition Year	ISBN Publisher
Course Website Link for (1) Mobile and Online Lectures, (2) Discussion Forum for online interaction and (3) Self-Test for each CR Block, Continuous Assessment Test and End Examination			
Text-Books			
CHE601	Organic Reaction Mechanism - Mr. Roshan A. Jadhav	2023	978-93-95855-76-1
Reference-Books: Explore additional details and reinforce learning, with this optional learning resource!			
CHE601- RB-1	Advanced Organic Chemistry Part-A & B -Carey, Francis A, Sundberg, Richard J.	4 th edition	9780306462450

		2017	
CHE601- RB-2	Advanced Organic Chemistry -Jerry March	8 th edition 2020	9781119371809
CHE601- RB-3	Organic Chemistry -Gene Davis	2013	9789381714195
CHE601- RB-4	Organic Chemistry -Clayden Greeves, Warren & wothers.	2012	9780199270293
CHE601- RB-5	Organic Structures from Spectra -L D field, S Sternhell, J R Kalman	1986	9780471906445
CD / DVD: Explore additional details and reinforce learning, with this optional learning resource!			
CHE601 - CD1			
Web Links: Explore additional details and reinforce learning, with this optional learning resource!			
CHE601- WL1			

COURSE OUTCOMES

After successful completion of this course, student should be able to

- Explain the Molecularity.
- Provide a versatile knowledge of different name reactions and their application in synthesis.
- Understand learn about familiar Oxidation and Reduction reactions. Gain knowledge about reaction intermediates.
- Use the principles and reaction mechanisms involving various Free radical reactions.
- Analyse the different organic reaction mechanisms.

CHE602: STEREOCHEMISTRY

PROGRAMME INFORMATION

SN	Description	Details
1	University	Yashwantrao Chavan Maharashtra Open University Nasik - 422 222, Maharashtra, India Website: http://www.ycmou.ac.in/ and http://ycmou.digitaluniversity.ac/
2	School	School of Sciences
3	Discipline	Science
4	Level	PG
5	Course Used in	V154: M.Sc.(Chemistry){2023 Pattern} & V142: M.Sc.(Chemistry){2022 Pattern}

COURSE INFORMATION

Sem	Major	Code	Course Name	CR	CST	ST	CA	EE	TM	Type
03	DSC	CHE609	StereoChemistry	4	12	120	30	70	100	T

PRESUMED KNOWLEDGE AND LEARNING OBJECTIVES

Presumed Knowledge	Learning Objectives
For successful completion of this course, student should have successfully complete: <ul style="list-style-type: none">B.Sc. with chemistry or equivalent from a recognized University/Board.	The objectives of this course are <ul style="list-style-type: none">To study about membrane and receptors in drug delivery process.To evaluate the various theoretical laws to predict the pharmaco-kinetics of the compounds.To study the molecular receptor binding and molecular recognition of the natural and synthetic compounds.

UNITS

UN	Name of the Unit	CSs	Questions
01-01	Conformational Analysis of Acyclic Compounds	CR 01 MLs 01-20	As per evaluation pattern, on Each Credit , Student is required to answer <ul style="list-style-type: none">Very Short Answer Question (VSAQ), of 03 marksShort Answer Question (SAQ), of 05 marksLong Answer Question (LAQ) of 10 Marks (LAQ may contain sub-questions (a), (b) and so on.)
01-02	Conformational Analysis of Alicyclic Compounds		
01-03	Conformation on Reactivity		
01-04	Kinetic Mechanism		
02-01	Conformational Analysis	CR 02 MLs 21-40	
02-02	Conformational Effects		
02-03	Fused Ring Systems		
02-04	Bridged Ring Systems		
03-01	Stereoselective Synthesis	CR 03 MLs 41-60	
03-02	Asymmetric Oxidations		
03-03	Diels-Alder Reactions		
03-04	Reduction Reactions		

04-01	Stereochemistry of Compounds	CR 04 MLs 61-80	
04-02	Configuration of Diastereomers		
04-03	O.R.D. and C.D.		
04-04	Conformation and Configuration		

DETAILED SYLLABUS

UN	Detailed Syllabus of the Unit	CR
01-01	Conformational Analysis of Acyclic Compounds: The difference between configuration and conformation. Klyne-Prelog terminology for torsionstrain, Pitzer strain, van der Waals interactions, hydrogen bonding, and gauche effect. Conformations of 2, 3-dimethylbutane, n-propyl chloride, 1, 2-dihaloethanes, glycols, halohydrines, Conformations of diastereoisomers; tartaric acid, ephedrine, pseudoephedrine and other compounds. Conformations around sp ³ -sp ² (carbonyls; aldehydes and ketones) and sp ² -sp ² (alkenes) bonds. Conformations around C-O and O-O bonds.	CR 01
01-02	Conformational Analysis of Alicyclic Compounds: Concept of Baeyer ring strain, Ring inversion, locking groups. Conformations of mono, di and polysubstituted cyclohexanes (1, 4-di-t-butylcyclohexane, 1, 4-cyclohexanediol, t-butylcyclohexanol, menthol, inositol, hexachlorocyclohexane and other related compounds). Conformations of rings containing sp ² hybridized carbon atoms; cyclohexanone and cyclohexene (substituted cyclohexanones: cyclohexanone-2-bromo cyclohexanone, dibromo cyclohexanone, 2-bromo-4, 4-dimethyl cyclohexanone and other related compounds).	
01-03	Conformation on Reactivity: Effect of conformation on reactivity of acyclic and cyclic systems, Curtin-Hammett principle. Effect of conformation on the course and rate of reactions in; debromination of 2,3-dibromobutane, semipinacolic deamination of 1,2-diphenyl-1-(p-chlorophenyl)-2-amino ethanol, dehydrohalogenation of stilbene dihalide and bromo-1,2-diphenyl propane, stereochemistry of molecular rearrangements; pyrolytic cis-elimination	
01-04	Kinetic Mechanism: Effect of conformation on the course and rate of the reactions, In cyclohexane systems illustrated by: (a) SN ₂ and SN ₁ reactions. (b) E ₁ , E ₂ eliminations illustrated by; (i) 4-t-butylcyclohexyltosylate (ii) 2-phenylcyclohexanol (iii) menthyl and neomenthyl chlorides and benzenehexachlorides. (c) Pyrolytic cis-elimination (d) semipinacolic deamination of 2-aminocyclohexanol, (e) esterification of hydroxyl carboxyl groups (methanol derivatives, (f) hydrolysis of esters and equatorial tosylates, (g) oxidation of cyclohexanols by chromic acid (h) epoxidation (formation and cleavage).	
02-01	Conformational Analysis: Conformational analysis of cycloalkanes other than cyclohexane: Shapes of four, five, seven, eight and higher membered rings. Concept of 'T' strain and trans-annular strain.	CR 02
02-02	Conformational Effects: Conformational effects in medium sized rings, (8-10 membered rings). Stability of rings and ease of rings formation. Conformational analysis of heterocycles (pyramidal inversion, anomeric effect, Rabbit-ear effect, Hockey-sticks effect). Conformations of dioxanes, monosaccharides and disaccharides.	
02-03	Fused Ring Systems: (a) Fused bicycles: cis and trans-decalins, octalins,	

	decalols, octahydronaphthalenes, decahydroquinoline, hydrindane (b) Fused polybicycles: Perhydroanthracene, perhydrophenanthrene, steroids. Locking groups of conformations indocalins and steroids.	
02-04	Bridged Ring Systems: Nomenclature, stereo chemical restrictions, Bredt's rule.	
03-01	Stereoselective Synthesis: Diastereo and enantio-controlled approaches, Chirality transfer. Stereoselectivity and stereospecificity: Kinetic and thermodynamic controls, asymmetric induction. General strategies for asymmetric synthesis: Chiron approaches, acyclic diastereoselective approaches, double asymmetric synthesis. Stereoselective addition of nucleophiles to carbonyl group: Re-Si face concepts, Cram's rule, Felkin Ahn rule, Houk model, Cram's chelate model. Asymmetric synthesis by use of chiral auxiliaries. Nucleophilic addition: use of chiral substrates, auxiliaries, reagents and catalysts; asymmetric conjugate addition; addition of allyl boron derivative; reactions at alpha carbon: enolate formation (regioselectivity and stereoselectivity); stereoselective enolate alkylation (oxazolidinone, oxazoline); asymmetric aldol reaction.	CR 03
03-02	Asymmetric Oxidations: Asymmetric epoxidation of allylic alcohols (Sharpless Epoxidation), dihydroxylation of olefins (Sharpless asymmetric dihydroxylation, Upjohn process, Milas hydroxylation), Asymmetric aminohydroxylation of olefins (Sharpless oxyamination), epoxidation of unfunctionalized olefins (Jacobsen epoxidation, Shi epoxidation, Dioxirane catalyst), Catalytic asymmetric epoxidation of aldehydes.	
03-03	Diels-Alder Reactions: Asymmetric Diels-Alder Reactions using chiral Lewis acids, (Narasakas catalyst, chiral lanthanide, bisulfonamides (Coreys catalyst), chiral acyloxy borane, bis (oxazoline), amino acid salts).	
03-04	Reduction Reactions: Asymmetric Catalytic Hydrogenation and Other Reduction Reactions, Chiral phosphine ligands for asymmetric catalytic hydrogenation, asymmetric reduction of carbonyl compounds.	
04-01	Stereochemistry of Compounds: Stereochemistry of compounds containing no chiral carbon atoms-Stereochemistry of allens, spirans and biphenyls, assignment of configuration.	CR 04
04-02	Configuration of Diastereomers: Geometrical isomerism based on physical and chemical methods.	
04-03	O.R.D. and C.D.: Linearly and circularly polarized lights, circular birefringence and circular dichroism, ORD and CD curves; cotton effect.	
04-04	Conformation and Configuration: Determination of the conformation and configuration, Empirical and semi-empirical rules; The octant rule, helicity rule, Lowe's rule, and axial haloketone rule.	

LEARNING RESOURCE DETAILS

LR Code	Title Author	Edition Year	ISBN Publisher
Course Website Link for (1) Mobile and Online Lectures, (2) Discussion Forum for online interaction and (3) Self-Test for each CR Block, Continuous Assessment Test and End Examination			
Text-Books			

CHE602	Stereochemistry - Dr. Nilesh B. patil	2023	978-93-95855-96-9
Reference-Books: Explore additional details and reinforce learning, with this optional learning resource!			
CHE602-RB1	Stereochemistry of organic compounds - D. Nasipuri	4 th edition 2020	978-9389802474
CHE602-RB2	Stereochemistry, Conformation and Mechanism - P.S. Kalsi	8 th edition 2015	978-8122435641
CHE602-RB3	Conformational analysis - Eliel, Allinger, Angyal and Morrison	1966	978-0444413758
CHE602-RB-4	Organic stereochemistry - Hallas	1965	978-0070940130
CHE602-RB-5	Organic stereochemistry - H. Kagan	1979	978-0470267257
CD / DVD: Explore additional details and reinforce learning, with this optional learning resource!			
CHE609 - CD1			
Web Links: Explore additional details and reinforce learning, with this optional learning resource!			
CHE602-WL1			

COURSE OUTCOMES

After successful completion of this course, student should be able to

- Comprehend the membrane and receptors in drug delivery process.
- Explore the various theoretical laws to predict the pharmaco-kinetics of the compounds.
- Analyses the molecular receptor binding and molecular recognition of the natural and synthetic compounds.

CHE603: ADVANCED SYNTHETIC METHODS

PROGRAMME INFORMATION

SN	Description	Details
1	University	Yashwantrao Chavan Maharashtra Open University Nasik - 422 222, Maharashtra, India Website: http://www.ycmou.ac.in/ and http://ycmou.digitaluniversity.ac/
2	School	School of Sciences
3	Discipline	Science
4	Level	PG
5	Course Used in	V154: M.Sc.(Chemistry){2023 Pattern} & V142: M.Sc.(Chemistry){2022 Pattern}

COURSE INFORMATION

Sem	Major	Code	Course Name	CR	CST	ST	CA	EE	TM	Type
03	DSC	CHE603	Advanced Synthetic Methods	2	6	60	15	35	50	T

PRESUMED KNOWLEDGE AND LEARNING OBJECTIVES

Presumed Knowledge	Learning Objectives
For successful completion of this course, student should have successfully complete: <ul style="list-style-type: none">B.Sc. / with Chemistry or equivalent from a recognized University/Board.	The objectives of this course are <ul style="list-style-type: none">To study the fundamental knowledge on structure, reactivity and reaction mechanism of organic compounds.To explore the organic transformations through disconnection approach.To study the application of spectroscopic techniques for compound characterization

UNITS

UN	Name of the Unit	CSs	Questions
01-01 01-02 01-03 01-04	Disconnection Approach Group Disconnections Retro-synthesis Retro-synthesis of Aromatic Heterocycles	CR 01 MLs 01-20	As per evaluation pattern, on Each Credit , Student is required to answer <ul style="list-style-type: none">Very Short Answer Question (VSAQ), of 03 marksShort Answer Question (SAQ), of 05 marksLong Answer Question (LAQ) of 10 Marks (LAQ may contain sub-questions (a), (b) and so on.)
02-01 02-02 02-03 02-04	Reagents and Reaction in synthesis-1 Reagents and Reaction in synthesis-2 Name Reaction-1 Name Reaction-2	CR 02 MLs 21-40	

DETAILED SYLLABUS

UN	Detailed Syllabus of the Unit	CR
01-01	Disconnection Approach: An introduction to Synthons and synthetic equivalents, disconnection approach, functional group interconversions importance of the order of events in organic synthesis.	CR 01
01-02	Group Disconnections: One group C-X, Two group disconnections in 1, 2; 1, 3 - 1, 4 & 1, 5-difunctional compounds,	
01-03	Retro-synthesis: alkene, acetylenes and aliphatic nitroalcohols and carbonyl compounds, amines. Importance of the Order of events in organicsynthesis, Chemoselectivity, Regioselectivity. Protecting groups, Diels-Alder reaction, Michael addition and Robinson anulation.	
01-04	Retro-synthesis of Aromatic Heterocycles: 3, 4, 5 and 6 membered carbocyclic and heterocyclic rings. Reversal of polarity (Umpolung).	
02-01	Reagents and Reaction In Synthesis-1: Application of the following reagents and reaction insynthesis, Lithium diisopropylamide (LDA) Dicyclohexyl carbodiimide (DCC), lead tetra acetate, PPA,	CR 02
02-02	Reagents and Reaction In Synthesis-2: Diazomethane, ozone, Phase transfer catalyst, Woodward-Prevost hydroxylation,	
02-03	Name Reaction-1 : Barton and Shapiro reaction, Hoffmann – Loffler-Fretag, Peterson synthesis, Selenium dioxide, Dess-Martinperiodinane,	
02-04	Name Reaction-2: Periodic acid, iodoisobenzyl diacetate, Olefin metathesis using Grub's catalysts.	

LEARNING RESOURCE DETAILS

LR Code	Title Author	Edition Year	ISBN Publisher
Course Website Link for (1) Mobile and Online Lectures, (2) Discussion Forum for online interaction and (3) Self-Test for each CR Block, Continuous Assessment Test and End Examination			
Text-Books			
CHE603	Advanced Synthetic Methods - Dr. Amol Kategaokar	2023	
Reference-Books: Explore additional details and reinforce learning, with this optional learning resource!			
CHE603-RB1	Organic Synthesis: Special Techniques Organic Synthesis -V. K. Ahluwalia, Renu Aggarwal	2001	9781842650585
CHE603-RB2	Advanced organic chemistry - Francis A. Carey , Richard J. Sundberg	2 nd edition 2008	978-0387683546
CHE603-RB3	Organic Synthesis Through Disconnection Approach -P S Kalsi	1 st edition 2014	978-9381714980
CD/DVD: Explore additional details and reinforce learning, with this optional learning resource!			
CHE603 -CD1			
Web Links: Explore additional details and reinforce learning, with this optional learning resource!			

COURSE OUTCOMES

After successful completion of this course, student should be able to

- Comprehend the fundamental knowledge on structure, reactivity and reaction mechanism of organic compounds.
- Explore the organic transformations through disconnection approach.
- Generalise application of spectroscopic techniques for compound characterization.

CHE604: LAB ACTIVITIES ON CHE 601, CHE 602 & CHE 603

PROGRAMME INFORMATION

SN	Description	Details
1	University	Yashwantrao Chavan Maharashtra Open University Nasik - 422 222, Maharashtra, India Website: http://www.ycmou.ac.in/ and http://ycmou.digitaluniversity.ac/
2	School	School of Sciences
3	Discipline	Science
4	Level	PG
5	Course Used in	V154: M.Sc.(Chemistry){2023 Pattern} & V142: M.Sc.(Chemistry){2022 Pattern}

COURSE INFORMATION

Sem	Major	Code	Course Name	CR	CST	ST	CA	EE	TM	Type
03	DSC	CHE604	Lab Activities On CHE 601, CHE 602 & CHE 603	4	12	120	50	50	100	T

PRESUMED KNOWLEDGE AND LEARNING OBJECTIVES

Presumed Knowledge	Learning Objectives
For successful completion of this course, student should have successfully complete: <ul style="list-style-type: none">B.Sc. / with Chemistry or equivalent from a recognized University/Board.	The objectives of this course are <ul style="list-style-type: none">To develop technical skill. To explain the basic principles about quantitative analyses.To evaluate the concepts and systematic procedure in gravimetric analysis.To apply the systematic procedure for estimation.To analyze the synthesis method for in-organic co-ordination complexesTo study the molecules and identify its nature through chromatography technique. To create ideas and concepts for water treatment process, food science and forensic fields.

UNITS/ACTIVITIES

UN	Name of the Unit	CSs
01-01	Single Stage Preparation Monitored by TLC (any 6)	CR 01
02-01	Two or three stage preparations starting with 5g or less and TLC.(Any 6)	CR 02
03-01 03-02	Extraction from Natural Products (Extraction and estimation of active constituents) Only for learning purpose and demo. (Any 4) Drug Analysis (Two)	CR 03

04-01	Green Chemistry Preparations (Any 6)	CR 04
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DETAILED PRACTICAL ACTIVITIES

No	List of Practical Activities	
01	I. Single Stage Preparation Monitored by TLC (any 6) a) Acetophenone to Benzalacetophenone. b) Resorcinol to 7-hydroxy, 4-methyl coumarin. c) Camphor to Borneol. d) Benzophenone to Benzhydrol. e) Acetoacetic ester to Pyrazolone. f) Paramino Benzoic Acid to Parachloro Benzoic Acid. g) 2-methoxy naphthalene to 1-formyl-2-methoxy naphthalene. h) Glycine to Benzoylglycine. i) Cyclohexanone to Adipic acid j) Cyclohexanone to Oxime k) P- nitrotoluene to p- nitrobenzoic acid.	CR 01
02	II. Two or three stage preparations starting with 5g or less and TLC.(Any 6) 1. Preparation of Anthranilic acid. 2. Preparation of p- Amino benzoic acid. 3. Preparation of p- Chloro nitrobenzene by Sandmeyer reaction. 4. Preparation of p- Iodonitrobenzene by Sandmeyer reaction. 5. Preparation of Benzylamine 6. Preparation of Benzimidazole 7. Preparation of 2-acetyl cyclohexanone 8. Multicomponent synthesis.	CR 02
03	III. A) Extraction from Natural Products (Extraction and estimation of active constituents) Only for learning purpose and demo. (Any 4) a. Lactose from milk. b. Caffeine from tea. c. Nicotine from tobacco extract. d. Citric acid or ascorbic acid from a tablet or from a natural source. e. Curcumin from turmeric. f. Lycopene from tomato. B) Drug Analysis (Two) a) Determination of iron from given drug sample. b) Determination of Magnesium from given Milk powder	CR 03
04	IV. A) Case Study of Stereochemistry & Use of Molecular Models (Any 3) B) Green Chemistry Preparations (Any 3) a) Bromination of acetanilide using Ferric ammonium nitrate. b) Preparation of Benzilic Acid using NaOH /KOH under Solvent-free Conditions. c) Photo reduction of benzophenone to benzopinacol in presence of sun light using isopropanol and acetic acid. d) Synthesis of Dibenzalpropanone from Benzaldehyde and Acetone (Aldol Condensation). e) Synthesis of Dihydropyrimidinone from Ethyl acetoacetate, Benzaldehyde and Urea. f) Synthesis of Aspirin.	CR 04

g) Synthesis of Polyvinylpyrrolidone (PVP).	
h) Synthesis of Soap.	

LEARNING RESOURCE DETAILS

LR Code	Title Author	Edition Year	ISBN Publisher
Course Website Link for (1) Mobile and Online Lectures, (2) Discussion Forum for online interaction and (3) Self-Test for each CR Block, Continuous Assessment Test and End Examination			
Text-Books			
CHE604	Lab Activities On CHE 601, CHE 602 & CHE 603 - Dr. Tukaram Thopate, Mr. Chandrashekar B. Patil, Mr. Ghanshyam S. Patil, Dr. Bharat More	2023	Publ. No: 2619, 2506
Reference-Books: Explore additional details and reinforce learning, with this optional learning resource!			
CHE604-RB1	Textbook of Practical Organic Chemistry – A. I. Vogel.	5 th edition 2005	9788177589573
CHE604-RB2	Practical Organic Chemistry – Mann & Saunders.	4 th edition 2009	978-8131727102
CHE604-RB3	A Handbook of Quantitative & Qualitative Analysis - H. T. Clarke.	4 th edition 2021	978-8123915012
CHE604-RB4	Organic Synthesis Collective Volumes -Jeremiah P. freeman	2004	9780471660521
CD / DVD: Explore additional details and reinforce learning, with this optional learning resource!			
CHE604 - CD1			
Web Links: Explore additional details and reinforce learning, with this optional learning resource!			
CHE604-WL1			

COURSE OUTCOMES

After successful completion of this course, student should be able to

- Develop technical skill. Explain the basic principles about quantitative analyses.
- Understand the concepts and systematic procedure in gravimetric analysis.
- Apply the systematic procedure for estimation.
- Analyze the synthesis method for in-organic co-ordination complexes
- Analyze the molecules and identify its nature through chromatography technique. Create ideas and concepts for water treatment process, food science and forensic fields.

CHE605: RESEARCH PROJECT

PROGRAMME INFORMATION

SN	Description	Details
1	University	Yashwantrao Chavan Maharashtra Open University Nasik – 422 222, Maharashtra, India Website: http://www.ycmou.ac.in/ and http://ycmou.digitaluniversity.ac/
2	School	School of Sciences
3	Discipline	Science
4	Level	PG
5	Course Used in	V154: M.Sc.(Chemistry){2023 Pattern} & V142: M.Sc.(Chemistry){2022 Pattern}

COURSE INFORMATION

Sem	Other	Code	Course Name	CR	CST	ST	CA	EE	TM	Type
03	RP	CHE605	Organic Chemistry Project Work	4	12	120	50	50	100	PW

PRESUMED KNOWLEDGE AND LEARNING OBJECTIVES

Presumed Knowledge	Learning Objectives
For successful completion of this course, student should have successfully complete: <ul style="list-style-type: none">B.Sc./ with Chemistry or equivalent from a recognized University/Board.	The objectives of this course are <ul style="list-style-type: none">To develop technical skillTo empower our students with practical skills to comprehend the physiology and other functions of each and every vital systems

GUIDELINES FOR PROJECT

No	Guidelines for Project
1	The “Project Work” course aims to imbibe in students the principle that working is learning. Learning and working are two sides of the same coin and thus, work experience enhances the learning.
2	This course is based on preliminary research oriented topics both in theory and experiment. The subject expert/ counselor will act as supervisors for the projects. Project shall be on the current and relevant topics and issues. Project topic is jointly finalized by the student and the project supervisors through discussion. At the completion of the project by the semester end, the student will submit a Project Report in the form of Dissertation which will be examined by the examiners. The end examination shall consist of (a) Presentation and (b) Comprehensive viva-voce.
3	Students are expected to work on “Project Work” for about 6 hours per week (About 2 hour’s self-study at residence and 12 hours in counselling session at study centre), during a semester. Thus only those projects, demanding such study efforts on all those activities, listed in above, should be selected.

4	<p>A single student will have to do a project.</p> <p>Since. The student invests his energy, time and resources in a project. The project therefore should, have important focus on some relevant practical aspects. This will help student to justify his efforts on project.</p>
5	<p>Employed Students are allowed to complete “Project Work” in the industry where he/she is employed or his/ her place of choice. Such a student has to identify a resource person in industry, who can take responsibility of guiding him in project work. Such person should be eligible to work as “ProjectGuide”.</p>
6	<p>Study centre should assist unemployed students, in locating sponsored “Projects” from local industries. Students are encouraged to locate sponsored projects from the local industries. But, in case, a student is unable to locate such project, he is also allowed to complete “Project Work” at his study center.</p>
7	<p>The Project Work must involve practical research work related to your selected discipline.</p>
8	<p>Students have to finance expenditure on “Project” by his own. Hence students should select those projects, accordingly.</p>
9	<p>Each “Project Guide” may be assigned maximum 5 students.</p>
10	<p>The original design requirements are not essential, although highly encouraged. Hence, normally, projects should not be repeated. The same project undertaken in recent past, by past students, should be avoided. But it is most important that, students must put his independent study efforts on the project. Thus, student should gain practical project execution knowledge about making some useful product, after he goes through all projects completion steps listed above.</p>
11	<p>There project report should be file bound/spiral bound/hard bound and should have following format</p> <ul style="list-style-type: none"> • Title Page/Cover page • Certificate endorsed by Project Guide/Supervisor, Learner Support Center Coordinator and Head • Declaration for followed ethical practice and non-plagiarism • Acknowledgement • Abstract of the project • Table of Contents • List of Figures • List of Tables • Chapters of Project Report – <ul style="list-style-type: none"> Chapter 1: Introduction: Background of the project, Need for the project, Brief idea of the project, Literature review, Aims and Objectives of the project Chapter 2: Design and Methodology: overview of the complete project, the scientific principles involved in the design of the project, Block Diagrams, Experimental/Theoretical Methodology/Circuit/Model/ materials required, etc. Chapter 3: Testing, Conduct of Experiment/ Module: Actual conduct of experiment, measurements, observations, etc Chapter 4: Analysis of Data: Analysis of the data and observations received during experimentation Chapter 5: Results, Discussion and Conclusions: Discuss why the specifications were not met or the reasons for the failure, if any. Discussed the

	<p>problems and difficulties encountered and how they were / can be eliminated. Discuss any extension work or modifications, which you want to suggest.</p> <p>Chapter 6: References: List the books, reference books, journals, websites, magazines and data manuals used, etc</p>
12	<p>Project Report Submission Process: Student should prepare 2 copies of the Project Report. At the beginning, the respective Project Guide must approve both copies positively before the end examination of Project Work. Then respective Study Center Coordinator approves both copies of the Project Report. Student should submit one of these approved copies to the study center. The student should retain remaining one of these approved copies. Study center should preserve their copy of, all project reports, till the end examination of Project Work. Even student must bring his own copy during this end examination.</p>
13	<p>Project Report Format:</p> <ol style="list-style-type: none"> The project report should be printed on only right side of A4 size (210 mm ´ 297 mm) paper. There is no minimum or maximum page number limit for the “Project Report”, but report of minimum 50–70 pages is expected. University recommends only flexible binding for the “Project Report”. But, if student wishes, he may also use spiral binding. Margins should be as follows:• <ul style="list-style-type: none"> Left Margin : 40mm Right Margin : 20mms

LEARNING RESOURCE DETAILS

LR Code	Title Author	Edition Year	ISBN Publisher
Course Website Link for (1) Mobile and Online Lectures, (2) Discussion Forum for online interaction and (3) Self-Test for each CR Block, Continuous Assessment Test and End Examination			
Text-Books			
CHE605	Organic Chemistry Project Work	2023	
Reference-Books: Explore additional details and reinforce learning, with this optional learning resource!			
CHE605-RB1	Modern Projects and Experiments in Organic Chemistry: Miniscale and Williamson Microscale -Jerry R. Mohrig , Christina Norin Hammond, Paul F. Schatz , Terrence C. Morrill	3rd edition 2003	9780716739210
CHE605-RB2	Organic Chemistry -Leroy G Wade	8rd edition 2016	9789332578586
CHE605-RB3			
CHE605-RB4			
CD / DVD: Explore additional details and reinforce learning, with this optional learning resource!			
CHE605 -CD1			
Web Links: Explore additional details and reinforce learning, with this optional learning resource!			

CHECHE605- WL1			
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COURSE OUTCOMES

After successful completion of this course, student should be able to

- Use to develop technical skill.
- Build empower our students with practical skills to comprehend the physiology and other functions of each and every vital systems.

CHE606: GREEN CHEMISTRY

PROGRAMME INFORMATION

SN	Description	Details
1	University	Yashwantrao Chavan Maharashtra Open University Nasik - 422 222, Maharashtra, India Website: http://www.ycmou.ac.in/ and http://ycmou.digitaluniversity.ac/
2	School	School of Sciences
3	Discipline	Science
4	Level	PG
5	Course Used in	V154: M.Sc.(Chemistry){2023 Pattern} & V142: M.Sc.(Chemistry){2022 Pattern}

COURSE INFORMATION

Sem	Major	Code	Course Name	CR	CST	ST	CA	EE	TM	Type
03	DSE	CHE606	Green Chemitry	4	12	120	30	70	100	T

PRESUMED KNOWLEDGE AND LEARNING OBJECTIVES

Presumed Knowledge	Learning Objectives
<p>For successful completion of this course, student should have successfully complete:</p> <ul style="list-style-type: none"> BSc/ with Chemistry or equivalent from a recognized University/Board. 	<p>The objectives of this course are</p> <ul style="list-style-type: none"> To discuss knowledge about the concept of Green chemistry. To understand the 12 principles of Green chemistry as well as the tools of Gree chemistry. To apply how to evaluate a reaction or process and determine “Greener” alternatives. To explore focus on the application of greener routes to improve industrial processes and to produce important products. To evaluate the greener synthetic pathway to produce pharmacological compounds. Understand the basics of Medicinal chemistry.

UNITS

UN	Name of the Unit	CSs	Questions
01-01	Introduction to Green Chemistry	CR 01 MLs 01-20	As per evaluation pattern, on Each Credit , Student is required to answer
01-02	Need for Green Chemistry		
01-03	Goals of Green Chemistry		
01-04	Principles of Green Chemistry		
02-01	Atom Economy-1	CR 02 MLs 21-40	<ul style="list-style-type: none"> Very Short Answer Question (VSAQ), of 03 marks Short Answer Question
02-02	Atom Economy-2		
02-03	Green Solvents-1		
02-04	Green Solvents-2		

03-01	Alternative Sources of Energy: Microwaves	CR 03 MLs 41-60	(SAQ), of 05 marks • Long Answer Question (LAQ) of 10 Marks (LAQ may contain sub-questions (a), (b) and so on.)
03-02	Alternative Sources of Energy: Ultrasonication		
03-03	Alternative Sources of Energy: Photochemistry		
03-04	Alternative Sources of Energy: Electro-synthesis		
04-01	Green Synthesis/Reaction	CR 04 MLs 61-80	
04-02	Real World Cases		
04-03	Chemical Industry		
04-04	Combinatorial Green Chemistry		

DETAILED SYLLABUS

UN	Detailed Syllabus of the Unit	CR
01-01	Introduction to Green Chemistry: Introduction to Green Chemistry, Green Chemistry: History Of Green Chemistry/Origins Of Green Chemistry, What is Green Chemistry: Definition, Principles of Green Chemistry	CR 01
01-02	Need for Green Chemistry: Introduction, Need for Green Chemistry, Advantages & Disadvantages of Green Chemistry, Limitations/Disadvantages Of Green Chemistry.	
01-03	Goals of Green Chemistry: Introduction to Goals Of Green Chemistry, Limitations/ Obstacles, In the pursuit of the goals of Green Chemistry.	
01-04	Principles of Green Chemistry: Introduction, Principles Of Green Chemistry, Atom Economy, Less Hazardous Chemical Syntheses, Twelve principles of Green Chemistry with their explanations.	
02-01	Atom Economy-1: Introduction, Atom Economy Of The Rearrangement Reactions, Atom Economy Of The Addition Reactions.	CR 02
02-02	Atom Economy-2: Introduction to Atom Economy Of The Substitution Reactions, Atom Economy Of The Elimination Reactions.	
02-03	Green Solvents-1: Introduction, Supercritical fluids, Water as a solvent for organic reactions, Ionic liquids, Fluorous biphasic solvent,	
02-04	Green Solvents-2: Introduction, PEG, solvent less processes, immobilized solvents and how to compare greenness of solvents.	
03-01	Alternative Sources of Energy: Microwaves: Introduction, Alternative sources of energy: use of microwaves, Microwave Reactions In Water, Microwave Reactions In Organic Solvents, Microwave Solvent-Free Reactions (Solid State Reactions).	CR 03
03-02	Alternative Sources of Energy: Ultrasonication: Introduction, Sonochemistry, Ultrasound Assisted Reactions.	
03-03	Alternative Sources of Energy: Photochemistry: Introduction, Photochemistry, Photochemical Reactions, Commercial Photochemical Process.	
03-04	Alternative Sources of Energy: Electro-synthesis: Introduction, Electrochemical Synthesis, Synthesis Of Adiponitrile, Synthesis Of Sebacic Acid, Synthesis Of 3-Bromothiophene.	

04-01	Green Synthesis/Reaction: Introduction, Green starting materials, Green reagents, Green solvents, reaction conditions, Green catalysis and Green synthesis-	CR 04
04-02	Real World Cases: Introduction, (Traditional processes and green ones) Synthesis of Ibuprofen, Adipic acid, disodium iminodiacetate (alternative to Strecker synthesis).	
04-03	Chemical Industry: Introduction, Hazard assessment and mitigation in chemical industry, Future trends in Green Chemistry-oxidation-reduction reagents and catalysts; biomimetic, multifunctional reagents.	
04-04	Combinatorial Green Chemistry: Introduction, Proliferation of solventless reactions; Noncovalent derivatization. Biomass conversion, emission control and biocatalysis.	

LEARNING RESOURCE DETAILS

LR Code	Title Author	Edition Year	ISBN Publisher
Course Website Link for (1) Mobile and Online Lectures, (2) Discussion Forum for online interaction and (3) Self-Test for each CR Block, Continuous Assessment Test and End Examination			
Text-Books			
CHE606	Green Chemistry -Dr. Santosh R. Deshmukh	2023	978-81-19453-03-0
Reference-Books: Explore additional details and reinforce learning, with this optional learning resource!			
CHE606-RB1	Green Chemistry: Theory and Practice -Anastas, P. T., & Warner, J. C.	2010	978-3642061653
CHE606-RB2	Green Chemistry Environmentally Benign Reactions -V K Ahluwalia	2014	9788180520228
CHE606-RB3	Introduction to Green Chemistry - Ryan, M. A., & Tinnesand, Washington:	2002	9780841238480
CHE606-RB4	New Trends in Green Chemistry -V K Ahluwalia and M Kidwai	2002	978-9401571029
CD / DVD: Explore additional details and reinforce learning, with this optional learning resource!			
CHE606 - CD1			
Web Links: Explore additional details and reinforce learning, with this optional learning resource!			
CHE606-WL1			

COURSE OUTCOMES

After successful completion of this course, student should be able to

- Comprehend the knowledge about the concept of Green chemistry.
- Understand the 12 principles of Green chemistry as well as the tools of Green

chemistry.

- Apply how to evaluate a reaction or process and determine “Greener” alternatives.
 - Build focus on the application of greener routes to improve industrial processes and to produce important products.
 - Evaluate the greener synthetic pathway to produce pharmacological compounds.
- Understand the basics of Medicinal chemistry.

CHE607: DRUGS AND HETEROCYCLIC

PROGRAMME INFORMATION

SN	Description	Details
1	University	Yashwantrao Chavan Maharashtra Open University Nasik - 422 222, Maharashtra, India Website: http://www.ycmou.ac.in/ and http://ycmou.digitaluniversity.ac/
2	School	School of Sciences
3	Discipline	Science
4	Level	PG
5	Course Used in	V154: M.Sc.(Chemistry){2023 Pattern} & V142: M.Sc.(Chemistry){2022 Pattern}

COURSE INFORMATION

Sem	Major	Code	Course Name	CR	CST	ST	CA	EE	TM	Type
03	DSE	CHE607	Drugs and Heterocyclic	4	12	120	30	30	100	T

PRESUMED KNOWLEDGE AND LEARNING OBJECTIVES

Presumed Knowledge	Learning Objectives
For successful completion of this course, student should have successfully complete: <ul style="list-style-type: none">B.Sc./ with Chemistry or equivalent from a recognized University/Board.	The objectives of this course are <ul style="list-style-type: none">To study the classification, Chemical structure, production, properties and uses of Drug.To discuss the dyeing process on fibers.To explain the types of dyes in various applicationsTo explore the Pollution Control in Drug Industry. Apply the various finishing process of Drug.To evaluate this fundamentals to fabricate the material and its dying process.

UNITS

UN	Name of the Unit	CSs	Questions
01-01 01-02 01-03 01-04	Drug Design Theories of Drug Activity Study of Antibiotics Anti-Malarial, Analgesic, Antipyretics & Anti-Inflammatory Drugs	CR 01 MLs 01-20	As per evaluation pattern, on Each Credit , Student is required to answer <ul style="list-style-type: none">Very Short Answer Question (VSAQ), of 03

02-01	Anti-Tubercular Agents, Antileprotic Agents And Anaesthetics	CR 02 MLs 21-40	marks • Short Answer Question (SAQ), of 05 marks • Long Answer Question (LAQ) of 10 Marks (LAQ may contain sub-questions (a), (b) and so on.)
02-02	Anti-Histamines And Psychoactive Drugs		
02-03	Anti-Infective Drugs & Cardiovascular Drugs		
02-04	Anti-Neoplastic Drugs		
03-01	Heterocycles	CR 03 MLs 41-60	
03-02	Small Ring Heterocycles		
03-03	Five Membered Heterocycles		
03-04	Six Membered Heterocycles-1		
04-01	Six Membered Heterocycles-2	CR 04 MLs 61-80	
04-02	Synthesis and Reactions of Benzo Fused Diazines		
04-03	Benzofused Heterocycles With Two Hetero Atom		
04-04	Benzthiazole and Benzoxazole		

DETAILED SYLLABUS

UN	Detailed Syllabus of the Unit	CR
01-01	Drug Design: Procedures followed in drug design, factors affecting development of new drugs, concepts of prodrugs and soft drugs, Isosterism, bioisosterism,	CR 01
01-02	Theories of Drug Activity: Quantitative structure activity relationship, QSAR theory, Concepts of drug receptors.	
01-03	Study of Antibiotics: Classification of antibiotics, Preparation of semi synthetic penicillin, Penicillin G, Penicillin V, conversion of penicillin into cephalosporin.	
01-04	Anti-Malarial, Analgesic, Antipyretics & Anti-Inflammatory Drugs: a) Antimalerials: Trimethoprim, Amodiaquine b) Analgesic & Antipyretics: Meperidine, Aminopyrine, Diflunisal c) Anti-Inflammatory: Oxyphenylbutazone, Indomethacin	
02-01	Antitubercular Agents, Antileprotic Agents And Anaesthetics a) Antitubercular & antileprotic: Dapsone, Pyrazinamide, Ethionamide b) Anaesthetics: Lidocaine, Thiopental	CR 02
02-02	Antihistamines And Psychoactive Drugs: a) Antihistamines: Cyproheptadine, Cetirizineg) b) Psychoactive drugs: Ethiosuximide, Glutethimid	
02-03	Anti-Infective Drugs & Cardiovascular Drugs: a) Antiinfective drugs: Grisefulvin, norfloxacin Anti AIDS: General study b) Cardiovascular: Synthesis of warfarim, Clofibrate, quinidine, methyl dopa, atenolol	
02-04	Anti-neoplastic drugs: Cancer chemotherapy, Synthesis of mechloraethamine, cyclophosphamide, Mephalan, uracils, mustards. Recent development in cancer chemotherapy. Hormones and natural products.	
03-01	Heterocycles: Introduction, Principles.	CR

03-02	Small Ring Heterocycles: Three membered and four membered Heterocycles- synthesis and reactions of aziridines, oxiranes, thiranes, azetidines.	03
03-03	Five Membered Heterocycles: Benzofused five membered Heterocycles, Synthesis and reactions of benzopyrroles, benzofurans and benzothiophenes.	
03-04	Six Membered Heterocycles-1: Six membered Heterocycles with one heteroatom, Synthesis and reactions of pyrilium salts and pyrones, coumarins, chromones.	
04-01	Six Membered Heterocycles-2: Six membered Heterocycles with two and more Heteroatoms	CR 04
04-02	Synthesis and Reactions of Benzo Fused Diazines: Synthesis and reactions of diazines & triazines.	
04-03	Benzofused Heterocycles With Two Hetero Atom: Benzofused heterocycles with two hetero atom, Synthesis and reactions of benzimidazole	
04-04	Benzthiazole and Benzoxazole: Heterocycles with two heteroatoms.	

LEARNING RESOURCE DETAILS

LR Code	Title Author	Edition Year	ISBN Publisher
Course Website Link for (1) Mobile and Online Lectures, (2) Discussion Forum for online interaction and (3) Self-Test for each CR Block, Continuous Assessment Test and End Examination			
Text-Books			
CHE607	Drug and Heterocycles - Dr. Santosh R. Deshmukh	2023	
Reference-Books:			
CHE607-RB1	Medicinal Chemistry, - A. Kar. (Wiley East)	7 th edition 2018	978-9386649720
CHE607-RB2	An introduction to chemistry of heterocyclic compounds, -R. M. Acheson	2008	9788126516605
CHE607-RB3	Heterocyclic chemistry, -R. K. Bansal	5 th edition 2020	978-81-224-3143-8
CD / DVD: Explore additional details and reinforce learning, with this optional learning resource!			
CHE607 -CD1			
Web Links: Explore additional details and reinforce learning, with this optional learning resource!			
CHE607-WL1			

COURSE OUTCOMES

After successful completion of this course, student should be able to

- Generalise the classification, Chemical structure, production, properties and uses of Drug.

- Understand the dyeing process on fibers.
- Analyzes the types of dyes in various applications
- Use the Pollution Control in Drug Industry. Apply the various finishing process of Drug.
- Explore this fundamental to fabricate the material and its dyeing process.

CHE608: BIOTECHNOLOGY

PROGRAMME INFORMATION

SN	Description	Details
1	University	Yashwantrao Chavan Maharashtra Open University Nasik - 422 222, Maharashtra, India Website: http://www.ycmou.ac.in/ and http://ycmou.digitaluniversity.ac/
2	School	School of Sciences
3	Discipline	Science
4	Level	PG
5	Course Used in	V154: M.Sc.(chemistry){2023 Pattern}

COURSE INFORMATION

Sem	Major	Code	Course Name	CR	CST	ST	CA	EE	TM	Type
03	DSE	CHE608	Biotechnology	4	12	120	30	70	100	T

PRESUMED KNOWLEDGE AND LEARNING OBJECTIVES

Presumed Knowledge	Learning Objectives
For successful completion of this course, student should have successfully complete: <ul style="list-style-type: none">B.Sc. with Chemistry or equivalent from a recognized University/Board.Computer fundamentals	The objectives of this course are <ul style="list-style-type: none">To study the origin, & history of Biotechnology.To discuss the classification on Proteins. & types of enzymes.To explore structural model of DNA. To explain Chemical composition structure and functions of RNA.To discuss on Microscopy & Spectroscopy.To explore Fundamentals of Bioinformatics, Databases and Industrial Bioprocesses

UNITS

UN	Name of the Unit	CSs	Questions
01-01	Biotechnology	CR 01 MLs 01-20	As per evaluation pattern, on Each Credit , Student is required to answer <ul style="list-style-type: none">Very Short Answer Question (VSAQ), of 03 marksShort Answer Question (SAQ), of 05 marksLong Answer Question
01-02	Commercial Potentials of Biotechnology		
01-03	Proteins		
01-04	Classification of Proteins		
02-01	Enzymes	CR 02 MLs 21-40	
02-02	Nucleic Acids		
02-03	Lipids		
02-04	Classification of Lipids		

03-01	Microscopy	CR 03 MLs 41-60	(LAQ) of 10 Marks (LAQ may contain sub-questions (a), (b) and so on.)
03-02	Spectroscopy		
03-03	Nanobiotechnology		
03-04	Applications of Nanobiotechnology		
04-01	Basics of Bioinformatics	CR 04 MLs 61-80	
04-02	Introductory Biological Databases		
04-03	Applications of Bioinformatics		
04-04	Industrial Bioprocesses		

DETAILED SYLLABUS

UN	Detailed Syllabus of the Unit (Discussed with Author and Modified Units 03-03 to 04-04 on 8 May 2024)	CR
01-01	Biotechnology: Origin & definition, history of biotechnology, biotechnology as a interdisciplinary area, scope & importance of biotechnology, branches of biotechnology, biotechnology in India.	CR 01
01-02	Commercial Potentials of Biotechnology: Achievements of Biotechnology, Misuse of Biotechnology, Prevention of misuse of Biotechnology, Future of Biotechnology.	
01-03	Proteins: Introduction, General structure of amino acids, Structure of peptide bond, Structural classification of amino acids based on R side chain.	
01-04	Classification of Proteins: classification of proteins based on chemical composition, conformation (globular & fibrous) and biological functions, structural levels of proteins.	
02-01	Enzymes: Definition, Structure- Concept of apoenzyme, coenzyme, cofactor, prosthetic group and active site. Types- Extracellular, Intracellular, Endoenzymes and exoenzymes, Constitutive and Inducible.	CR 02
02-02	Nucleic Acids: Nucleosides, nucleotides, polynucleotide, Watson and Crick's structural model of DNA, Polymorphism of DNA helices (A, B, C, D, E, & Z) & RNA: Chemical composition structure and functions of mRNA, rRNA, tRNA. Forces stabilizing nucleic acid structure.	
02-03	Lipids: Definition, Classification of fatty acids based on nature of Hydrocarbon chain – Saturated and unsaturated.	
02-04	Classification of Lipids: Classification of lipids based on backbone structure – simple (triacylglycerols & waxes), compound (phospholipids, sphingolipids, cerebrosides), derived – e.g. cholesterol, Functions of lipids.	
03-01	Microscopy: <u>A. General Principles of Microscopy</u> – Image formation, Magnification, Numerical aperture (uses of oil immersion objective), Resolving power and Working distance. <u>B. Ray diagram, special features, applications and comparative study of – i) Compound Microscope ii) Electron Microscope</u>	CR 03
03-02	Spectroscopy: Lambert-Beer's law principle, construction & working of colorimeter, spectrophotometer. Physical methods to find out molecular	

	structure: NMR & X-ray crystallography.	
03-03	Nanobiotechnology: Introduction, what is Nanotechnology and Nanobiotechnology, Principles of nanoparticle synthesis using living organisms and characterization.	
03-04	Application of Nano-biotechnology: Different morphological forms of nanomaterials (nanosphere, Nano capsules, dendrimers), Application in drug delivery, importance of nanomedicine, Biochips.	
04-01	Basics of Bioinformatics: Introduction to Bioinformatics: History, Development and Advantages of Bioinformatics. Relation of Bioinformatics and chemistry in real world.	CR 04
04-02	Introductory Biological Databases: Introduction, Nature of Biological data, characteristics of data, Tools for Protein function analysis, Homology and similarity, structure analysis, sequence analysis, BLAST, FASTA, EMBOSS, Clustalw.	
04-03	Applications of Bioinformatics: Drug Designing, Proteomics analysis, Drug dose regime analysis, Biometrical analysis for improvising crop management, Evolutionary study.	
04-04	Industrial Bioprocesses: Microbial production of organic acids, amino acids, proteins polysaccharides, lipids, antibiotics & pharmaceuticals; methods & applications of immobilization of cells & enzymes; biosensors; biofuels; biopesticides; environmental bioremediation.	

LEARNING RESOURCE DETAILS

LR Code	Title Author	Edition Year	ISBN Publisher
Course Website Link for (1) Mobile and Online Lectures, (2) Discussion Forum for online interaction and (3) Self-Test for each CR Block, Continuous Assessment Test and End Examination			
Text-Books			
CHE608	Biotechnology		
Reference-Books: Explore additional details and reinforce learning, with this optional learning resource!			
CHE608-RB1	Biotechnology expanding horizons - B. D. Singh	2010	978-8127261535
CHE608-RB2	Biotechnology - V. Kumarsan,	2015	978-9384826109
CHE608-RB3	Computer Fundamentals -P. K. Sinha		
CHE608-RB4	Bioinformatics – P.Rastogi, S.C. Rastogi, N. Mendiritta	4 th edition 2013	978-8120347854
CHE608-RB5			
CD / DVD: Explore additional details and reinforce learning, with this optional learning			

resource!			
CHE608 - CD1			
Web Links: Explore additional details and reinforce learning, with this optional learning resource!			
CHE608-WL1			

COURSE OUTCOMES

After successful completion of this course, student should be able to

- Generalise the classification on proteins & types of enzymes
- Understand the structural model of DNA, Chemical composition, structure and functions of RNA.
- Analyzes the Microscopy & Spectroscopy
- Use the Fundamentals of Computers & Bioinformatics.
- Explore the Commercial potentials of Biotechnology.

SEMESTER 04

CHE609: ADVANCED ORGANIC CHEMISTRY

PROGRAMME INFORMATION

SN	Description	Details
1	University	Yashwantrao Chavan Maharashtra Open University Nasik - 422 222, Maharashtra, India Website: http://www.ycmou.ac.in/ and http://ycmou.digitaluniversity.ac/
2	School	School of Sciences
3	Discipline	Science
4	Level	PG
5	Course Used in	V154: M.Sc.(Chemistry){2023 Pattern} & V142: M.Sc.(Chemistry){2022 Pattern}

COURSE INFORMATION

Sem	Major	Code	Course Name	CR	CST	ST	CA	EE	TM	Type
04	DSC	CHE609	Advanced Organic Chemistry	4	12	120	30	70	100	T

PRESUMED KNOWLEDGE AND LEARNING OBJECTIVES

Presumed Knowledge	Learning Objectives
<p>For successful completion of this course, student should have successfully complete:</p> <ul style="list-style-type: none">B.Sc./ with Chemistry or equivalent from a recognized University/Board.	<p>The objectives of this course are</p> <ul style="list-style-type: none">To study about versatile knowledge of rearrangementsTo explain the different organic (radical and concerted) reactions and their applications in synthesis. To implement this basic concept to design and produce the new organic molecules.To explore the principles of conformational analysis and stereochemistry.To describe the concepts in organic photochemistry.To evaluate the various theories in pericyclic reactions.

UNITS

UN	Name of the Unit	CSs	Questions
01-01	Molecular Rearrangements	CR 01 MLs 01-20	As per evaluation pattern, on Each Credit , Student is required to answer <ul style="list-style-type: none">Very Short Answer Question (VSAQ), of 03
01-02	Migration to Carbonyl Carbon		
01-03	Rearrangements to Electron Deficient Nitrogen and Oxygen		
01-04	Non-cyclic Rearrangements		

02-01	Conformational Analysis and Stereochemistry	CR 02 MLs 21-40	marks • Short Answer Question (SAQ), of 05 marks • Long Answer Question (LAQ) of 10 Marks (LAQ may contain sub-questions (a), (b) and so on.)
02-02	Stereochemistry of Simple Addition and Elimination Reactions		
02-03	Planar Chirality		
02-04	Molecular Chirality		
03-01	Radical Reactions	CR 03 MLs 41-60	
03-02	Radical Substitution		
03-03	Typical Reactions		
03-04	Oxidation and Reductions-Mechanisms		
04-01	Organic Photochemistry	CR 04 MLs 61-80	
04-02	Paterno Buchi Reaction		
04-03	Pericyclic Reactions		
04-04	Cycloaddition - [2+2] Addition - Diel's-Alder Reaction		

DETAILED SYLLABUS

UN	Detailed Syllabus of the Unit	CR
01-01	Molecular Rearrangements: Introduction, Intramolecular 1, 2 - shifts - Wagner - Meerwein and Pinacol-Pinacolone rearrangements.	CR 01
01-02	Migration to Carbonyl Carbon: Introduction, Demyanov Neber and Benzil-benzilic acidrearrangements.	
01-03	Rearrangements to Electron Deficient Nitrogen and Oxygen: Introduction, Baeyer -Villiger, Dienone -phenol, Favorskii, Fries, Wolff, Benzidine, Hoffmann, Beckmann Rearrangement and Stevens rearrangements.	
01-04	Non-cyclic Rearrangements: Introduction, Chapman and Wallach rearrangements.	
02-01	Conformational Analysis and Stereochemistry: Introduction, Stereochemistry of sulphur and nitrogen compounds, stereo-selective and stereo-specific reactions -R/S-notation of optically active carbon compounds. Optical isomerism of biphenyl, allenes and spiranes.	CR 02
02-02	Stereochemistry of Simple Addition and Elimination Reactions: Introduction, Stereospecific and Stereoselective synthesis.	
02-03	Planar Chirality: Introduction, cyclophanes and ansa compounds - geometrical isomerism - E/Z notation-configuration in aldoximes and ketoximes. Conformation in cyclic system decalins, perhydro phenanthrene and perhydro anthracene. Conformation and reactivity of cyclohexanes.	
02-04	Molecular Chirality: Introduction, Allenes, Spiranes, Biphenyls-Conformations of Cyclopentane, Cyclohexane, Cyclohexene and Fused (decalin) and Bridged (norbornane type) ring systems -Anomeric effect in cyclic compounds.	
03-01	Radical Reactions: Introduction, Configuration and generation of short lived free radicals-characteristics of free radical reactions	CR 03
03-02	Radical Substitution: Introduction, Radical additions and rearrangement of free radicals.	
03-03	Typical Reactions: Introduction, such as Sandmeyer, Gomberg, Pechmann, Ullmann, Pschorr and Hunsdiecker reactions.	
03-04	Oxidation and Reductions-Mechanisms: Introduction, aromatisation,	

	oxidation of alcohols and glycols, ozonolysis, Sommelet reaction and selectivity in reduction-metal hydride reduction-reduction of nitro compounds and acyloin condensation.	
04-01	Organic Photochemistry: Introduction, Introductory theory of light absorption- Jablonski diagram-photophysical processes-excimer and exciplexes - energy transfer-geometry of excited states –quantum efficiency-photochemical reaction of ketones- Norrish type-I and type-II reactions.	CR 04
04-02	Paterno Buchi Reaction: Introduction, cis and trans isomerisation-Photo-Fries rearrangement-Enone reaction- Di-pimethane rearrangement-Barton reaction-photoreduction of ketones.	
04-03	Pericyclic Reactions: Introduction, Definition-classification-characteristic features- the electrocyclic reaction-Woodward –Hofmann rules- orbital correlation diagram- the Frontier molecular orbital theory-electrocyclic conversion of 1,3-dienes and 1,3,5-trienes.	
04-04	Cycloaddition - [2+2] Addition-Diel's Alder Reaction: Introduction, stereochemistry of Diel's Alder reaction. Sigmatropic reactions –[1,3], [1,5] and [3,3] sigmatropic shifts - Cope and Claisen rearrangements.	

LEARNING RESOURCE DETAILS

LR Code	Title Author	Edition Year	ISBN Publisher
Course Website Link for (1) Mobile and Online Lectures, (2) Discussion Forum for online interaction and (3) Self-Test for each CR Block, Continuous Assessment Test and End Examination			
Text-Books			
CHE609	Organic Chemistry –II - Dr. Nilesh B. Patil	2023	978-93-95855-70-9
Reference-Books: Explore additional details and reinforce learning, with this optional learning resource!			
CHE609RB-1	Reactions, Rearrangements and Reagents - Sanyal, S. N.	4 th edition 2019	978-8177096057
CHE609RB-2	Advanced Organic Reaction Mechanism (III Edition). - Tewari, N. Kolkata:Books and Allied (P) Ltd.	1 th edition 2019	978-8187134565
CHE609RB-3	March's Advanced Organic Chemistry: Reactions, Mechanisms, and Structure - Smith, M. B.	7 th edition 2015	978-8126556588
CHE609RB-4	Organic Chemistry -Clayden Greeves, Warren & wothers.	2012	9780199270293
CD / DVD: Explore additional details and reinforce learning, with this optional learning resource!			
CHE510 -CD1			
Web Links: Explore additional details and reinforce learning, with this optional learning resource!			
CHE510-WL1			

COURSE OUTCOMES

After successful completion of this course, student should be able to

- Know about versatile knowledge of rearrangements
- Explain the different organic (radical and concerted) reactions and their applications in synthesis. Implement this basic concept to design and produce the new organic molecules.
- Analyze the principles of conformational analysis and stereochemistry.
- Describe the concepts in organic photochemistry.
- Analyze the various theories in pericyclic reactions.

CHE610: ADVANCED ORGANIC SPECTROSCOPY

PROGRAMME INFORMATION

SN	Description	Details
1	University	Yashwantrao Chavan Maharashtra Open University Nasik - 422 222, Maharashtra, India Website: http://www.ycmou.ac.in/ and http://ycmou.digitaluniversity.ac/
2	School	School of Sciences
3	Discipline	Science
4	Level	PG
5	Course Used in	V154: M.Sc.(Chemistry){2023 Pattern} & V142: M.Sc.(Chemistry){2022 Pattern}

COURSE INFORMATION

Sem	Major	Code	Course Name	CR	CST	ST	CA	EE	TM	Type
04	DSC	CHE609	Advanced Organic Spectroscopy	4	12	120	30	70	100	T

PRESUMED KNOWLEDGE AND LEARNING OBJECTIVES

Presumed Knowledge	Learning Objectives
<p>For successful completion of this course, student should have successfully complete:</p> <ul style="list-style-type: none"> B.Sc./with Chemistry or equivalent from a recognized University/Board. 	<p>The objectives of this course are</p> <ul style="list-style-type: none"> To study the Electronic spectroscopy, about IR spectroscopy. To describe the basic concept of NMR spectroscopy To apply the different aspects of NMR spectroscopy to predict the structure of compounds. To analyze about the mass spectroscopy and Mossbauer spectroscopy. To evaluate about the invaluable tools in synthetic chemistry for the confirmation of To known molecules and elucidation of shape and structures of unknown compounds of high complexity with a high degree of certainty.

UNITS

UN	Name of the Unit	CSs	Questions
01-01 01-02 01-03 01-04	Ultra Violet and Visible Spectroscopy Molecular Structure Woodward-Fisher Rules Calculation of λ Max	CR 01 MLs 01-20	As per evaluation pattern, on Each Credit , Student is required to answer
02-01 02-02 02-03 02-04	Infrared Spectroscopy IR Spectroscopy: Characteristics Vibrational Frequencies Detailed Study of Vibrational Frequencies of Carbonyl Compounds FT-IR Materials of Gaseous, Solids And Polymeric Materials	CR 02 MLs 21-40	<ul style="list-style-type: none"> Very Short Answer Question (VSAQ), of 03 marks Short Answer Question (SAQ), of 05 marks

03-01	NMR Spectroscopy	CR 03 MLs 41-60	• Long Answer Question (LAQ) of 10 Marks (LAQ may contain sub-questions (a), (b) and so on.)
03-02	General Introduction and Definition		
03-03	Stereochemistry		
03-04	¹³C NMR Spectroscopy		
04-01	Mass Spectrometry	CR 04 MLs 61-80	
04-02	Analysis of Spectra		
04-03	Fragmentation Associated With Functional Groups		
04-04	Mossbauer Spectroscopy		

DETAILED SYLLABUS

UN	Detailed Syllabus of the Unit	CR
01-01	Ultraviolet and Visible Spectroscopy: spectra Electronic of diatomic molecules - laws of photochemistry-electronicabsorptiontransitions-	CR 01
01-02	Molecular Structure: correlation of electronic structure with molecular structuresimple chromophoric groups - effects of conjugation-	
01-03	Woodward -Fisher Rules: For α , β unsaturatedcarbonyl compounds & dienes -aromatic systems with extended conjugation - applicationstoorganicand inorganiccompounds-Instrumentation.	
01-04	Calculation of λ Max: Ultraviolet spectra of aromatic and heterocyclic compounds, Steric effect in biphenyls.	
02-01	Infrared Spectroscopy: The vibrating diatomic molecules –the simple harmonic oscillator and anharmonic oscillator. The diatomic rotor –factors influencing vibrational frequencies –identification of fundamental groups. Fingerprint region-application to organic and inorganic compounds-.	CR 02
02-02	IR Spectroscopy: Characteristics Vibrational Frequencies: Characteristic vibrational frequencies of alkanes; alkenes; alkynes; aromatic compounds; alcohols; ethers; phenols and amines.	
02-03	Detailed Study of Vibrational Frequencies of Carbonyl Compounds: [ketones; aldehydes; esters; amides; acids; anhydrides; lactones; lactams and conjugated carbonyl compounds] Effect of hydrogen bonding and solventeffect on vibrational frequencies; overtones; combination bands and Fermi resonance.	
02-04	FT-IR Materials of Gaseous, Solids And Polymeric Materials: Gaseous, Solids and polymeric materials.	
03-01	NMR Spectroscopy: Principle of NMR spectroscopy – description of the PMR instrument, factors affectingchemicalshifts-chemicalshiftequivalence andmagnetic equivalence-spin-spincoupling first order and non-first order spectra - Hetero nuclear coupling in ¹ HNMR - deuteriumexchange - high field spectra - double resonance-shift reagents-applications to organic andinorganiccompounds.	CR 03
03-02	General Introduction and Definition: Chemical shift; spin –spin interaction; shielding mechanism of measurement; chemical shift values and correlation for protons bonded to carbons [aliphatic; olefinic; aldehydic and aromatic] and other nuclei [alcohols; phenols; enols; acids; ammines; amides and mercaptans]; chemical exchange; effect of deuteration; complex spin-spin interaction between two; three; four; and five nuclei [first order spectra]; virtual coupling	
03-03	Stereochemistry: Stereochemistry hindered rotation; Karplus curve	

	variation of coupling constant with dihedral angle. Simplification of complex spectra; nuclear magnetic double resonance; shift reagent; solvent effect. Fourier transform technique, nuclear overhauser effect [NOE] Resonance of other nuclei – F; P.	
03-04	¹³C NMR Spectroscopy: Factors affecting the chemical shifts - broad band and off-resonance decoupling-applications in organic chemistry.	
04-01	Mass Spectrometry: Principles of mass spectrometry, Resolution - description of single focusing and double focusing electron impact mass spectrometers –presentation and analysis of spectra.	CR 04
04-02	Analysis of Spectra: Nitrogen rule- Stevenson's rule - isotope abundance analysis - meta stable ions and peaks the molecular ion peak - fragmentation processes –Retro Diels –Alder rearrangement –McLafferty rearrangement.	
04-03	Fragmentation Associated With Functional Groups: Ortho effect fragmentation associated with functional groups, Aldehydes, ketones, carboxylic acids, esters, amides, alcohols, thiols, amine, ethers, sulphides and halides.	
04-04	Mossbauer Spectroscopy: Mossbauer spectroscopy–principles, spectrometer-isomer shift-quadrupole interaction nuclear Zeeman splitting–applications.	

LEARNING RESOURCE DETAILS

LR Code	Title Author	Edition Year	ISBN Publisher
Course Website Link for (1) Mobile and Online Lectures, (2) Discussion Forum for online interaction and (3) Self-Test for each CR Block, Continuous Assessment Test and End Examination			
Text-Books			
CHE610	Advanced Organic Spectroscopy - Dr. Nazia A. Rashidi	2023	978-93-95855-75-4
Reference-Books: Explore additional details and reinforce learning, with this optional learning resource!			
CHE610 – RB 1	Advanced Organic Chemistry Part-A & B -Carey, Francis A, Sundberg, Richard J.	4 th edition 2017	9780306462450
CHE610- RB2	Advanced Organic Chemistry -Jerry March	8 th edition 2020	9781119371809
CHE610 – RB3	Fundamentals of Molecular & Spectroscopy - Banwell, McGraw-Hill Education (India) Pvt. Limited	4 th edition 2017	978-9352601738
CHE610- RB4	Elementary Organic Spectroscopy: Principles and Chemical Applications - Sharma, Y. R.	5 th edition 2013	978-8121928847
CHE610- RB5	Organic Structure From Spectra -L D Field, S Sternhell	1986	9780471906476
CD / DVD: Explore additional details and reinforce learning, with this optional learning resource!			
CHE610 - CD1			
Web Links: Explore additional details and reinforce learning, with this optional learning resource!			

CHE610- WL1			
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COURSE OUTCOMES

After successful completion of this course, student should be able to

- Explain the Electronic spectroscopy.
Understand about IR spectroscopy. Describe the basic concept of NMR spectroscopy
- Apply the different aspects of NMR spectroscopy to predict the structure of compounds.
- Analyze about the mass spectroscopy and Mossbauer spectroscopy.
- Evaluate about the invaluable tools in synthetic chemistry for the confirmation of
- Known molecules and elucidation of shape and structures of unknown compounds of high complexity with a high degree of certainty.

CHE611: LAB ACTIVITIES ON CHE 609 & CHE 610

PROGRAMME INFORMATION

SN	Description	Details
1	University	Yashwantrao Chavan Maharashtra Open University Nasik - 422 222, Maharashtra, India Website: http://www.ycmou.ac.in/ and http://ycmou.digitaluniversity.ac/
2	School	School of Sciences
3	Discipline	Science
4	Level	PG
5	Course Used in	V154: M.Sc.(Chemistry){2023 Pattern} & V142: M.Sc.(Chemistry){2022 Pattern}

COURSE INFORMATION

Sem	Major	Code	Course Name	CR	CST	ST	CA	EE	TM	Type
04	DSC	CHE611	Lab Activities On CHE 609, CHE 610	4	12	120	50	50	100	T

PRESUMED KNOWLEDGE AND LEARNING OBJECTIVES

Presumed Knowledge	Learning Objectives
<p>For successful completion of this course, student should have successfully complete:</p> <ul style="list-style-type: none"> B.Sc./ with Chemistry or equivalent from a recognized University/Board. 	<p>The objectives of this course are</p> <ul style="list-style-type: none"> To develop technical skill. To explain the basic principles about quantitative analyses. To evaluate the concepts and systematic procedure in gravimetric analysis. To apply the systematic procedure for estimation. To analyze the synthesis method for in-organic co-ordination complexes To study the molecules and identify its nature through chromatography technique. To creates ideas and concepts for water treatment process, food science and forensic fields.

UNITS/ACTIVITIES

UN	Name of the Unit	CSs
01-01	Qualitative Analysis (Any 6)	CR 01
02-01	Quantitative analysis-Two step Preparations (Any 6)	CR 02
03-01	Estimation: (Any2) Preparations: Single Stage (Any 4)	CR 03
04-01	Preparations: Single Stage (Any 6)	CR 04
04-02	Interpretation of UV, FT-IR and ¹H-NMR & Mass spectrum of above synthesized compounds. (Any 6 Compounds)	

DETAILED PRACTICAL ACTIVITIES

No	List of Practical Activities	
01	<p>Qualitative Analysis and Quantitative Analysis: Qualitative Analysis (Any 6) Separation, purification and identification of compounds of ternary mixtures using semi-microanalysis, TLC, column chromatography and chemical tests. IR spectra to be used for functional group identification.</p>	CR 01
02	<p>Quantitative analysis 1. Two step Preparations(Any 6) a) Preparation of m-Nitroaniline b) Preparation of Benzanilide from benzophenone c) Preparation of Phthalimide d) Preparation of N-Bromosuccinimide e) Preparation of 4-methyl -7-acetoxy coumarin f) Preparation of 1, 2, 3, 4- Tetrahydro carbazole g) Preparation of p-ethoxy acetanilide</p>	CR 02
03	<p>Estimation:(Any 2) a) Todetermine the percentage or numberof phenolic groups in the given sample by The acetylation method. b) Todetermine the percentage or number of methoxyl groups in the given sample byThe Zeisel’s method. c) Todetermine the percentage or number of acetyl groups in an Acetyl Ester. d) Estimation of the amount of HCHO in the given solution by sodium sulphite method.</p> <p>Preparations: Single Stage (Any 4) 13) Benzophenone to Benzpinacol 14) p-Nitrotoluene to p-Nitrobenzoic acid 15) Anisole to 2,4-Dinitroanisole 16) Phthalic anhydride to phthalimide 17) Phthalimide to Anthranilic acid 18) Acetanilide to p-Bromoacetanide 19) p-Bromoacetanide to p-Bromoaniline 20) m-Dinitrobenzene to m-Nitroaniline</p>	CR 03
04	<p>1. Preparations: Single Stage (Any 6) 1) Cyclohexanone to Adipic acid 2) Benzophenone to Benzhydral 3) Anthracene to Anthraquinone 4) Chlorobenzene to 2,4-Dinitrochlorobenzene 5) 2,4-Dinitrochlorobenzene to 2,4-Dinitrophenol 6) Acetoacetic ester to 1-Phenyl-3-methyl-5 pyrazolone 7) Benzaldehyde to Cinnamic acid 8) 4-Chlorobenzaldehyde to 4-Chlorobenzoic acid + 4-Chlorobenzyl alcohol 9) Benzene to β-Benzoyl propionic acid 10) Benzaldehyde to Dibenzylidene acetone 11) p-Aminobenzoic acid to p-Chlorobenzoic acid 12) N,N-Dimethylaniline to 4-Formyl-N, N-dimethyl aniline</p> <p>2. Interpretation of UV, FT-IR and ¹H-NMR & Mass spectrum of above synthesized compounds. (Any 6 Compounds)</p>	CR 04

LEARNING RESOURCE DETAILS

LR Code	Title Author	Edition Year	ISBN Publisher
Course Website Link for (1) Mobile and Online Lectures, (2) Discussion Forum for online interaction and (3) Self-Test for each CR Block, Continuous Assessment Test and End Examination			
Text-Books			
CHE611	Lab Activities On CHE 609, CHE 610 - Dr. Tukaram Thopate, Mr. Chandrashekar B. Patil, Mr. Ghanshyam S. Patil, Dr. Bharat More	2023	Publ. No: 2619, 2506
Reference-Books: Explore additional details and reinforce learning, with this optional learning resource!			
CHE611- RB1	Textbook of Practical Organic Chemistry – A. I. Vogel.	5 th edition 2005	9788177589573
CHE611- RB2	Practical Organic Chemistry – Mann & Saunders.	4 th edition 2009	978-8131727102
CHE611- RB3	A Handbook of Quantitative & Qualitative Analysis - H. T. Clarke.	4 th edition 2021	978-8123915012
CHE611- RB4	Organic Synthesis Collective Volumes -Jeremiah P. freeman	2004	9780471660521
CD / DVD: Explore additional details and reinforce learning, with this optional learning resource!			
CHE611 - CD1			
Web Links: Explore additional details and reinforce learning, with this optional learning resource!			
CHE611- WL1			

COURSE OUTCOMES

After successful completion of this course, student should be able to

- Develop technical skill. Explain the basic principles about quantitative analyses.
- Understand the concepts and systematic procedure in gravimetric analysis.
- Apply the systematic procedure for estimation.
- Analyze the synthesis method for in-organic co-ordination complexes
- Analyze the molecules and identify its nature through chromatography technique. Create ideas and concepts for water treatment process, food science and forensic fields.

CHE612: RESEARCH PROJECT

PROGRAMME INFORMATION

SN	Description	Details
1	University	Yashwantrao Chavan Maharashtra Open University Nasik – 422 222, Maharashtra, India Website: http://www.ycmou.ac.in/ and http://ycmou.digitaluniversity.ac/
2	School	School of Sciences
3	Discipline	Science
4	Level	PG
5	Course Used in	V154: M.Sc.(Chemistry){2023 Pattern}

COURSE INFORMATION

Sem	Other	Code	Course Name	CR	CST	ST	CA	EE	TM	Type
04	RP	CHE612	Organic Chemistry Project Work	6	12	120	75	75	150	PW

PRESUMED KNOWLEDGE AND LEARNING OBJECTIVES

Presumed Knowledge	Learning Objectives
For successful completion of this course, student should have successfully complete: <ul style="list-style-type: none">B.Sc./ with Chemistry or equivalent from a recognized University/Board.	The objectives of this course are <ul style="list-style-type: none">To develop technical skillTo empower our students with practical skills to comprehend the physiology and other functions of each and every vital systems

GUIDELINES FOR PROJECT

No	Guidelines for Project
1	The “Project Work” course aims to imbibe in students the principle that working is learning. Learning and working are two sides of the same coin and thus, work experience enhances the learning.
2	This course is based on preliminary research oriented topics both in theory and experiment. The subject expert/ counselor will act as supervisors for the projects. Project shall be on the current and relevant topics and issues. Project topic is jointly finalized by the student and the project supervisors through discussion. At the completion of the project by the semester end, the student will submit a Project Report in the form of Dissertation which will be examined by the examiners. The end examination shall consist of (a) Presentation and (b) Comprehensive viva-voce.
3	Students are expected to work on “Project Work” for about 6 hours per week (About 2 hour’s self-study at residence and 12 hours in counselling session at study centre), during a semester. Thus only those projects, demanding such study efforts on all those activities, listed in above, should be selected.

4	<p>A single student will have to do a project.</p> <p>Since. The student invests his energy, time and resources in a project. The project therefore should, have important focus on some relevant practical aspects. This will help student to justify his efforts on project.</p>
5	<p>Employed Students are allowed to complete “Project Work” in the industry where he/she is employed or his/ her place of choice. Such a student has to identify a resource person in industry, who can take responsibility of guiding him in project work. Such person should be eligible to work as “ProjectGuide”.</p>
6	<p>Study centre should assist unemployed students, in locating sponsored “Projects” from local industries. Students are encouraged to locate sponsored projects from the local industries. But, in case, a student is unable to locate such project, he is also allowed to complete “Project Work” at his study center.</p>
7	<p>The Project Work must involve practical research work related to your selected discipline.</p>
8	<p>Students have to finance expenditure on “Project” by hisown. Hence students should select those projects, accordingly.</p>
9	<p>Each “Project Guide” may be assigned maximum 5 students.</p>
10	<p>The original design requirements are not essential, although highly encouraged. Hence, normally, projects should not be repeated. The same project undertaken in recent past, by past students, should be avoided. But it is most important that, students must put his independent study efforts on the project. Thus, student should gain practical project execution knowledge about making some useful product, after he goes through all projects completion steps listed above.</p>
11	<p>There project report should be file bound/spiral bound/hard bound and should have following format</p> <ul style="list-style-type: none"> • Title Page/Cover page • Certificate endorsed by Project Guide/Supervisor, Learner Support Center Coordinator and Head • Declaration for followed ethical practice and non-plagiarism • Acknowledgement • Abstract of the project • Table of Contents • List of Figures • List of Tables • Chapters of Project Report – <ul style="list-style-type: none"> Chapter 1: Introduction: Background of the project, Need for the project, Brief idea of the project, Literature review, Aims and Objectives of the project Chapter 2: Design and Methodology: overview of the complete project, the scientific principles involved in the design of the project, Block Diagrams, Experimental/Theoretical Methodology/Circuit/Model/ materials required, etc. Chapter 3: Testing, Conduct of Experiment/ Module: Actual conduct of experiment, measurements, observations, etc Chapter 4: Analysis of Data: Analysis of the data and observations received during experimentation Chapter 5: Results, Discussion and Conclusions: Discuss why the specifications were not met or the reasons for the failure, if any. Discussed the

	<p>problems and difficulties encountered and how they were / can be eliminated. Discuss any extension work or modifications, which you want to suggest.</p> <p>Chapter 6: References: List the books, reference books, journals, websites, magazines and data manuals used, etc</p>
12	<p>Project Report Submission Process: Student should prepare 2 copies of the Project Report. At the beginning, the respective Project Guide must approve both copies positively before the end examination of Project Work. Then respective Study Center Coordinator approves both copies of the Project Report. Student should submit one of these approved copies to the study center. The student should retain remaining one of these approved copies. Study center should preserve their copy of, all project reports, till the end examination of Project Work. Even student must bring his own copy during this end examination.</p>
13	<p>Project Report Format:</p> <ol style="list-style-type: none"> 3. The project report should be printed on only right side of A4 size (210 mm ´ 297 mm) paper. There is no minimum or maximum page number limit for the “Project Report”, but report of minimum 50–70 pages is expected. University recommends only flexible binding for the “Project Report”. But, if student wishes, he may also use spiral binding. 4. Margins should be as follows:• <ul style="list-style-type: none"> ▪ Left Margin : 40mm ▪ Right Margin : 20mm

LEARNING RESOURCE DETAILS

LR Code	Title Author	Edition Year	ISBN Publisher
Course Website Link for (1) Mobile and Online Lectures, (2) Discussion Forum for online interaction and (3) Self-Test for each CR Block, Continuous Assessment Test and End Examination			
Text-Books			
CHE612	Organic Chemistry Project Work		
Reference-Books: Explore additional details and reinforce learning, with this optional learning resource!			
CHE612- RB1	Modern Projects and Experiments in Organic Chemistry: Miniscale and Williamson Microscale -Jerry R. Mohrig , Christina Norin Hammond, Paul F. Schatz , Terrence C. Morrill	3rd edition 2003	9780716739210
CHE612- RB2	Organic Chemistry -Leroy G Wade	8rd edition 2016	9789332578586
CHE612- RB3			
CHE612- RB4			
CD / DVD: Explore additional details and reinforce learning, with this optional learning resource!			
CHE612 - CD1			
Web Links: Explore additional details and reinforce learning, with this optional learning resource!			

CHE612- WL1			
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COURSE OUTCOMES

After successful completion of this course, student should be able to

- Use to develop technical skill.
- Build empower our students with practical skills to comprehend the physiology and other functions of each and every vital systems.

CHE613: NATURAL PRODUCTS

PROGRAMME INFORMATION

SN	Description	Details
1	University	Yashwantrao Chavan Maharashtra Open University Nasik - 422 222, Maharashtra, India Website: http://www.ycmou.ac.in/ and http://ycmou.digitaluniversity.ac/
2	School	School of Sciences
3	Discipline	Science
4	Level	PG
5	Course Used in	V154: M.Sc.(Chemistry){2023 Pattern} & V142: M.Sc.(Chemistry){2024 Pattern}

COURSE INFORMATION

Sem	Major	Code	Course Name	CR	CST	ST	CA	EE	TM	Type
04	DSE	CHE613	Natural Products	4	12	120	30	70	100	T

PRESUMED KNOWLEDGE AND LEARNING OBJECTIVES

Presumed Knowledge	Learning Objectives
<p>For successful completion of this course, student should have successfully complete:</p> <ul style="list-style-type: none"> B.Sc. with Chemistry or equivalent from a recognized University/Board. 	<p>The objectives of this course are</p> <ul style="list-style-type: none"> To study the Importance of natural products. To understand the terpenoids and its application. Knowledge about steroids and its synthesis. To evaluate the importance of alkaloids in medicinal field and its synthesis To discuss the various proteins and enzymes. To understand the concepts present in the nucleic acids.

UNITS

UN	Name of the Unit {Revised as per SLM book on 24 Feb 2024}	CSs	Questions
01-01 01-02 01-03 01-04	Terpenoids Rule-Gem-Dialkyl Structure of Terpenoids Abietic Acid	CR 01 MLs 01-20	As per evaluation pattern, on Each Credit , Student is required to answer
02-01 02-02 02-03 02-04	Introduction: Structural Elucidation & Synthesis of Cholesterol & Ergosterol Vitamin D Oestrone Bile Acids	CR 02 MLs 21-40	<ul style="list-style-type: none"> Very Short Answer Question (VSAQ), of 03 marks Short Answer Question (SAQ), of 05

03-01	Alkaloids	CR 03 MLs 41-60	marks • Long Answer Question (LAQ) of 10 Marks (LAQ may contain sub-questions (a), (b) and so on.)
03-02	Structural Elucidation		
03-03	Morphine and Quinine		
03-04	Quinoline Alkaloids		
04-01	General Nature of Proteins	CR 04 MLs 61-80	
04-02	The Spatial Arrangements of Protein Molecules		
04-03	Enzymes		
04-04	Nucleic Acids		

DETAILED SYLLABUS

UN	Detailed Syllabus of the Unit	CR
01-01	Terpenoids: Introduction--General properties of terpenoids Isolation-Isoprene	CR 01
01-02	Rule-Gem-Dialkyl: Rule-Classification of terpenoids--	
01-03	Structure of Terpenoids: General methods of determining structure of terpenoids, structural elucidation and synthesis of Zingiberene, Eudesmol,	
01-04	Abietic Acid: Caryophyllene and Santonin-biosynthesis of monoterpenoids.	
02-01	Introduction: Structural Elucidation & Synthesis of Cholesterol & Ergosterol: structural elucidation and synthesis of Cholesterol (synthesis not necessary), Ergosterol.	CR 02
02-02	Vitamin D: Equilenin.	
02-03	Oestrone: Testosterone and Progesterone.	
02-04	Bile Acids: Biosynthesis of sterols.	
03-01	Alkaloids: Definition of an alkaloid-extraction of alkaloids-general properties, General methods of determining structure of alkaloids	CR 03
03-02	Structural Elucidation : synthesis of Atropine,	
03-03	Morphine and Quinine: Biosynthesis of quinoline alkaloids.	
03-04	Quinoline Alkaloids : Synthesis, Preparation, Properties & Application	
04-01	General Nature of Proteins: Classification of proteins - the peptide linkage-the primary structure of peptides- synthesis of peptides- oxytocin-insulin.	CR 04
04-02	The Spatial Arrangements of Protein Molecules: Introduction-secondary, tertiary, and structure of proteins-quaternary structure of proteins.	
04-03	Enzymes: General nature of enzymes-nomenclature and classification-cofactors- Specificity of enzyme action- mechanism of enzyme action.	
04-04	Nucleic acids: Introduction-classification of nucleic acids-relation among nucleic acids, nucleotides and nucleosides-isolation of nucleic acids-components of nucleic acids-constitution of nucleic acids-structure of nucleosides- structure of nucleotides-sequence of nucleic acids-structure of DNA- structure of RNA.	

LEARNING RESOURCE DETAILS

LR Code	Title Author	Edition Year	ISBN Publisher
Course Website Link for (1) Mobile and Online Lectures, (2) Discussion Forum for online interaction and (3) Self-Test for each CR Block, Continuous Assessment Test and End Examination			
Text-Books			
CHE613	Natural Products -Prof. P. M. Jadhav	2023	978-93-95855-67-9
Reference-Books: Explore additional details and reinforce learning, with this optional learning resource!			
CHE613- RB-1	Organic Chemistry Vol. II: Stereochemistry and the Chemistry of Natural Products (V Edition) - Finar, I. L.	5 th edition 2005	978-8177585414
CHE613-RB- 2	Organic Chemistry of Natural Products Vol. II. - Chatwal, G. R.	2015	978-8184881080
CHE613- RB-3	Organic Chemistry of Natural Products. Vol. I. - Chatwal, G. R.	2015	9789350246641
CHE613- RB-4	Advanced Natural Products (Revised IV Edition) - Saluja, M. P., Raj Kumar & Anuja Agarwal	2017	5551234097143
CHE613- RB-5	Organic Chemistry -Clayden Greeves, Warren & wothers.	2012	9780199270293
CHE613- RB-6	Organic Structures from Spectra -L D field, S Sternhell, J R Kalman	1986	9780471906445
CD / DVD: Explore additional details and reinforce learning, with this optional learning resource!			
CHE613 - CD1			
Web Links: Explore additional details and reinforce learning, with this optional learning resource!			
CHE613- WL1			

COURSE OUTCOMES

After successful completion of this course, student should be able to

- Comprehend the Importance of natural products.
- Understand the terpenoids and its application. Knowledge about steroids and its synthesis.
- Explore the importance of alkaloids in medicinal field and its synthesis
- Analyze the various proteins and enzymes.
- Apply the concepts present in the nucleic acids.

CHE614: INDUSTRIAL ORGANIC CHEMISTRY

PROGRAMME INFORMATION

SN	Description	Details
1	University	Yashwantrao Chavan Maharashtra Open University Nashik - 422 222, Maharashtra, India Website: http://www.ycmou.ac.in/ and http://ycmou.digitaluniversity.ac/
2	School	School of Sciences
3	Discipline	Science
4	Level	PG
5	Course Used in	V154: M.Sc.(Chemistry){2023 Pattern} & V142: M.Sc.(Chemistry){2022 Pattern}

COURSE INFORMATION

Sem	Major	Code	Course Name	CR	CST	ST	CA	EE	TM	Type
04	DSE	CHE614	Industrial Organic Chemistry	4	12	120	30	70	100	T

PRESUMED KNOWLEDGE AND LEARNING OBJECTIVES

Presumed Knowledge	Learning Objectives
<p>For successful completion of this course, student should have successfully complete:</p> <ul style="list-style-type: none">B.Sc./Bs.c. with Chemistry or equivalent from a recognized University/Board.	<p>The objectives of this course are</p> <ul style="list-style-type: none">To study the concept of retrosynthesis and the terms involvedTo discuss about the one group and two group disconnectionsTo explain the various protection and deprotection of important functional groupsTo understand the use of important reagents in organic synthesis. Explain the selected name reactions in Organic synthesis.To provide them a brief idea on organic synthesis in industries.

UNITS

UN	Name of the Unit {Revised as per SLM book on 24 Feb 2024}	CSs	Questions
01-01 01-02 01-03 01-04	Pesticides Herbicides Juvenile Hormone Perfumery	CR 01 MLs 01-20	As per evaluation pattern, on Each Credit , Student is required to answer

02-01	Chemoselectivity	CR 02 MLs 21-40	<ul style="list-style-type: none"> • Very Short Answer Question (VSAQ), of 03 marks • Short Answer Question (SAQ), of 05 marks • Long Answer Question (LAQ) of 10 Marks (LAQ may contain sub-questions (a), (b) and so on.)
02-02	Three, Four, Five & Six Membered Heterocycles		
02-03	Protection of Hydroxyl		
02-04	Umpolung Reagents & Protection of C-C Multiple Bonds		
03-01	Petroleum Technology	CR 03 MLs 41-60	(LAQ may contain sub-questions (a), (b) and so on.)
03-02	Downstream		
03-03	Petroleum Product Profile		
03-04	Environmental Management		
04-01	Organic Reagents	CR 04 MLs 61-80	
04-02	Corey's Reagent		
04-03	Name Reactions In Organic Synthesis-1		
04-04	Name Reactions In Organic Synthesis-2		

DETAILED SYLLABUS

UN	Detailed Syllabus of the Unit	CR
01-01	Pesticides: Agrochemicals, Organochlorinepesticides, Introduction, synthesis and mode of action of endrin, aldrin, dieldrin.	CR 01
01-02	Herbicides: Synthesis and mode of action of Triazines, triazoles, pyridazinones and Bipyridylum compounds: diquat, paraquat.	
01-03	Juvenile Hormone: Introduction & structures JHA importance synthesis, IPM.	
01-04	Perfumery: Synthesisandapplicationsofperfumery, 2-Phenylethanol, vanillin and other food flavours, synthetic muskandionones.	
02-01	Chemoselectivity: One group C-C and C-X disconnection (disconnection of alcohols,alkenes, and carbonyl compounds) Two group C-C & C-X disconnections: 1,3 and 1,5 Difunctionalised compounds,	CR 02
02-02	Three, Four, Five & Six Membered Heterocycles: Carbonyl compounds, control in carbonyl condensation, synthesis of 3, 4, 5 and 6 membered rings in organic synthesis. Diels-Alder reaction, Connection in retro synthesis.	
02-03	Protection of Hydroxyl: Carboxyl, carbonyl, amino groups.	
02-04	Umpolung Reagents & Protection of C-C Multiple Bonds: Definition of umpolung, acyl anion equivalent, Protection of carbon-carbon multiple bonds.Illustration of protection and deprotection in synthesis.	
03-01	Petroleum Technology: 'Upstream'— the exploration and production sector of the industry; survey, exploration, drilling, drilling fluid, well stimulation, enhanced oil recovery, transportation and storage.	CR 03
03-02	Downstream: The sector which deals with refining and processing of crude oil and gasproducts.	
03-03	Petroleum Product Profile: Crude oil evaluation, natural gas and petroleum products, processing and purifying/refining of crude oil and natural gas, reforming.	
03-04	Environmental Management: corrosion prevention in petroleum technology.	

04-01	Organic Reagents: Use of the following reagents in organic synthesis and functional group transformation, 1,3-Dithianes, N-Bromosuccinimide, Organolithium reagents, Sodamide, Organosilicon compounds, Diazomethane, Periodic acids, Pyridinium chlorochromate.	CR 04
04-02	Corey's Reagent: Lead tetraacetate, Fenton's reagent, Phase transfer catalyst, Crown ethers, Merrifield resin, Wilkinson's catalyst and Baker yeast.	
04-03	Name Reactions In Organic Synthesis-1: Peterson olefination, McMurry, Shapiro reaction, Bomford-Stevens reaction, Palladium based reactions- Suzuki, Heck, Sonogashira, Hiyama, Stille, Glaser-Eglinton coupling, Henry reaction.	
04-04	Name Reactions In Organic Synthesis-2: Birch reduction, Clemmensen reduction, Dess-Martin oxidation, Hofmann-Löffler-Freytag reaction, Etard reaction, Baylis Hillman reaction, Wolff-Kishner reduction.	

LEARNING RESOURCE DETAILS

LR Code	Title Author	Edition Year	ISBN Publisher
Course Website Link for (1) Mobile and Online Lectures, (2) Discussion Forum for online interaction and (3) Self-Test for each CR Block, Continuous Assessment Test and End Examination			
Text-Books			
CHE614	Industrial Organic Chemistry - Dr. Raju R. Kale & Mr. Ghanshyam S. Patil	2022	978-93-95855-74-7
Reference-Books: Explore additional details and reinforce learning, with this optional learning resource!			
CHE614-RB-1	Organic Synthesis the Disconnection approach - Warren, S. Wiley and sons,	2008	978-0470712368
CHE614-RB-2	Reactions and Reagents - Nasir Hussain and Saba Khan.	2016	9788179065495
CHE614-RB-3	Organic Chemistry - Clayden Greeves, Warren & Wothers.	2012	9780199270293
CHE614-RB-4	Reactions, Rearrangements and Reagents - Sanyal, S. N.	4 th edition 2019	978-8177096057
CHE614-RB-5	March's Advanced Organic Chemistry: Reactions, Mechanisms, and Structure (VII Edition) - Smith, M. B.	2013	978-0470462591
CD / DVD: Explore additional details and reinforce learning, with this optional learning resource!			
CHE614-CD1			
Web Links: Explore additional details and reinforce learning, with this optional learning resource!			
CHE611-WL1			

COURSE OUTCOMES

After successful completion of this course, student should be able to

- Use the concept of retrosynthesis and the terms involved

- Comprehend about the one group and two group disconnections
- Explore the various protection and deprotection of important functional groups
- Apply the use of important reagents in organic synthesis. Explain the selected name reactions in Organic synthesis.
- Generalise them a brief idea on organic synthesis in industries.

CHE615: PHARMACEUTICALS CHEMISTRY

PROGRAMME INFORMATION

SN	Description	Details
1	University	Yashwantrao Chavan Maharashtra Open University Nasik - 422 222, Maharashtra, India Website: http://www.ycmou.ac.in/ and http://ycmou.digitaluniversity.ac/
2	School	School of Sciences
3	Discipline	Science
4	Level	PG
5	Course Used in	V154: M.Sc.(chemistry){2023 Pattern}

COURSE INFORMATION

Sem	Major	Code	Course Name	CR	CST	ST	CA	EE	TM	Type
04	DSE	CHE615	Pharmaceuticals Chemistry	4	12	120	30	70	100	T

PRESUMED KNOWLEDGE AND LEARNING OBJECTIVES

Presumed Knowledge	Learning Objectives
For successful completion of this course, student should have successfully complete: <ul style="list-style-type: none">B.Sc. with Chemistry or equivalent from a recognized University/Board.	The objectives of this course are <ul style="list-style-type: none">To study the Importance of drugs & pharmaceuticals.To understand the terminology.To evaluate the limit tests.To discuss on the central nervous system.To understand the respiratory system.Pharmaceutical chemistry is concerned with the design (drug design) and synthesis of biologically active molecules.

UNITS

UN	Name of the Unit	CSs	Questions
01-01	Introduction to Drugs & Pharmaceuticals	CR 01 MLs 01-20	As per evaluation pattern, on Each Credit , Student is required to answer <ul style="list-style-type: none">Very Short Answer Question (VSAQ), of 03 marksShort Answer Question (SAQ), of 05 marksLong Answer Question (LAQ) of 10 Marks
01-02	Terminology		
01-03	Formulations, Properties & Their Influence		
01-04	Additive and Their Role		
02-01	Impurities & Sources of Impurities In Drug Formulations	CR 02 MLs 21-40	
02-02	Limit Tests		
02-03	Development of Pharmaceuticals		
02-04	Laboratory Accreditation		

03-01	Introduction Anatomical Terms	CR 03 MLs 41-60	(LAQ may contain sub-questions (a), (b) and so on.)
03-02	Nervous Systems		
03-03	Central Nervous system		
03-04	Cardiovascular System		
04-01	Respiratory System	CR 04 MLs 61-80	
04-02	Digestive System		
04-03	Endocrine System		
04-04	Urinogenital System		

DETAILED SYLLABUS

UN	Detailed Syllabus of the Unit	CR
01-01	Introduction To Drugs & Pharmaceuticals: Introduction: Origin, development and scope of chemical sciences, pharmaceutical sciences, introduction to the fundamentals of pharmaceutical sciences, Drug and disease (definition). Historical evolution. Sources-plant, Animal and synthetic Biotechnology and human gene therapy.	CR 01
01-02	Terminology: Pharmacy, pharmacology, pharmacophore, pharmacodynamics, Pharmacokinetic- (ADME, Receptors- brief treatment), Metabolites and Anti-metabolites. Nomenclature: Chemical name, Generic name, and Trade names with examples. Classification: Classification based on structures and therapeutic activity with one example each.	
01-03	Formulations, Properties & Their Influence: Introduction: Need of conversion of drugs into medicine. Classification: Classification of formulations-(form wise, dose wise) with example.	
01-04	Additive and Their Role: classification and uses of following additives in formulation of different dosage forms: preservatives, antioxidants, surfactants, hydrocolloids, emulsifying agents, suspending agents, diluents, binders, lubricants, and organoleptic additives. Physical, chemical and biological properties of drug molecules and their influence on drug formulation.	
02-01	Impurities & Sources of Impurities In Drug Formulations: Purity- Broad based highest attainable standard, Biological response VS. Chemical purity and Official standard VIS-VIS manufacturing standards. Specific tests for identifying impurities- egs. Presence of salicylic acid in Aspirin, 4-aminophenol in Paracetamol, (+)-2-amino-Butan-1ol in Ethambutol Hydrochloride, Digitonin in Digitoxin etc.	CR 02
02-02	Limit Tests: Introduction, specificity, sensitivity and Personal errors. Types of limit tests for quantitative determination- Limit for insoluble matter, limits for soluble matter, limits for moisture, volatile matter and residual solvents. Limit tests for Acid radical impurities: For Chlorides, Sulphates, Arsenate, carbonate, Cyanide, Nitrate, Oxalate and Phosphate.	
02-03	Development of Pharmaceuticals: Introduction to Pharmacopoeias - IP, BP, USP & International Pharmacopoeia, National Formularies and Extra Pharmacopoeia. Typical parts of a monograph of Indian pharmacopoeia with examples, quality control and quality assurance, introduction to GLP, GMP	

02-04	Laboratory Accreditation: quality estimation of aspirin, acetaminophen, isoniazid, ascorbic acid, codeine phosphate, Chloride in Ringers lactate, ethambutol.	
03-01	Introduction Anatomical Terms: Terms in relation to parts of the body, system and organs. Elementary knowledge of the human skeleton. Tissues of the body – properties and functions of epithelial, connective, muscular, nervous and osteous (bone) tissues. General principles of membrane permeability, diffusion, transport, membrane potentials and action potentials.	CR 03
03-02	Nervous Systems: Autonomic nervous system: Physiology and functions of the autonomic nervous system, Mechanism of neuro humoral transmission in ANS;	
03-03	Central Nervous system: Functions of different parts of brain and spinal cord, Neurohumoral transmission in the central nervous system, reflex action, electroencephalogram, specialized functions of the brain, cranial nerves and their functions.	
03-04	Cardiovascular System: Heart, blood vessels, cardiac cycle, circulation, blood pressure and its regulations. Blood (composition and function).	
04-01	Respiratory System: Gross anatomy of respiratory passages, physiology of respiration, nervous control of respiration, vital capacity, respiratory volume, introduction to terms such as anoxia, hypoxia & dyspnoea.	CR 04
04-02	Digestive System: Gross anatomy of alimentary canal, movements of alimentary canal, gastric secretions and the enzymes involved in digestion.	
04-03	Endocrine System: general mechanisms of hormonal secretion, Physiological considerations of thyroid, pancreas, pituitary, parathyroid, adrenal glands and gonads. Disorders of hypo and hyper secretion.	
04-04	Urinogenital System: Various parts, structure and functions of the kidney and urinary tract. Physiology of urine formation, output and factors controlling it.	

LEARNING RESOURCE DETAILS

LR Code	Title Author	Edition Year	ISBN Publisher
Course Website Link for (1) Mobile and Online Lectures, (2) Discussion Forum for online interaction and (3) Self-Test for each CR Block, Continuous Assessment Test and End Examination			
Text-Books			
CHE615	Pharmaceuticals Chemistry		
Reference-Books: Explore additional details and reinforce learning, with this optional learning resource!			
CHE615- RB1	Pharmaceutical Drug analysis -Ashtoshkar	3 rd edition 2015	9788122432732

CHE615- RB2	Introduction to pharmaceuticals -Mittal	3 rd edition 2019	978-8123902739
CHE615- RB3	Principles of Anatomy and Physiology -Ross & Wilson.	12th edition 2008	978-0470392348
CHE615- RB4	Pharmaceutical Chemistry-1 -Dr Kasture Dr Wadodkar	2015	978-8185790121
CHE615- RB5	Pharmaceutical Chemistry- 2 -S G Wadodkar and A V Kasture	14th edition 2014	978-8185790206
CD / DVD: Explore additional details and reinforce learning, with this optional learning resource!			
CHE615 - CD1			
Web Links: Explore additional details and reinforce learning, with this optional learning resource!			
CHE615- WL1			

COURSE OUTCOMES

After successful completion of this course, student should be able to

- Develop analytical instrumental techniques for identification, characterization and quantification of drugs.
- Describe different techniques of organic synthesis, mechanisms, their application to process chemistry and drug discovery.
- Understanding of interactions between medications in the body.
- Discuss the fundamental of volumetric analysis, significance of quality control in pharmaceutical analysis and use methods of concentration expression.

END OF DOCUMENTS