

Chaudhary Bansi Lal University, Bhiwani

(A State University established under Haryana Act No. 25 of 2014)



**Examination Scheme and Syllabus
For
Undergraduate Programme
In
Chemistry Subject**

as per NEP 2020

**Curriculum and Credit Framework for Postgraduate Programmes
(Multiple Entry-Exit, Internship and Choice Based Credit System LOCF)**

With effect from the Session 2024-25 (in phased manner)

**DEPARTMENT OF CHEMISTRY
FACULTY OF PHYSICAL SCIENCES
Chaudhary Bansi Lal University, Prem Nagar– 127031
BHIWANI
HARYANA, INDIA**

Scheme A- It is applicable to Undergraduate programmes (Multidisciplinary) of Chaudhary Bansi Lal University, Bhiwani under NEP-2020 w.e.f. the Academic Session 2024-25.

Scheme B- it is applicable to Undergraduate Programmes with Single Major after first year of UG Programme (Multidisciplinary) of Chaudhary Bansi Lal University, Bhiwani under NEP-2020 w.e.f. the Academic Session 2024-25.

Scheme C- It is applicable to Undergraduate Programmes with Single Major of Chaudhary Bansi Lal University, Bhiwani under NEP-2020 w.e.f. the Academic Session 2024-25.

Scheme D- It is applicable to Undergraduate Programmes (Interdisciplinary) of Chaudhary Bansi Lal University, Bhiwani under NEP-2020 w.e.f. the Academic Session 2024-25.

1. Key Terms

1.1 Academic Year and Semester: Two consecutive (one odd and one even) semesters will constitute one academic year. A semester will consist of 90 days of academic work.

1.2 Credit: A unit by which the course work is measured. It determines the number of hours of instructions required per week over the duration of one semester. For calculation of the teaching hours, one credit means one hour of lecture or one hour of tutorial or one hour of seminar or two hours of practicum/laboratory work per week over the duration of a semester.

1.3 Learning Outcome based Curriculum Framework (LOCF): The learning outcomes of the programme are mapped against well-defined Course Learning Outcomes (CLOs).

1.4 Choice Based Credit System (CBCS): The CBCS provides choices to students to select disciplinary and interdisciplinary courses to fit into their own requirements and to learn at their own pace within the framework.

1.5 Programme: A programme is made up of courses and leads to the award of a Certificate, Diploma or Degree after completing requisite courses successfully.

1.6 Course: A course refers to component of a programme. A course may comprise of lectures/tutorials/practicum or laboratory work/field practice/project work/seminar/community engagement and service/internship/dissertation, etc. or any combination of these.

1.6.1 Lecture: Component of a course which is taught by a teacher through lectures covering the contents of a course.

1.6.2 Tutorial: Component of a course which involves problem-solving, learning through discussions and remedial teaching related to the contents and periphery of a course with the direct involvement of a teacher.

1.6.3 Practicum: A course or a component of a course which enables students to learn or to attain skills or to get procedural knowledge for the contents of a course through practical/laboratory activity/project and to apply learnt/studied principles/theory/concepts related to the chosen field of learning, work/vocation, or professional practice in the field of learning, work/vocation under the supervision of a teacher.

1.6.4 Seminar: A course or a component of a course which makes students to learn a specific

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topic through in-depth exploration and analysis of facts about the topic in a set-up that involves presentation, interactive discussions and collaborative learning under the supervision of a teacher.

1.6.5 Internship: A course requiring students to participate in professional employment-related activity or work experience or co-operative education activity with an entity external to the educational institution normally under the supervision of an employee of an organization or an individual professional. A key aspect of the internship is induction into actual, formal and organized work situations. Internship involves working with local industry (Government or Private organizations), business establishments, artists, craft persons, etc. to provide opportunities for students to actively engage in on-site experiential learning.

1.6.6 Studio Activity: A studio activity involves engagement of students in creative, artistic or experimental activities involving visual, digital, audio, video and other professional experiential work.

1.6.7 Field Work/Practice/Survey/Project: A course or a component of course which enables students to participate in field-based learning/project, involving application of knowledge in solving/analyzing/exploring a real-life situation/difficult problem under the supervision of a teacher/mentor.

1.6.8 Project Work: A course or a component of a course which facilitates students to apply their knowledge, skills and critical thinking ability to complete a specific task in a given time frame through conceptualization, exploration and analysis of research-based activities to suggest tangible solutions for a given problem related to the chosen field of learning.

1.6.9 Community Engagement and Service: A course or a component of a course which exposes the students to the socio-economic issues prevailing in society so that the theoretical learning can be supplemented by actual life experiences to understand and generate solutions to real-life problems.

1.7 Major and Minor Subject: Major subject is a subject of choice in a discipline which equips a student with knowledge, understanding and skills majorly in the chosen field of learning contributing to the core of the programme.

Minor subject helps a student to gain a broader understanding in addition to the Major subject. The courses in Major subjects will be Core Courses (CC), while a Minor subject will include CC as well as Vocational Courses (VOC).

1.7.1 Core Course (CC): A compulsory course of a subject aimed to cover the basics of Major/Minor subject.

1.7.2 Vocational Courses (VOC): A vocational course is focused on practical work, preparing students for a particular skilled profession. Such courses develop capacities for sustenance, work, and economic participation and develop values and sensibilities toward physical work.

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Ch. Bansilal University, Prem Nagar, Bhiwani

Scheme of Examination for Chemistry Subject in Under Graduate Programmes
as per NEP 2020 Curriculum and Credit Framework for Undergraduate Programmes
(Multiple Entry-Exit, Internships and Choice Based Credit System LOCF) with effect from session 2024-25 (in a phased manner)

Semester-I

Course Type Total Credits	Applicable Scheme	Course Code	Nomenclature of the Course	Credits	Contact hours per week	Internal Assessment Marks	End term Examination Marks	Total Marks	Examination Hrs.
CC-1 MCC-1 04 Credits	Scheme A, B & C	24UN-CHE-101	Chemistry-I	03	03	20	50	70	03
			Practical	01	02	10	20	30	03
MCC-2 04 Credits	Scheme C Only	24UN-CHE-102	Physical Chemistry - I	03	03	20	50	70	03
			Practical	01	02	10	20	30	03
*CC-M1 02 Credits	Scheme A, B & D	24UN-CHE-103	Minor Chemistry - I	02	02	15	35	50	03
CC-M1 04 Credits	Scheme C	From Available CC-1/MCC-1 of 4 credits as per NEP							
MDC-1 03 Credits	Scheme A, B & C	From Available pool of Multidisciplinary Courses from a subject of different discipline as per NEP.							
AEC-1 02 Credits	A, B & C	From Available pool of Ability Enhancement Courses as per NEP							
SEC-1 03 Credits	A, B & C	From Available pool of Skill Enhancement Courses as per NEP							
VAC-1 02 Credits	A, B & C	From Available pool of Value Added Courses as per NEP							

*For students who opt Chemistry as a minor subject.

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Semester-II

Course Type Total Credits	Applicable Scheme	Course Code	Nomenclature of the Course	Credits	Contact hours per week	Internal Assessment Marks	End term Examination Marks	Total Marks	Examination Hrs.
CC-2 MCC-3 04 Credits	Scheme A, B & C	24UN-CHE-201	Chemistry – II	03	03	20	50	70	03
			Practical	01	02	10	20	30	03
DSEC-1 04 Credits	Scheme C Only	24UN-CHE-202	Physical Chemistry Skill - I	03	03	20	50	70	03
			Practical	01	02	10	20	30	03
*CC-M2 02 Credits	Scheme A, B & D	24UN-CHE-203	Minor Chemistry - II	02	02	15	35	50	03
CC-M2 04 Credits	Scheme C Only		From Available CC-2/MCC-3 of 4 credits as per NEP						
MDC-2 03 Credits	Scheme A, B, C & D		From Available pool of Multidisciplinary Courses from a subject of different discipline as per NEP.						
AEC-2 02 Credits	Scheme A, B & C		From Available pool of Ability Enhancement Courses as per NEP						
SEC-2 03 Credits	Scheme A, B, C & D		From Available pool of Skill Enhancement Courses as per NEP						
VAC-2 02 Credits	Scheme A & C		From Available pool of Value Added Courses as per NEP						
Internship 04 Credits	Scheme A & C		Internship of 04 Credits of 4-6 weeks duration after 2 nd Semester						

*For students who opt Chemistry as a minor subject.





Semester-III

Course Type Total Credits	Applicable Scheme	Course Code	Nomenclature of the Course	Credits	Contact hours per week	Internal Assessment Marks	End term Examination Marks	Total Marks	Examination Hrs.
CC-3	Scheme A, B, C & D	24UN-CHE-301	Chemistry – III	03	03	20	50	70	03
MCC-4 04 Credits			Practical	01	02	10	20	30	03
MCC-5 04 Credits	Scheme B & C	24UN-CHE-302	Inorganic Chemistry – I	03	03	20	50	70	03
			Practical	01	02	10	20	30	03
MCC-2 04 Credits	Scheme B only	24UN-CHE-102	Physical Chemistry - I	03	03	20	50	70	03
			Practical	01	02	10	20	30	03
CC-M3 04 Credits	Scheme A, C & D		From Available CC-3/MCC-4 of 4 credits as per NEP						
CC-M3 (V) 04 Credits	Scheme B only		From Available pool of Minor (Vocational) Courses VOC-1						
MDC-3 03 Credits	Scheme A, B, C & D		From Available pool of Multidisciplinary Courses from a subject of different discipline as per NEP.						
AEC-3 02 Credits	Scheme A, B, C & D		From Available pool of Ability Enhancement Courses as per NEP						
SEC-3 03 Credits	Scheme A, B, C & D		From Available pool of Skill Enhancement Courses as per NEP						
VAC-3 02 Credits	Scheme C only		From Available pool of Value Added Courses as per NEP						



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Semester-IV

Course Type Total Credits	Applicable Scheme	Course Code	Nomenclature of the Course	Credits	Contact hours per week	Internal Assessment Marks	End term Examination Marks	Total Marks	Examination Hrs.
CC-4	Scheme A, B, C & D	24UN-CHE-401	Chemistry – IV	03	03	20	50	70	03
MCC-6 04 Credits			Practical	01	02	10	20	30	03
MCC-7 04 Credits	Scheme B & C	24UN-CHE-402	Organic Chemistry – I	03	03	20	50	70	03
			Practical	01	02	10	20	30	03
MCC-8 04 Credits	Scheme B & C	24UN-CHE-403	Physical Chemistry – II	03	03	20	50	70	03
			Practical	01	02	10	20	30	03
DSE-1 04 Credits Select one option	Scheme B & C	24UN-CHE-404	Elective Chemistry- I	03	03	20	50	70	03
			Practical	01	02	10	20	30	03
			OR						
			Elective Chemistry- II	03	03	20	50	70	03
			Practical	01	02	10	20	30	03
CC-M4 (V) 04 Credits A 02 Credits VAC-3 02 Credits VAC-4 02 Credits Internship 04 Credits	Scheme A, B, C & D	24UN-CHE-406	Elective Chemistry- III	03	03	20	50	70	03
			Practical	01	02	10	20	30	03
			OR						
			From Available pool of Minor (Vocational) Courses VOC-2						
			From Available pool of Ability Enhancement Courses as per NEP						
Internship 04 Credits	Scheme A, B & C		From Available pool of Value Added Courses as per NEP						
			From Available pool of Value Added Courses as per NEP						
			From Available pool of Value Added Courses as per NEP						
			Internship of 04 Credits of 4-6 weeks duration after 4 th Semester (If not done after 2 nd Semester)						

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Semester-V

Course Type Total Credits	Applicable Scheme	Course Code	Nomenclature of the Course	Credits	Contact hours per week	Internal Assessment Marks	End term Examination Marks	Total Marks	Examination Hrs.
CC-5 MCC-9 04 Credits	Scheme A, B, C & D	24UN-CHE-501	Chemistry – V	03	03	20	50	70	03
			Practical	01	02	10	20	30	03
			Inorganic Chemistry – II	03	03	20	50	70	03
MCC-10 04 Credits	Scheme B & C	24UN-CHE-502	Practical	01	02	10	20	30	03
			Elective Chemistry- IV	03	03	20	50	70	03
			Practical	01	02	10	20	30	03
DSE-2 04 Credits Select one option	Scheme B & C	24UN-CHE-504	Elective Chemistry- V	03	03	20	50	70	03
			Practical	01	02	10	20	30	03
			OR						
DSE-3 04 Credits Select one option	Scheme B & C	24UN-CHE-505	Elective Chemistry- VI	03	03	20	50	70	03
			Practical	01	02	10	20	30	03
			OR						
DSE-3 04 Credits Select one option	Scheme B & C	24UN-CHE-506	Elective Chemistry- VII	03	03	20	50	70	03
			Practical	01	02	10	20	30	03
			OR						
DSE-3 04 Credits Select one option	Scheme B & C	24UN-CHE-507	Elective Chemistry- VIII	03	03	20	50	70	03
			Practical	01	02	10	20	30	03
			OR						
DSE-3 04 Credits Select one option	Scheme B & C	24UN-CHE-508	Elective Chemistry- IX	03	03	20	50	70	03
			Practical	01	02	10	20	30	03
			OR						






			Practical	01	02	10	20	30	03
CC-M5 (V)									
04 Credits	Scheme A, C & D	From Available pool of Minor (Vocational) Courses VOC-1							
Internship 04 Credits	Scheme A, B, C & D	Internship of 04 Credits of 4-6 weeks duration after 4 th Semester (If not done after 2 nd & 4 th Semester)							

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Semester-VI

Course Type Total Credits	Applicable Scheme	Course Code	Nomenclature of the Course	Credits	Contact hours per week	Internal Assessment Marks	End term Examination Marks	Total Marks	Examination Hrs.
CC-6 MCC-11 04 Credits	Scheme A, B, C & D	24UN-CHE-601	Chemistry - VI	03	03	20	50	70	03
			Practical	01	02	10	20	30	03
	Scheme B & C	24UN-CHE-602	Organic Chemistry - II	03	03	20	50	70	03
			Practical	01	02	10	20	30	03
DSE-4 04 Credits Select one option	Scheme B & C	24UN-CHE-603	Elective Chemistry- X	03	03	20	50	70	03
			Practical	01	02	10	20	30	03
		24UN-CHE-604	Elective Chemistry- XI	03	03	20	50	70	03
			Practical	01	02	10	20	30	03
DSE-5 04 Credits Select one option	Scheme B & C	24UN-CHE-605	Elective Chemistry- XII	03	03	20	50	70	03
			Practical	01	02	10	20	30	03
		24UN-CHE-606	Elective Chemistry- XIII	03	03	20	50	70	03
			Practical	01	02	10	20	30	03
CC-M6 04 Credits	Scheme A only	24UN-CHE-607	Elective Chemistry- XIV	03	03	20	50	70	03
			Practical	01	02	10	20	30	03
		24UN-CHE-608	Elective Chemistry- XV	03	03	20	50	70	03
			Practical	01	02	10	20	30	03
CC-M5 (V)	Scheme B only								
CC-M6 (V)	Scheme C only								

From Available pool of Minor (Vocational) Courses VOC-3

From Available CC-6/MCC-11 of 4 credits as per NEP (Only for Minor subject as Chemistry)

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CC-M7 (V)	Scheme A & D	From Available pool of Skill Enhancement Courses As Per NEP
SEC-4	Scheme C only	

Note: 1. Four Credits of internship, earned by a student during summer internship after 2nd semester or 4th semester, will be taken into account in 5th semester of a student who pursue 3 year UG Programme without taking exit option.

- 2. 1.6 credits earned in two subjects studied in first year, other than major subject opted in second year will be taken into account as Credits of Minor as per Scheme-B of the ordinance.







Semester-VII (For Honours/Honours with Research in Chemistry)

Course Type Total Credits	Applicable Scheme	Course Code	Nomenclature of the Course	Credits	Contact hours per week	Internal Assessment Marks	End term Examination Marks	Total Marks	Examination Hrs.
CC-H1 04 Credits	Scheme B & C	24UN-CHE-701	Physical Chemistry – III	04	04	30	70	100	03
CC-H2 04 Credits	Scheme B & C	24UN-CHE-702	Inorganic Chemistry – III	04	04	30	70	100	03
CC-H3 04 Credits	Scheme B & C	24UN-CHE-703	Organic Chemistry – III	04	04	30	70	100	03
DSE-6 04 Credits Select one option	Scheme B & C	24UN-CHE-704	Advanced Chemistry-I	04	04	30	70	100	03
		OR							
		24UN-CHE-705	Advanced Chemistry-II	04	04	30	70	100	03
		OR							
PC-H1 CC-HM1	Scheme B & C	24UN-CHE-706	Advanced Chemistry-III	04	04	30	70	100	03
		24UN-CHE-707	Practical Chemistry	04	08	30	70	100	08
From the Available core courses in Minor Subjects of 04 Credits As Per NEP									








Semester-VIII (For Honours in Chemistry)

Course Type Total Credits	Applicable Scheme	Course Code	Nomenclature of the Course	Credits	Contact hours per week	Internal Assessment Marks	End term - Examination Marks	Total Marks	Examination Hrs.
CC-H4 04 Credits	Scheme B & C	24UN-CHE-801	Physical Chemistry – IV	04	04	30	70	100	03
CC-H5 04 Credits	Scheme B & C	24UN-CHE-802	Inorganic Chemistry – IV	04	04	30	70	100	03
CC-H6 04 Credits	Scheme B & C	24UN-CHE-803	Organic Chemistry – IV	04	04	30	70	100	03
DSE-7 04 Credits Select one option	Scheme B & C	24UN-CHE-804	Advanced Chemistry- IV	04	04	30	70	100	03
		OR							
		24UN-CHE-805	Advanced Chemistry- V	04	04	30	70	100	03
PC-H2 04 Credits	Scheme B & C	OR							
		24UN-CHE-806	Advanced Chemistry- VI	04	04	30	70	100	03
		24UN-CHE-807	Practical Chemistry	04	08	30	70	100	08
CC-HM2 04 Credits	Scheme B & C	From the Available core courses in Minor Subjects of 04 Credits As Per NEP							






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Semester-VIII (For Honours with Research in Chemistry)

Course Type Total Credits	Applicable Scheme	Course Code	Nomenclature of the Course	Credits	Contact hours per week	Internal Assessment Marks	End term Examination Marks	Total Marks	Examination Hrs.
CC-H4 04 Credits	Scheme B & C	24UN-CHE-801	Physical Chemistry – IV	04	04	30	70	100	03
CC-H5 04 Credits	Scheme B & C	24UN-CHE-802	Inorganic Chemistry – IV	04	04	30	70	100	03
Project / Dissertation 12 Credits	Scheme B & C	24UN-CHE-808	Project / Dissertation in Chemistry	12	--	--	--	300	--
CC-HM2 04 Credits	Scheme B & C								
From the Available core courses in Minor Subjects of 04 Credits As Per NEP									






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Pool of MDC, VAC, SEC and VOC Courses in the subject of Chemistry to be offered to the University Pool

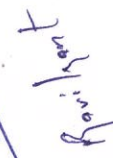
Course Type Total Credits	SEM	Applicable Scheme	Course Code	Nomenclature of the Course	Credits	Contact hours per week	Internal Assessment Marks	End term Examination Marks	Total Marks	Examination Hrs.
MDC-1 03 Credits	I	Scheme A, C & D	24UN-CHE-MDC101	Introductory Chemistry - I	02	02	15	35	50	03
				Practical	01	02	05	15	20	03
MDC-2 03 Credits	II	Scheme A, C & D	24UN-CHE-MDC201	Introductory Chemistry - II	02	02	15	35	50	03
				Practical	01	02	05	15	20	03
MDC-3 03 Credits	III	Scheme A, B, C & D	24UN-CHE-MDC301	Introductory Chemistry - III	02	02	15	35	50	03
				Practical	01	02	05	15	20	03
VAC-3	III	Scheme C	24UN-CHE-VAC301	Chemistry in everyday life	02	02	15	35	50	03
	IV	Scheme A, B & D								
VAC-4	IV	Scheme C	24UN-CHE-VAC401	Agriculture Chemistry	02	02	15	35	50	03
SEC-2	II	Scheme A, C & D	24UN-CHE-SEC201	Chemistry of Food, Flavors and Colorants	02	02	15	35	50	03
				Practical	01	02	05	20	25	03
SEC-3	III	Scheme A, B, C & D	24UN-CHE-SEC301	Analytical Chemistry	02	02	1	35	50	03
				Practical	01	02	05	20	25	03
SEC-4	VI	Scheme C only	24UN-CHE-SEC601	Food Adulteration Testing	02	02	15	35	50	03
				Practical	01	02	05	20	25	03
CC-M3 (V)	III	Scheme B only	24UN-CHE-	Chemistry of Fertilizers and Pesticides	03	03	20	50	70	03

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CC-M5 (V)	V	Scheme A & C	VOC-1	Practical	01	02	10	20	30	03
CC-M4 (V)	IV	Scheme A, B & C	24UN-CHE- VOC-2	Chemistry of Cosmetics and Perfumes	03	03	20	50	70	03
CC-M5 (V)	VI	Scheme B only	24UN-CHE- VOC-3	Practical	01	02	10	20	30	03
CC-M6 (V)		Scheme C only		Green Laboratory Techniques	03	03	20	50	70	03
CC-M7 (V)		Scheme A only		Practical	01	02	10	20	30	03







Course composition- Theory/ Theory +Practical				
Course Credit	Internal Assessment marks	End term exam marks	Total marks	
2	15	35	50	
3	20	50	70	
4	30	70	100	
Course composition- Theory + Practical				
Course Credit	Theory		Practical	Total marks
Theory +Practical	Internal Assessment marks	End term exam marks	Internal Assessment marks	End term exam marks
1+1	10	20	5	15
2+1	15	35	5	15
2+2	15	35	15	35
3+1	20	50	10	20
0+4	NA	NA	30	70

1. Internal assessment (30%) shall be broadly based on the following defined components of;

- Class participation
- Seminar/Presentation/Assignment/Quiz/class test, etc.
- Mid Term Exam

Total Internal Assessment Marks (Theory)	Class Participation	Seminar/Presentation/Assignment/Quiz/class test, etc.	Mid-Term Exam
10	4	-	6
15	4	4	7
20	5	5	10
30	5	10	15
Total Internal Assessment Marks (Practicum)	Class Participation	Seminar/Demonstration/Viva-Voce/Lab record, etc.	Mid-Term Exam
5	--	5	NA
10	--	10	NA
15	5	10	NA
30	5	10	15

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CC-3/MCC-4

Part A - Introduction			
Subject	Chemistry		
Semester	III		
Name of the Course	Chemistry-III		
Course Code	24UN-CHE-301		
Course Type: (CC/MCC/MDC/CC-M/DSEC/VOC/DSE/PC/AEC/VAC)	CC/MCC		
Level of the course (As per Annexure-I)	200-299		
Pre-requisite for the course (if any)	Chemistry as a subject at 4.0 Level (Class-XII)		
Course Learning Outcomes (CLO):	After completing this course, the learner will be able to: 1. To learn about the structure of S and P-block elements, their properties and discuss their use in daily life as well as industrial applications. 2. To understand about various laws and theories related to electrochemistry-I and know about their thermodynamic properties. 3. To understand about variation of conductance studies with concentration and explain with many phenomenon. 4. The fundamental properties, structures and reactivity of organic compounds such alkene, alkyne arenes, alkyl and aryl halide etc. 5. * Learning about reaction mechanism and predict the outcome of the reactions. 6. How to distinguish between the organic compounds by use of different chemical tests.		
	Theory	Practical	Total
Credits	3	1	4
Contact Hours/week	03	02	05
Internal Assessment Marks	20	10	30
End Term Exam Marks	50	20	70
Examination hrs	03	03	---
Max. Marks: 100 (Theory:70 & Practical: 30)			

Part B- Contents of the Course

Instructions for Paper- Setter

Note: The examiner is requested to set nine questions in all, selecting two questions from each SECTION and one question (Question No.1 based on entire syllabus will consist of short answer type. All questions carry equal marks. The candidate is required to attempt five questions in all selecting one from each SECTION. Question No.1 is compulsory. Log table and non- programmable calculator is allowed.

Unit	Topics	Contact Hours
I	s and p-Block Elements Salient features of hydrides, oxides, halides, hydroxides of s- block elements (methods of preparation excluded). Structure, preparation and properties of Diborane and Borazine. Structure of oxides of Nitrogen and Phosphorous. Structure of oxyacids of Nitrogen, phosphorous, sulphur and chlorine and comparison of acidic strength of oxyacids. low chemical reactivity of noble gases, structure and bonding in fluorides, oxides and oxyfluorides of xenon.	11
II	Electrochemistry-I Electrolytic conduction, factors affecting electrolytic conduction, specific conductance, molar conductance, equivalent conductance and relation among them, their variation with concentration. Concepts of pH and pK _a , Buffer solution, Buffer action, Henderson – Hazel equation, Buffer mechanism of buffer action. Electrochemistry-II Reversible & irreversible cells, Calculation of thermodynamic quantities of cell reaction (ΔG , ΔH & K). Types of reversible electrodes – metal- metal ion, gas electrode, metal – insoluble salt- anion and redox electrodes. Nernst equation, Standard Hydrogen electrode, calomel electrodes.	11
III	Alkynes Nomenclature and its structure. Methods of formation: using Calcium carbide, dehydrohalogenation, Kolbe's electrolysis. Chemical reactions: Mechanism of electrophilic and nucleophilic addition reactions, formation of metal acetylides, addition of bromine and alkaline KMnO ₄ , ozonolysis. Acidity of alkynes. Stereochemistry of Organic Compounds Concept of isomerism: Structural and Stereoisomerism. Symmetry elements, enantiomers, optical activity, properties of enantiomers, chiral and achiral molecules (up-to 2 asymmetric centres), diastereomers, threo- and erythro- nomenclature, meso-compounds, Relative and absolute configuration, sequence rules, R and S system of nomenclature. Cis- Trans isomerism, E & Z system of nomenclature, Conformational analysis of ethane and n-butane,	11

	conformations of cyclohexane, axial and equatorial bonds. Newman and Sawhorse projection formulae.	
IV	Benzene and its derivatives: Nomenclature, Aromatic nucleus and side chain, Huckels' rule of aromaticity. Aromatic electrophilic substitution, mechanism of nitration, halogenation, sulphonation, and Friedel- Crafts reaction. Energy profile diagrams. Activating, deactivating substituents and orientation. Alkyl halides: Nomenclature, methods of formation: from alkenes and alcohol, nucleophilic substitution reactions of alkyl halides, SN2 and SN1 reactions with energy profile diagrams. Aryl halides: Methods of formation: halogenation, Sandmeyer reaction. The addition-elimination, and the elimination- addition mechanisms of nucleophilic aromatic substitution reactions. Relative reactivities of alkyl halides vs allyl, vinyl, and aryl halides.	12
Practicals		
	Gravimetric Analysis: Estimation of Ni^{2+} as Ni-dimethylglyoxime. Colorimetry: To verify Beer-Lambert law for KMnO_4 / $\text{K}_2\text{Cr}_2\text{O}_7$ and determine the unknown concentration of the given solution of KMnO_4 / $\text{K}_2\text{Cr}_2\text{O}_7$ solution. - To prepare acidic and basic buffer solutions of pH 5 and 9 respectively. - Preparation of Cuprous chloride - Preparation of tetra ammine cupric sulphate. - To determine the CST of phenol-water system. - To determine the solubility of Benzoic acid at various temperatures and to determine the ΔH of the dissolution process. - To determine the Enthalpy of neutralisation of strong base Vs strong acid. - To determine the Enthalpy of neutralisation of weak acid Vs. strong base and determine the enthalpy of ionisation of the weak acid. - To determine the Enthalpy of neutralisation of strong acid Vs. weak base and determine the enthalpy of ionisation of the strong acid and determine the enthalpy of ionisation of the strong acid.	30

Suggested Evaluation Methods	
Internal Assessment: > Theory:20 • Class Participation: 5 • Seminar/presentation/ assignment/ quiz/ class test etc.: 5 • Mid-Term Exam: 10 > Practicum:10 • Class Participation: NA • Seminar/ Demonstration/ Viva - voce/ Lab records etc.: 10 • Mid-Term Exam: NA	End Term Examination: > Theory: 50 Written examination > Practicum: 20 Lab record, viva-voce, Demonstration of practical
Part C- Learning Resources	
Recommended Books/e-resources/LMS: 1. Lee, J.D.; (2010), Concise Inorganic Chemistry, Wiley India. 2. Kapoor, K.L. (2015), A Textbook of Physical Chemistry, Vol 1, 6 th Edition, Mc Graw Hill Education. 3. Morrison, R. N.; Boyd, R. N. Organic Chemistry, Dorling Kindersley (India) Pvt. Ltd. (Pearson Education). 4. Finar, I. L. Organic Chemistry (Volume 1& 2), Dorling Kindersley (India) Pvt. Ltd. (Pearson Education) 5. Solomons, T. W. G.; Fryhle, C. B. ; Snyder, S. A. (2016), Organic Chemistry, 12th Edition, Wiley. 6. Clayden, J.; Greeves, N.; Warren, S. (2012), Organic Chemistry, Oxford. 7. Nasipuri, D. (2018), Stereochemistry of Organic Compounds: Principles and Applications, 3rd Edition, New Age International. 8. Gunstone, F. D. (1975), Guidebook to Stereochemistry, Prentice Hall Press.	

MCC-5

Session: 2024-25			
Part A - Introduction			
Subject	Chemistry		
Semester	III		
Name of the Course	Inorganic Chemistry-I		
Course Code	24UN-CHE-302		
Course Type: (CC/MCC/MDC/CC-M/DSEC/VOC/DSE/PC/AEC/VA C)	MCC		
Level of the course (As per Annexure-I)	200-299		
Pre-requisite for the course (if any)	4.0		
Course Learning Outcomes(CLO):	After completing this course, the learner will be able to: 1. To learn about the bonding fundamentals for transition elements. 2. To learn on Qualitative ideas of valence bond and bond theories of metallic bond. 3. To learn about general physical properties, reactivities and application of coordination complexes. 4. To get knowledge on General physical properties, reactivities and application of coordination complexes. 5* To learn about on quantitative estimation of Cu^{2+} ions. Also get knowledge to the calculation of ΔH, ΔG and ΔS for dissolving a salts at given temperature.		
Credits	Theory	Practical	Total
	3	1	4
Contact Hours	03	02	05
Internal assessment Marks	20	10	30
End term Exam Marks	50	20	70
Examination Hrs	03	03	-

Maximum Marks: (Theory: 70 & Practical: 30)

Part B- Contents of the Course

Instructions for Paper- Setter

Note: The examiner is requested to set nine questions in all, selecting two questions from each SECTION and one question (Question No.1 based on entire syllabus will consist of short answer type. All questions carry equal marks. The candidate is required to attempt five questions in all selecting one from each SECTION. Question No.1 is compulsory. Log table and non-programmable calculator is allowed.

Unit	Topics	Contact Hours
I	Coordination Chemistry: Recapitulation of Werner's Coordination theory. IUPAC nomenclature of coordination Compounds, isomerism in coordination compounds with coordination numbers 4 and 6. A brief idea about chelate effect and labile and inert complexes.	12
II	Valence bond theory and its application to complexes of coordination numbers 4 and 6. Examples of inner and outer orbital complexes, Crystal field theory, measurement of Δ_o . Calculation of CFSE in weak and strong fields, concept of pairing energies, factors affecting the magnitude of Δ_o . Octahedral vs. tetrahedral coordination, tetragonal distortions from octahedral geometry Jahn-Teller theorem, square planar geometry. Qualitative aspect of Ligand field and MO Theory (for octahedral σ -donor, π - acceptor and π - donor complexes).	11
III	A brief discussion of differences between the first, second and third transition series. Some important compounds of Cr, Mn, Fe and Co and their roles as laboratory reagents; Potassium dichromate, potassium permanganate, potassium ferrocyanide, potassium ferricyanide, sodium nitroprusside and sodium cobaltinitrite. Lanthanoids and Actinoids: A brief discussion of electronic configuration, oxidation states, colour, spectral and magnetic properties.	11
IV	Inorganic Reaction Mechanism: Introduction to inorganic reaction mechanisms. Concept of reaction pathways, transition state, intermediate and activated complex. Substitution reactions in square planar complexes, Trans- effect, theories of trans-effect.	11

[illegible]

*Applicable for courses having practical component.

MDC-3

Session: 2024-25			
Part A - Introduction			
Subject	Chemistry		
Semester	III		
Name of the Course	Introductory Chemistry-III		
Course Code	24UN-CHE-MDC301		
Course Type: (CC/MCC/MDC/CC-M/DSEC/VOC/DSE/PC/AEC/VAC)	MDC		
Level of the course (As per Annexure-I)	0-99		
Pre-requisite for the course (if any)	Higher secondary other than science discipline		
Course Learning Outcomes(CLO):	After completing this course, the learner will be able to: 1. To learn about different energy resources. 2. To learn about the purification process of water quality 3. To Know more about Pesticides and their bad impacts on health 4. To get more knowledge on the impacts of pollution on environment		
	5*. To get acquaint about the pH of different food items.		
Credits	Theory	Practical	Total
	2	1	3
Contact Hours	30	30	60
Max. Marks:50+20* Internal Assessment Marks:15+5* End Term Exam Marks: 35+15*		Time:03+03*	
Part B- Contents of the Course			
Instructions for Paper- Setter			

Note: The examiner is requested to set nine questions in all, selecting two questions from each SECTION and one question (Question No.1 based on entire syllabus will consist of short answer type. All questions carry equal marks. The candidate is required to attempt five questions in all selecting one from each SECTION. Question No.1 is compulsory. Log table and non-programmable calculator is allowed.

Also, the candidate may answer either in Hindi or English.

Unit	Topics	Contact Hours
I	Pollution and their types: Plastic and polyethene pollution, pollution sources, Recycling of plastic, greenhouse effect, ozone depletion	8
II	Energy: Energy sources, renewable and non-renewable sources, cells and batteries, fuel cell, solar cell, polymer cell	8
III	Water: Sources of drinking water and uses, water conservation, Permissible TDS, Techniques of purification of water, R.O. water purification process (Osmosis and Reverse Osmosis), wastewater management	7
IV	Pesticides and Herbicides: General introduction and definition, biological control and chemical control: natural and synthetic pesticides, benefits and adverse effects of DDT, BHC, malathion.	7
V*	Practicals: - To check the TDS of different samples of water. - Purify the given sample of water using different purification techniques. - Identify the pH of different samples of food items. - Neutralize the given samples of base using acids	30

Suggested Evaluation Methods

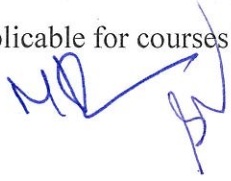
Internal Assessment: 15 + 5* Theory - Class Participation: 4 - Seminar/presentation/assignment/quiz/class test etc.: 4 - Mid-Term Exam: 7 Practicum - Class Participation: NA - Seminar/Demonstration/Viva-voce/Lab records etc.: 5 - Mid-Term Exam: NA	End Term Examination: 35+15*
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Part C-Learning Resources

Recommended Books/e-resources/LMS:

1. **Zero Waste: Management Practices for Environmental Sustainability** by Ashok K. Rathoure
2. **Sustainable Solid Waste Management** by Ni-Bin Chang
3. **Handbook of Advanced Industrial and Hazardous Wastes Treatment** by Lawrence K. Wang (Editor); Nazih K. Shammass (Editor); Yung Tse Hung (Editor)
4. **Pesticides and Insecticides, Development and Use**, Bobby Jones|2018
5. **WATER TREATMENT, How To Make Water Safe To Drink**, David Holman
6. **Energy, A Beginner's Guide**, Vaclav Smil, 2017
7. **Advanced Physical Chemistry, Practical Handbook**, Gurdeep Raj, Edition (2016)
8. **Advanced Practical Physical Chemistry, Handbook**, J.B. Yadav, Edition (2016)
9. **Goyal, P K, Water Pollution Causes, Effects and Control** New age International Publishers

*Applicable for courses having practical component.



VAC-3

Session: 2024-25			
Part A – Introduction			
Subject	Chemistry		
Semester	III		
Name of the Course	Chemistry in everyday life		
Course Code	24UN-CHE-VAC301		
Course Type: (CC/MCC/MDC/CC-M/DSEC/VOC/DSE/PC/AEC/VAC)	VAC		
Level of the course (As per Annexure-I)	200-299		
Pre-requisite for the course (if any)	4.0		
Course Learning Outcomes (CLO):	After completing this course, the learner will be able to: 1. Critically think about the presence of chemicals in daily life 2. Understand presence of chemicals used in food 3. Analyse importance of Vitamins and minerals 4. Think about general medicines 5*. -NA-		
	Theory	Practical	Total
Credits	2	N. A.	2
Contact Hours/week	2	N. A.	2
Internal Assessment Marks	15	N. A.	15
End Term Exam Marks	35	N. A.	35
Examination Time	3hrs		
Maximum Marks: 50			
Part B- Contents of the Course			

MR

W

BR

<u>Instructions for Paper- Setter</u> Note: The examiner is requested to set nine questions in all, selecting two questions from each SECTION and one question (Question No.1 based on entire syllabus will consist of short answer type. All questions carry equal marks. The candidate is required to attempt five questions in all selecting one from each SECTION. Question No.1 is compulsory.		
Unit	Topics	Contact Hours
I	Soaps and detergents, cleansing action of soap, Cleansing action of detergents Propellants, Solid propellant, liquid propellants, hybrid propellants dyes: Cause of exhibition of color, chromophore, auxochrome, classification of dyes Advanced chemical materials: Ceramics, Sunscreens	8 Hrs
II	Chemicals used in foods Preservatives, coloring agents, sweetening agents, flavoring agents, antioxidants Chemicals used to grow, protect foods and crops: Fertilizers, Fungicides, Herbicide and Insecticide etc.	7 Hrs
III	Vitamins and minerals Definition, their significance, Fat soluble vitamins Names, daily dietary requirement, natural sources, Deficiency diseases Water soluble vitamins Names, daily dietary requirement, natural sources, Deficiency diseases Minerals Major and Minor nutrients, daily dietary requirement, natural sources, Deficiency diseases	7 Hrs
IV	Chemicals in Medicine Drug - target interaction (enzymes as drug targets and receptors as drug targets), chemical messengers, types of chemical messengers (hormones and neurotransmitters) Chemotherapy antipyretics, analgesics, antidepressants, antiseptics and disinfectants, antiviral drugs, antacids, antimalarial, anesthetics, tranquilizers, hypnotics and sedatives, ant allergic drugs and histamines	8 Hrs
V*	N.A.	
Suggested Evaluation Methods Short Answer and MCQ Type QUESTIONS		

Internal Assessment: ➤ Theory: 15 ● Class Participation: 04 ● Seminar/presentation/assignment/quiz/class test etc.: 04 ● Mid-Term Exam: 07 ➤ Practicum Nil ● Class Participation: ● Seminar/Demonstration/Viva-voce/Lab records etc.: ● Mid-Term Exam:	End Term Examination: 35
Part C-Learning Resources	
Recommended Books/e-resources/LMS: ✓ NCERT Chemistry	



SEC-3

Part A – Introduction			
Subject	Chemistry		
Semester	III		
Name of the Course	Analytical Chemistry-I		
Course Code	24UN-CHE-SEC301		
Course Type: (CC/MCC/MDC/CC-M/DSEC/VOC/DSE/PC/AEC/VAC)	SEC		
Level of the course (As per Annexure-I)	0-99		
Pre-requisite for the course (if any)	4.0		
Course Learning Outcomes (CLO):	After completing this course, the learner will be able to: 1. Analyse concepts about chromatography & its types; 2. Understand about soil analysis; 3. Learn water purification methods; 4. Perform food processing analysis. 5*. Practically analyse the soil composition.		
	Theory	Practical	Total
Credits	2	1	3
Contact Hours/week	2	2	4
Internal Assessment Marks	15	05	20
End Term Marks	35	20	55
Examination Time	03 Hours	03 Hours	-
Maximum Marks: 75 (Theory : 50 & Practical: 25)			
Part B- Contents of the Course			
<u>Instructions for Paper- Setter</u> Note: The examiner is requested to set nine questions in all, selecting two questions from each SECTION and one question (Question No.1 based on entire syllabus will consist of short answer type. All questions carry equal			

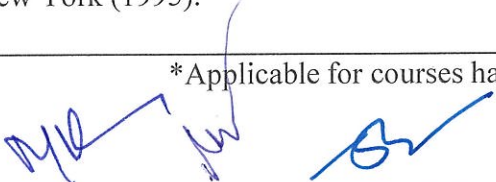
marks. The candidate is required to attempt five questions in all selecting one from each SECTION. Question No.1 is compulsory.		
Unit	Topics	Contact Hours
I	Chromatography: Definition, general introduction on principles of chromatography, Column chromatography, paper chromatography, TLC & ion-exchange chromatography.	8 Hrs
II	Analysis of soil: Composition of soil, Concept of pH and pH measurement, Complexometric titrations, Chelation, Chelating agents, use of indicators.	7 Hrs
III	Analysis of water: Definition of pure water, sources responsible for contaminating water, water sampling methods, water purification methods.	8 Hrs
IV	Analysis of food products: Nutritional value of foods, idea about food processing and food preservation and adulteration.	7 Hrs
V*	1. Paper chromatographic separation of mixture of metal ion (Fe^{3+} and Al^{3+}). 2. To compare samples of dyes/paints by TLC method. 3. Identification of adulterants in some common food items like coffee powder, asafoetida, chilli powder, turmeric powder, coriander powder and pulses, etc. 4. Determination of pH of soil samples. 5. Estimation of Calcium and Magnesium ions as Calcium carbonate by complexometric titration. 6. Determination of pH, acidity and alkalinity of a water	30 Hrs
Suggested Evaluation Methods Short Answer and MCQ Type QUESTIONS		
Internal Assessment: 15 ➤ Theory ● Class Participation: 04 ● Seminar/presentation/assignment/quiz/class test etc.: 04 ● Mid-Term Exam: 07 ➤ Practicum: 05 ● Class Participation: 02 ● Seminar/Demonstration/Viva-voce/Lab records etc.: 03 ● Mid-Term Exam: NIL		End Term Examination: 35+20*

Part C-Learning Resources

Recommended Books/e-resources/LMS:

- ✓ E. Stocchi: *Industrial Chemistry*, Vol -I, Ellis Horwood Ltd. UK.
- ✓ Willard, H.H., Merritt, L.L., Dean, J. & Settoe, F.A. *Instrumental Methods of Analysis*. 7th Ed. Wadsworth Publishing Co. Ltd., Belmont, California, USA, 1988.
- ✓ Skoog, D.A. Holler F.J. & Nieman, T.A. *Principles of Instrumental Analysis*, Cengage Learning India Ed.
- ✓ Skoog, D.A.; West, D.M. & Holler, F.J. *Fundamentals of Analytical Chemistry* 6th Ed., Saunders College Publishing, Fort Worth (1992).
- ✓ Harris, D. C. *Quantitative Chemical Analysis*, W. H. Freeman.
- ✓ Dean, J. A. *Analytical Chemistry Notebook*, McGraw Hill.
- ✓ Day, R. A. & Underwood, A. L. *Quantitative Analysis*, Prentice Hall of India.
- ✓ Freifelder, D. *Physical Biochemistry* 2nd Ed., W.H. Freeman and Co., N.Y. USA (1982).
- ✓ Cooper, T.G. *The Tools of Biochemistry*, John Wiley and Sons, N.Y. USA. 16 (1977).
- ✓ Vogel, A. I. *Vogel's Qualitative Inorganic Analysis* 7th Ed., Prentice Hall.
- ✓ Vogel, A. I. *Vogel's Quantitative Chemical Analysis* 6th Ed., Prentice Hall.
- ✓ Robinson, J.W. *Undergraduate Instrumental Analysis* 5th Ed., Marcel Dekker, Inc., New York (1995).

*Applicable for courses having practical component



CC-M3(V) or CC-M5(V)

Session: 2024-25			
Part A – Introduction			
Subject	Chemistry		
Semester	III		
Name of the Course	Chemistry of Fertilizers and Pesticides		
Course Code	24UN-CHE-VOC-1		
Course Type: (CC/MCC/MDC/CC-M/DSEC/VOC/DSE/PC/AEC/VAC)	VOC		
Level of the course (As per Annexure-I)	200-299		
Pre-requisite for the course (if any)	4.0		
Course Learning Outcomes (CLO):	After completing this course, the learner will be able to: 1. Know about fertilizers and nutrients; 2. Understand types of nitrate fertilizers; 3. Understand types of phosphate fertilizers; 4. Get the knowledge about pesticides. 5*. Understand the issues involved in pesticides and fertilizers		
	Theory	Practical	Total
Credits	3	1	4
Contact Hours/week	3	2	5
Internal Assessment Marks	20	10	30
End Term Marks	50	20	70
Examination Time	3hrs	3hrs	
Maximum Marks: 100 (Theory: 70 & Practical : 30)			
Part B- Contents of the Course			

Instructions for Paper- Setter

Note: The examiner is requested to set nine questions in all, selecting two questions from each SECTION and one question (Question No.1 based on entire syllabus will consist of short answer type. All questions carry equal

marks. The candidate is required to attempt five questions in all selecting one from each SECTION. Question No.1 is compulsory.

Unit	Topics	Contact Hours
I	Methods and time of fertilizer applications, tips to get best efficiency of Applied fertilizers, Integrated nutrient management, fertilizers and its relations to plant nutrients, Factors effecting optimum fertilizer dose.	12 Hrs
II	Classification and types of fertilizers, Nitrogenous fertilizers: Ammonium nitrate, Urea, Calcium Cyanamide, Calcium Ammonium Nitrate, Sodium Nitrate, Ammonium Chloride: Introduction, Raw materials, Action of as a fertilizers.	11Hrs
III	Phosphate fertilizers: Normal super phosphate, Triple Super Phosphate, Ammonium Phosphate. Potassic fertilizers (Types and optimum doses)	11Hrs
IV	pesticides: Classification, synthesis, structure activity relationship (SAR), mode of action, uses and adverse effects of representative pesticides in the following classes: Organochlorines (DDT, Gammaxene); Organophosphates (Malathion, Parathion); Carbamates (Carbofuran and Carbaryl); Quinones (Chloranil), Anilides (Alachlor and Butachlor).	11Hrs
V*	1. To carryout market survey of potent pesticides with details as follows: a) Name of pesticide b) Chemical name, class and structure of pesticide c) Type of formulation available and Manufacturer's name d) Useful information on label of packaging regarding: Toxicity, LD50 ("Lethal Dose, 50%"), Side effects and Antidotes. 2. To carryout market survey of potent botanical pesticides with details as follows: a) Botanical name and family; b) Chemical name (active ingredient) and structure of active ingredient; c) Type of formulation available and Manufacturer's name; d) Useful information on label of packaging regarding: Toxicity, LD50 ("Lethal Dose, 50%"), Side effects and Antidotes. 3. Preparation of simple Organochlorine pesticides. 4. To calculate acidity/alkalinity in given sample of pesticide formulations as per BIS specifications.	30 Hrs
	5. To calculate active ingredient in given sample of pesticide formulations as per BIS specifications. 6. Preparation of Neem based botanical pesticides. 7. To study about identification of crops, seeds, fertilizers and pesticides.	

Suggested Evaluation Methods Short Answer and MCQ Type QUESTIONS	
Internal Assessment: 20+10*=30 > Theory: 20 ● Class Participation: 05 ● Seminar/presentation/assignment/quiz/class test etc.:05 ● Mid-Term Exam: 10 > Practicum:10 ● Class Participation: 05 ● Seminar/Demonstration/Viva-voce/Lab records etc.: 05 ● Mid-Term Exam: N. A.	End Term Examination: 50+20*
Part C-Learning Resources	
Recommended Books/e-resources/LMS: ✓ Gopal Rao: Outlines in Chemical Technology. ✓ Shukla and Pandey: Introduction to Chemical Technology ✓ Perry, A.S.; Yamamoto, I.; Ishaaya, I.; Perry, R.Y.(1998), Insecticides in Agriculture and Environment, Springer-Verlag Berlin Heidelberg. ✓ Kuhr, R.J. ; Derough, H.W.(1976), Carbamate Insecticides: Chemistry, Biochemistry and Toxicology, CRC Press, USA.	

MCC-2

Session: 2023-24

Part A - Introduction			
Subject	Chemistry		
Semester	I		
Name of the Course	Physical Chemistry-I		
Course Code	24UN-CHE-102		
Course Type: (CC/MCC/MDC/CC-M/DSEC/VOC/DSE/PC/AEC/VA C)	MCC		
Level of the course (As per Annexure-I)	100-199		
Pre-requisite for the course (if any)	Chemistry as a subject at 4.0 Level (Class-XII)		
Course Learning Outcomes (CLO):	After completing this course, the learner will be able to: 1. Get the knowledge of concepts of rates of chemical reactions and its application in determination of order of various reactions. 2. Get the knowledge of various thermodynamic variables and properties. 3. To learn about the concepts of physical and thermodynamic functions in different reversible reactions and get the knowledge of molecular structure. 4. To learn about the various properties of molecules related to its magnetic behavior. 5. Hand on practice in preparation of solutions, compounds, estimation and determination of physical properties of some compounds.		
	Theory	Practical	Total
Credits	3	1	4
Contact Hours/week	03	02	05
Internal Assessment Marks	20	10	30
End Term Exam Marks	50	20	70
Examination hrs	03	03	---

Part B- Contents of the Course

Instructions for Paper- Setter

Note: The examiner is requested to set nine questions in all, selecting two questions from each SECTION and one question (Question No.1 based on entire syllabus will consist of short answer type. All questions carry equal marks. The candidate is required to attempt five questions in all selecting one from each SECTION. Question No.1 is compulsory. Log table and non- programmable calculator is allowed.

Unit	Topics	Contact Hours
I	Chemical Kinetics: Kinetics Rate of reaction, rate equation and its types, factors influencing the rate of a reaction – concentration, temperature, pressure, solvent, light, catalyst. Order and molecularity of a reaction, integrated rate expression for zero order, first order, second and third order reactions (for equal and unequal concentrations of reactants), methods of determination of order of reaction, Half-life period of a reaction. Effect of temperature on the rate of reaction – Arrhenius equation.	12
II	Chemical Kinetics & Thermodynamics: Theories of reaction rate – Simple collision theory for unimolecular collision. Transition state theory of bimolecular reactions. Definition of thermodynamic terms: system, surrounding etc. Types of systems, intensive and extensive properties. State and path functions and their differentials. Thermodynamic process. Thermodynamic equilibrium, Concept of heat and work. First law of thermodynamics: statement, concepts of internal energy and enthalpy. Heat capacity, heat capacities at constant volume and pressure and their relationship.	11
III	Thermodynamics, Physical Properties and Molecular Structure-I: Joule–Thomson coefficient for ideal gas and real gas and inversion temperature. Calculation of w, q, dU & dH for the expansion of ideal gases under isothermal and adiabatic conditions for reversible process. Optical activity, polarization – (Clausius – Mossotti equation-derivation excluded). Orientation of dipoles in an electric field, dipole moment, induced dipole moment.	11
IV	Physical Properties and Molecular Structure-II: Measurement of dipole moment-temperature method and refractivity method, dipole moment and structure of molecules, Magnetic permeability, magnetic susceptibility and its determination. Application of magnetic susceptibility, magnetic properties – paramagnetism, diamagnetism and ferromagnetism.	11

Practical

1. Acid/Base titration: Determination of strength of HCl using NaOH. 2. Redox titrations: Determination of $\text{C}_2\text{O}_4^{2-}$ ions using KMnO_4 . 3. To determine the surface tension of given liquid using Stalagmometer by drop weight methods. 4. To study the effect of surfactant on surface tension of water. 5. To study the process of sublimation of Camphor and Phthalic acid.	30
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Suggested Evaluation Methods

Internal Assessment ➤ Theory: 20 - Class Participation: 5 - Seminar/presentation/assignment/quiz/class test etc.: 5 - Mid-Term Exam: 10 ➤ Practicum: 10 - Class Participation: NA - Seminar/Demonstration/ Viva -voce/ Lab records etc.: 10 - Mid-Term Exam: NA	End Term Examination: ➤ Theory: 50 Written examination ➤ Practicum: 20 Lab record, viva-voce, Demonstration of practical
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Part C- Learning Resources

Recommended Books/e-resources/LMS:

1. Atkins, P.W.; Paula, J.de. (2014), **Atkin's Physical Chemistry Ed.**, 10th Edition, Oxford University Press.
2. Ball, D. W. (2017), **Physical Chemistry**, 2 nd Edition, Cengage Learning, India.
3. Castellan, G. W. (2004), **Physical Chemistry**, 4 th Edition, Narosa.
4. Kapoor, K.L. (2015), **A Textbook of Physical Chemistry**, Vol 1, 6 th Edition, McGraw Hill Education.
5. Khosla, B.D.; Garg, V.C.; Gulati, A. (2015), **Senior Practical Physical Chemistry**, R. Chand &Co, New Delhi.
6. Garland, C. W.; Nibler, J. W.; Shoemaker, D. P. (2003), **Experiments in Physical Chemistry**, 8 th Edition, McGraw-Hill, New York.

