



# UNIVERSITY OF JAMMU

(NAAC ACCREDITED 'A' GRADE' UNIVERSITY)  
(Baba Sahib Ambedkar Road, Jammu-180006 (J&K))

Academic Section

Email: [academicsectionju14@gmail.com](mailto:academicsectionju14@gmail.com)

## NOTIFICATION

(24/February/Adp./113)

It is hereby notified for the information of all concerned that the Vice-Chancellor, in anticipation of the approval of the Academic Council, is pleased to authorize the adoption of the Syllabi and Courses of Study in the subject of **Chemistry** of Semesters Vth, VIth, VIIth and VIIIth for **Four Year Under Graduate Programme** under the **Choice Based Credit System** as per **NEP-2020** (as given in the annexure) for the examinations to be held in the years as per the details given below:

Subject	Semester	for the examination to be held in the years
Chemistry	Semester-V	December 2024, 2025 and 2026
	Semester-VI	May 2025, 2026 and 2027
	Semester-VII	December 2025, 2026 and 2027
	Semester-VIII	May 2026, 2027 and 2028

The Syllabi of the courses are available on the University website: [www.jammuuniversity.ac.in](http://www.jammuuniversity.ac.in)

Sd/-  
DEAN ACADEMIC AFFAIRS

No. F. Acd/II/24/ 14685-740

Dated: 14-03-2024

Copy for information and necessary action to:

1. Dean, Faculty of Science
2. Convener, Board of Studies in **Chemistry**
3. Sr. P.A. to the Controller of Examinations
4. All members of the Board of Studies
5. Confidential Assistant to the Controller of Examinations
6. I/C Director, Computer Centre, University of Jammu
7. Deputy Registrar/Asst. Registrar (Conf. /Exams. UG/Eval Non-Prof)
8. Incharge, University Website for Uploading of the notification

Sunil Shamo  
Deputy Registrar (Academic)  
13/3/24

12/3/24  
12/3/24  
12/3/24

Syllabus and courses of studies in the subject of Chemistry under CBCS as per NEP-2020

**UNIVERSITY OF JAMMU**

**SYLLABUS FOR FOUR YEAR UNDERGRADUATE PROGRAMME (FYUGP) IN CHEMISTRY W.E.F. ACADEMIC SESSION 2022 AS PER NATIONAL EDUCATION POLICY (NEP 2020)**

**Semester-wise Grid Plan [Semesters I–VIII]**

S. No.	Sem., Level	Credits and Type of Course	Course Code	Course Title	Credits Distribution Lecture-Tutorial-Practical (L-T-P)
1.	UG/Sem-I, 100 Levels	4 as Major	UMICHT101	Foundation Course Chemistry-I	4 (3-0-1)
2.	UG/Sem-I, 100 Levels	4 as Minor	UMICHT102	Foundation Course Chemistry-I	4 (3-0-1)
3.	UG/Sem-I	3 as Multidisciplinary	UMDCHT103	Chemistry in Everyday Life	3 (3-0-0)
4.	UG/Sem-I	2 as Skill Enhancement	USECHT104	Basic Analytical Techniques in Chemistry	2 (1-0-1)
5.	UG/Sem-II, 100 Levels	4 as Major	UMJCHT201	Foundation Course Chemistry-II	4 (3-0-1)
6.	UG/Sem-II, 100 Levels	4 as Minor	UMICHT202	Foundation Course Chemistry-II	4 (3-0-1)
7.	UG/Sem-II	3 as Multidisciplinary	UMDCHT203	Hazardous Waste and its Treatment	3 (3-0-0)
8.	UG/Sem-II	2 as Skill Enhancement	USECHT204	Chemistry of Soaps, Detergents and Surfactants	2 (1-0-1)
9.	UG/Sem-III, 200 Levels	4 as Major	UMICHT301	Foundation Course Chemistry-III	4 (3-0-1)
10.	UG/Sem-III, 200 Levels	4 as Major	UMICHT302	Analytical Chemistry	4 (3-0-1)
11.	UG/Sem-III, 200 Levels	4 as Minor	UMICHT303	Foundation Course Chemistry-III	4 (3-0-1)
12.	UG/Sem-III	3 as Multidisciplinary	UMDCHT304	Chemistry in Everyday Life	3 (3-0-0)
13.	UG/Sem-III	2 as Skill Enhancement	USECHT305	Chemistry of Food and Cosmetics	2 (1-0-1)
14.	UG/Sem-IV, 200 Levels	4 as Major	UMJCHT401	Physical Chemistry-I	4 (3-0-1)
15.	UG/Sem-IV, 200 Levels	4 as Major	UMJCHT402	Organic Chemistry-I	4 (3-0-1)
16.	UG/Sem-IV, 200 Levels	4 as Major	UMJCHT403	Inorganic Chemistry-I	4 (3-0-1)
17.	UG/Sem-IV, 200 Levels	4 as Major	UMJCHT404	Spectroscopic & Nuclear Chemistry	4 (3-1-0)
18.	UG/Sem-IV, 200 Levels	4 as Minor	UMICHT405	Inorganic Chemistry-I	4 (3-0-1)
19.	UG/Sem-V, 300 Levels	4 as Major	UMICHT501	Physical Chemistry-II	4 (3-0-1)
20.	UG/Sem-V, 300 Levels	4 as Major	UMICHT502	Organic Chemistry-II	4 (3-0-1)
21.	UG/Sem-V, 300 Levels	4 as Major	UMICHT503	Inorganic Chemistry-II	4 (3-0-1)
22.	UG/Sem-V, 300 Levels	2 as Major	UMICHT504	Polymer Science & Technology	2 (2-0-0)
23.	UG/Sem-V, 200 Levels	4 as Minor	UMICHT-505	Organic Chemistry-I	4 (3-0-1)
24.	UG/Sem-V	2 as Skill Enhancement	USECHT506	Summer Internship	2 (0-0-2)
25.	UG/Sem-VI, 300 Levels	4 as Major	UMJCHT-601	Physical Chemistry-III	4 (3-0-1)
26.	UG/Sem-VI, 300 Levels	4 as Major	UMJCHT-602	Organic Chemistry-III	4 (3-0-1)
27.	UG/Sem-VI, 300 Levels	4 as Major	UMJCHT-603	Inorganic Chemistry-III	4 (3-0-1)
28.	UG/Sem-VI, 300 Levels	4 as Major	UMJCHT-604	Green Chemistry Technology	4 (3-1-0)
29.	UG/Sem-VI, 200 Levels	4 as Minor	UMICHT-605	Physical Chemistry-I	4 (3-0-1)
30.	UG/Sem-VII, 400 Levels	4 as Major	UMICHT-701	Physical Chemistry-IV	4 (3-1-0)
31.	UG/Sem-VII, 400 Levels	4 as Major	UMJCHT-702	Organic Chemistry-IV	4 (3-0-1)
32.	UG/Sem-VII, 400 Levels	4 as Major	UMJCHT-703	Inorganic Chemistry-IV	4 (3-0-1)
33.	UG/Sem-VII, 400 Levels	4 as Major (for Honors)	UMJCHT-704	Principles of Spectroscopy	4 (3-1-0)
		4 as Major (for Honors with Research)	UMJCHT-705	Research Methodology & Research Ethics	4 (3-1-0)
34.	UG/Sem-VII, 300 Levels	4 as Minor	UMICHT-706	Principles of Spectroscopy	4 (3-1-0)

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Syllabus and courses of studies in the subject of Chemistry under CBCS as per NEP-2020

S. No.	Sem., Level	Credits and Type of Course	Course Code	Course Title	Credits Distribution Lecture-Tutorial-Practical (L-T-P)
<b>B. Sc. Honors</b>					
35.	UG/Sem-VIII, 400 Levels	4 as Major	UMJCHT-801	Physical Chemistry-V	4 (3-0-1)
36.	UG/Sem-VIII, 400 Levels	4 as Major	UMJCHT-802	Organic Chemistry-V	4 (3-0-1)
37.	UG/Sem-VIII, 400 Levels	4 as Major	UMJCHT-803	Inorganic Chemistry-V	4 (3-0-1)
38.	UG/Sem-VIII, 400 Levels	4 as Major	UMJCHT-804	Applications of Spectroscopy in Organic Chemistry	4 (3-1-0)
39.	UG/Sem-VIII, 300 Levels	4 as Minor	UMICHT-805	Green Chemistry Technology	4 (3-1-0)
<b>B. Sc. Honors with Research</b>					
40.	UG/Sem-VIII, 400 Levels	4 as Major	UMJCHT-806/ UMICHT-807/ UMICHT-808/ UMICHT-809	Physical Chemistry-V Or Organic Chemistry-V Or Inorganic Chemistry-V Or Applications of Spectroscopy in Organic Chemistry	4 (3-0-1)
41.	UG/Sem-VIII, 300 Levels	4 as Minor	UMICHT-810	Green Chemistry Technology	4 (3-1-0)
42.	UG/Sem-VIII	12 as Major	UMICHP-811	Research Project as Dissertation	12 (0-0-12)

**Course Codes:**

U= Undergraduate

MJ=Major; MI=Minor; MD=Multi-Disciplinary; SE=Skill Enhancement

CH= Chemistry

T= Theory; I=Internship; P=Project

Syllabus and courses of studies in the subject of Chemistry under CBCS as per NEP-2020

(For examinations to be held in the years Dec. 2022, 2023 & 2024)

**Semester-I**

Course No.: UMJCHT101 (Major course)

Title: FOUNDATION COURSE CHEMISTRY-I

Credits: 03 (Theory) + 01 (Practical)

Maximum Marks: 100 [75 (Theory) + 25 (Practical)]

Duration of Examination: 3 hours (Theory) and 2½ Hours (Practical)

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Theory: 03 Credits

Contact Hours: 45 hours

**Course learning outcomes:**

After completing this course contents, students will be able to understand

- Atomic Structure in terms of atomic orbitals and electronic configuration
- Periodic properties through periodic table
- Electronic displacement and bond cleavage in organic molecules
- Properties of Gaseous state

**Unit-I: Atomic Structure**

(15 Hours)

Introduction to Quantum mechanics, Time independent Schrodinger wave equation and its derivation. Significance of  $\psi$  and  $\psi^2$ , Application of Schrödinger equation to hydrogen atom (in terms of spherical polar coordinates), Radial and angular parts of the hydrogenic wavefunctions (atomic orbitals) and their variations for  $1s$ ,  $2s$ ,  $2p$ ,  $3s$ ,  $3p$  and  $3d$  orbitals (Only graphical representation). Radial and angular nodes and their significance. Probability distribution curves and radial probability distribution curves, Quantum numbers and their significance, Shapes of  $s$ ,  $p$  and  $d$  atomic orbitals.

Rules governing electronic configuration in various atomic orbitals: Aufbau principle, Pauli's Exclusion Principle and Hund's rule of maximum multiplicity, Concept of exchange energy-extra stability of half-filled and fully filled electronic configurations. Anomalous electronic configurations.

**Unit-II: Classifications of Elements and Periodic Properties**

(10 Hours)

**Periodic Table-** Periodic Laws (Mendeleev and Mosley), Classification of elements into  $s$ ,  $p$ ,  $d$  and  $f$ -blocks, Nuclear Charge, Effective Nuclear Charge, Shielding effect and their inter-relation i.e., Slater's Rule.

Concept, Variations and factors affecting various periodic properties (atomic/ionic radii, ionisation energy, electron affinity and electronegativity), Inert pair effect, Anomalous behaviour of first element in respective groups of representative elements, Diagonal relationship of Li and Mg; Be and Al.

**Unit-III: General Organic Chemistry**

(10 Hours)

**Electronic Displacements:** Inductive Effect, Electromeric Effect, Mesomeric Effect/Resonance and Hyperconjugation, Polar and Non-Polar organic Molecules, Dipole moment and Hydrogen bonding.

**Bond Cleavage:** Homolytic and Heterolytic fission with suitable examples, formal charge, Concept of Electrophiles and Nucleophiles (with suitable examples).

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Syllabus and courses of studies in the subject of Chemistry under CBCS as per NEP-2020

(For examinations to be held in the years Dec. 2022, 2023 & 2024)

**Semester-I**

**Course No.: UMJCHT101 (Major course)**

**Title: FOUNDATION COURSE CHEMISTRY-I**

**Credits: 03 (Theory) + 01 (Practical)**

**Maximum Marks: 100 [75 (Theory) + 25 (Practical)]**

**Duration of Examination: 3 hours (Theory) and 2½ Hours (Practical)**

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**Reactive Intermediates:** Types, shape and relative stability of Carbocations, Carbanions, Free radicals and carbenes.

Introduction to types of organic reactions: Addition, Elimination and Substitution reactions.

**UNIT-IV: States of Matter -I**

**(10 Hours)**

**Gaseous State:** Postulates of Kinetic Theory of Gases, Concept of Ideal & Non-ideal Gases, Ideal Gas equation, Deviation of gases from ideal behaviour, compressibility factor, causes of deviation and van der Waal's equation.

**Molecular velocities:** Root mean square, average and most probable velocities, Collision Theory- Collision number, mean free path and collision diameter.

Liquefaction of gases, LPG and critical phenomenon, Critical constants and their calculations from van der Waals equation. Andrew's isotherm of CO<sub>2</sub>.

**NOTE FOR PAPER SETTING:**

***Note for paper setter for End Semester Examination:***

The question paper will be of **60 marks**. There shall be **2 Sections** in the question paper with pattern as follows:

**Section-A** shall comprise of **4** short answer type questions of (**3** marks each) with one question from each unit. The students have to attempt all the questions from Section-A.

**Section-B** shall comprise of a total of **8** questions with two questions selected from each unit. Each question shall be of **12 marks**. The students have to attempt **4** questions by selecting only one question from each unit.

The numerical problems should not exceed more than 20% of the maximum marks.

***Note for paper setter for Mid Semester Examination:***

The Mid Semester Examination shall be conducted by the course coordinator after completion of **50%** of the syllabus.

The question paper will be of **15** marks and duration of examination shall be **1½** hour. There shall be **2** sections in the question paper with pattern as follows:

**Section-A** shall comprise of **3** questions (of **4** marks each) and the students are required to attempt any two questions.

**Section-B** shall comprise of **2** questions (of **7** marks each) and the students are required to attempt any one question.

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Syllabus and courses of studies in the subject of Chemistry under CBCS as per NEP-2020

(For examinations to be held in the years Dec. 2022, 2023 & 2024)

**Semester-I**

**Course No.: UMJCHT101 (Major course)**

**Title: FOUNDATION COURSE CHEMISTRY-I**

**Credits: 03 (Theory) + 01 (Practical)**

**Maximum Marks: 100 [75 (Theory) + 25 (Practical)]**

**Duration of Examination: 3 hours (Theory) and 2½ Hours (Practical)**

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**BOOKS RECOMMENDED:**

1. Concise Inorganic Chemistry; J.D. Lee; 5thEdn., OUP/Wiley India Pvt. Limited, 2008.
2. Principles of Inorganic Chemistry; B.R. Puri, L.R. Sharma and K.C. Kalia; 33<sup>rd</sup>Edn., Milestone Publishers & Distributors/ Vishal Publishing Co., 2017.
3. Advanced General Organic Chemistry: A Modern Approach; S.K. Ghosh; 3rd Revised Edn., New Central, 2010.
4. Organic Chemistry; R.T. Morrison, R.N. Boyd, S. K. Bhattacharjee; 7th Edn., Pearson India, 2011.
5. Organic Chemistry; J. Clayden, N. Greeves and S. Warren, 2nd Edn., Oxford University Press, 2012.
6. Advanced Organic Chemistry; Dr.Jagdamba Singh and LDS Yadav; Pragati edition, 2017.
7. Principles of Physical Chemistry; B.R. Puri, L.R. Sharma and L.S. Pathania; 47<sup>th</sup>Edn., Vishal Pubs & Co, 2017.
8. Physical Chemistry; T. Engel, P. Reid; 3rd Edn., Pearson India, 2013.
9. Atkins' Physical chemistry; P. Atkins, J. De Paula and J. Keeler, 11th Edn., Oxford University Press, 2017.

**Practical: 01 Credit**

**Contact Hours: 30 hours**


**Course learning outcomes:**

After completing this course contents, students will be able to understand

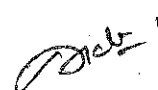
- Preparation of standard solutions of different concentrations
- Purification of organic compounds by different methods
- Determination of extra elements present in the organic compound.

**Suggested Experiments:**

1. Preparation of solutions of different concentrations; Standardization of solutions (acids and bases).
2. Estimation of sodium carbonate and sodium hydrogen carbonate present in a mixture.
3. Volumetric estimation of oxalic acid by titrating it with KMnO<sub>4</sub>.
4. Purification of organic compounds by crystallization (from water and alcohol) and sublimation.
5. Criteria of purity: Determination of melting point/boiling point.
6. Detection of N, S and halogens in organic compounds.



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Syllabus and courses of studies in the subject of Chemistry under CBCS as per NEP-2020

(For examinations to be held in the years Dec. 2022, 2023 & 2024)

**Semester-I**

Course No.: UMJCHT101 (Major course)

Title: FOUNDATION COURSE CHEMISTRY-I

Credits: 03 (Theory) + 01 (Practical)

Maximum Marks: 100 [75 (Theory) + 25 (Practical)]

Duration of Examination: 3 hours (Theory) and 2½ Hours (Practical)

**NOTE FOR PAPER SETTING:**

**EVALUATION OF PRACTICALS:**

Daily evaluation of practical records/viva-voce etc.		10 marks
Final examination (to be conducted by the course coordinator internally)	100 % Syllabus	15 marks (10 marks = practical assessment + 5 marks= viva-voce examination)

**BOOKS RECOMMENDED:**

1. Comprehensive Practical Organic Chemistry: Qualitative analysis V. K. Ahluwalia & Sunita Dhingra; Universities Press, India, 2004.
2. Advanced Practical Organic Chemistry; N. K. Vishnoi; 3rd Edn; Vikas Publishing, 2009.
3. Advanced Practical Physical Chemistry; J.B. Yadav; Krishna Prakashan Media(P) Limited, 2015.
4. Advanced Physical Chemistry Experiments; J. N. Gurtu, A. Gurtu, Pragati Prakashan, 2008.

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Syllabus and courses of studies in the subject of Chemistry under CBCS as per NEP-2020

(For examinations to be held in the years Dec. 2022, 2023 & 2024)

**Semester-I**

**Course No.: UMICHT102 (Minor course)**

**Title: FOUNDATION COURSE CHEMISTRY-I**

**Credits: 03 (Theory) + 01 (Practical)**

**Maximum Marks: 100 [75 (Theory) + 25 (Practical)]**

**Duration of Examination: 3 Hours (Theory) and 2½ Hours (Practical)**

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**Theory: 03 Credits**

**Contact Hours: 45 hours**

**Course learning outcomes:**

After completing this course contents, students will be able to understand

- Atomic Structure in terms of atomic orbitals and electronic configuration
- Periodic properties through periodic table
- Electronic displacement and bond cleavage in organic molecules
- Properties of Gaseous state

**Unit-I: Structure of atom**

**(15 Hours)**

Recapitulation of Bohr's theory and its limitations. Wave mechanics: de Broglie equation, Heisenberg's Uncertainty Principle and its significance.

Schrödinger's wave equation (Elementary idea only), Significance of  $\psi$  and  $\psi^2$ .

Quantum numbers and their significance. Radial and angular nodes, Shapes of s, p and orbitals. Rules governing electronic configuration in various atomic orbitals: Aufbau principle, Pauli's Exclusion Principle and Hund's rule of maximum multiplicity, Concept of exchange energy-extra stability of half-filled and fully filled electronic configurations.

**Unit-II: Classifications of Elements and Periodic Properties**

**(10 Hours)**

**Periodic Table-** Classification of elements into s, p, d and f-blocks, Nuclear Charge, Effective Nuclear Charge, Shielding effect and their inter-relation i.e., Slater's Rule.

Concept, Variations and factors affecting various periodic properties (atomic/ionic radii, ionisation energy, electron affinity and electronegativity), Inert pair effect, Diagonal relationship of Lithium and Magnesium.

**Unit-III: General Organic Chemistry**

**(10 Hours)**

**Electronic Displacement:** Inductive Effect, Electromeric Effect, Mesomeric Effect/Resonance and Hyperconjugation, Polar and Non-Polar organic Molecules, Dipole moment and Hydrogen bonding.

**Bond Cleavage:** Homolytic and Heterolytic fission with suitable examples, formal charge, Concept of Electrophiles and Nucleophiles (with suitable examples).

**Reactive Intermediates:** Types, shape and relative stability of Carbocations, Carbanions and Free radicals.

Introduction to types of organic reactions: Addition, Elimination and Substitution reactions (Elementary idea only).

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Syllabus and courses of studies in the subject of Chemistry under CBCS as per NEP-2020

(For examinations to be held in the years Dec. 2022, 2023 & 2024)

**Semester-I**

Course No.: UMICHT102 (Minor course)

Title: FOUNDATION COURSE CHEMISTRY-I

Credits: 03 (Theory) + 01 (Practical)

Maximum Marks: 100 [75 (Theory) + 25 (Practical)]

Duration of Examination: 3 Hours (Theory) and 2½ Hours (Practical)

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**Unit- IV: States of Matter -I**

**(10 Hours)**

**Gaseous State:** Kinetic Theory of Gases, Ideal & Non-ideal Gases, Ideal Gas equation, Deviation of gases from ideal behaviour, van der Waal's equation.

**Molecular velocities:** Root mean square, average and most probable velocities (basic concepts only). Collision Theory- Collision number, mean free path and collision diameter. Liquefaction of gases, LPG and critical phenomenon (Andrew's Experiment).

**NOTE FOR PAPER SETTING:**

***Note for paper setter for End Semester Examination:***

The question paper will be of **60 marks**. There shall be **2 Sections** in the question paper with pattern as follows:

**Section-A** shall comprise of **4** short answer type questions of (**3** marks each) with one question from each unit. The students have to attempt all the questions from Section-A.

**Section-B** shall comprise of a total of **8** questions with two questions selected from each unit. Each question shall be of **12 marks**. The students have to attempt **4** questions by selecting only one question from each unit.

The numerical problems should not exceed more than 20% of the maximum marks.

***Note for paper setter for Mid Semester Examination:***

The Mid Semester Examination shall be conducted by the course coordinator after completion of **50%** of the syllabus.

The question paper will be of **15** marks and duration of examination shall be **1½** hour. There shall be **2** sections in the question paper with pattern as follows:

**Section-A** shall comprise of **3** questions (of **4** marks each) and the students are required to attempt any two questions.

**Section-B** shall comprise of **2** questions (of **7** marks each) and the students are required to attempt any one question.

**BOOKS RECOMMENDED:**

1. Concise Inorganic Chemistry; J.D. Lee; 5thEdn., OUP/Wiley India Pvt. Limited, 2008.
2. Principles of Inorganic Chemistry; B.R. Puri, L.R. Sharma and K.C. Kalia; 33<sup>rd</sup> Edn., Milestone Publishers & Distributors/ Vishal Publishing Co., 2017.
3. Advanced General Organic Chemistry: A Modern Approach; S.K. Ghosh; 3rd Revised Edn., New Central, 2010.
4. Organic Chemistry; R.T. Morrison, R.N. Boyd, S. K. Bhattacharjee; 7th Edn., Pearson India, 2011.
5. Organic Chemistry; J. Clayden, N. Greeves and S. Warren, 2nd Edn., Oxford University Press, 2012.

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Syllabus and courses of studies in the subject of Chemistry under CBCS as per NEP-2020

(For examinations to be held in the years Dec. 2022, 2023 & 2024)

**Semester-I**

**Course No.: UMICHT102 (Minor course)**

**Title: FOUNDATION COURSE CHEMISTRY-I**

**Credits: 03 (Theory) + 01 (Practical)**

**Maximum Marks: 100 [75 (Theory) + 25 (Practical)]**

**Duration of Examination: 3 Hours (Theory) and 2½ Hours (Practical)**

6. Advanced Organic Chemistry; Dr. Jagdamba Singh and LDS Yadav; Pragati edition, 2017.
7. Principles of Physical Chemistry; B.R. Puri, L.R. Sharma and L.S. Pathania; 47<sup>th</sup>Edn., Vishal Pubs & Co, 2017.
8. Physical Chemistry; T. Engel, P. Reid; 3rd Edn., Pearson India, 2013.
9. Atkins' Physical chemistry; P. Atkins, J. De Paula and J. Keeler, 11th Edn., Oxford University Press, 2017.

**Practical: 01 Credit**

**Contact Hours: 30 Hours**

**Course learning outcomes:**

After completing this course contents, students will be able to understand

- Preparation of standard solutions of different concentrations
- Purification of organic compounds by different methods
- Determination of extra elements present in the organic compound.

**Suggested Experiments:**

1. Preparation of solutions of different concentrations; Standardization of solutions (acids and bases).
2. Estimation of sodium carbonate and sodium hydrogen carbonate present in a mixture.
3. Volumetric estimation of oxalic acid by titrating it with  $\text{KMnO}_4$ .
4. Purification of organic compounds by crystallization (from water and alcohol) and sublimation.
5. Criteria of purity: Determination of melting point/boiling point.
6. Detection of N, S and halogens in organic compounds.

**NOTE FOR PAPER SETTING:**

**EVALUATION OF PRACTICALS:**

Daily evaluation of practical records/viva-voce etc.	10 marks	
Final examination (to be conducted by the course coordinator internally)	100 % Syllabus	15 marks (10 marks = practical assessment + 5 marks= viva-voce examination)



Syllabus and courses of studies in the subject of Chemistry under CBCS as per NEP-2020

(For examinations to be held in the years Dec. 2022, 2023 & 2024)

**Semester-I**

Course No.: UMICHT102 (Minor course)

Title: FOUNDATION COURSE CHEMISTRY-I

Credits: 03 (Theory) + 01 (Practical)

Maximum Marks: 100 [75 (Theory) + 25 (Practical)]

Duration of Examination: 3 Hours (Theory) and 2½ Hours (Practical)

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**BOOKS RECOMMENDED:**

1. Comprehensive Practical Organic Chemistry: Qualitative analysis V. K. Ahluwalia, & Sunita Dhingra; Universities Press, India, 2004.
2. Advanced Practical Organic Chemistry; N. K. Vishnoi; 3rd Edn; Vikas Publishing, 2009.
3. Advanced Practical Physical Chemistry; J.B. Yadav; Krishna Prakashan Media(P) Limited, 2015.
4. Advanced Physical Chemistry Experiments; J. N. Gurtu, A. Gurtu, Pragati Prakashan, 2008.

**Syllabus and courses of studies in the subject of Chemistry under CBCS as per NEP-2020**

(For examinations to be held in the years Dec. 2022, 2023 & 2024)

**Semester-I**

**Course No.: UMDCHT103 (Multi -Disciplinary Course)**

**Title: CHEMISTRY IN EVERYDAY LIFE**

**Credits: 03**

**Maximum Marks: 75**

**Contact Hours: 45 Hours**

**Duration of Examination: 3 Hours**

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**Course learning outcomes:**

After completing this course contents, students will be able to understand

- To learn about food additives and chemical composition of drugs.

**Unit-I: Chemotherapy**

**(13 Hours)**

Definition of chemotherapy- examples each for (i) Analgesics, (ii) antibacterial, (iii) anti-inflammatory, (iv) antipyretic, (v) antibiotic, (vi) antacid (vii) antiviral, (viii) antidepressant, (ix) antiallergic, (x) antidiabetics, (xi) antihypertensive, (xii) anaesthetics (local and general)

**Structures not necessary.**

**Unit-II: Food Additives and Preservation**

**(12 Hours)**

Artificial sweeteners - saccharin - cyclamate and aspartate, food flavours esters and aldehydes. Food colours - restricted use of spurious colors - emulsifying agents - leavening agents, baking powder, yeast - taste makers - MSG, vinegar. Food preservation – Methods – preservation by low temperature, high temperature - preservatives.

**Structures not necessary.**

**Unit-III: Biomolecules-I**

**(10 Hours)**

**Carbohydrates:** Definition, classification and their importance

**Amino acids:** Essential and non-essential. Definition, classification and their importance.

**Oils and Fats:** Definition, classification and importance. Saponification value

**Structure not necessary.**

**Unit- IV: Biomolecules-II**

**(10 Hours)**

**Vitamins:** Nomenclature and Classification, Sources, deficiency diseases due to vitamins A, B,C, D, E and K. Structure not necessary.

**Minerals:** Macro and micro elements, importance and deficiency diseases.

**Structure not necessary.**

**NOTE FOR PAPER SETTING:**

***Note for paper setter for End Semester Examination:***

The question paper will be of **60 marks**. There shall be **2 Sections** in the question paper with pattern as follows:

**Section-A** shall comprise of **4** short answer type questions of **(3 marks each)** with one question from each unit. The students have to attempt all the questions from Section-A.

Syllabus and courses of studies in the subject of Chemistry under CBCS as per NEP-2020

(For examinations to be held in the years Dec. 2022, 2023 & 2024)

**Semester-I**

**Course No.: UMDCHT103 (Multi -Disciplinary Course)**

**Title: CHEMISTRY IN EVERYDAY LIFE**

**Credits: 03**

**Maximum Marks: 75**

**Contact Hours: 45 Hours**

**Duration of Examination: 3 Hours**

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**Section-B** shall comprise of a total of **8** questions with two questions selected from each unit. Each question shall be of **12 marks**. The students have to attempt **4** questions by selecting only one question from each unit.

The numerical problems should not exceed more than 20% of the maximum marks.

**Note for paper setter for Mid Semester Examination:**

The Mid Semester Examination shall be conducted by the course coordinator after completion of **50%** of the syllabus.

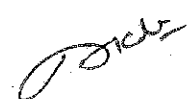
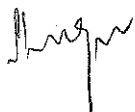
The question paper will be of **15** marks and duration of examination shall be 1½ hour. There shall be **2** sections in the question paper with pattern as follows:

**Section-A** shall comprise of **3** questions (of **4** marks each) and the students are required to attempt any two questions.

**Section-B** shall comprise of **2** questions (of **7** marks each) and the students are required to attempt any one question.

**BOOKS RECOMMENDED:**

1. Thangamma Jacob, Textbook of Applied chemistry for home science and Allied Science, New Delhi, Macmillan Co., (1979).
2. Macmillan, 1st Ed., 1990. M. Swaminathan, Text Book on Food chemistry, Printing and Publishing Co., Ltd., Bangalore, 1993.
3. Alex Ramani, V., Food Chemistry, MJP Publishers, Triplicane, Chennai, 2009. 9. Sivasankar, B., Food Processing and Preservation, PHI Learning Private Limited, Delhi, 2013.
4. B. S. Bahl, A. Bhal, —Textbook of Organic chemistry, S. Chand and Company Ltd., New Delhi, 22nd Ed., 2016.
5. Organic Chemistry of Natural Products-Volume I and II by Gurdeep R Chatwal, Himalaya Publishing House.



Syllabus and courses of studies in the subject of Chemistry under CBCS as per NEP-2020

(For examinations to be held in the years Dec. 2022, 2023 & 2024)

**Semester-I**

**Course No.: USECHT104 (Skill Enhancement Course)**

**Title: BASIC ANALYTICAL TECHNIQUES IN CHEMISTRY**

**Credits: 01 (Theory) + 01 (Practical)**

**Maximum Marks: 50 [25 (Theory) + 25 (Practical)]**

**Duration of Examination: 2 Hours (Theory) and 2½ Hours (Practical)**

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**Theory: 01 Credit**

**Contact Hours: 15 Hours**

**Course learning outcomes:**

After completing this course contents, students will be able to understand

- Principles of the volumetry
- Various types of titrations.
- Normality, equivalent weight of compounds.
- Hardness and analysis of water.
- Purification and separation techniques in Organic Chemistry

**Unit-I**

**(5 Hours)**

Titrimetric Analysis: definitions - standard solutions, equivalence point, end point, molarity, molality, normality, mole fraction, primary and secondary standards - types of titrimetric reactions - acid-base, redox, acid-base and redox indicators (External and Internal Indicators) Oxidation-reduction: oxidation number and oxidation states - equivalent weights of oxidizing and reducing agents.

**Unit-II**

**(5 Hours)**

Water quality parameters: Introduction, Hard water and Soft water, Measurement of Hardness of Water, Water softening, Chemical Analysis (Dissolved Oxygen, Total Dissolved, suspended and volatile Solids, Chlorides contents, Free and available chlorine and chlorine demand), Battery water and its preparation.

**Unit-III**

**(5 Hours)**

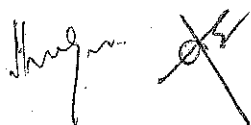
Distillation and Chromatographic Techniques: Introduction, Basic Distillation apparatus, Simple, Fractional and Steam Distillation, Separation of Liquid mixture, Azeotropes. Chromatographic techniques and types-Paper chromatography, Thin Layer chromatography and Column Chromatography. Separation of Mixtures and  $R_f$  value.

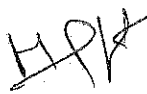
**NOTE FOR PAPER SETTING:**

***Note for paper setter for End Semester Examination:***

The question paper will be of **25 marks**. There shall be **2 Sections** in the question paper with pattern as follows:

**Section-A** shall comprise of **4** short answer type questions of (2½ marks each) with atleast one question from each unit. The students have to attempt all the questions from Section-A.









## Syllabus and courses of studies in the subject of Chemistry under CBCS as per NEP-2020

(For examinations to be held in the years Dec. 2022, 2023 & 2024)

### Semester-I

Course No.: USECHT104 (Skill Enhancement Course)

Title: BASIC ANALYTICAL TECHNIQUES IN CHEMISTRY

Credits: 01 (Theory) + 01 (Practical)

Maximum Marks: 50 [25 (Theory) + 25 (Practical)]

Duration of Examination: 2 Hours (Theory) and 2½ Hours (Practical)

Section-B shall comprise of a total of 6 questions with two questions selected from each unit. Each question shall be of 5 marks. The students have to attempt 3 questions by selecting only one question from each unit.

Practical: 01 Credit

Contact Hours: 30 Hours

### Course learning outcomes:

After completing this course contents, students will be able to understand

- Preparation of standard solutions
- Practical applications of volumetric analysis

### Suggested Experiments:

1. Preparation of solutions of different concentrations; Standardization of Solutions, acid base and redox titrations.
2. Estimation of sodium carbonate and Sodium Hydrogen Carbonate present in a mixture.
3. Preparation of Battery water.
4. Purification of Organic compounds by Distillation.
5. Identification and separation of components of a given mixture (amino acids and sugars) by paper chromatography.
6. Determination of chloride, available chloride and chlorine demand.
7. Determination of Suspended solid (SS), Total Dissolved solid (TDS), Total suspended solid (TSS) and Total volatile solids (TVS).

### NOTE FOR PAPER SETTING:

### EVALUATION OF PRACTICALS:

Daily evaluation of practical records/viva-voce etc.	10 marks	
Final examination (to be conducted by the course coordinator internally)	100 % Syllabus	15 marks (10 marks = practical assessment + 5 marks = viva-voce examination)

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Syllabus and courses of studies in the subject of Chemistry under CBCS as per NEP-2020

(For examinations to be held in the years Dec. 2022, 2023 & 2024)

**Semester-I**

Course No.: USECHT104 (Skill Enhancement Course)

Title: BASIC ANALYTICAL TECHNIQUES IN CHEMISTRY

Credits: 01 (Theory) + 01 (Practical)

Maximum Marks: 50 [25 (Theory) + 25 (Practical)]

Duration of Examination: 2 Hours (Theory) and 2½ Hours (Practical)

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**BOOKS RECOMMENDED:**

(Theory and Practicals)

1. P. L. Soni, Mohan Katyal, "Text book of Inorganic Chemistry", 20th Revised Ed., (2007), Sultan Chand & Sons, New Delhi. (UNIT I & II)
2. Shashi Chawla, "A textbook of Engineering Chemistry," S. Chand.
3. Vogel's textbook of quantitative chemical analysis Mendham, John. Denney, Ronald C. Barnes, John D. Thomas, M., 7th Ed., Prentice Hall, New York, 6th Ed., 2000.
4. A K De, Environmental Chemistry, VIII Edition, New Age International Publishers.
5. Svehla, G. *Vogel's Qualitative Inorganic Analysis*, Pearson Education, 2012.
6. Mendham, J. *Vogel's Quantitative Chemical Analysis*, Pearson, 2009.
7. Mann, F.G. & Saunders, B.C. Practical Organic Chemistry Orient-Longman, 1960.
8. Vogel, A.I., Tatchell, A.R., Furnis, B.S., Hannaford, A.J. & Smith, P.W.G., Textbook of Practical Organic Chemistry, Prentice-Hall, 5th edition, 1996.





Syllabus and courses of studies in the subject of Chemistry under CBCS as per NEP-2020

(For examinations to be held in the years Dec. 2023, 2024 & 2025)

**Semester-III**

Course No.: UMJCHT-301 (Major course)

Title: FOUNDATION COURSE CHEMISTRY-III

Credits: 03 (Theory) + 01 (Practical)

Maximum Marks: 100 [75 (Theory) + 25 (Practical)]

Duration of Examination: 3 Hours (Theory) and 2½ Hours (Practical)

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Theory: 03 Credits

Contact Hours: 45 Hours

**Course learning outcomes:**

After completing this course contents, students will be able to understand

- Chemistry of saturated, unsaturated Aliphatic and aromatic Hydrocarbons
- Concept of thermodynamics
- Chemistry of s and p Block Elements

**Unit-I: Chemistry of saturated and unsaturated Aliphatic Hydrocarbons**

(13 Hours)

a) **Chemistry of Alkanes** : Formation of alkanes by Wurtz Reaction, Wurtz Fitting Reaction, Free Radical Substitution in alkanes, Halogenation : Relative reactivity and selectivity.

b) **Chemistry of Alkenes and Alkynes:**

**Formation of Alkenes** by E1, E2, E1cB reactions, Hoffmann Elimination and Saytzeff rule. Addition of Halogen to alkenes: Carbocation and Halonium ion Mechanism. Ozonolysis of Propene with Mechanism. Addition of Hydrogen halides to alkenes with mechanism, Markownikoff's rule Addition of HBr to Propene ( Peroxide Effect/Anti-Markownikoff addition), Syn and Anti Addition Hydrogenation, Hydroxylation , Hydration , reaction with NBS

**Alkynes:** Acidity of Alkynes, Alkylation of terminal Alkynes, hydrogenation and hydration of Alkynes

**Relative Reactivity of Alkenes and Alkynes**

c) **Butadiene:** 1,2 and 1,4 addition reaction of butadiene

d) **Cycloalkanes (upto Cyclohexane)** : Nomenclature, Methods of Preparation. Stability of Cycloalkanes: Bayer Strain Theory

**Unit-II: Aromatic hydrocarbons**

(10 Hours)

**Concept of Aromaticity:** Benzenoids and Hückel's rule, **Structure of Benzene:** Kekule Structures, Resonance and Molecular Orbital Theory

**Preparation (Case Benzene):** from Phenol, , from Acetylene, from Benzene sulphonic acid, by decarboxylation

**Reactions: (Case Benzene):** General mechanism of Electrophilic Substitution reactions,  $\sigma$  and  $\pi$  complexes, Nitration, Halogenation and Sulphonation.

**Friedel-Craft's reaction: alkylation** (upto 3 carbons on benzene) and **acylation**

**Side chain oxidation of alkyl benzenes** (upto 3 carbons on benzene).

Activating and Deactivating groups, Orientation effect, Ortho-para ratio

Aromatic nucleophilic Substitution ( $S_NAr$ ) with mechanism.

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Syllabus and courses of studies in the subject of Chemistry under CBCS as per NEP-2020

(For examinations to be held in the years Dec. 2023, 2024 & 2025)

**Semester-III**

Course No.: UMJCHT-301 (Major course)

Title: FOUNDATION COURSE CHEMISTRY-III

Credits: 03 (Theory) + 01 (Practical)

Maximum Marks: 100 [75 (Theory) + 25 (Practical)]

Duration of Examination: 3 Hours (Theory) and 2½ Hours (Practical)

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**Unit-III: Thermodynamics-I**

**(11 Hours)**

Definition of thermodynamics terms: system, surroundings, boundary. Types of system, Thermodynamic variables, intensive and extensive properties. State and path functions. Thermodynamic equilibrium. Thermodynamic process. Concept of heat and work.

First Law of Thermodynamics: Statement and our daily life examples, internal energy and its physical significance. Heat change at constant volume, heat change at constant pressure: Enthalpy. Heat capacity, heat capacities at constant volume and pressure and their relationship. Variation of internal energy with temperature and volume, Joules law. Variation of enthalpy with temperature and pressure, Joule-Thomson coefficient and inversion temperature.

**Unit-IV: Chemistry of s and p Block Elements-I**

**(11 Hours)**

Inert pair effect, Relative stability of different oxidation states, diagonal relationship and anomalous behaviour of first member of each group. Allotropy and catenation. Complex formation tendency of s and p block elements. Hydrides and their classification ionic, covalent and interstitial. Preparation, structure and bonding of borohydrides (diborane).

**NOTE FOR PAPER SETTING:**

*Note for paper setter for End Semester Examination:*

The question paper will be of **60 marks**. There shall be **2 Sections** in the question paper with pattern as follows:

**Section-A** shall comprise of **4** short answer type questions of (**3** marks each) with one question from each unit. The students have to attempt all the questions from Section-A.

**Section-B** shall comprise of a total of **8** questions with two questions selected from each unit. Each question shall be of **12 marks**. The students have to attempt **4** questions by selecting only one question from each unit.

The numerical problems should not exceed more than 20% of the maximum marks.

*Note for paper setter for Mid Semester Examination:*

The Mid Semester Examination shall be conducted by the course coordinator after completion of **50%** of the syllabus.

The question paper will be of **15** marks and duration of examination shall be 1½ hour. There shall be **2** sections in the question paper with pattern as follows:

**Section-A** shall comprise of **3** questions (of **4** marks each) and the students are required to attempt any two questions.

**Section-B** shall comprise of **2** questions (of **7** marks each) and the students are required to attempt any one question.

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Syllabus and courses of studies in the subject of Chemistry under CBCS as per NEP-2020

(For examinations to be held in the years Dec. 2023, 2024 & 2025)

**Semester-III**

Course No.: UMJCHT-301 (Major course)

Title: FOUNDATION COURSE CHEMISTRY-III

Credits: 03 (Theory) + 01 (Practical)

Maximum Marks: 100 [75 (Theory) + 25 (Practical)]

Duration of Examination: 3 Hours (Theory) and 2½ Hours (Practical)

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**BOOKS RECOMMENDED:**

1. Morrison, R.N., Boyd, R.N. & Bhattacharjee, S.K. (2010) Organic Chemistry.
2. Finar, I.L. (2002) Organic Chemistry Volume I, II, 6<sup>th</sup> Edition Pearson Education.
3. McMurry, J.E. Fundamentals of Organic Chemistry, 7<sup>th</sup> Ed. Cengage Learning India Edition, 2013.
4. Sykes, P.A. Guidebook to Mechanism in Organic Chemistry, Orient Longman, Longman, New Delhi (1988).
5. Bahl, A. & Bahl, B.S. Advanced Organic Chemistry, S. Chand, 2010.
6. R.P. Rastogi, R.R. Misra. Sixth Revised Edition. Vikas Publishing House Pvt. Ltd.
7. Bell, R. P., Proton in Chemistry, 2nd Ed., Chapman Hall, (1973).
8. Drago, R. S., Modern Approach to Acid base Chemistry, J. C.Chem. Educ., 51, 300 (1974).
9. Gillespie, R. R., Proton acids, Lewis acids, hard acids, soft acids and super acids. Chapman and Hall (1975).
10. Jensen, W.B., The Lewis Acid-Base Concepts, Wiley, New York (1980).
11. Nicholls, D. Inorganic Chemistry in Liquid Ammonia, Elsevier (1979).
12. Pearson, R. G., Ed., Hard and Soft Acids and Bases, Dowden, Hutchinson (1973).

Practical: 01 Credit

Contact Hours: 30 Hours

**Course learning outcomes:**

After completing this course contents, students will be able to understand

- Qualitative analysis of common organic compounds
- Determination of heat capacity and heat of neutralization
- Semi-micro qualitative analysis of cations and anions

**Suggested Experiments:**

**Section A: Organic Chemistry:**

Qualitative analysis of following Organic Compounds:

1. Naphthalene
2. Anthracene
3. Benzoic Acid
4. Salicylic Acid
5. Glucose
6. Sucrose
7. Catechol
8. Resorcinol

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Syllabus and courses of studies in the subject of Chemistry under CBCS as per NEP-2020

(For examinations to be held in the years Dec. 2023, 2024 & 2025)

**Semester-III**

Course No.: UMJCHT-301 (Major course)

Title: FOUNDATION COURSE CHEMISTRY-III

Credits: 03 (Theory) + 01 (Practical)

Maximum Marks: 100 [75 (Theory) + 25 (Practical)]

Duration of Examination: 3 Hours (Theory) and 2½ Hours (Practical)

9. Salicylaldehyde
10. Acetophenone
11. Benzophenone
12. P-aminobenzoic
13. Urea
14. Thiourea
14. Acetamide
15. Benzamide

(Note: Any 07 to 09 Compounds to be analysed in a semester)

**Section B: Physical Chemistry:**

1. Determination of heat capacity of calorimeter.
2. Determination of heat of neutralization hydrochloric acid with sodium hydroxide.

**Section C: Inorganic Chemistry:**

Semi-micro qualitative analysis using H<sub>2</sub>S of mixtures of salts (not more than four ionic species, two anions and two cations and excluding insoluble salts) out of the following:

Cations : NH<sub>4</sub><sup>+</sup>, Pb<sup>2+</sup>, Ag<sup>+</sup>, Bi<sup>3+</sup>, Cu<sup>2+</sup>, Cd<sup>2+</sup>, Sn<sup>2+</sup>, Fe<sup>3+</sup>, Al<sup>3+</sup>, Co<sup>2+</sup>, Cr<sup>3+</sup>, Ni<sup>2+</sup>, Mn<sup>2+</sup>, Zn<sup>2+</sup>, Ba<sup>2+</sup>, Sr<sup>2+</sup>, Ca<sup>2+</sup>, K<sup>+</sup>

Anions : CO<sub>3</sub><sup>2-</sup>, S<sup>2-</sup>, SO<sub>2</sub><sup>-</sup>, S<sub>2</sub>O<sub>3</sub><sup>2-</sup>, NO<sub>3</sub><sup>-</sup>, CH<sub>3</sub>COO<sup>-</sup>, Cl<sup>-</sup>, Br<sup>-</sup>, I<sup>-</sup>, NO<sub>3</sub><sup>-</sup>, SO<sub>4</sub><sup>2-</sup>, PO<sub>4</sub><sup>3-</sup>, BO<sub>3</sub><sup>3-</sup>, C<sub>2</sub>O<sub>4</sub><sup>2-</sup>, F<sup>-</sup> (Students should be encouraged to perform Spot tests wherever feasible)

**NOTE FOR PAPER SETTING:**

**EVALUATION OF PRACTICALS:**

Daily evaluation of practical records/viva-voce etc.		10 marks
Final examination (to be conducted by the course coordinator internally)	100 % Syllabus	15 marks (10 marks = practical assessment + 5 marks= viva-voce examination)

**BOOKS RECOMMENDED:**

1. Vogel's Textbook of Practical Organic Chemistry, Brian S. Furniss, Antony J. Hannaford, Peter W. G. Smith, Austin R. Tatchell. Pearson, 5<sup>th</sup> Edition, 2012.
2. Man, F.G. & Saunders, B.C. Practical Organic Chemistry, Pearson education (2009).
3. Practical Physical Chemistry; Khosla, B. D.; Garg, V. C. & Gulati, A.; R. Chand & Co.; 2011.
4. Experiments in Physical Chemistry; Das, R. C, and Behra, B.; Tata McGraw Hill.

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Syllabus and courses of studies in the subject of Chemistry under CBCS as per NEP-2020

(For examinations to be held in the years Dec. 2023, 2024 & 2025)

**Semester-III**

**Course No.: UMJCHT-301 (Major course)**

**Title: FOUNDATION COURSE CHEMISTRY-III**

**Credits: 03 (Theory) + 01 (Practical)**

**Maximum Marks: 100 [75 (Theory) + 25 (Practical)]**

**Duration of Examination: 3 Hours (Theory) and 2½ Hours (Practical)**

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5. Svehla, G. Vogel's Qualitative Inorganic Analysis, Pearson Education, 2012.
6. Mendham, J. Vogel's Quantitative Chemical Analysis, Pearson, 2009.

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Syllabus and courses of studies in the subject of Chemistry under CBCS as per NEP-2020

(For examinations to be held in the years Dec. 2023, 2024 & 2025)

**Semester-III**

Course No.: UMJCHT-302 (Major course)

Title: ANALYTICAL CHEMISTRY

Credits: 03 (Theory) + 01 (Practical)

Maximum Marks: 100 [75 (Theory) + 25 (Practical)]

Duration of Examination: 3 Hours (Theory) and 2½ Hours (Practical)

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Theory: 03 Credits

Contact Hours: 45 Hours

**Course learning outcomes:**

After completing this course contents, students will be able to understand

- Basics of analytical Chemistry
- Acid-base, complexometric, precipitation and redox titrations
- Chromatographic methods

**Unit-I: Basics of Analytical chemistry**

(12 Hours)

Classification of analytical techniques. Choice of analytical method chosen: accuracy, precision, sensitivity, selectivity and method validation. Limit of detection (LOD), Limit of quantification (LOQ), Limitations of analytical methods – Errors: Determinate and indeterminate errors, absolute error, relative error, minimization of errors.

Basic laboratory practices: calibration of glassware (pipette, burette and volumetric flask), Sampling (solids and liquids), weighing, drying, dissolving, Acid treatment, Safety in Chemical

Laboratory, Rules of fire prevention and accidents, First aid, Precautions to be taken while handling toxic chemicals, concentrated/fuming acids and organic solvents.

**Unit-II: Acid-base and complexometric Titrimetry**

(11 Hours)

Basic principle and Classification of titrimetric analysis.

**Acid-base titrimetry:** Titration curves for strong acid vs strong base, weak acid vs strong base and weak base vs strong acid titrations. Titration curves, Quantitative applications – selecting and standardizing a titrant, inorganic analysis - alkalinity, acidity.

**Complexometric titrimetry:** Indicators for EDTA titrations- theory of metal ion indicators, titration methods employing EDTA - direct, back, displacement and indirect determinations, Application-determination of hardness of water.

**Unit-III: Redox and Precipitation Titrimetry and Gravimetric Analysis**

(11 Hours)

**Redox titrimetry:** Balancing redox equations, calculation of the equilibrium constant of redox reactions, titration curves, Theory of redox indicators, calculation of standard potentials using Nernst equation. Applications.

**Precipitation titrimetry:** Titration curves, titrants and standards, indicators for precipitation titrations involving silver nitrate- Volhard's and Mohr's methods and their differences.

**Gravimetric Analysis:** Principle and mechanism of precipitation, Factors influencing precipitation, Co-precipitation, post-precipitation, Advantages of organic reagents over

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# Syllabus and courses of studies in the subject of Chemistry under CBCS as per NEP-2020

(For examinations to be held in the years Dec. 2023, 2024 & 2025)

## Semester-III

Course No.: UMJCHT-302 (Major course)

Title: ANALYTICAL CHEMISTRY

Credits: 03 (Theory) + 01 (Practical)

Maximum Marks: 100 [75 (Theory) + 25 (Practical)]

Duration of Examination: 3 Hours (Theory) and 2½ Hours (Practical)

Practical: 01 Credit

Contact Hours: 30 Hours

### Course learning outcomes:

After completing this course contents, students will be able to understand

- Separation of organic compounds and transition metal ions by chromatographic methods
- Use of complexometric, redox and acid-base titrations in practical applications

### Suggested Experiments:

1. Separation of ortho- & para-nitrophenol and o- and p-aminophenol by thin layer chromatography (TLC) and calculation of their  $R_f$  values.
2. Separation of divalent 3d transition metal ions by paper chromatography.
3. Determination of carbonate and bicarbonate present in water sample.
4. Preparation of EDTA solution and estimation of hardness ( $\text{CaCO}_3$ ) of two different samples.
5. Preparation of standard  $\text{Na}_2\text{CO}_3$  solution, standardization of given HCl solution and estimation of alkali present in given antacid.
6. Determination of chlorine in two different samples of bleaching powder by iodometry (standard sodium thiosulphate solution to be supplied)
7. Estimation of Cu(II) using sodium thiosulphate solution (Iodometrically).
8. Estimation of  $\text{K}_2\text{Cr}_2\text{O}_7$  using sodium thiosulphate solution (Iodometrically).

### NOTE FOR PAPER SETTING:

### EVALUATION OF PRACTICALS:

Daily evaluation of practical records/viva-voce etc.	10 marks	
Final examination (to be conducted by the course coordinator internally)	100 % Syllabus	15 marks (10 marks = practical assessment + 5 marks = viva-voce examination)

### BOOKS RECOMMENDED:

1. Jeffery, G.H., Bassett, J., Mendham, J. & Denney, R.C. Vogel's Textbook of Quantitative Chemical Analysis, John Wiley & Sons, 1989.
2. Willard, H. H., Merritt, L.L., Dean, J. & Settle, F.A. Instrumental Methods of Analysis, Wadsworth Publishing Company Ltd., Belmont, California, USA, 1988.
3. Christian, G.D; Analytical Chemistry, VI Ed. John Wiley & Sons, New York, 2004.

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**Syllabus and courses of studies in the subject of Chemistry under CBCS as per NEP-2020**

(For examinations to be held in the years Dec. 2023, 2024 & 2025)

**Semester-III**

**Course No.: UMJCHT-302 (Major course)**

**Title: ANALYTICAL CHEMISTRY**

**Credits: 03 (Theory) + 01 (Practical)**

**Maximum Marks: 100 [75 (Theory) + 25 (Practical)]**

**Duration of Examination: 3 Hours (Theory) and 2½ Hours (Practical)**

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4. Harris, D. C. Exploring Chemical Analysis, Ed. New York, W.H. Freeman, 2001.
5. Skoog, D. A. Holler F.J. & Nieman, T.A. Principles of Instrumental Analysis, Cengage Learning India Ed, 2017.
6. Ditts, R.V. Analytical Chemistry; Methods of Separation, van Nostrand, 1974.
7. Fifield, F.W.; Kealey, D. (2000), Principles and Practice of Analytical Chemistry, Wiley.
8. Harris, D. C. (2007), Exploring Chemical Analysis, W.H. Freeman and Co.
9. Harris, D. C. (2007), Quantitative Chemical Analysis, 6th Edition, Freeman.
10. Mikes, O. (2000), Laboratory Handbook of Chromatographic methods, D.Van Nostrand Company Inc.

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Syllabus and courses of studies in the subject of Chemistry under CBCS as per NEP-2020

(For examinations to be held in the years Dec. 2023, 2024 & 2025)

**Semester-III**

Course No.: UMJCHT-302 (Major course)

Title: ANALYTICAL CHEMISTRY

Credits: 03 (Theory) + 01 (Practical)

Maximum Marks: 100 [75 (Theory) + 25 (Practical)]

Duration of Examination: 3 Hours (Theory) and 2½ Hours (Practical)

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inorganic reagents, Importance of reagents used in gravimetry [8-hydroxyquinoline (oxine) and dimethyl glyoxime (DMG)].

**Unit-IV: Chromatographic Methods**

**(11 Hours)**

Classification of chromatographic methods: Principles of differential migration, description of Chromatographic process, distribution coefficients, capacity factor, column efficiency and resolution, Techniques of sample preparation in chromatography.

Brief overview of paper chromatography (detections of spots, retardation factors, factors that affect reproducibility of  $R_f$  values) and Thin Layer Chromatography (Stationary phase, adsorbents, liquid phase support, plate preparation, mobile phase, sample application, development, detection of spot,  $R_f$  values).

**NOTE FOR PAPER SETTING:**

*Note for paper setter for End Semester Examination:*

The question paper will be of **60 marks**. There shall be **2 Sections** in the question paper with pattern as follows:

**Section-A** shall comprise of **4** short answer type questions of (**3** marks each) with one question from each unit. The students have to attempt all the questions from Section-A.

**Section-B** shall comprise of a total of **8** questions with two questions selected from each unit. Each question shall be of **12 marks**. The students have to attempt **4** questions by selecting only one question from each unit.

The numerical problems should not exceed more than **20%** of the maximum marks.

*Note for paper setter for Mid Semester Examination:*

The Mid Semester Examination shall be conducted by the course coordinator after completion of **50%** of the syllabus.

The question paper will be of **15** marks and duration of examination shall be **1½** hour. There shall be **2** sections in the question paper with pattern as follows:

**Section-A** shall comprise of **3** questions (of **4** marks each) and the students are required to attempt any two questions.

**Section-B** shall comprise of **2** questions (of **7** marks each) and the students are required to attempt any one question.

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Syllabus and courses of studies in the subject of Chemistry under CBCS as per NEP-2020

(For examinations to be held in the years Dec. 2023, 2024 & 2025)

**Semester-III**

**Course No.: UMICHT-303 (Minor course)**

**Title: FOUNDATION COURSE CHEMISTRY-III**

**Credits: 03 (Theory) + 01 (Practical)**

**Maximum Marks: 100 [75 (Theory) + 25 (Practical)]**

**Duration of Examination: 3 Hours (Theory) and 2½ Hours (Practical)**

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**Theory: 03 Credits**

**Contact Hours: 45 Hours**

**Course learning outcomes:**

After completing this course contents, students will be able to understand

- Chemistry of saturated, unsaturated Aliphatic and aromatic Hydrocarbons
- Concept of thermodynamics
- Chemistry of s and p Block Elements

**Unit-I: Chemistry of saturated and unsaturated Aliphatic Hydrocarbons**

**(13 Hours)**

**a) Chemistry of Alkanes:** Formation of alkanes by Wurtz Reaction, Wurtz Fitting Reaction, Free Radical Substitution in alkanes, Halogenation: Relative reactivity and selectivity.

**b) Chemistry of Alkenes and Alkynes:**

**Formation of Alkenes** by E1, E2, E1cB reactions, Hoffmann Elimination and Saytzeff rule. Addition of Halogen to alkenes: Carbocation and Halonium ion Mechanism. Ozonolysis of Propene with Mechanism. Addition of Hydrogen halides to alkenes with mechanism, Markownikoff's rule, Addition of HBr to Propene (Peroxide Effect/Anti-Markownikoff addition), Syn and Anti Addition Hydrogenation, Hydroxylation, Hydration.

**Alkynes:** Acidity of Alkynes, Alkylation of terminal Alkynes, hydrogenation and hydration of Alkynes

**Relative Reactivity of Alkenes and Alkynes**

**c) Cycloalkanes ( upto Cyclohexane) :** Nomenclature and Methods of Preparation.

**Unit-II: Aromatic hydrocarbons**

**(10 Hours)**

**Concept of Aromaticity:** Benzenoids and Hückel's rule, **Structure of Benzene:** Kekule Structures, Structure of Benzene on the basis of Resonance and Molecular Orbital Theory. Concept of resonance energy.

**Preparation (Benzene):** from Phenol, from Acetylene, from Benzene sulphonic acid, by decarboxylation

**Reactions: (Benzene):** General mechanism of Electrophilic Substitution reactions, Nitration, Halogenation and Sulphonation.

**Friedel-Craft's reaction :** alkylation (upto 3 carbons on benzene) and acylation  
Activating and deactivating groups, Orientation effect, ortho-para ratio.

**Unit-III: Thermodynamics-I**

**(11 Hours)**

Definition of thermodynamics terms: system, surroundings, boundary. Types of system, Thermodynamic variables, intensive and extensive properties. State and path functions. Thermodynamic equilibrium. Thermodynamic process. Concept of heat and work.

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Syllabus and courses of studies in the subject of Chemistry under CBCS as per NEP-2020

(For examinations to be held in the years Dec. 2023, 2024 & 2025)

**Semester-III**

Course No.: UMICHT-303 (Minor course)

Title: FOUNDATION COURSE CHEMISTRY-III

Credits: 03 (Theory) + 01 (Practical)

Maximum Marks: 100 [75 (Theory) + 25 (Practical)]

Duration of Examination: 3 Hours (Theory) and 2½ Hours (Practical)

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First Law of Thermodynamics: Statement and our daily life examples, internal energy and its physical significance. Heat change at constant volume, heat change at constant pressure: Enthalpy. Heat capacity, heat capacities at constant volume and pressure and their relationship. Variation of internal energy with temperature and volume. Variation of enthalpy with temperature and pressure. Entropy and its significance. 2<sup>nd</sup> Law of thermodynamics.

**Unit-IV: Chemistry of s and p Block Elements – I**

**(11 Hours)**

Inert pair effect, Relative stability of different oxidation states, diagonal relationship and anomalous behaviour of first member of each group. Allotropy and catenation. Complex formation tendency of s and p block elements. Hydrides and their classification ionic, covalent and interstitial. Preparation, structure and bonding of borohydrides (diborane).

**NOTE FOR PAPER SETTING:**

*Note for paper setter for End Semester Examination:*

The question paper will be of **60 marks**. There shall be **2 Sections** in the question paper with pattern as follows:

**Section-A** shall comprise of **4** short answer type questions of (**3** marks each) with one question from each unit. The students have to attempt all the questions from Section-A.

**Section-B** shall comprise of a total of **8** questions with two questions selected from each unit. Each question shall be of **12 marks**. The students have to attempt **4** questions by selecting only one question from each unit.

The numerical problems should not exceed more than 20% of the maximum marks.

*Note for paper setter for Mid Semester Examination:*

The Mid Semester Examination shall be conducted by the course coordinator after completion of **50%** of the syllabus.

The question paper will be of **15** marks and duration of examination shall be 1½ hour. There shall be **2** sections in the question paper with pattern as follows:

**Section-A** shall comprise of **3** questions (of **4** marks each) and the students are required to attempt any two questions.

**Section-B** shall comprise of **2** questions (of **7** marks each) and the students are required to attempt any one question.

**BOOKS RECOMMENDED:**

1. Morrison, R.N., Boyd, R.N.' Bhattacharjee, S.K. (2010) Organic Chemistry.
2. Finar, I.L. (2002) Organic Chemistry Volume I, II, 6<sup>th</sup> Edition, Pearson Education.
3. McMurry, J.E. Fundamentals of Organic Chemistry, 7<sup>th</sup> Ed., Cengage Learning India Edition, 2013.

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Syllabus and courses of studies in the subject of Chemistry under CBCS as per NEP-2020

(For examinations to be held in the years Dec. 2023, 2024 & 2025)

**Semester-III**

**Course No.: UMICHT-303 (Minor course)**

**Title: FOUNDATION COURSE CHEMISTRY-III**

**Credits: 03 (Theory) + 01 (Practical)**

**Maximum Marks: 100 [75 (Theory) + 25 (Practical)]**

**Duration of Examination: 3 Hours (Theory) and 2½ Hours (Practical)**

4. Sykes, P.A. Guidebook to Mechanism in Organic Chemistry, Orient Longman, Longman, New Delhi (1988).
5. Bahl, A. & Bahl, B.S. Advanced Organic Chemistry, S. Chand, 2010.
6. R.P. Rastogi, R.R. Misra. Sixth Revised Edition. Vikas Publishing House Pvt. Ltd.
7. Bell, R. P. , Proton in Chemistry , 2nd Ed., Chapman Hall, (1973).
8. Drago, R. S., Modern Approach to Acid base Chemistry, J. C.Chem. Educ., 51, 300 (1974),
9. Gillespie, R. R., Proton acids, Lewis acids, hard acids, soft acids and super acids. Chapman and Hall (1975).
10. Jensen, W.B., The Lewis Acid-Base Concepts, Wiley, New York (1980).
11. Nicholls, D. Inorganic Chemistry in Liquid Ammonia, Elsevier (1979).
12. Pearson, R. G., Ed., Hard and Soft Acids and Bases, Dowden, Hutchinson (1973).

**Practical: 01 Credit**

**Contact Hours: 30 Hours**

**Course learning outcomes:**

After completing this course contents, students will be able to understand

- Qualitative analysis of common organic compounds
- Determination of heat capacity and heat of neutralization
- Semi-micro qualitative analysis of cations and anions

**Suggested Experiments:**

**Section A: Organic Chemistry :**

Qualitative analysis of following Organic Compounds :

1. Naphthalene
2. Anthracene
3. Benzoic Acid
4. Oxalic Acid
5. Salicylic Acid
6. Sucrose
7. Catechol
8. Resorcinol
9. Salicylaldehyde
10. Acetophenone
11. Benzophenone
12. P-aminobenzoic acid
13. p-chlorobenzoic acid

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## Syllabus and courses of studies in the subject of Chemistry under CBCS as per NEP-2020

(For examinations to be held in the years Dec. 2023, 2024 & 2025)

### Semester-III

Course No.: UMICHT-303 (Minor course)

Title: FOUNDATION COURSE CHEMISTRY-III

Credits: 03 (Theory) + 01 (Practical)

Maximum Marks: 100 [75 (Theory) + 25 (Practical)]

Duration of Examination: 3 Hours (Theory) and 2½ Hours (Practical)

14. Thiourea

15. Acetamide

16. Benzamide

(Note : Any 07 to 09 Compounds to be analysed in a semester)

### **Section B: Physical Chemistry :**

1. Determination of heat capacity of calorimeter.
2. Determination of heat of neutralization hydrochloric acid with sodium hydroxide.
3. Determination of heat of neutralization acetic acid with sodium hydroxide.

### **Section C: Inorganic Chemistry :**

Semi-micro qualitative analysis using  $H_2S$  of mixtures of salts (not more than four ionic species, two anions and two cations and excluding insoluble salts) out of the following:

Cations :  $NH_4^+$ ,  $Pb^{2+}$ ,  $Ag^+$ ,  $Bi^{3+}$ ,  $Cu^{2+}$ ,  $Cd^{2+}$ ,  $Sn^{2+}$ ,  $Fe^{3+}$ ,  $Al^{3+}$ ,  $Co^{2+}$ ,  $Cr^{3+}$ ,  $Ni^{2+}$ ,  $Mn^{2+}$ ,  $Zn^{2+}$ ,  $Ba^{2+}$ ,  $Sr^{2+}$ ,  $Ca^{2+}$ ,  $K^+$

Anions :  $CO_3^{2-}$ ,  $S^{2-}$ ,  $SO_3^{2-}$ ,  $S_2O_3^{2-}$ ,  $NO_3^-$ ,  $CH_3COO^-$ ,  $Cl^-$ ,  $Br^-$ ,  $I^-$ ,  $NO_2^-$ ,  $SO_4^{2-}$ ,  $PO_4^{3-}$ ,  $BO_3^{3-}$ ,  $C_2O_4^{2-}$ ,  $F^-$  (Students should be encouraged to perform Spot tests wherever feasible)

### **NOTE FOR PAPER SETTING:**

### **EVALUATION OF PRACTICALS:**

Daily evaluation of practical records/viva-voce etc.	10 marks	
Final examination (to be conducted by the course coordinator internally)	100 % Syllabus	15 marks (10 marks = practical assessment + 5 marks= viva-voce examination)

### **BOOKS RECOMMENDED:**

1. Vogel's Textbook of Practical Organic Chemistry, Brian S. Furniss, Antony J. Hannaford, Peter W. G. Smith, Austin R. Tatchell. Pearson 5th Edition, 2012.
2. Man, F.G. & Saunders, B.C. Practical Organic Chemistry, Pearson education (2009).
3. Practical Physical Chemistry; Khosla, B. D.; Garg, V. C. & Gulati, A.; R. Chand & Co.; 2011.
4. Experiments in Physical Chemistry; Das, R. C, and Behra, B.; Tata McGraw Hill.
5. Svehla, G. Vogel's Qualitative Inorganic Analysis, Pearson Education, 2012.
6. Mendham, J. Vogel's Quantitative Chemical Analysis, Pearson, 2009.

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Syllabus and courses of studies in the subject of Chemistry under CBCS as per NEP-2020

(For examinations to be held in the years Dec. 2023, 2024 & 2025)

**Semester-III**

**Course No.: UMDCHT-304 (Multi-Disciplinary Course)**

**Title: CHEMISTRY IN EVERYDAY LIFE**

**Credits: 03**

**Maximum Marks: 75**

**Contact Hours: 45 Hours**

**Duration of Examination: 3 Hours**

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**Course learning outcomes:**

After completing this course contents, students will be able to understand

- Chemotherapy
- Food Additives and Preservation
- Biomolecules

**Unit-I: Chemotherapy**

**(13 Hours)**

Definition of chemotherapy- examples each for (i) Analgesics, (ii) antibacterial, (iii) anti-inflammatory, (iv) antipyretic, (v) antibiotic, (vi) antacid (vii) antiviral, (viii) antidepressant, (ix) antiallergic, (x) antidiabetics, (xi) antihypertensive, (xii) anaesthetics (local and general)

**Structures not necessary.**

**Unit-II: Food Additives and Preservation**

**(12 Hours)**

Artificial sweeteners - saccharin - cyclamate and aspartate, food flavours esters and aldehydes. Food colours - restricted use of spurious colors - emulsifying agents - leavening agents, baking powder, yeast - taste makers - MSG, vinegar. Food preservation – Methods – preservation below temperature, high temperature - preservatives.

**Structures not necessary.**

**Unit-III: Biomolecules-I**

**(10 Hours)**

**Carbohydrates:** Definition, classification and their importance

**Amino acids:** Essential and non-essential. Definition, classification and their importance.

**Oils and Fats:** Definition, classification and importance. Saponification value

**Structure not necessary.**

**Unit- IV: Biomolecules-II**

**(10 Hours)**

**Vitamins:** Nomenclature and Classification, Sources, deficiency diseases due to vitamins A, B,C, D, E and K. Structure not necessary.

**Minerals:** Macro and micro elements, importance and deficiency diseases.

**Structure not necessary.**

**NOTE FOR PAPER SETTING:**

*Note for paper setter for End Semester Examination:*

The question paper will be of **60 marks**. There shall be **2 Sections** in the question paper with pattern as follows:

**Section-A** shall comprise of **4** short answer type questions of (**3** marks each) with one question from each unit. The students have to attempt all the questions from Section-A.

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**Syllabus and courses of studies in the subject of Chemistry under CBCS as per NEP-2020**

(For examinations to be held in the years Dec. 2023, 2024 & 2025)

**Semester-III**

**Course No.: UMDCHT-304 (Multi-Disciplinary Course)**

**Title: CHEMISTRY IN EVERYDAY LIFE**

**Credits: 03**

**Maximum Marks: 75**

**Contact Hours: 45 Hours**

**Duration of Examination: 3 Hours**

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**Section-B** shall comprise of a total of **8** questions with two questions selected from each unit. Each question shall be of **12 marks**. The students have to attempt **4** questions by selecting only one question from each unit.

The numerical problems should not exceed more than **20%** of the maximum marks.

**Note for paper setter for Mid Semester Examination:**

The Mid Semester Examination shall be conducted by the course coordinator after completion of **50%** of the syllabus.

The question paper will be of **15** marks and duration of examination shall be **1½** hour. There shall be **2** sections in the question paper with pattern as follows:

**Section-A** shall comprise of **3** questions (of **4** marks each) and the students are required to attempt any two questions.

**Section-B** shall comprise of **2** questions (of **7** marks each) and the students are required to attempt any one question.

**BOOKS RECOMMENDED:**

1. Thangamma Jacob, Textbook of Applied chemistry for home science and Allied Science, New Delhi, Macmillan Co., (1979).
2. Macmillan, 1st Ed., 1990. M. Swaminathan, Text Book on Food chemistry, Printing and Publishing Co., Ltd., Bangalore, 1993.
3. Alex Ramani, V., Food Chemistry, MJP Publishers, Triplicane, Chennai, 2009. 9. Sivasankar, B., Food Processing and Preservation, PHI Learning Private Limited, Delhi, 2013.
4. B. S. Bahl, A. Bhal, —Textbook of Organic chemistry, S. Chand and Company Ltd., New Delhi, 22nd Ed., 2016.
5. Organic Chemistry of Natural Products-Volume I and II by Gurdeep R Chatwal, Himalaya Publishing House.

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Syllabus and courses of studies in the subject of Chemistry under CBCS as per NEP-2020

(For examinations to be held in the years Dec. 2023, 2024 & 2025)

**Semester-III**

Course No.: USECHT-305 (Skill Enhancement Course)

Title: CHEMISTRY OF FOOD AND COSMETICS

Credits: 01 (Theory) + 01 (Practical)

Maximum Marks: 50 [25 (Theory) + 25 (Practical)]

Duration of examination: 2 Hours (Theory) and 2½ Hours (Practical)

Theory: 01 Credit

Contact Hours: 15 Hours

**Course learning outcomes:**

After completing this course contents, students will be able to understand

- Food Preservation and Food Adulteration
- Chemistry of Cosmetics

**Unit-I: Food Preservation and Food Adulteration (05 Hours)**

Principles of Food Preservation: Meaning, mode of action and changes in foods.

Traditional methods of Food Preservation: Smoking, Sun Drying, Pickling and Fermentation.

Food Adulteration: Common adulterants in different foods- milk and milk products, vegetable oils, and fats, spices and condiments, cereals, pulses.

Sweetening agents and beverages.

Contamination with toxic chemicals- pesticides and insecticides. Methods involved in the detection and prevention of food adulteration.

**Unit-II: Chemistry of Cosmetics (05 Hours)**

History of cosmetics, classification of cosmetics, professional image of self grooming, beauty and wellness. Chemical peels and peeling agents, lasers and light devices, Electro Chemistry, bath salts, gels, soaps, bubble baths and scrubs.

**Unit-III: Cosmetic Products (05 Hours)**

A general study including preparation and uses of the following: Hair dye, hair spray, shampoo, suntan lotions, sun screen, face powder, lipsticks, talcum powder, nail enamel, creams (cold, vanishing and shaving creams), moisturisers, cleansers, acne and anti aging creams.

**NOTE FOR PAPER SETTING:**

*Note for paper setter for End Semester Examination:*

The question paper will be of 25 marks. There shall be 2 Sections in the question paper with pattern as follows:

**Section-A** shall comprise of 4 short answer type questions of (2½ marks each) with atleast one question from each unit. The students have to attempt all the questions from Section-A.

**Section-B** shall comprise of a total of 6 questions with two questions selected from each unit. Each question shall be of 5 marks. The students have to attempt 3 questions by selecting only one question from each unit.

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Syllabus and courses of studies in the subject of Chemistry under CBCS as per NEP-2020

(For examinations to be held in the years Dec. 2023, 2024 & 2025)

**Semester-III**

Course No.: USECHT-305 (Skill Enhancement Course)

Title: CHEMISTRY OF FOOD AND COSMETICS

Credits: 01 (Theory) + 01 (Practical)

Maximum Marks: 50 [25 (Theory) + 25 (Practical)]

Duration of examination: 2 Hours (Theory) and 2½ Hours (Practical)

Practical: 01 Credit

Contact Hours: 30 Hours

**Course learning outcomes:**

After completing this course contents, students will be able to understand

- Methods of preparation of shampoo, face cream, soap and lip balm
- Testing of adulterants in food samples

**Suggested Experiments:**

1. Preparation of shampoo
2. Preparation of face cream
3. Preparation of Soap
4. Preparation of Lip Balm
5. Testing for the presence of adulterants in various food samples -milk and milk products, vegetable oils, and fats, spices and condiments, cereals, pulses.
6. Practice any two traditional methods of food Preservation (from theory component).

**NOTE FOR PAPER SETTING:**

**EVALUATION OF PRACTICALS:**

Daily evaluation of practical records/viva-voce etc.	10 marks	
Final examination (to be conducted by the course coordinator internally)	100 % Syllabus	15 marks (10 marks = practical assessment + 5 marks= viva-voce examination)

**BOOKS RECOMMENDED:**

1. Rick Parker (2003) Introduction to Food Science, New York: Delmar Thomson Learning.
2. Scottsmith and Hui Y.H (Editors) (2004) Food Processing – Principles and Applications, London Blackwell Publishing.
3. Subbulakshmi, G and Udipi, S. A. (2001).Foods Processing and Preservation, New Delhi, New Age International (P) Ltd. Publishing.
4. Swaminathan, M. (1995). Food Science Chemistry and Experimental Food, The Bangalore Printing and Publishing Co. Ltd.
5. Vacklavick, V. and Christian, E. (2003). Essentials of Food Science. New York, Kluwer Academic/ Plenum Publisher.

\*\* All new journals related to Food Preservation\*\*

6. Perry Romanowski, Beginning Cosmetic Chemistry, Allured Pub Corp.2009.
7. Dr. Ramesh Kumari, Chemistry of Cosmetics, Prestige Publishers.

*Handwritten signatures and initials:*  
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Syllabus and courses of studies in the subject of Chemistry under CBCS as per NEP-2020

(For examinations to be held in the years Dec. 2023, 2024 & 2025)

**Semester-III**

**Course No.: USECHT-305 (Skill Enhancement Course)**

**Title: CHEMISTRY OF FOOD AND COSMETICS**

**Credits: 01 (Theory) + 01 (Practical)**

**Maximum Marks: 50 [25 (Theory) + 25 (Practical)]**

**Duration of examination: 2 Hours (Theory) and 2½ Hours (Practical)**

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8. Srilakshmi B., Food Science, New age International Pvt. Ltd. Publishers, III ed. 2003.
9. Shakuntala Manay N. and Shadaksharaswamy M. FOODS: Facts and Principles. New Age International Pvt. Ltd. Publishers, II ed. 2002.
10. Norman N. Potter, Food Science, CBS Publishers and Distributors, New Delhi. 1994.
11. Swaminathan M. Advanced Text Book on Food and Nutrition, Volume I and II Printing and Publishing Co., Ltd., Bangalore. 1993.

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Syllabus and courses of studies in the subject of Chemistry under CBCS as per NEP-2020

(For examinations to be held in the years May 2024, 2025 & 2026)

**Semester-IV**

**Course No.: UMJCHT-401 (Major course)**

**Title: PHYSICAL CHEMISTRY-1**

**Credits: 03 (Theory) + 01 (Practical)**

**Maximum Marks: 100 [75 (Theory) + 25 (Practical)]**

**Duration of Examination: 3 Hours (Theory) and 2½ Hours (Practical)**

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**Theory: 03 Credits**

**Contact Hours: 45 Hours**

**Course learning outcomes:**

After completing this course contents, students will be able to understand

- Chemical equilibrium and phase equilibrium
- Electrochemistry

**Unit-I: Chemical Equilibrium**

**(11 Hours)**

Introduction, State of chemical equilibrium, Law of mass action, Law of chemical equilibrium, Thermodynamic derivation of the law of chemical equilibrium, Types of equilibrium constants, Relationship between  $K_p$  and  $K_c$ , Application of equilibrium constants, Van't Hoff Reaction Isotherm, Le Chatlier's Principle, Applications of Le Chatlier's Principle, Clausius-Clapeyron Equation.

**Unit-II: Phase Equilibrium**

**(12 Hours)**

Introduction, Phase, Component, Degree of freedom, Criteria for Phase Equilibrium, Thermodynamic derivation of phase rule, Phase Diagram, One Component system, phase diagram of water, Sulphur, Freezing Mixtures.

Immiscible liquids, Steam Distillation, Partially miscible liquids (Upper and Lower Critical Solution Temperature), Effect of temperature on Critical Solution Temperature, Nernst Distribution Law, Introduction, thermodynamic derivation of law and its applications.

**Unit-III: Electrochemistry-I**

**(11 Hours)**

Introduction, Electrolytic Conductance, Conductance, Cell constant, Specific conductivity, Equivalent conductivity, Molar conductivity and their relation with specific conductivity, Variation of different types of conductivities with dilution.

Arrhenius theory of ionisation, Ostwald's dilution law, Debye-Huckel-Onsager equation, Anomalous behaviour of strong electrolytes, Kohlrausch's Law, Transport Number, Determination of transport number (Hittorf's and Moving Boundary Method), Conductometric titrations.

**Unit-IV: Electrochemistry-II**

**(11 Hours)**

Electrochemical Cell, Electrolytic Cell, EMF of a cell, Reversible and Irreversible Cell, Types of electrodes, Relationship between electrical energy and chemical energy, Measurement of electrode potentials (Zinc and copper electrodes), Electrochemical series, Applications, Nernst Equation for measuring EMF of a cell, Concentration Cells (definition and examples only), Liquid Junction Potential (definition only), Potentiometric titrations.

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Syllabus and courses of studies in the subject of Chemistry under CBCS as per NEP-2020

(For examinations to be held in the years Dec. 2024, 2025 & 2026)

**Semester-V**

**Course No.: UMJCHT-501 (Major course)**

**Title: PHYSICAL CHEMISTRY-II**

**Credits: 03 (Theory) + 01 (Practical)**

**Maximum Marks: 100 [75 (Theory) + 25 (Practical)]**

**Duration of Examination: 3 Hours (Theory) and 2½ Hours (Practical)**

**Theory: 03 Credits**

**Contact Hours: 45 Hours**

**Course learning outcomes:**

After completing this course contents, students will be able to understand

- Laws of thermodynamics, chemical kinetics and catalysis
- Adsorption and colloidal state
- Liquid-liquid mixture

**Unit-I: Thermodynamics- II**

**(10 Hours)**

Introduction- Need for the second Law, Different statements of the law, Carnot Cycle and its efficiency, Entropy, Entropy change in reversible and irreversible processes, Entropy change on mixing of ideal gases, Nernst Heat Theorem, Third law of thermodynamics, Importance, Residual Entropy.

**Unit-II: Chemical Kinetics and Catalysis**

**(12 Hours)**

Introduction, Factors affecting rate of reaction, Molecularity of a reaction, Rate Law and rate constant, Zero Order, First Order, Second order Reactions (Definition, examples, integrated rate equations), Relation between half-life period and order of a reaction, Various methods for the determination of order of a reaction, Arrhenius Equation and Temperature Dependence, Collision Theory of reaction rates, Theory of activated complex.

**Unit-III: Adsorption and Colloidal State**

**(11 Hours)**

Introduction, Physical and Chemical Adsorption, Adsorption Isotherm, Freundlich Adsorption Isotherm, Langmuir Adsorption Isotherm, Application of Adsorption.

Introduction and classification of colloids, Lyophilic and lyophobic colloids, Coagulation and Hardy Schulze Rule, Micelles, Protective Colloids and Gold Number.

**Unit-IV: Liquid-Liquid Mixtures**

**(12 Hours)**

Introduction, Miscible, Immiscible, Partially Miscible Liquids, Henry's Law, Principle of distillation (Miscible and immiscible liquids), Azeotropes, Steam Distillation, Partially Miscible Liquids, Critical Solution Temperature (Different Types and Examples), Effect of Temperature on CST, Nernst Distribution Law (definition, examples and limitations).

**NOTE FOR PAPER SETTING:**

**Note for paper setter for End Semester Examination:**

The question paper will be of **60 marks**. There shall be **2 Sections** in the question paper with pattern as follows:

**Section-A** shall comprise of **4** short answer type questions of **(3 marks each)** with one question from each unit. The students have to attempt all the questions from Section-A.

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Syllabus and courses of studies in the subject of Chemistry under CBCS as per NEP-2020

(For examinations to be held in the years Dec. 2024, 2025 & 2026)

**Semester-V**

**Course No.: UMJCHT-501 (Major course)**

**Title: PHYSICAL CHEMISTRY-II**

**Credits: 03 (Theory) + 01 (Practical)**

**Maximum Marks: 100 [75 (Theory) + 25 (Practical)]**

**Duration of Examination: 3 Hours (Theory) and 2½ Hours (Practical)**

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**Section-B** shall comprise of a total of **8** questions with two questions selected from each unit. Each question shall be of **12 marks**. The students have to attempt **4** questions by selecting only one question from each unit.

The numerical problems should not exceed more than 20% of the maximum marks.

**Note for paper setter for Mid Semester Examination:**

The Mid Semester Examination shall be conducted by the course coordinator after completion of **50%** of the syllabus.

The question paper will be of **15** marks and duration of examination shall be **1½** hour. There shall be **2** sections in the question paper with pattern as follows:

**Section-A** shall comprise of **3** questions (of **4** marks each) and the students are required to attempt any two questions.

**Section-B** shall comprise of **2** questions (of **7** marks each) and the students are required to attempt any one question.

**BOOKS RECOMMENDED:**

1. Barrow, G.M. Physical Chemistry, Tata McGraw-Hill, (2007).
2. Castellan, G.W. Physical Chemistry, 4<sup>th</sup> Ed., Narosa, (2004).
3. P. W. Atkins, J de Paula, Physical Chemistry, 8th Ed, Oxford University Press, New Delhi (2006).
4. I. N. Levine, Physical Chemistry, 6th Ed, McGraw Hill Education (2011).
5. Physical Chemistry by R.L. Madan, McGraw Hill Education (2015).
6. Physical Chemistry by S.C. Hketerpal, Vol. II, Pradeep Publications, 10<sup>th</sup> Ed. 2012.

**Practical : 01 Credit**

**Contact Hours: 30 Hours**

**Course learning outcomes:**

After completing this course contents, students will be able to understand

- Miscibility of different solutions
- Chemical Kinetics

**Suggested Experiments:**

1. Determination of heat capacity of calorimeter for different volumes.
2. Determination of enthalpy of neutralization of hydrochloric acid with sodium hydroxide.
3. Determination of enthalpy of ionization of acetic acid.
4. Determination of integral enthalpy of solution of salts (KNO<sub>3</sub>, NH<sub>4</sub>Cl).
5. Determination of enthalpy of hydration of copper sulphate.

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Syllabus and courses of studies in the subject of Chemistry under CBCS as per NEP-2020

(For examinations to be held in the years Dec. 2024, 2025 & 2026)

**Semester-V**

Course No.: UMJCHT-501 (Major course)

Title: PHYSICAL CHEMISTRY-II

Credits: 03 (Theory) + 01 (Practical)

Maximum Marks: 100 [75 (Theory) + 25 (Practical)]

Duration of Examination: 3 Hours (Theory) and 2½ Hours (Practical)

6. Determination of the critical solution temperature and composition of the phenol water system and study of the effect of impurities on it.
7. Study of the variation of mutual solubility temperature with concentration for the phenol water system and determination of the critical solution temperature.
8. Study of the variation of mutual solubility temperature with the addition of impurity for the phenol water system and determination of the critical solution temperature.
9. Determination of the velocity constant of alkaline hydrolysis of ethyl acetate.

**NOTE FOR PAPER SETTING:**

**EVALUATION OF PRACTICALS:**

Daily evaluation of practical records/viva-voce etc.	10 marks	
Final examination (to be conducted by the course coordinator internally)	100 % Syllabus	15 marks (10 marks = practical assessment + 5 marks= viva-voce examination)

**BOOKS RECOMMENDED:**

1. Practical Physical Chemistry; Khosla , B.D. Garg, V.C. & Gulati , A.R. Chanad & Co.; 2011.
2. Advanced physical Chemistry Experiments by J.N. Gurtu and A. Gurtu: Pragati Prakashan
3. Advanced Practical Physical Chemistry by J.B. Yadav, Krishna's Publications.
4. Practical Physical Chemistry, A.M. James and F.E. Prichard, Longman
5. Experimental Physical Chemistry; R.C. Das and B. Behera, Tata McGraw Hill.
6. Experiments in Physical Chemistry by Shoemaker.
7. Practical Physical Chemistry by Viswanathan and Raghavan

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Syllabus and courses of studies in the subject of Chemistry under CBCS as per NEP-2020

(For examinations to be held in the years Dec. 2024, 2025 & 2026)

**Semester-V**

Course No.: UMJCHT-502 (Major course)

Title: ORGANIC CHEMISTRY-II

Credits: 03 (Theory) + 01 (Practical)

Maximum Marks: 100 [75 (Theory) + 25 (Practical)]

Duration of Examination: 3 Hours (Theory) and 2½ Hours (Practical)

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Theory: 03 Credits

Contact Hours: 45 Hours

**Course learning outcomes:**

After completing this course contents, students will be able to understand

- Reactions of alcohols and phenols.
- Reactions of aldehydes, ketones and carboxylic acids
- Chemistry of lipids and fats

**UNIT-I: Alcohols and Phenols-II**

**Dihydric Alcohols:** Preparation from alkenes, formation of Ketals and Acetals, Oxidative cleavage using  $\text{Pb}(\text{OAc})_4$ ,  $\text{HIO}_4$  and Pinacol- Pinacolone rearrangement.

**Trihydric Alcohols:** Preparation of glycerol from fatty acids and preparation of trinitro glycerine from glycerol

**Acidic character:** Comparison of acidic strengths of alcohols and phenols.

**Reactions of Phenols:** Reactions and mechanism of Fries rearrangement, Kolbe reaction, Acylation, Schotten- Baumann, Laderer- Manasse reaction.

**UNIT-II: Aldehydes and Ketones:**

Brief introduction of aldehydes and ketones, Preparation from alcohols, alkenes, acid chlorides and nitriles, Etard Reaction.

**Reactions:** Nucleophilic addition reaction with  $\text{HCN}$ ,  $\text{ROH}$ ,  $\text{NaHSO}_3$ , ammonia and its derivatives, Iodoform Test, Aldol, Cannizzaro and Wittig reaction, Mannich Reaction, Benzoin, Knoevenagel Condensation, Clemmenson and Wolff Krishner Reduction, MPV,  $\text{LiAlH}_4$  and  $\text{NaBH}_4$  reductions.

**UNIT-III: Carboxylic acids and their derivatives**

Brief introduction of carboxylic acids, Strength of organic acids, comparative study with emphasis on factors affecting their  $\text{pK}$  values

**Preparation of carboxylic acids:** acidic and alkaline hydrolysis of esters and nitriles, Arndt-Eistert homologation.

**Reactions:** Hell-Vohlard Zelinsky reaction, decarboxylation, reduction, reaction with organolithium and organomagnesium compounds.

**Carboxylic acid derivatives**

**Preparation:** Acid chlorides, Anhydrides, Esters and Amides from acids and their interconversion.

**Reactions:** Comparison of nucleophilicity of acyl derivatives. Reformatsky Reaction and Perkin Condensation.

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Syllabus and courses of studies in the subject of Chemistry under CBCS as per NEP-2020

(For examinations to be held in the years Dec. 2024, 2025 & 2026)

**Semester-V**

Course No.: UMJCHT-502 (Major course)

Title: ORGANIC CHEMISTRY-II

Credits: 03 (Theory) + 01 (Practical)

Maximum Marks: 100 [75 (Theory) + 25 (Practical)]

Duration of Examination: 3 Hours (Theory) and 2½ Hours (Practical)

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**UNIT-IV: Lipids and Fats**

**Lipids:** Definition, Classification and biological functions.

**Introduction to oils and fats:** Common fatty acids present in oils and fats and their importance, Hydrogenation of fats and oils, Saponification value, acid value, iodine number, Calorific value of food, Soap Detergents and their mechanism of action.

**NOTE FOR PAPER SETTING:**

*Note for paper setter for End Semester Examination:*

The question paper will be of **60 marks**. There shall be **2 Sections** in the question paper with pattern as follows:

**Section-A** shall comprise of **4** short answer type questions of (**3** marks each) with one question from each unit. The students have to attempt all the questions from Section-A.

**Section-B** shall comprise of a total of **8** questions with two questions selected from each unit. Each question shall be of **12 marks**. The students have to attempt **4** questions by selecting only one question from each unit.

The numerical problems should not exceed more than 20% of the maximum marks.

*Note for paper setter for Mid Semester Examination:*

The Mid Semester Examination shall be conducted by the course coordinator after completion of **50%** of the syllabus.

The question paper will be of **15** marks and duration of examination shall be 1½ hour. There shall be **2** sections in the question paper with pattern as follows:

**Section-A** shall comprise of **3** questions (of **4** marks each) and the students are required to attempt any two questions.

**Section-B** shall comprise of **2** questions (of **7** marks each) and the students are required to attempt any one question.

**BOOKS RECOMMENDED:**

1. Organic Chemistry-P. Y. Bruice, 7<sup>th</sup> Ed., Pearson Education Pvt. Ltd., New Delhi (2013).
2. Heterocyclic Chemistry- R. K. Bansal, 3<sup>rd</sup> Ed., New- Age International, New Delhi, 2004.
3. McMurry, J.E. Fundamentals of Organic Chemistry, 7<sup>th</sup> Ed., Cengage Learning India Edition, 2013.
4. Sykes, P. A Guidebook to Mechanism in Organic Chemistry, Orient Longman, New Delhi (1988).

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Syllabus and courses of studies in the subject of Chemistry under CBCS as per NEP-2020

(For examinations to be held in the years Dec. 2024, 2025 & 2026)

**Semester-V**

Course No.: UMJCHT-502 (Major course)

Title: ORGANIC CHEMISTRY-II

Credits: 03 (Theory) + 01 (Practical)

Maximum Marks: 100 [75 (Theory) + 25 (Practical)]

Duration of Examination: 3 Hours (Theory) and 2½ Hours (Practical)

5. Stereochemistry-Conformation and Mechanism-P. S. Kalsi, Wiley-Eastern Ltd, New Delhi.
6. Morrison, R.T. & Boyd, R.N. Organic Chemistry, Pearson, 2010.
7. Bahl, A. & Bahl, B.S. Advanced Organic Chemistry, S. Chand, 2010.
8. Graham Solomons, T. W., Fryhle, C. B. & Snyder, S.A. Organic Chemistry, John Wiley & Sons (2014).
9. Organic Chemistry Volume-I, II- I. L. Finar, 6th Edition, ELBS London (2004).
10. Organic Chemistry-F. A. Carey, 4th Edition, McGraw Hill (2000).
11. Modern Organic Chemistry - R.O.C. Norman and D.J. Waddington, ELBS, 1983.
12. Understanding Organic reaction mechanisms - A. Jacobs, Cambridge Univ. Press, 1998.
13. Organic Chemistry - L. Ferguson, Von Nostrand, 1985.
14. Organic Chemistry - M. K. Jain, Nagin & Co., 1987.
15. Organic Chemistry- Mehta and Mehta, PHI Learning Pvt. Ltd, New Delhi, 2005.

Practical: 01 Credit

Contact Hours: 30 Hours

**Course learning outcomes:**

After completing this course contents, students will be able to understand

- How to test presence of oils and fats in the given sample
- Preparation of some organic compounds

**Suggested Experiments:**

1. To study some simple tests to identify the presence of oils and fats in the given sample (Solubility test, Translucent spot test, Acrolein test, Baudouin test, Huble's test)
2. To determine the acid value and free fatty acids in the given sample of oil/fat
3. **Preparations**
  - i. 2,4-Dinitrophenylhydrazone from benzophenone and 2,4-dinitrophenylhydrazine
  - ii. Synthesis of benzamide from benzoic acid
  - iii. Benzoylation of  $\alpha$ -naphthol
  - iv. Cannizaro reaction: Synthesis of benzoic acid and benzyl alcohol

**NOTE FOR PAPER SETTING:**

**EVALUATION OF PRACTICALS:**

Daily evaluation of practical records/viva-voce etc.	10 marks
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Syllabus and courses of studies in the subject of Chemistry under CBCS as per NEP-2020

(For examinations to be held in the years Dec. 2024, 2025 & 2026)

**Semester-V**

**Course No.: UMJCHT-502 (Major course)**

**Title: ORGANIC CHEMISTRY-II**

**Credits: 03 (Theory) + 01 (Practical)**

**Maximum Marks: 100 [75 (Theory) + 25 (Practical)]**

**Duration of Examination: 3 Hours (Theory) and 2½ Hours (Practical)**

Final examination (to be conducted by the course coordinator internally)	100 % Syllabus	15 marks (10 marks = practical assessment + 5 marks= viva-voce examination)
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**BOOKS RECOMMENDED:**

1. Vogel, A.I. Elementary Practical Organic Chemistry, Part1: Small Scale Preparations, Pearson 2011).
2. F.G. & Saunders, B.C. Practical Organic Chemistry, Pearson Education (2009).
3. Furniss, B.S.; Hannaford, A.J.; Smith, P.W.G.; Tatchell, A.R. Practical Organic Chemistry, 5<sup>th</sup> Ed., Pearson(2012).
4. Ahluwalia, V.K. & Aggarwal, R. Comprehensive Practical Organic Chemistry: Preparation and Quantitative Analysis, University Press (2000).
5. Ahluwalia, V.K. & Dhingra, S. Comprehensive Practical Organic Chemistry: Qualitative Analysis, University Press (2000).
6. R.M. Felder, R.W. Rousseau: Elementary Principles of Chemical Processes, Wiley Publishers, New Delhi.
7. Vogel, A.I., Tatchell, A.R., Furnis, B.S., Hannaford, A.J. & Smith, P.W.G., Textbook of Practical Organic Chemistry, Prentice-Hall, 5th edition, 2012.
8. Advanced Organic Practical by N.K. Vishnoi.

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Syllabus and courses of studies in the subject of Chemistry under CBCS as per NEP-2020

(For examinations to be held in the years Dec. 2024, 2025 & 2026)

**Semester-V**

Course No.: UMJCHT-503 (Major Course)

Title: INORGANIC CHEMISTRY-II

Credits: 03 (Theory) + 01 (Practical)

Maximum Marks: 100 [75 (Theory) + 25 (Practical)]

Duration of Examination: 3 Hours (Theory) and 2½ Hours (Practical)

Theory: 03 Credits

Contact Hours: 45 Hours

**Course learning outcomes:**

After completing this course contents, students will be able to understand

- Theories of bonding in transition metal complexes
- Acid-bases and non-aqueous solvents
- Theoretical principles in qualitative analysis

**Unit-I: Theories of Bonding in Transition Metal Complexes-I (12 Hours)**

Valence bond theory, Limitations of Valence Bond Theory, The electro neutrality principle and back bonding, Crystal field theory, Octahedral and tetrahedral, Crystal field stabilizing energy (CFSE), Factors affecting the magnitude of crystal field splitting, Spectrochemical series, Crystal field splitting and magnetic properties of the complexes.

**Unit-II: Acids and Bases (11 Hours)**

Arrhenius, Bronsted-Lowry, the Lux-Flood, solvent system and Lewis concepts of acids and bases, A Generalized Acid Base Concept.

Hard and Soft Acids and Bases (HSAB): Classification of acids and bases as hard and soft. Pearson's HSAB concept, acid-base strength and hardness and softness.

**Unit-III: Non-aqueous Solvents (11 Hours)**

Physical properties of a solvent, types of solvents and their general characteristics, reaction in non-aqueous solvents with reference to liquid NH<sub>3</sub> and liquid SO<sub>2</sub>.

**Oxidation-reduction:** Redox equations, standard electrode potential and its applications to inorganic reactions. Principles involved in some volumetric analyses (iron and copper).

**Unit-IV: Theoretical Principles in Qualitative Analysis (11 Hours)**

Basic principles involved in analysis of cations and anions, solubility products and common ion effect. Principles involved in separation of cations into groups and choice of group reagents. Interfering anions (fluoride, borate, oxalate and phosphate) and need to remove them after Group II.

Syllabus and courses of studies in the subject of Chemistry under CBCS as per NEP-2020

(For examinations to be held in the years Dec. 2024, 2025 & 2026)

**Semester-V**

**Course No.: UMJCHT-503 (Major Course)**

**Title: INORGANIC CHEMISTRY-II**

**Credits: 03 (Theory) + 01 (Practical)**

**Maximum Marks: 100 [75 (Theory) + 25 (Practical)]**

**Duration of Examination: 3 Hours (Theory) and 2½ Hours (Practical)**

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**NOTE FOR PAPER SETTING:**

***Note for paper setter for End Semester Examination:***

The question paper will be of **60 marks**. There shall be **2 Sections** in the question paper with pattern as follows:

**Section-A** shall comprise of **4** short answer type questions of (**3** marks each) with one question from each unit. The students have to attempt all the questions from Section-A.

**Section-B** shall comprise of a total of **8** questions with two questions selected from each unit. Each question shall be of **12 marks**. The students have to attempt **4** questions by selecting only one question from each unit.

The numerical problems should not exceed more than **20%** of the maximum marks.

***Note for paper setter for Mid Semester Examination:***

The Mid Semester Examination shall be conducted by the course coordinator after completion of **50%** of the syllabus.

The question paper will be of **15** marks and duration of examination shall be **1½** hour. There shall be **2** sections in the question paper with pattern as follows:

**Section-A** shall comprise of **3** questions (of **4** marks each) and the students are required to attempt any two questions.

**Section-B** shall comprise of **2** questions (of **7** marks each) and the students are required to attempt any one question.

**BOOKS RECOMMENDED:**

1. Inorganic Chemistry, J.E. Huhey, Harpes & Row.
2. Chemistry of the Elements, N.N. Greenwood and A. Earnshaw, Pergamon.
3. New Concise Inorganic Chemistry by J.D. Lee Edition III Compton Printing Ltd London
4. Cotton, F.A.G.; Wilkinson & Gaus, P.L. Basic Inorganic Chemistry 3rd Ed.; Wiley India,
5. Huheey, J. E.; Keiter, E.A. & Keiter, R.L. Inorganic Chemistry, Principles of Structure and Reactivity 4 th Ed., Harper Collins 1993, Pearson, 2006..
6. Comprehensive Coordination Chemistry eds., G. Wilkinson, R.D. Gillars and J.A. McClaverty, Pergamon.
7. Inorganic Chemistry, Gary L. Miessler, Donald A. Tarr, Prentice Hall (4th Edition), 2010.
8. Concepts and Models of Inorganic Chemistry, Bodie Douglas, Darl Mcdaniel, John Alexander, Wiley; Third edition (2006)
9. Inorganic Chemistry by A. G. Sharpe, Pearson India; 3rd Edition (2002).
10. Vogel, A.I. Qualitative Inorganic Analysis, Longman, 1972.

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# Syllabus and courses of studies in the subject of Chemistry under CBCS as per NEP-2020

(For examinations to be held in the years Dec. 2024, 2025 & 2026)

## Semester-V

Course No.: UMJCHT-503 (Major Course)

Title: INORGANIC CHEMISTRY-II

Credits: 03 (Theory) + 01 (Practical)

Maximum Marks: 100 [75 (Theory) + 25 (Practical)]

Duration of Examination: 3 Hours (Theory) and 2½ Hours (Practical)

Practical : 01 Credit

Contact Hours: 30 Hours

### Course learning outcomes:

After completing this course contents, students will be able to understand

- Preparation of some coordination complexes
- Qualitative semimicro analysis of mixtures containing 3 anions and 3 cations.

### Suggested Experiments:

1. Inorganic Preparations:

- i) Tetraamminecopper (II) sulphate,  $[\text{Cu}(\text{NH}_3)_4]\text{SO}_4 \cdot \text{H}_2\text{O}$
- ii) Cis and trans  $\text{K}[\text{Cr}(\text{C}_2\text{O}_4)_2 \cdot (\text{H}_2\text{O})_2]$
- iii) Potassium dioxalatodiaquachromate (III)
- iv) Tetraamminecarbonatocobalt (III) ion
- v) Potassium tris(oxalate)ferrate(III)

2. Qualitative semimicro analysis of mixtures containing 3 anions and 3 cations. Emphasis should be given to the understanding of the chemistry of different reactions. The following radicals are suggested:  $\text{CO}_3^{2-}$ ,  $\text{NO}_2^-$ ,  $\text{S}^{2-}$ ,  $\text{SO}_3^{2-}$ ,  $\text{S}_2\text{O}_3^{2-}$ ,  $\text{CH}_3\text{COO}^-$ ,  $\text{F}^-$ ,  $\text{Cl}^-$ ,  $\text{Br}^-$ ,  $\text{I}^-$ ,  $\text{NO}_3^-$ ,  $\text{BO}_3^{3-}$ ,  $\text{C}_2\text{O}_4^{2-}$ ,  $\text{PO}_4^{3-}$ ,  $\text{NH}_4^+$ ,  $\text{K}^+$ ,  $\text{Pb}^{2+}$ ,  $\text{Cu}^{2+}$ ,  $\text{Cd}^{2+}$ ,  $\text{Bi}^{3+}$ ,  $\text{Sn}^{2+}$ ,  $\text{Sb}^{3+}$ ,  $\text{Fe}^{3+}$ ,  $\text{Al}^{3+}$ ,  $\text{Cr}^{3+}$ ,  $\text{Zn}^{2+}$ ,  $\text{Mn}^{2+}$ ,  $\text{Co}^{2+}$ ,  $\text{Ni}^{2+}$ ,  $\text{Ba}^{2+}$ ,  $\text{Sr}^{2+}$ ,  $\text{Ca}^{2+}$ ,  $\text{Mg}^{2+}$

3. Mixtures should preferably contain one interfering anion, or insoluble component ( $\text{BaSO}_4$ ,  $\text{SrSO}_4$ ,  $\text{PbSO}_4$ ,  $\text{CaF}_2$  or  $\text{Al}_2\text{O}_3$ ) or combination of anions e.g.  $\text{CO}_3^{2-}$  and  $\text{SO}_3^{2-}$ ,  $\text{NO}_2^-$  and  $\text{NO}_3^-$ ,  $\text{Cl}^-$  and  $\text{Br}^-$ ,  $\text{Cl}^-$  and  $\text{I}^-$ ,  $\text{Br}^-$  and  $\text{I}^-$ ,  $\text{NO}_3^-$  and  $\text{Br}^-$ ,  $\text{NO}_3^-$  and  $\text{I}^-$ .

4. Any other experiment introduced by the Teacher.

### NOTE FOR PAPER SETTING:

### EVALUATION OF PRACTICALS:

Daily evaluation of practical records/viva-voce etc.		10 marks
Final examination (to be conducted by the course coordinator internally)	100 % Syllabus	15 marks (10 marks = practical assessment + 5 marks = viva-voce examination)

### BOOKS RECOMMENDED:

1. Synthesis and Characterization of Inorganic Compounds, William L. Jolly, Prentice Hall.
2. Vogel's Textbook of Quantitative Inorganic Analysis, 4th Edn., Longman Group Limited, London.

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Syllabus and courses of studies in the subject of Chemistry under CBCS as per NEP-2020

(For examinations to be held in the years Dec. 2024, 2025 & 2026)

**Semester-V**

**Course No.: UMJCHT-504 (Major Course)**

**Title: POLYMER SCIENCE AND TECHNOLOGY**

**Credits: 02**

**Contact Hours: 30 Hours**

**Maximum Marks: 50**

**Duration of Examination: 2½ Hours**

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**Course learning outcomes:**

After completing this course contents, students will be able to understand

- Polymer chemistry and Technology
- Biopolymers and Bio-nanocomposites

**Unit-I: Polymer Chemistry**

**(10 Hours)**

Definition, Classification of polymers, Chain configuration of macromolecules, Isotactic polymers, Atactic polymers, Syndiotactic polymers, Graft polymers, Mechanism of polymerization, Molecular mass of polymers, Number and Mass average molecular mass, Degree of polymerization, General Characteristics of Chain Growth Polymerization; Alkene Polymerization by Free Radical, Cationic and Anionic Initiators; General Characteristics of Step Growth Polymerization; Synthesis of Polymers by Step Growth Polymerization: Polyesters, Polyamides, Ring-opening Polymerization of Ethers and Lactones

**Unit-II: Biopolymers and Bio-nanocomposites**

**(10-Hours)**

Structure, functions and properties of biopolymers such as chitin, chitosan, alginates, cellulose, hemicellulose, pectins, xanthan, polylactic acid, dextran and starch. Composites-Matrix, fillers (definition), Biocomposites (definition), Bionanocomposites-methods of fabrications, applications in food packaging, water remediation and biomedical engineering.

**Unit-III: Polymer Technology**

**(10 Hours)**

Additives for Plastics: Fillers, Plasticizers, Stabilizers, Lubricants, Flame Retardants, Foaming Agents, Crosslinking Agents, Manufacture, Properties and Applications of Major Thermoplastics and Thermosetting Polymers: PE, PP, PVC, PS, Polyamides, Polyesters, Phenolic Resins, Amino Resins and Epoxy Resins, Polymeric Coatings

**NOTE FOR PAPER SETTING:**

***Note for paper setter for End Semester Examination:***

The question paper will be of **40 marks**. There shall be **2 Sections** in the question paper with pattern as follows:

**Section-A** shall comprise of 4 short answer type questions of (2½ marks each) with atleast one question from each unit. The students have to attempt all the questions from Section-A.

**Section-B** shall comprise of a total of 6 questions with two questions selected from each unit. Each question shall be of **5 marks**. The students have to attempt 3 questions by selecting only one question from each unit.

The numerical problems should not exceed more than 20% of the maximum marks.

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Syllabus and courses of studies in the subject of Chemistry under CBCS as per NEP-2020

(For examinations to be held in the years Dec. 2024, 2025 & 2026)

**Semester-V**

**Course No.: UMJCHT-504 (Major Course)**

**Title: POLYMER SCIENCE AND TECHNOLOGY**

**Credits: 02**

**Contact Hours: 30 Hours**

**Maximum Marks: 50**

**Duration of Examination: 2½ Hours**

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***Note for paper setter for Mid Semester Examination:***

The Mid Semester Examination shall be conducted by the course coordinator after completion of 50% of the syllabus.

The question paper will be of 10 marks and duration of examination shall be 1 hour. There shall be 2 sections in the question paper with pattern as follows:

**Section-A** shall comprise of 3 questions (of 2 marks each) and the students are required to attempt any two questions.

**Section-B** shall comprise of 2 questions (of 6 marks each) and the students are required to attempt any one question.

**BOOKS RECOMMENDED:**

1. Text Book of Polymer Science by F. W. Billmeyer.
2. Introduction to Polymer Science, V. R. Gowarikar, N. V. Vishwanathan and J. Sridhar - Wiley Eastern.
3. Introduction to Polymers by R. J. Young and P.A. Lovell.
4. Handbook of Biopolymers by Shakeel Ahmed, CRC Press.
5. Polymer Chemistry by G. Challa.
6. Polymers: Chemistry and Physics of Modern Materials by JMG Cowie.
7. Principles of Polymerization by George Odian.
8. Advanced Green Materials, Shakeel Ahmed, Woodhead Publishing, UK.
9. Applications of Advanced Green Materials, Shakeel Ahmed, Woodhead Publishing, UK.
10. Bionanocomposites for Food Packaging Applications, Shakeel Ahmed, Woodhead Publishing, UK.
11. Bionanocomposites in Tissue Engineering and Regenerative Medicine, Shakeel Ahmed, Woodhead Publishing, UK.

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Syllabus and courses of studies in the subject of Chemistry under CBCS as per NEP-2020

(For examinations to be held in the years Dec. 2024, 2025 & 2026)

**Semester-V**

**Course No.: UMICHT-505 (Minor course)**

**Title: ORGANIC CHEMISTRY-I**

**Credits: 03 (Theory) + 01 (Practical)**

**Maximum Marks: 100 [75 (Theory) + 25 (Practical)]**

**Duration of Examination: 3 Hours (Theory) and 2½ Hours (Practical)**

**Theory: 03 Credits**

**Contact Hours: 45 Hours**

**Course learning outcomes:**

After completing this course contents, students will be able to understand

- Reactions of alkyl & aryl halides, alcohols & phenols
- Reactions of ethers, epoxides and carbohydrates

**Unit-I: Alkyl & Aryl Halides**

**(12 Hours)**

**Alkyl Halides** (Upto 5 Carbons) Types of Nucleophilic Substitution (SN1, SN2 and SNi) reactions.

*Preparation:* from alkenes and alcohols.

*Reactions:* hydrolysis, nitrite & nitro formation, nitrile & isonitrile formation. Williamson's ether synthesis.

**Aryl Halides Reactions (Chlorobenzene):** Aromatic nucleophilic substitution (replacement by -OH group) and effect of nitro substituent. Benzyne Mechanism: KNH<sub>2</sub>/NH<sub>3</sub> (or NaNH<sub>2</sub>/NH<sub>3</sub>). Reactivity and Relative strength of C-Halogen bond in alkyl, allyl, benzyl, vinyl and aryl halides.

**Unit-II: Alcohols & Phenols**

**(13 Hours)**

**Alcohols**

*Preparation:* Preparation of 1°, 2° and 3° alcohols: using Grignard reagent, Ester hydrolysis, Reduction of aldehydes, ketones, carboxylic acid and esters.

*Reactions:* With sodium, HX (Lucas test), esterification, oxidation (PCC, alk. KMnO<sub>4</sub>, acidic dichromate, conc. HNO<sub>3</sub>). Oppeneauer oxidation.

**Phenols:** (Phenol case) *Preparation:* Cumene hydroperoxide method, from diazonium salts.

*Reactions:* Electrophilic substitution: Nitration, halogenation and sulphonation. Reimer-Tiemann Reaction, Gattermann-Koch Reaction, Houben-Hoesch reaction.

**Unit-III: Ethers & Epoxides**

**(10 Hours)**

Nomenclature of ethers and methods of their formation, physical properties, Chemical reactions – cleavage and autoxidation, Ziesel's method. Synthesis of epoxides, Acid and base-catalyzed ring opening of epoxides, orientation of epoxide ring opening, reactions of Grignard and organolithium reagents with epoxides.

**Unit-IV: Carbohydrates**

**(10 Hours)**

Classification and General Properties, Glucose and Fructose (open chain and cyclic structure), Determination of configuration of monosaccharides, absolute configuration of Glucose and Fructose, Mutarotation, ascending and descending in monosaccharides. Structure of

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Syllabus and courses of studies in the subject of Chemistry under CBCS as per NEP-2020

(For examinations to be held in the years Dec. 2024, 2025 & 2026)

**Semester-V**

**Course No.: UMICHT-505 (Minor course)**

**Title: ORGANIC CHEMISTRY-I**

**Credits: 03 (Theory) + 01 (Practical)**

**Maximum Marks: 100 [75 (Theory) + 25 (Practical)]**

**Duration of Examination: 3 Hours (Theory) and 2½ Hours (Practical)**

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disacharrides (sucrose, maltose, lactose) and polysacharrides (starch and cellulose) excluding their structure elucidation.

**NOTE FOR PAPER SETTING:**

***Note for paper setter for End Semester Examination:***

The question paper will be of **60 marks**. There shall be **2 Sections** in the question paper with pattern as follows:

**Section-A** shall comprise of **4** short answer type questions of (**3** marks each) with one question from each unit. The students have to attempt all the questions from Section-A.

**Section-B** shall comprise of a total of **8** questions with two questions selected from each unit. Each question shall be of **12 marks**. The students have to attempt **4** questions by selecting only one question from each unit.

The numerical problems should not exceed more than 20% of the maximum marks.

***Note for paper setter for Mid Semester Examination:***

The Mid Semester Examination shall be conducted by the course coordinator after completion of **50%** of the syllabus.

The question paper will be of **15** marks and duration of examination shall be **1½** hour. There shall be **2** sections in the question paper with pattern as follows:

**Section-A** shall comprise of **3** questions (of **4** marks each) and the students are required to attempt any two questions.

**Section-B** shall comprise of **2** questions (of **7** marks each) and the students are required to attempt any one question.

**BOOKS RECOMMENDED:**

1. Graham Solomon, T.W., Fryhle, C.B. & Snyder, S.A. Organic Chemistry, John Wiley & Sons (2014).
2. McMurry, J.E. Fundamentals of Organic Chemistry, 7<sup>th</sup> Ed., Cengage Learning India Edition, 2013.
3. Sykes, P. A Guidebook to Mechanism in Organic Chemistry, Orient Longman, New Delhi (1988).
4. Finar, I.L. Organic Chemistry (Vol. I & II), E.L.B.S.
5. Morrison, R.T. & Boyd, R.N. Organic Chemistry, Pearson, 2010.
6. Bahl, A & Bahl, B.S. Advanced Organic Chemistry, S. Chand, 2010.
7. Berg, J.M., Tymoczko, J.L. & Stryer, L. Biochemistry, W.H. Freeman, 2002.
8. Petrucci, R.H. General Chemistry, 5th Ed., Macmillan Publishing Co., New York (1985).
9. Kotz, J.C., Treichel, P.M. & Townsend, J.R. General Chemistry, Cengage Learning India Pvt. Ltd., New Delhi (2009).

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## Syllabus and courses of studies in the subject of Chemistry under CBCS as per NEP-2020

(For examinations to be held in the years Dec. 2024, 2025 & 2026)

### Semester-V

Course No.: UMICHT-505 (Minor course)

Title: ORGANIC CHEMISTRY-I

Credits: 03 (Theory) + 01 (Practical)

Maximum Marks: 100 [75 (Theory) + 25 (Practical)]

Duration of Examination: 3 Hours (Theory) and 2½ Hours (Practical)

Practical: 01 Credit

Contact Hours: 30 Hours

### Course learning outcomes:

After completing this course contents, students will be able to understand

- Purification of organic compound
- Mechanisms of various reactions

### Suggested Experiments:

1. Purification of organic compounds by crystallization (from water and alcohol) and distillation.
2. Criteria of Purity: Determination of melting and boiling points.
3. Preparations: Mechanism of various reactions involved to be discussed.
4. Recrystallisation, determination of melting point and calculation of quantitative yields to be done.
  - (a) Bromination of Phenol/Aniline
  - (b) Benzoylation of amines/phenols
  - (c) Oxime and 2,4-dinitrophenylhydrazone of aldehyde/ketone
5. Action of salivary amylase on starch
6. Effect of temperature on the action of salivary amylase on starch.
7. Differentiation between a reducing and a non-reducing sugar.

### NOTE FOR PAPER SETTING:

### EVALUATION OF PRACTICALS:

Daily evaluation of practical records/viva-voce etc.		10 marks
Final examination (to be conducted by the course coordinator internally)	100 % Syllabus	15 marks (10 marks = practical assessment + 5 marks= viva-voce examination)

### BOOKS RECOMMENDED:

1. Vogel, A.I., Tatchell, A.R., Furnis, B.S., Hannaford, A.J. & Smith, P.W.G., Textbook of Practical Organic Chemistry, Prentice-Hall, 5<sup>th</sup> edition, 1996.
2. Mann, F.G. & Saunders, B.C. Practical Organic Chemistry Orient-Longman, 1960.
3. Ahluwalia, V.K. & Aggarwal, R. Comprehensive Practical Organic Chemistry, Universities Press.

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Syllabus and courses of studies in the subject of Chemistry under CBCS as per NEP-2020

(For examinations to be held in the years Dec. 2024, 2025 & 2026)

**Semester-V**

**Course No.: USECHI-506 (Skill Enhancement)**

**Title: SUMMER INTERNSHIP**

**Credits: 02 (Practical)**

**Maximum Marks: 50**

**Duration of examination: 2½ hours**

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**Course learning outcomes:**

After completing the internship, the students will develop professional ability through an appropriate training.

**Summer Internship:**

All students will undergo Internships/Apprenticeships in a firm, industry, or organization or Training in labs with faculty and researchers in their own or other HEIs/research institutions during the summer term. Students will be provided with opportunities for internships with local industry, business organizations, health and allied areas, local governments (such as panchayats, municipalities), Parliament or elected representatives, media organizations, artists, crafts persons, and a variety of organizations so that students may actively engage with the practical side of their learning and, as a by-product, further improve their employability.

The internship shall be under a college teacher who will be designed as Internship Supervisor. After completion of summer internship, students will have to produce a report related to the work carried out by the student and duly signed by Internship Supervisor and College Principal. The Internship Report will be Evaluated Internally by a Board of Examiners set up by the Principal of the College.

