

Signature of Dean	Signature of BoS Convenor	Signature of DR (Academic-II)

Syllabus

- CHM-63T-201 – Chemistry of s, p-block elements and Noble Gases, Non-aqueous Solvent, Nuclear Chemistry, Hydrocarbons and Alkyl halide, Fundamentals of Thermodynamics, Solutions and their Colligative Properties.**
- CHM-63P-202 PRACTICAL-III**

III – Semester – Chemistry

Semester	Code of the Course	Title of the Course/Paper			NHEQF Level	Credits	
III	CHM-63T-201	UG0802/03 – CHM-63T-201 – Chemistry of s, p-block elements and Noble Gases, Non-aqueous Solvent, Nuclear Chemistry, Hydrocarbons and Alkyl halide, Fundamentals of Thermodynamics, Solutions and their Colligative Properties.			6	4	
III	CHM-63P-202	PRACTICAL-III			6	2	
Level of Course	Type of the Course	Credit Distribution			Offered to NC Students	Course Delivery Method	
		Theory	Practical	Total		Through Lecture, Sixty (60) Lectures	Class room Teaching/Power-Point (PPT)
6	Major	4	2	6	Yes	Through Lecture, Sixty (60) Lectures	Class room Teaching/Power-Point (PPT)
List of Programme Codes in which offered as Minor Discipline		-NA-					


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Prerequisites/Eligibility	<p>The students must have earned a minimum of 52 credits (26 × 2 credits)</p> <p style="text-align: center;">OR</p> <p>For promotion from the current year to next year it is mandatory to pass all the prescribed co-course of the previous year with the C grade (40%).</p>
Course Objectives:	<p>The main objective of this course is to provide a theoretical knowledge about s-and p- block element's chemistry with their periodic trends, properties and applications along with noble gases. The uses of non-aqueous aprotic solvents in chemical research and essentials of nuclear chemistry are also included to enrich the knowledge in these fields. Moreover, our aim is to provide clear understanding of the organic reactions of saturated and unsaturated hydrocarbons. Characteristic reactions of alkyl halides and the concepts related to the field of basic and applied thermodynamics, solutions with their colligative properties are also incorporated to enrich the conceptual knowledge in these fields.</p>


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Syllabus

CHM-63T-201: Chemistry of s, p-block elements and Noble Gases, Non-aqueous Solvent, Nuclear Chemistry, Hydrocarbons and Alkyl halide, Fundamentals of Thermodynamics, Solutions and their Colligative Properties.

Unit-I

s-Block Elements: Comparative study of properties of alkaline and alkaline earth metals, diagonal relationships, salient features of hydrides, solvation and complexation tendencies including their function in biosystems, an introduction to alkyls and aryls.

Periodicity of p-block elements: Periodicity in properties of p-block elements with special reference to atomic and ionic radii, ionization energy, electron-affinity, electronegativity, diagonal relationship, catenation.

Some Important Compounds of p-block Elements: Hydrides of boron, diborane and higher boranes, borazine, borohydrides, fullerenes, carbides, fluorocarbons, silicates (structural principle), tetrasulphur tetranitride, basic properties of halogens, interhalogens and polyhalides.

Chemistry of Noble Gases: Chemical properties of the noble gases, chemistry of Xenon, structure and bonding in Xenon compounds.

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Unit-II

Oxidation and Reduction:

Uses of Redox Potential data, analysis of redox cycle, redox stability in water. Frost, Latimer and Pourbaix diagrams. Principles involved in the extraction of the elements.

Non-aqueous Solvents:

Physical properties of a solvent, types of solvents and their general characteristics, reactions in non-aqueous solvents with reference to liquid NH_3 and liquid SO_2

Nuclear Chemistry: Fundamental particles of nucleus (nucleons), concept of nuclides and its representation, Isotopes, Isobars and Isotones (with specific examples), forces operating between nucleons (n-n, p-p & n-p), Qualitative idea of stability of nucleus (n/p ratio).

Radioactive elements chemistry: Natural and artificial radioactivity, Radioactive disintegration series, Radioactive displacement law, Radioactivity decay rates, Half-life and average life, Nuclear binding energy, mass defect and calculation of defect and binding energy, Nuclear reactions, Spallation, Nuclear fission and fusion. Brief discussion on Atom bomb, Nuclear reactor and Hydrogen bomb.

15 Lecture

Unit-III

Alkanes and Cycloalkanes: Free radical halogenations of Alkanes: mechanism, orientation, reactivity and selectivity. Cycloalkanes - nomenclature, methods of formation, chemical reactions. Baeyer's strain theory and its limitations. Theory of strainless rings.

Alkenes, Cycloalkenes, Dienes and Alkynes: Relative stabilities of alkenes. Chemical reactions of alkenes - hydroboration-oxidation, oxymercuration-reduction. Epoxidation, ozonolysis and oxidation with KMnO_4 . Polymerization of alkenes. Substitution at the allylic and vinylic positions of alkenes.

Classification and Nomenclature of isolated, conjugated and cumulated dienes. Structure of allenes and butadiene. Methods of formation, properties and chemical reactions - 1,2- and 1,4-additions, Diels-Alder reaction and polymerization reactions.

Structure and bonding in alkynes. Methods of formation. Chemical reactions - acidity of alkynes: mechanism of electrophilic and nucleophilic addition reactions; hydroboration-oxidation; metal-ammonia reduction, oxidation and polymerization.

Alkyl Halides: Methods of formation of alkyl halides, chemical reactions. Mechanisms of nucleophilic substitution reactions of alkyl halides $\text{S}_{\text{N}}2$ and $\text{S}_{\text{N}}1$ reactions with energy profile diagrams.

15 Lecture

Unit-IV

Thermodynamics - I

Definition of Thermodynamic Terms: System, surroundings, etc. Types of systems, intensive and extensive properties. State and path functions and their differentials. Thermodynamic process, concept of heat and work.

First Law of Thermodynamics: Statement, definition of internal energy and enthalpy, heat capacity, heat capacities at constant volume and pressure and their relationship. Joule's law, Joule-Thomson coefficient and inversion temperature. Calculation of w , q , dU & dH for the expansion of Ideal gases under isothermal



and adiabatic conditions for reversible process.

Thermochemistry:

Standard state, standard enthalpy of formation, Hess's law of heat summation and its applications. Heat of reaction at constant pressure and at constant volume. Enthalpy of neutralization. Bond dissociation energy and its calculation from thermo-chemical data, temperature dependence of enthalpy. Kirchhoff's equation.

Solutions, Dilute Solutions and Colligative Properties:

Ideal and non-ideal solutions, methods of expressing concentrations of solutions, activity and activity coefficient.

Dilute solution, colligative properties, Raoult's law, relative lowering of vapor pressure, molecular weight determination. Osmosis, law of osmotic pressure and its measurement, determination of molecular weight from osmotic pressure. Elevation of boiling point and depression in freezing point. Thermodynamic derivation of relation between molecular weight and elevation of boiling point and depression in freezing point. Experimental methods for determining various colligative properties. Abnormal molar mass, degree of dissociation and association of solutes.

15 Lecture

Suggested Books and References:

1. Concise Inorganic Chemistry by J.D. Lee, Wiley, India.
2. Inorganic Chemistry by Housecroft, E. Catherine & Sharpe, G Alan, Pearson Education Ltd.
3. Advanced Inorganic Chemistry by G. D. Tuli, S. Chand, New Delhi.
4. Advanced Inorganic Chemistry by Satya Prakash, S. Chand, New Delhi.
5. Nuclear and Radiochemistry: Fundamental and Applications, 2 Vols., Jens-Volker Kratz and Karl Heinrich Lieser; 3rd Edn., John Wiley & Sons: UK, 2013.
6. Essentials of Nuclear Chemistry by H. J. Arnikar, Wiley, New York.
7. Principles of Inorganic Chemistry by Puri, Sharma & Kalia, Vishal Publishing Co.
8. Organic Chemistry by R. T. Morrison & R. N. Boyd, Prentice Hall
9. Organic Chemistry by I. L. Finar, (Vpl. I & II) ELBS
10. Reaction Mechanism in Organic Chemistry by S. M. Mukherji & S. P. Singh, Reaction Mechanism in Organic Chemistry by S. M. Mukherji & S. P. Singh, TRINITY Press.
11. Physical Chemistry by R. J. Silbey, R. A. Alberty & M. G. Bawendi, John Wiley & Sons.
12. Principles of Physical Chemistry by B. R. Puri, L. R. Sharma and M. S. Pathania, Vishal Publishing Co.
13. An Introduction to Chemical Thermodynamics by R. P. Rastogi & R. R. Mishra, Vikas Publishing House.
14. A Text Book of Physical Chemistry: A. S. Negi and S. C. Anand, New Age International Publishers.
15. Advanced Physical Chemistry by Gurdeep Raj, Goel Publishing House.
16. Elements of Physical Chemistry, P. Atkins and J. De Paula, Oxford.
17. A Textbook of Physical Chemistry, Application of Thermodynamics, by K. L. Kapoor, (Volume- 3) McGraw Hill.
18. An Introduction to Chemical Thermodynamics by R. P. Rastogi & R. R. Mishra, Vikas Publishing House.
19. Solutions, Phase Equilibrium, Conductance & Electrochemistry by Puri, Sharma, Pathania and Kaur, Vishal Publishing Co.



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Suggested E-resources:

All the above suggested books are available as e-books.

Online Lecture Notes and Course Materials: Online Lecture Notes and Course Materials:

All prescribed syllabus is available digitally in the form of e-books, Adobe Acrobat documents (PDF), web page ,etc.

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Syllabus

CHM-63P-202: Chemistry Lab III

(4 Hrs./week)

Inorganic Chemistry

10 marks

Gravimetric estimations: (Any three)

- Estimate zinc as zinc ammonium phosphate.
- Estimate lead as lead chromate.
- Estimate copper as cuprous thiocyanate.
- Estimate nickel as nickel dimethyl glyoximate.

Organic Chemistry

10 marks

Qualitative Analysis

- Identification of organic compounds (solids or liquids) through element detection (N, S and



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halogens) melting /boiling points, functional group analyses with the preparation of suitable derivative. (Any two)

(b) One step organic synthesis containing: -

i. Acetylation

- (a) Acetanilide from Aniline
- (b). Aspirin from salicylic acid

ii. Reduction

- (a) *m*-nitro aniline from *m*-dinitrobenzene.
- (b) Anthrone by anthraquinone

iii. Electrophilic substitution Reactions

Nitration of nitrobenzene

Physical Chemistry

10 marks

Distribution law

- (a) To determine partition coefficient of iodine between water and $CCl_4/CHCl_3/CS_2$ at room temperature.
- (b) To study the distribution of benzoic acid between benzene and water.

Chemical kinetics

- (a) Determine the velocity constant and order of reaction for the hydrolysis of ethyl acetate by sodium hydroxide at room temperature (saponification of an ester).

Thermochemistry

- (a) To determine heat of neutralization of given acid and base.
- (b) To determine the dissociation energy of given weak acid.

Solution

- (a) To determine the molecular mass of given non-volatile substance cryscopically.

Viva-voce

5 marks

Practical Record

5 marks

Suggested Books and References:

1. Advanced Practical Organic Chemistry by N K Vishnoi, Vikas Publishing House PVT LTD
2. Comprehensive Practical Organic Chemistry: Preparation and Quantitative Analysis, V. K Ahluwalia. Universities Press, Hyderabad.
3. Advanced Practical Organic Chemistry by N K Vishnoi, Vikas Publishing House PVT LTD
4. Vogel's Qualitative Inorganic Analysis, A. I. Vogel Prentice Hall.
5. Vogel's Quantitative Inorganic Analysis Including Elementary Instrumental Analysis, ELBS.
6. Vogel's Textbook of Quantitative Chemical Analysis, A. I. Vogel, Pearson Education Ltd.
7. Laboratory Techniques in Organic Chemistry by V. K Ahluwalia, I K International, N
8. Advanced Practical Organic Chemistry J. B Yadav, Goel Publishing House.
9. Practical Physical Chemistry, by B. D Khosla, S. Chand & Company.

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Suggested E-resources:

All the above suggested books are available as e-books.

Online Lecture Notes and Course Materials:

All prescribed syllabus is available digitally in the form of e-books, Adobe Acrobat documents (PDF), web page, etc.

Course Learning Outcomes:

With the completion of this course, students will be able to understand concepts related to periodic trends of s and p-block elements their properties, applications along with noble gases. Student will gain knowledge about the uses of non-aqueous aprotic solvents in chemical research and the essentials of nuclear chemistry with their uses range from agricultural to medical and space exploration to water desalination. Moreover, the organic reactions of saturated and unsaturated hydrocarbons and their uses are incorporated to gain clear understanding in this field. Concepts related to the field of basic and applied thermodynamics and solutions with their colligative properties are also incorporated to enrich the knowledge in these fields,

By the end of this degree programme, student would have achieved the essential conceptual knowledge in the field of chemical sciences and will be able to conduct experiments and demonstrate efficiency with appropriate lab skills, techniques and instrumentations.

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Syllabus

IV – Semester – Chemistry

Semester	Code of the Course	Title of the Course/Paper	NHEQF Level	Credits
IV	CHM-64T-203	UG0802/03 – CHM-64T-203 – Chemistry of d & f block elements, Chemistry of Oxygen/Nitrogen-Containing Functional Groups and Chemical and Ionic Equilibrium, Second	6	4

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