UNIVERSITY OF RAJASTHAN

JAIPUR-302004

THREE/ FOUR-YEAR UNDERGRADUATE PROGRAMME

Name of Faculty	**Science**
Name of Discipline	**Chemistry**
Type of Discipline	**Major**
List of Programme offered as Minor Discipline	**NA**
Offered to Non-Collegiate Students	**YES**

Programme: UG0802/03 – Three /Four Year Bachelor of Science

(Syllabus as per NEP-2020 and Choice Based Credit System)

(Academic Year 2024-25 onwards)

Dy Registrar
(Academic)
University of Rajasthan
JAIPUR

SEMESTER-WISE PAPER TITLES WITH DETAILS

UG0802/03 – Four Year Bachelor of Science								
#	Level	Semester	Type	Chemistry	Credits			
				Course Title	L	T	P	Total
1.	5	I	MJR	UG0802/03 – CHM-51T-101 – Structure-bonding, Mathematical concept and States of matter	4	0	0	4
2.	5	I	MJR	UG0802/03– CHM-51P-102 – Practical I	0	0	2	2
3.	5	II	MJR	UG0802/03 – CHM-52T-103 – Reaction mechanism, Stereochemistry, Aromatic hydrocarbon and Chemical kinetics.	4	0	0	4
4.	5	II	MJR	UG0802/03 – CHM-52P-104 – Practical II	0	0	2	2
5.	6	III	MJR	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.	4	0	0	4
6.	6	III	MJR	UG0802/03 – CHM-63P-202 – Practical III	0	0	2	2
7.	6	IV	MJR	UG0802/03 – CHM-64T-203 – Chemistry of Oxygen/Nitrogen-Containing Functional Groups and Chemistry of d & f block elements, Chemical and Ionic Equilibrium, Second and Third law of Thermodynamics.	4	0	0	4
8.	6	IV	MJR	UG0802/03 – CHM-64P-204 – Practical IV	0	0	2	2
9.	7	V	MJR	UG0802/03 – CHM-75T-301 –	4	0	0	4
10.	7	V	MJR	UG0802/03 – CHM-75P-302 – Practical V	0	0	2	2
11.	7	VI	MJR	UG0802/03 – CHM-76T-303 –	4	0	0	4
12.	7	VI	MJR	UG0802/03 – CHM-76P-304 – Practical VI	0	0	2	2
13.	8	VII	MJR	UG0802/03 – CHM-87T-401 –	4	0	0	4
14.	8	VII	MJR	UG0802/03 – CHM-87P-402 – Practical VII	0	0	2	2
15.	8	VIII	MJR	UG0802/03 – CHM-88T-403 –	4	0	0	4
16.	8	VIII	MJR	UG0802/03 – CHM-88P-404 – Practical VIII	0	0	2	2

Dy. Registrar
(Academic)
University of Rajasthan
JAIPUR

PROGRAMME OUTCOMES (POs)

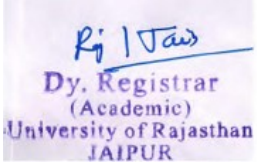
1. **Conceptual knowledge of chemical science**: Students will get acquainted with the conceptual knowledge of chemical science which will help them to understand the subject and it will be beneficial in long run.
2. **Training to manage unusual and unexpected incidents/disasters**: The knowledge of chemical science will help them to deal with unusual incidents in the neighborhood. Sudden explosion by chemicals and excessive misuse of unwanted substances can be managed with basic knowledge of chemistry as well as environmental pollution may be controlled by the students by spreading awareness in the society about the harmful pollutants viz; plastic, pesticides, harmful smog, unused drugs etc.
3. **Laboratory Experimental Skills**: As we know the fact that trials are an essential part of an exploration in our life therefore the students will gain practical experience by conducting experiments, using laboratory instruments and apparatus.
4. **Employment opportunities**: Students will acquire employment in the various national and private R & D sectors such as:
   - The students with the strong chemistry background can get jobs in chemical and related industries viz. Agrochemicals, Metallurgical, Fertilizer, Biofertilizer, Textile, Food, Ceramics, Cement, Petrochemicals, Pesticides, Plastics, Polymers, etc.
   - The students can find opportunities in Pharmaceutical companies, Forensic Lab,etc.
   - Petroleum, Soil Testing Labs, Environment consulting firms and other sectors such as Analytical Chemist, Chemical Product Officer, Radiologist and Toxicologist.
5. **Integrated M.Sc.-Ph.D. courses at prestigious institutions:** After completing this bachelor's degree course**, s**tudents can get engaged in integrated M,Sc.-Ph.D. courses or can get Master's degree in various interdisciplinary fields at prestigious institutions like CSIR, IISc, IITs, NCL (national chemical laboratories), IISERs, NISER etc.

Dy. Registrar
(Academic)
University of Rajasthan
JAIPUR

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

Examination Scheme:

1. **1 credit = 25 marks** for examination/evaluation.
2. For **Regular Students there will be Continuous assessment**, in which sessional work and the terminal examination will contribute to the final grade. Each course in Semester Grade Point Average (SGPA) has two components- Continuous assessment (20% weightage) and (End of Semester Examination) EoSE (80% weightage).
3. For Regular Students, **75% Attendance is mandatory** for appearing in EoSE.
4. To appear in the EoSE examination of a course/subject student must appear in the mid-semester examination and obtain at least a C grade in the course/subject.
5. Credit points in a Course/Subject will be assigned only if, the regular student obtains at least a C (40%) grade in the CA (Continuous Assessment) and EoSE examination of a Course/Subject.
6. In case of **the Non-Collegiate Students there will be no continuous assessment**(CA) and credit points in a Course/Subject will be assigned only if, the Non-Collegiate Student obtains at least a C grade(40%) in the EoSE examination of a Course/Subject.



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

Examination scheme for Continuous assessment (CA)

DISTRIBUTION OF CONTINUOUS ASSESSMENT (CA) MARKS

S. No.	CATEGORY	Weightage (out of total internal marks)		THEORY					PRACTICAL		
				CORE (Only Theory)	CORE (Theory + Practical)	AEC	SEC	VAC	CORE (Theory + Practical)	SEC	VAC
	Max Internal Marks			30	20	20	10	10	10	10	10
1	Mid-term Exam	50%		15	10	10	5	5	5	5	5
2	Assignment	25%		7.5	5	5	5	2.5	2.5	2.5	2.5
3	Attendance	25%		7.5	5	5	5	2.5	2.5	2.5	2.5
		Regular Class Attendance	= 75%	3	2	2	1	1	1	1	1
			75 – 80%	4	3	3	1.5	1.5	1.5	1.5	1.5
			80 – 85%	5	4	4	2	2	2	2	2
			> 85%	7.5	5	5	2.5	2.5	2.5	2.5	2.5

Note:

1. Continuous assessment will be the sole responsibility of the teacher concerned [**under the heading assignment, interactive sessions/ group discussion among students may be conducted by the concerned teacher / PPT for selective topics may be assigned by the teacher at college level.].**
2. For continuous assessment no remuneration will be paid for paper setting, evaluation, invigilation etc.
3. For continuous assessment paper setting and evaluation responsibility will be of teacher concerned.
4. For continuous assessment no Answer sheets/question papers etc. will be provided by the University.

Dy. Registrar
(Academic)
University of Rajasthan
JAIPUR

5. Colleges are advised to keep records of continuous assessment, attendance etc.

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

Examination Scheme for EoSE-

CA – Continuous Assessment
EoSE – End of Semester Examination

For Regular Students –

Type of Examination	Course Code / Nomenclature	Duration of Examination		Maximum Marks		Minimum Marks	
Theory	UG0802/03 - CHM-63T-201 - Chemistry of s, p-block elements and Noble Gases, Non-aqueous Solvent, Nuclear Chemistry, Hydrocarbons and Alkyl halides, Fundamentals of Thermodynamics, Solutions and their Colligative Properties.	CA	1 Hr.	CA	20	CA	8
		EoSE	3 Hrs.	EoSE	80	EoSE	32
Practical	UG0802/03 – CHM-63P-202 – Practical I	CA	1 Hr.	CA	10	CA	4
		EoSE	4 Hrs.	EoSE	40	EoSE	16

The question paper (EoSE – End of Semester Examination) will consist of two parts A & B

PART – A: 20 Marks

Part A will be compulsory having 10 very short answer-type questions (with a limit of 20 words) of two marks each.

PART – B: 60 Marks

Part B of the question paper shall be divided into four units comprising question number 2-5. There will be one question from each unit with internal choice. Each question will carry 15 marks.

Dy. Registrar
(Academic)
University of Rajasthan
JAIPUR

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

Non-Collegiate Students –

Type of Examination	Course Code and Nomenclature	Duration of Examination	Maximum Marks	Minimum Marks
Theory	UG0802/03 – CHM-63T-201 – Chemistry of s, p-block elements and Noble Gases, Non-aqueous Solvent, Nuclear Chemistry, Hydrocarbons and Alkyl halides, Fundamentals of Thermodynamics, Solutions and their Colligative Properties.	3 Hrs.	100	40
Practical	UG0802/03–CHM-63P-202 Practical III	4 Hrs.	50	20

The question paper (EoSE – End of Semester Examination) will consist of two parts A & B

PART – A: 20 Marks

Part A will be compulsory having 10 very short answer-type questions (with a limit of 20 words) of two marks each.

PART – A: 80 Marks

Part B of the question paper shall be divided into four units comprising question number 2-5. There will be one question from each unit with internal choice. Each question will carry 20 marks.

Dy. Registrar
(Academic)
University of Rajasthan
JAIPUR

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			
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-					

Dy. Registrar
(Academic)
University of Rajasthan
JAIPUR

Prerequisites/Eligibility	**The students must have earned a minimum of 52 credits (26×2 cerdits)** **OR** **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%).**
Course Objectives:	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.

Dy. Registrar
(Academic)
University of Rajasthan
JAIPUR

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.

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.

15 Lecture

Dy. Registrar
(Academic)
University of Rajasthan
JAIPUR

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 S_N2 and S_N1 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. Boyed, 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.

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.

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

Syllabus

CHM-63P-202: Chemistry Lab III (4 Hrs./week)

Inorganic Chemistry **10 marks**

Gravimetric estimations: (Any three)

(a) Estimate zinc as zinc ammonium phosphate.
(b) Estimate lead as lead chromate.
(c) Estimate copper as cuprous thiocyanate.
(d) Estimate nickel as nickel dimethyl glyoximate.

Organic Chemistry **10 marks**

Qualitative Analysis

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

Dy. Registrar
(Academic)
University of Rajasthan
JAIPUR

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.

.

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.

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

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**

Dy. Registrar
(Academic)
University of Rajasthan
JAIPUR

		and Third law of Thermodynamics.					
IV	**CHM-64P-204**	**PRACTICAL-IV**				**6**	**2**
Level of Course	**Type of the Course**	**Credit Distribution**			**Offered to NC Students**	**Course Delivery Method**	
		Theory	**Practical**	**Total**			
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-**					
Prerequisites/Eligibility		Every student automatically promoted from the III to the IV semester.					
Course Objectives:		The objective of this course is to provide a theoretical knowledge about first, second and third series of transition elements, lanthanides and actinides chemistry with their periodic trends, properties and applications. The characteristic organic reactions associated with O/ N-elements containing functional groups with their interconversion are also included to enrich the knowledge in these fields. Moreover, chemical and ionic equilibrium and applied thermodynamics are incorporated to gain conceptual knowledge.					

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

Syllabus

CHM-64T-203- **Chemistry of d & f block elements, Chemistry of Oxygen/Nitrogen-Containing Functional Groups and Chemical and Ionic Equilibrium,**

Dy. Registrar
(Academic)
University of Rajasthan
JAIPUR

Thermodynamics-II.

Unit-I

Chemistry of Elements of First Transition Series:
Characteristic properties of d-block elements. Properties of the elements of the first transition series, their binary compounds and complexes illustrating relative stability of their oxidation-states, coordination number and geometry.
Chemistry of Elements of Second and Third Transition Series:
General characteristics, comparative treatment with their 3d-analogues in respect of ionic radii, oxidation states, magnetic behaviour, spectral properties and stereochemistry.
Chemistry of Lanthanide and Actinide Elements:
Electronic structure, oxidation states, ionic radii and lanthanide contraction, complex formation, occurrence and isolation, lanthanide compounds.
General features and chemistry of actinides, chemistry of separation of Np, Pu and Am from U, similarities between the later actinides and the later lanthanides.

15 Lecture

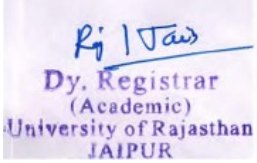
Unit-II

Alcohols - Classification and nomenclature.
Monohydric alcohols - Methods of formation by reduction of aldehydes, ketones, carboxylic acids and esters. Hydrogen bonding, Acidic nature. Reactions of alcohol with mechanism.
Dihydric alcohols - methods of formation, chemical reactions of vicinal glycols, oxidative cleavage [$Pb(OAc)_4$ and HIO_4] and pinacol-pinacolone rearrangement.
Trihydric alcohols - methods of formation, chemical reactions of glycerol.
Phenols
Nomenclature, structure and bonding. Preparation of Phenols. Physical properties and acidic character. Comparative acidic strength of alcohols and phenols. Reactions of phenols- electrophilic aromatic substitution, acylation and carboxylation. Mechanisms of Fries rearrangement, Claisen rearrangement, Gattermann synthesis, Hauben-Hoesch reaction, Lederer-Manasse reaction and Reimer-Tiemann reaction.
Ethers and Epoxides
Methods of formation, physical properties. Chemical reactions - cleavage and autooxidation. 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.

Aldehydes and Ketones
Structure of the carbonyl group. Syntheses of aldehydes from acid chlorides, synthesis of aldehydes and ketones using 1,3-dithianes, syntheses of ketones from nitriles and from carboxylic acids. Physical properties.
Mechanism of nucleophilic additions to carbonyl group with particular emphasis on benzoin, aldol, Perkin and Knoevenagel condensations. Condensation with ammonia and its derivatives. Wittig reaction, Mannich reaction. Oxidation of aldehydes, Baeyer-Villiger oxidation of ketones, Cannizzaro reaction, MPV (Meervein-Pondrof-Verley), Clemmensen, Wolff-Kishner, $LiAlH_4$ and $NaBH_4$ reductions, Halogenation of enolizable ketones. Use of acetals and 1,3-dithiane as protecting group.

15 Lecture

Unit-III



Carboxylic Acids

Structure and bonding, physical properties, acidity of carboxylic acids, effects of substituents on acid strength. Preparation of carboxylic acids. Reactions of carboxylic acids, Hell-Volhard-Zelinsky reaction. Reduction of carboxylic acids, mechanism of decarboxylation.

Methods of formation and chemical reactions of halo acids. Hydroxy acids - malic, tartaric and citric acids.

Dicarboxylic acids: methods of formation and effect of heat and dehydrating agents (succinic, glutaric and adipic acids).

Carboxylic Acid Derivatives

Structure, nomenclature and synthesis of acid chlorides, esters, amides (urea) and acid anhydrides. Relative stability of acyl derivatives. Physical properties, interconversion of acid derivatives by nucleophilic acyl substitution.

Preparation of carboxylic acid derivatives, chemical reactions, mechanisms of esterification and hydrolysis (acidic and basic).

Organic Compounds of Nitrogen

Preparation of nitroalkanes and nitroarenes. Chemical reactions of nitroalkanes. Mechanisms of nucleophilic substitution in nitroarenes and their reductions in acidic, neutral and alkaline media. Picric acid.

Amines: Structure, nomenclature and preparation of alkyl, and aryl amines (reduction of nitro compounds, nitriles), reductive amination of aldehydic and ketonic compounds. Physical properties, stereochemistry of amines. Separation of a mixture of primary, secondary and tertiary amines. Structural features effecting basicity of amines. Amine salts as phase-transfer catalysts. Gabriel-phthalimide reaction and Hoffmann bromamide reaction with mechanism.

Reactions of amines, electrophilic aromatic substitution in aryl amines, reactions of amines with nitrous acid. Diazotisation and mechanism. Synthetic transformations of aryl diazonium salts, azo coupling and its applications.

15 Lecture

Unit- IV

Thermodynamics –II

Second Law of Thermodynamics: Need for the law, different statements of the law. Carnot cycle and its efficiency, Carnot-Theorem. Thermodynamic scale of temperature.

Concept of Entropy: Entropy as a state function, entropy as a function of V&T, entropy as a function of P&T, entropy change in physical change, Clausius inequality and entropy as a criteria of spontaneity and equilibrium. Entropy changes in ideal gases and mixing of gases.

Third Law of Thermodynamics: Nernst heat theorem, statement and concept of residual entropy, evaluation of absolute entropy from heat capacity data. Gibbs and Helmholtz functions: Gibbs function (G) and Helmholtz function **(A)** as: thermodynamic quantities. A & G as criteria for thermodynamic equilibrium and spontaneity, their advantage over entropy change. Variation of G and A with P, V and T.

Chemical Equilibrium:

Equilibrium constant and free energy. Thermodynamic derivation of law of mass action. Le Chatelier's principle. Reaction Isotherm and reaction isochore. Clapeyron equation and Clausius-Clapeyron equation, applications.

Ionic Equilibrium: Strong, moderate and weak electrolytes, degree of ionization, factors affecting degree of ionization, ionization constant and ionic product of water. Ionization of weak acids and bases, pH scale,

common ion effect. Salt hydrolysis – calculation of hydrolysis constant, degree of hydrolysis and pH for different salts. Buffer solutions. Solubility and solubility product.

15 Lecture

Suggested Books and References:

1. Basic Inorganic Chemistry, F.A. Cotton, G. Wilkinson, & P.L Gaus, Willey.
2. Concise Inorganic Chemistry by J. D. Lee, Wiley-India.
3. Inorganic Chemistry by Catherine E. Housecroft, & Alan G Sharpe, Pearson Education Ltd.
4. Principles of Inorganic Chemistry by Puri, Sharma & Kalia, Vishal Publishing Co.
5. Concise Coordination Chemistry by R. Gopalan and V. Ramalingam, Vikas Publishing House Pvt, Ltd.
6. Concepts and Models of Inorganic Chemistry, B.E. Douglas, D. McDaniel, & J. Alexander, Wiley.
7. March's Advanced Organic Chemistry: Reactions, Mechanisms and Structure by J March, & M. B Smith Wiley.
8. Organic Chemistry by R. T. Morrison & R. N. Boyed, Prentice Hall
9. Reaction Mechanism in Organic Chemistry by S. M. Mukherji & S. P. Singh, TRINITY Press.
10. Organic Chemistry by I. L. Finar, (Vol. I & II) ELBS.
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 Electrochemistry by Samuel Glasstone, BSC Publishers.
19. Electrochemistry and its Applications by G. Whitmore, Sarup & Sons.
20. Physical Chemistry by G.M Barrow, Tata McGraw-Hill.
21. Fundamentals of Electrochemistry by Morris Sylvin, Sarup & Sons.
22. Solutions, Phase Equilibrium, Conductance & Electrochemistry by Puri, Sharma, Pathania and Kaur, Vishal Publishing Co.
23. Phase Equilibria, Phase Diagrams and Phase Transformations by Mats Hillert, Cambridge University Press
24. Textbook of Physical Chemistry, (Volume 5) by Kapoor, K. L Macmillan India Ltd.

Suggested E-resources:

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

Online Lecture Notes and Course Materials: Suggested E-resources:

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

Dy. Registrar
(Academic)
University of Rajasthan
JAIPUR

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

Syllabus

CHM-64P-204: Chemistry Lab IV 4 Hrs./week

Inorganic Chemistry **10 marks**

Inorganic Preparations

(a) Preparation of tetraamminecopper(II) sulphate
(b) Preparation of cis and trans-potassium diaquadioxalatochromate(III).
(c) Synthesis of sodium trioxalatoferrate(III).
(d) Preparation of bis(glyoxamato)nickel (II).

Organic Chemistry **10 marks**

Organic Syntheses

(a) Synthesis of iodoform from ethanol and acetone (Aliphatic Electrophilic Substitution).
(b) Synthesis of aspirin from salicylic acid (Acetylation).
(c) Synthesis of phthalimide from phthalic anhydride.
(d) Synthesis of succinic anhydride.

Physical Chemistry **10 marks**

Transition Temperature

(a) Determination of transition temperature of the given substance ($Na_2SO_4.10H_2O, MnCl_2.4H_2O$ or $SrBr_2.6H_2O$) by thermometric method**.**

Phase Equilibrium

(a) To construct the phase diagram of two component system like phenol-H_2O system and determine the CST (critical solution temperature) and composition of the solution at CST.
(b) To study the effect of solute $NaCl$ and succinic acid etc. on the CST (critical solution temperature) of two partially miscible liquids (phenol-H_2O system) and determine the concentration of that solute in the given partially miscible liquid system.

Ionic Equilibrium

Preparation of different types of buffer solutions and determination of pH using pH meter.

Viva voce **5 marks**

Dy. Registrar
(Academic)
University of Rajasthan
JAIPUR

Practical Record **5 marks**

Suggested Books and References:

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

Suggested E-resources:

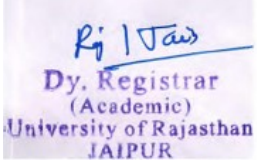
All the above suggested books are available as **e- books.**

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 degree programme, student will achieve 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.

Student will be able to understand the theoretical knowledge about first, second and third series of transition metals, lanthanides and actinides chemistry with their periodic trends, properties and applications in various fields. In addition to the above, student will acquire knowledge about the characteristic organic reactions associated with O/ N-elements containing functional groups and their interconversion with their uses in synthetic organic chemistry. Moreover, chemical and ionic equilibrium and applied thermodynamics are incorporated to enrich student's conceptual knowledge through the above prescribed course.



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

Dy. Registrar
(Academic)
University of Rajasthan
JAIPUR