SIDO KANHU MURMU UNIVERSITY, DUMKA

(A State University recognized under Section 2(f) & 12(B) of the UGC Act, 1956)

ASSOCIATED CORE & ELECTIVE COURSE SYLLABUS

OF

CHEMISTRY

In accordance with the

Implementation of FYUGP in State Universities of Jharkhand Regulations, 2024

Implemented from
Academic Session 2025-2029 Onwards

Proceedings of the Board of the Studies ,University Department of Chemistry, S.K.M. University, Dumka dated 10.10.2025 from 1 P.M.

In compliance to the University letter no. SKMU/R-G/735/25 and followed up letter by the Department vide no. PG/Chem/SKMU/57/25 at 24/09/2025 seeking permission from the Honourable Vice Chancellor , S.K. M. University, Dumka to appoint external expert to review and finalise UG Chemistry Syllabus for FYUGP under NEP-2020 in the meeting of the members of the Board of Studies (BOS) scheduled to be held on 10.10.2025.The same has been organised at the University Department of Chemistry, Sido Kanhu Murmu University, Dumka under the Chairmanship of Dr. Sanjay Kumar Singh, Dean, Faculty of Science and Head, University Department of Chemistry, S.K.M. University, Dumka, to frame and finalize the updated syllabus for Undergraduate Chemistry (B.Sc. Major and BSc Minor courses) for implementation of the Four-Year Undergraduate Programme (FYUGP) in accordance with the Jharkhand Regulations, 2024 (Under NEP-2020).

Agenda of the Meeting

1. To deliberate upon the framework and structure of the FYUGP in Chemistry as per the Jharkhand State Higher Education Council (JSHEC) Regulations, 2024.
2. To design the revised syllabus and course structure for Undergraduate Chemistry (Major, Minor Courses) as per the NEP-2020 guidelines.
3. To ensure alignment of Learning Outcomes (LOs) with Choice-Based Credit System (CBCS) and Outcome-Based Education (OBE) frameworks.
4. To finalize and recommend the draft syllabus for submission to the Academic Council of S.K.M. University, Dumka, for approval.

Discussion:

The Chairman, Dr. Sanjay Kumar Singh, welcomed all the members of the Board of Studies and the External Expert, Prof. Shailendra, and briefed the house about the objectives of the meeting. He highlighted the significance of implementing the Four-Year Undergraduate Programme (FYUGP) under the National Education Policy (NEP-2020) and the need to update the existing syllabus of Undergraduate Chemistry in accordance with the Jharkhand Regulations, 2024, issued vide Notification No. *JSHEC/NEP-04/2024-437 dated 04/12/2024* by the Department of Higher, Technical Education & Skill Development, Government of Jharkhand.

The Chairman emphasized that the new structure should ensure flexibility, multidisciplinary learning with special emphasis on using Indian knowledge system in Chemistry Courses ,skill development, and research orientation, thereby promoting holistic education and employability among students.

The External Expert, Prof. Shailendra, appreciated the initiative taken by Sido Kanhu Murmu University, Dumka, in implementing the NEP-2020 framework and provided valuable suggestions regarding the course distribution, credit allocation, and sequencing of theoretical and practical components. He recommended the inclusion of modern topics such as Green Chemistry, Computational Chemistry, Environmental Chemistry ,introduction of Major-5 Paper based on Indian Knowledge system in UG Chemistry Course and Instrumental

Methods of Analysis, along with an emphasis on laboratory safety, digital tools, and analytical skill development

Dr. Santosh Kumar Singh, Coordinator, presented the draft structure of the FYUGP syllabus prepared in accordance with the guidelines of the Jharkhand State Higher Education Council (JSHEC) and the UGC model curriculum. He explained the credit framework, semester-wise course pattern, and Learning Outcome-based Curriculum Framework (LOCF) designed to meet national standards.

The members held a detailed discussion on the following aspects:

1. Core Courses (Major): Alignment with NEP-2020 standards, ensuring coverage of fundamental areas such as Inorganic, Organic, Physical, and Analytical Chemistry, with an added focus on experimental and applied components.
2. Minor Courses: Integration of interdisciplinary subjects like Environmental Science, Physics, Biology, and Materials Science to promote cross-disciplinary understanding.
3. Research and Internship Components: Inclusion of research projects, field work, and internships in the 7th and 8th semesters to foster innovation and practical exposure.
4. Continuous Assessment and Evaluation: Adoption of a balanced approach between internal assessments, laboratory work, and end-semester examinations to ensure comprehensive evaluation.

All members actively contributed to refining the proposed syllabus and expressed their appreciation for the collective effort toward academic advancement. The Board unanimously agreed on the necessity to maintain a balance between academic depth and applied relevance while ensuring that the curriculum remains in line with national academic and industrial standards.

Board of studies meeting finally concluded with the Vote of Thanks by the Coordinator Dr. Santosh Kumar Singh, Assistant Professor , University Department of Chemistry, S.K.M. University, Dumka .

Members Present

Chairman:
Dr. Sanjay Kumar Singh
Dean, Faculty of Science, S.K.M. University, Dumka
Associate Professor & Head, University Department of Chemistry,
S.K.M. University, Dumka

External Expert:
Prof. Shailendra **(Online)**
University Professor & Head, University Department of Chemistry,
Patna University, Patna

10|10|2025

Coordinator:
Dr. Santosh Kumar Singh
Assistant Professor, University Department of Chemistry,
S.K.M. University, Dumka

10/10/25

Members:

1. **Dr. Hashmat Ali**
   Associate Professor, University Department of Chemistry,
   S.K.M. University, Dumka
2. **Dr. Ved Prakash Sahay**
   Assistant Professor & Head, Department of Chemistry,
   S.P. College, Dumka
3. **Dr. N.K. Mandal**
   Principal I/C, Degree College, Jarmundi, Dumka
4. **Dr. C.S. Azad**
   Assistant Professor, Department of Chemistry,
   Godda College, Godda
5. **Dr. Anil Kumar**
   Assistant Professor & Head, Department of Chemistry,
   Sahibganj College, Sahibganj
6. **Sri Anil Kumar**
   Assistant Professor & Head, Department of Chemistry,
   A.S. College, Deoghar

Chairperson
Dr. Sanjay Kumar Singh
Dean, Faculty of Science, S.K.M. University, Dumka
Associate Professor & Head, University Department of Chemistry,
S.K.M. University, Dumka

Member of Board of Studies to frame updated syllabus for UG Chemistry for the implementation of Four-Year Undergraduate Programme (FYUGP) as per Jharkhand Regulations,2024(Under NEP-2020) vide Notification No. JSHEC/NEP-04/2024-437 dated 04/12/2024 by the Principal Secretary, Department of Higher, Technical Education & Skill Development, Government of Jharkhand and as per the guidelines of Sido Kanhu Murmu University, Dumka.

Chairman :-
Dr. Sanjay Kumar Singh
Dean, Faculty of Science, S.K.M. University, Dumka
Associate Professor & Head, University Department of Chemistry, S.K.M. University, Dumka

10/10/2025

External Expert :-
Prof. Shailendra (Online)-
University Professor & Head,
University Department of Chemistry,
Patna University, Patna

10/10/2025

Coordinator:-
Dr. Santosh Kumar Singh
Assistant Professor, University Department of Chemistry, S.K.M. University, Dumka

10/10/25

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1. **Dr. Hashmat Ali**
   Associate Professor, University Department of Chemistry, S.K.M. University, Dumka

10.10.25

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— 10.10.25

3. **Dr. N.K. Mandal**
   Principal I/C,
   Degree College, Jarmundi ,Dumka

— 10.10.25

4. **Dr. C.S. Azad**
   Assistant Professor,Department of Chemistry, Godda College, Godda

— 10/10/25

5. **Dr. Anil Kumar**
   Assistant Professor & Head ,Department of Chemistry, Sahibganj College, Sahibganj

6. **Sri Anil Kumar**
   Assistant Professor & Head ,Department of Chemistry, A.S. College, Deoghar

Anil Kumar 10/10/25

Semester wise AC & ELC Subject Combination of CHEMISTRY

Semester	Course Category	Code	Papers	Credits
Semester I / II	Associated Core (CHEMISTRY)	AC-CHEM	INTRODUCTORY CHEMISTRY	4
Semester III / IV	Elective Core (CHEMISTRY) - 1	ELC-CHEM -1	EQUILIBRIA & FUNCTIONAL GROUPS	4
Semester V / VI	Elective Core (CHEMISTRY) - 2	ELC-CHEM -2	CHEMISTRY OF s- & p-BLOCK ELEMENTS AND STATES OF MATTER	4
Semester VII / VIII	Elective Core (CHEMISTRY) - 3	ELC-CHEM -3	CHEMISTRY OF d- & f-BLOCK ELEMENTS & MOLECULES OF LIFE	4

INSTRUCTIONS FOR QUESTION SETTER

1. **Semester Internal Examination Question Pattern** (15 Marks)

The **Semester Internal Examination (SIE)** will carry a total of **15 marks**, which includes **10 marks for the internal test** and **5 marks for class attendance**. The question paper will have **two groups**.
Group A will have:**Question 1:** Five very short answer questions (1 mark each, total 5 marks)
Group B will have:Two descriptive-type questions of 5 marks each, out of which students must answer **any one** (total 5 marks)The remaining **5 marks** will be based on **class attendance**, as per the following:

- Up to 45% attendance: 1 mark
- 46% to 54%: 2 marks
- 55% to 64%: 3 marks
- 65% to 74%: 4 marks
- 75% and above: 5 marks

2. **End Semester University External ExaminationQuestion Pattern**(60 Marks)

The **End Semester Examination (ESE)** will be of **60 marks** and will also have **two groups**.
Group A (Compulsory) will include:**Question 1:** Five very short answer questions (1 mark each, total 5 marks)
Questions 2 and 3: Two short answer questions (5 marks each, total 10 marks)**Group B** will contain **five descriptive-type questions** of **15 marks each**, out of which students must answer **any three** (total 45 marks)
Note: Questions may have sub-parts if needed in the theory examination.

3. **End Semester University Practical ExaminationQuestion Pattern** (25 Marks)

The **End Semester Practical Examination (ESE)** will be of **6 hours duration**. The total marks and evaluation should be done as per the following guidelines:

- **Experiment/Activity performed during the exam** – 15 marks
- **Practical record notebook** – 5 marks
- **Viva-voce (oral questions)** – 5 marks

Students must score **at least 10 marks** to pass the practical examination.

PROMOTION CRITERIA

- All students will be promoted in odd Semesters (I, III, V & VII).
- To get a promotion from Semester II to Semester III, from Semester IV to Semester V, and from Semester VI to Semester VII a student has to procure a minimum of 4 CGPA.
- However, it will be necessary to obtain a minimum credit (4) to pass in each of the subjects individually before completion of the course.

CALCULATION OF MARKS FOR THE PURPOSE OF RESULT

The passing in a subject will be based on the combined marks obtained in both the internal and external examinations of the semester. However, the student must pass the and practical examinations separately.

Question format for **10 Marks:**

Subject/ Code

F.M. =10 Exam Year

Time=1Hr.

General Instructions:

i. **Group A** carries very short answer type compulsory questions.
ii. **Answer 1 out of 2** subjective/ descriptive questions given in **Group B**.
iii. Answer in your own words as far as practicable.
iv. Answer all sub parts of a question at one place.
v. Numbers in right indicate full marks of the question.

Group A [5x1=5]

i. .....
.
ii. .....
.
iii. .....

Group B

2. ..... [5]
.. ---

Note: There may be subdivisions in each question asked in Theory

Question format for **60 Marks:**

Subject/ Code

F.M. =60 Exam Year

Time=3Hrs.

General Instructions:

i. **Group A** carries very short answer type **compulsory** questions.
ii. **Answer 3 out of 5** subjective/ descriptive questions given in **Group B**.
iii. Answer in your own words as far as practicable.
iv. Answer all sub parts of a question at one place.
v. Numbers in right indicate full marks of the question.

Group A

1. [5x1=5]
i. .....
ii. .....
iii. .....
iv. .....
v. .....
2. ..... [5]
3. ..... [5]

Group B

4. ..... [15]
5. ..... [15]
6. ..... [15]
7. ..... [15]
8. ..... [15]

Note: There may be subdivisions in each question asked in Theory

SEMESTER –I/II

COURSE: ASSOCIATED CORE (CHEMISTRY) **TOTAL CREDITS:** THEORY-03, PRACTICAL-01
PAPER NAME: INTRODUCTORY CHEMISTRY **TEACHING HOURS:** THEORY-45, PRACTICAL-30

EVALUATION			
	External Exam	**Internal Exam**	**Practical**
Full Marks	**60**	15 (10 Written + 5 Attendance/Overall Class Performance)	**25**
Duration of Exam	3 Hours	1 Hour	6 Hours
Pass Marks	30 Marks		10 marks

PART 'A'

Instruction to Question Setter for
Semester Internal Examination (SIE 10+5=15 marks):
There will be two group of questions.
The Semester Internal Examination shall have two components. (a) One Semester Internal Examination Written Test (SIE) of 10 Mark. Question No.1 will be very short answer type in Group A consisting of five questions of 1 mark each. Group B will contain descriptive type two questions of five marks each, out of which any one to answer. (b) Class Attendance Score (CAS) including the behaviour of the student towards teachers and other students of the College of 5 marks.

End Semester Examination (ESE 60 marks):
There will be two group of questions. Group A is compulsory which will contain three questions. Question No.1 will be very short answer type consisting of five questions of 1 mark each. Question No.2 & 3 will be short answer type of 5 marks. Group B will contain descriptive type five questions of fifteen marks each, out of which any three are to answer.
Note: There may be subdivisions in the questions of group B.

Section A: Physical Chemistry

UNIT I: Chemical Energetics: (8 classes each of 60 minutes duration)
Important principles and definitions of thermochemistry. Concept of standard state and standard enthalpies of formations. Calculation of bond energy, bond dissociation energy from thermochemical data. Statement of Third Law of thermodynamics and calculation of absolute entropies of substances.

UNIT II: Chemical Kinetics: (7 classes each of 60 minutes duration)
The concept of reaction rates. Effect of temperature, pressure, catalyst and other factors on reaction rates. Order and molecularity of a reaction. Derivation of integrated rate equations for zero, first and second order reactions (both for equal and unequal concentrations of reactants). Half–life of a reaction. General methods for determination of order of a reaction. Concept of activation energy and its calculation from Arrhenius equation.

Section B: Inorganic Chemistry

UNIT III: Atomic Structure: (5 classes each of 60 minutes duration)
What is Quantum mechanics? Time independent Schrodinger equation and meaning of various terms in it. Significance of ψ and ψ^2 , Schrodinger equation for hydrogen atom. Radial distribution functions and the concept of the most probable distance with special reference to 1s and 2s atomic orbitals. Significance of quantum numbers, orbital angular momentum and quantum numbers ml and m_s. Shapes of s, p and d atomic orbitals, nodal planes. Discovery of spin, spin quantum number (s) and magnetic spin quantum number (m_s).

Rules for filling electrons in various orbitals, Electronic configurations of the atoms. Stability of half-filled and completely filled orbitals, concept of exchange energy. Relative energies of atomic orbitals, Anomalous electronic configurations.

UNIT IV: Chemical Bonding and Molecular Structure: (10 classes each of 60 minutes duration)

Ionic Bonding: General characteristics of ionic bonding. Energy considerations in ionic bonding, lattice energy and solvation energy and their importance in the context of stability and solubility of ionic compounds. Polarizing power and polarizability. Fajan's rules, ionic character in covalent compounds, bond moment, dipole moment and percentage ionic character.

Covalent bonding: VB Approach: Shapes of some inorganic molecules and ions on the basis of VSEPR and hybridization with suitable examples of linear, trigonal planar, square planar, tetrahedral, trigonal bipyramidal and octahedral arrangements.

Section C: Organic Chemistry

UNIT V: Fundamentals of Organic Chemistry: (3 classes each of 60 minutes duration)

Inductive Effect, Electromeric Effect, Resonance and Hyperconjugation. Cleavage of Bonds: Homolysis and Heterolysis. Structure, shape and reactivity of organic molecules: Nucleophiles and electrophiles. Reactive Intermediates: Carbocations, Carbanions and free radicals.

Aromaticity: Benzenoids and Hückel's rule.

UNIT VI: Aliphatic hydrocarbons:

Alkanes: (4 classes each of 60 minutes duration) (Upto 5 Carbons)

Preparation: Catalytic hydrogenation, Wurtz reaction, Kolbe's synthesis, from Grignard reagent. Reactions: Free radical Substitution: Halogenation

Alkenes: (3 classes each of 60 minutes duration) (Upto 5 Carbons)

Preparation: Elimination reactions: Dehydration of alkenes and dehydrohalogenation of alkyl halides (Saytzeff's rule), Reactions: cis-addition (alk. $KMnO_4$) and trans-addition (bromine), Addition of HX (Markownikoff's and antiMarkownikoff's addition), Hydration, Ozonolysis, oxymecuration-demercuration, Hydroboration-oxidation.

Alkynes: (3 classes each of 60 minutes duration) (Upto 5 Carbons)

Preparation: Acetylene from CaC_2 and conversion into higher alkynes, by dehalogenation of tetra halides and dehydrohalogenation of vicinal-dihalides.

Reactions: Formation of metal acetylides, addition of bromine and alkaline $KMnO_4$, ozonolysis and oxidation with hot alkaline $KMnO_4$.

UNIT VII: Aromatic hydrocarbons: (5 classes each of 60 minutes duration)

Preparation of benzene: from phenol, by decarboxylation, from acetylene, from benzene sulphonic acid. Reactions of benzene: Electrophilic substitution: nitration, halogenation and sulphonation. Friedel-Craft's reaction (alkylation and acylation). Side chain oxidation of alkyl benzenes (upto 4 carbons on benzene)

Reference Books:

1. J. C. Kotz, P. M. Treichel & J. R. Townsend: General Chemistry, Cengage Lening India Pvt. Ltd., New Delhi (2009)
2. Lee, J. D. Concise Inorganic Chemistry, Wiley, 5th Edn.
3. Douglas, B.E., McDaniel, D.H., Alexander J.J., Concepts & Models of Inorganic Chemistry, (Third Edition) John Wiley & Sons,1999.
4. Atkins, P. W. and De Paula, J. Physical Chemistry, Tenth Edition, Oxford University Press, 2014.
5. Douglas, B.E, Mc Daniel, D.H. & Alexander, J.J. Concepts & Models of Inorganic Chemistry 3rd Ed., John Wiley Sons, N.Y. 1994.
6. Peter Sykes, A Guide Book to Mechanism in Organic Chemistry, Longman.
7. C. K. Ingold, Structure and Mechanism in Organic Chemistry, Cornell University Press.
8. R. T. Morrison and R. N. Boyd, Organic Chemistry, Prentice-Hall.
9. H. 0. House, Modern Organic Reactions, Benjamin.
10. 0. C. Norman and J. M. Coxon, Principles of Organic Synthesis, Blackle Academic & Professional.
11. Ali, Hashmat, Reaction Mechanism in Organic Chemistry, S Chand

PART 'B'

PRACTICAL COURSE CONTENTS:

End Semester Examination (ESE):
There will be one Practical Examination of 6 Hours duration. Evaluation of Practical Examination may be as per the following guidelines:
Two Experiments = 20 marks
Practical record notebook = 03 marks
Viva-voce = 02 marks

Section A: Physical Chemistry: Thermochemistry

1. Determination of heat capacity of calorimeter.
2. Determination of enthalpy of neutralization of hydrochloric acid with sodium hydroxide.
3. Determination of enthalpy of hydration of copper sulphate.

Section B: Inorganic Chemistry - Volumetric Analysis

1. Acid-Base Titrations

a) Estimation of carbonate and hydroxide present together in mixture
b) Estimation of carbonate and bicarbonate present together in a mixture.

2. Oxidation-Reduction Titrimetry

a) Estimation of Fe(II) in supplied solution using standardized $KMnO_4$ solution.
b) Estimation of oxalic acid using standardized KMnO4 solution.

Section C: Organic Chemistry

1.Purification of organic compounds by crystallization (from water and alcohol) and distillation.
2.Criteria of Purity: Determination of melting and boiling points.
3.Recrystallisation, determination of melting point and calculation of quantitative yields to be done.

Reference Books:

1.Vogel's Qualitative Inorganic Analysis, A.I. Vogel, Prentice Hall, 7th Edition.
2.F. G. Mann & B. C. Saunders, Practical Organic Chemistry, Orient Longman (1960).
3.B.D. Khosla, Senior Practical Physical Chemistry, R. Chand & Co.
4.S. M. Khopkar, Environmental Pollution Analysis: Wiley Eastern Ltd, New Delhi.

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SEMESTER –III/IV

COURSE: ELECTIVE COURSE (CHEMISTRY)-1 **TOTAL CREDITS:** THEORY-03, PRACTICAL-01
PAPER NAME: EQUILIBRIA & FUNCTIONAL GROUPS **TEACHING HOURS:** THEORY-45, PRACTICAL-30

EVALUATION			
	External Exam	**Internal Exam**	**Practical**
Full Marks	**60**	15 (10 Written + 5 Attendance/Overall Class Performance)	**25**
Duration of Exam	3 Hours	1 Hour	6 Hours
Pass Marks	30 Marks		10 marks

PART 'A'

Instruction to Question Setter for
Semester Internal Examination (SIE 10+5=15 marks):
There will be two group of questions.
The Semester Internal Examination shall have two components. (a) One Semester Internal Examination Written Test (SIE) of 10 Mark. Question No.1 will be very short answer type in Group A consisting of five questions of 1 mark each. Group B will contain descriptive type two questions of five marks each, out of which any one to answer. (b) Class Attendance Score (CAS) including the behaviour of the student towards teachers and other students of the College of 5 marks.

End Semester Examination (ESE 60 marks):
There will be two group of questions. Group A is compulsory which will contain three questions. Question No.1 will be very short answer type consisting of five questions of 1 mark each. Question No.2 & 3 will be short answer type of 5 marks. Group B will contain descriptive type five questions of fifteen marks each, out of which any three are to answer.
Note: There may be subdivisions in the questions of group B.

Section A: Physical Chemistry
UNIT I: Equilibrium: (15 classes each of 60 minutes duration)
Chemical Equilibria: Le Chatelier's principle. Relationships between Kp, Kc and Kx for reactions involving ideal gases.
Ionic Equilibria: 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. Buffer solutions. Solubility and solubility product of sparingly soluble salts

Section B: Inorganic Chemistry (8 classes each of 60 minutes duration)
MO Approach: Rules for the LCAO method, bonding and antibonding MOs and their characteristics for s-s, sp and p-p combinations of atomic orbitals, nonbonding combination of orbitals, MO treatment of homonuclear diatomic molecules of 1st and 2nd periods.

Section C: Organic Chemistry
UNIT II: Alkyl and Aryl Halides
Alkyl Halides (Upto 5 Carbons) (5 classes each of 60 minutes duration)
Types of Nucleophilic Substitution (SN^1, SN^2 and SN_i) reactions. Preparation: from alkenes and alcohols. Reactions: hydrolysis, nitrite & nitro formation, nitrile & isonitrile formation. Elimination vs substitution.
Aryl Halides (3 classes each of 60 minutes duration)
Preparation: (Chloro, bromo and iodo-benzene case): from phenol, Sandmeyer & Gattermann reactions. Reactions (Chlorobenzene):

Reactivity and Relative strength of C-Halogen bond in alkyl, allyl, benzyl, vinyl and aryl halides.

Alcohols: (4 classes each of 60 minutes duration)

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 (with PCC, alk. $KMnO_4$, acidic dichromate, conc. HNO_3). Oppeneauer oxidation Diols: (Upto 6 Carbons) oxidation of diols. Pinacol-Pinacolone rearrangement.

Phenols: (3 classes each of 60 minutes duration)

Preparation: Cumene hydroperoxide method, from diazonium salts.

Reactions: Electrophilic substitution: Nitration, halogenation and sulphonation. Reimer- Tiemann Reaction, Gattermann-Koch Reaction, Houben–Hoesch Condensation, Schotten – Baumann Reaction.

Ethers (aliphatic and aromatic): (2 classes each of 60 minutes duration)

Methods of Preparations aliphatic and aromatic ethers, Williamson's ether synthesis: Cleavage of ethers with HI.

Aldehydes and ketones (aliphatic and aromatic): (5 classes each of 60 minutes duration)

(Formaldehye, acetaldehyde, acetone and benzaldehyde) Preparation: from acid chlorides and from nitriles. Reactions– Reaction with HCN, ROH, $NaHSO_3$, NH_2-G derivatives. Iodoform test. Aldol Condensation, Cannizzaro's reaction, Clemensen reduction and Wolff Kishner reduction.

Reference Books:

1. T. W. Graham Solomons: Organic Chemistry, John Wiley and Sons.
2. Peter Sykes: A Guide Book to Mechanism in Organic Chemistry, Orient Longman.
3. I.L. Finar: Organic Chemistry (Vol. I & II), E. L. B. S.
4. R. T. Morrison & R. N. Boyd: Organic Chemistry, Prentice Hall.
5. Arun Bahl and B. S. Bahl: Advanced Organic Chemistry, S. Chand.
6. G. M. Barrow: Physical Chemistry Tata McGraw-Hill (2007).
7. G. W. Castellan: Physical Chemistry 4th Edn. Narosa (2004).
8. J. C. Kotz, P. M. Treichel & J. R. Townsend: General Chemistry Cengage Lening India Pvt. Ltd., New Delhi (2009).
9. B. H. Mahan: University Chemistry 3rd Ed. Narosa (1998).
10. R. H. Petrucci: General Chemistry 5th Ed. Macmillan Publishing Co.: New York (1985).
11. Ali, Hashmat, Reaction Mechanism in Organic Chemistry ,S Chand

PART 'B'

PRACTICAL COURSE CONTENTS:

End Semester Examination (ESE):

There will be one Practical Examination of 6 Hours duration. Evaluation of Practical Examination may be as per the following guidelines:

Two Experiments = 20 marks

Practical record notebook = 03 marks

Viva-voce = 02 marks

Section A: Physical Chemistry

Ionic equilibria pH measurements

1.Determine the pH of the given aerated drinks fruit juices, shampoos and soaps.

2.Preparation of buffer solutions:

a. Sodium acetate-acetic acid

b. Ammonium chloride-ammonium hydroxide

Section B: Organic Chemistry

1. Detection of hetero elements in organic compounds.
2. Functional group tests for alcohols, phenols, carbonyl and carboxylic acid group.
3. Preparation of 2,4 dinitrophenylhydrazone of aldehyde/ketone

Reference Books

1. B.D. Khosla, Senior Practical Physical Chemistry, R. Chand & Co.
2. A.I. Vogel: Textbook of Practical Organic Chemistry, 5th edition, Prentice-Hall.
3. F. G. Mann & B. C. Saunders, Practical Organic Chemistry, Orient Longman (1960).
4. Waites M.J. (2008). Industrial Microbiology: An Introduction, 7th Edition, Blackwell Science, London, UK.
5. Prescott S.C., Dunn C.G., Reed G. (1982). Prescott & Dunn's Industrial Microbiology, 4th Edition, AVI Pub. Co., USA.
6. Reed G. (2004). Prescott & Dunn's industrial microbiology, 4th Edition, AVI Pub. Co., USA.
7. JR Casida L.E. (2015). Industrial Microbiology, 3rd Edition, New Age International (P) Limited Publishers, New Delhi, India.
8. Waites M.J., Morgan N.L., Rockey J.S. and Higton G. (2001) Industrial Microbiology: An Introduction. 1st Edition, Blackwell Science, London, UK.
9. Pelczar M.J., Chan E.C.S. and Krieg N.R. (2003) Microbiology. 5th Edition, Tata McGraw-Hill Publishing Company Limited, New Delhi.

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SEMESTER –V/VI

COURSE: ELECTIVE COURSE (CHEMISTRY)-2 **TOTAL CREDITS:** THEORY-03, PRACTICAL-01
PAPER: CHEMISTRY OF s- & p-BLOCK ELEMENTS AND STATES OF MATTER
TEACHING HOURS: THEORY-45, PRACTICAL-30

EVALUATION			
	External Exam	**Internal Exam**	**Practical**
Full Marks	**60**	15 (10 Written + 5 Attendance/Overall Class Performance)	**25**
Duration of Exam	3 Hours	1 Hour	6 Hours
Pass Marks	30 Marks		10 marks

PART 'A'

Instruction to Question Setter for
Semester Internal Examination (SIE 10+5=15 marks):
There will be two group of questions.
The Semester Internal Examination shall have two components. (a) One Semester Internal Examination Written Test (SIE) of 10 Mark. Question No.1 will be very short answer type in Group A consisting of five questions of 1 mark each. Group B will contain descriptive type two questions of five marks each, out of which any one to answer. (b) Class Attendance Score (CAS) including the behaviour of the student towards teachers and other students of the College of 5 marks.
End Semester Examination (ESE 60 marks):
There will be two group of questions. Group A is compulsory which will contain three questions. Question No.1 will be very short answer type consisting of five questions of 1 mark each. Question No.2 & 3 will be short answer type of 5 marks. Group B will contain descriptive type five questions of fifteen marks each, out of which any three are to answer.
Note: There may be subdivisions in the questions of group B.

SECTION-A: Inorganic Chemistry

UNIT I: General Principles of Metallurgy: (5 Lectures)

Chief modes of occurrence of metals based on standard electrode potentials. Ellingham diagrams for reduction of metal oxides using carbon as reducing agent. Hydrometallurgy, Methods of purification of metals (Al, Pb, Ti, Fe, Cu, Ni, Zn): electrolytic, oxidative refining, Kroll process, Parting process, van Arkel-de Boer process and Mond's process.

UNIT II: s- and p-Block Elements: (5 Lectures)

Periodicity in s- and p-block elements with respect to electronic configuration, atomic and ionic size, ionization enthalpy, electronegativity (Pauling, Mulliken, and Alfred-Rochow scales). Allotropy in C, S, and P. Oxidation states with reference to elements in unusual and rare oxidation states like carbides and nitrides), inert pair effect, diagonal relationship and anomalous behaviour of first member of each group.

UNIT III: Compounds of s- and p-Block Elements: (10 Lectures)

Hydrides and their classification (ionic, covalent and interstitial), structure and properties with respect to stability of hydrides of p- block elements. Concept of multicentre bonding (diborane). Structure, bonding and their important properties like oxidation/reduction, acidic/basic nature of the following compounds and their applications in industrial, organic and environmental chemistry. Hydrides of nitrogen (NH_3, N_2H_4, N_3H, NH_2OH) Oxoacids of P, S and Cl. Halides and oxohalides: PCl_3, PCl_5, $SOCl_2$ and SO_2Cl_2

Section B: Physical Chemistry

UNIT IV: Kinetic Theory of Gases: (15 Lectures)

Postulates of Kinetic Theory of Gases and derivation of the kinetic gas equation. Most probable, average and root mean square velocities (no derivation). Collision number, collision frequency, collision diameter and mean free path of molecules. Maxwell Boltzmann distribution laws of molecular velocities and molecular energies.

Deviation of real gases from ideal behaviour, compressibility factor, causes of deviation. Van der Waals equation of state for real gases. Boyle temperature (derivation not required). Critical phenomena, critical constants and their calculation from van der Waals equation. Andrews isotherms of CO_2.

UNIT V: Liquids: (4 Lectures)

Surface tension and its determination using stalagmometer. Viscosity of a liquid and determination of coefficient of viscosity using Ostwald viscometer. Effect of temperature on surface tension and coefficient of viscosity of a liquid (qualitative treatment only)

UNIT VI: Solids (6 Lectures)

Forms of solids. Symmetry elements, unit cells, crystal systems, Bravais lattice types and identification of lattice planes. Laws of Crystallography – Law of constancy of interfacial angles, Law of rational indices. Miller indices. X–Ray diffraction by crystals, Bragg's law. Structures of NaCl, KCl and CsCl (qualitative treatment only).

Reference Books:

1. G. M. Barrow: Physical Chemistry Tata McGraw-Hill (2007).
2. G. W. Castellan: Physical Chemistry 4th Edn. Narosa (2004).
3. J. C. Kotz, P. M. Treichel & J. R. Townsend: General Chemistry Cengage Lening India Pvt. Ltd., New Delhi (2009).
4. B. H. Mahan: University Chemistry 3rd Ed. Narosa (1998).
5. R. H. Petrucci: General Chemistry 5th Ed. Macmillan Publishing Co.: New York (1985).
6. J. D. Lee: A New Concise Inorganic Chemistry, E.L.B.S.
7. F.A. Cotton & G. Wilkinson: Basic Inorganic Chemistry, John Wiley.
8. D. F. Shriver and P. W. Atkins: Inorganic Chemistry, Oxford University Press.
9. Gary Wulfsberg: Inorganic Chemistry, Viva Books Pvt. Ltd.

PART 'B'

PRACTICAL COURSE CONTENTS:

End Semester Examination (ESE):

There will be one Practical Examination of 6 Hours duration. Evaluation of Practical Examination may be as per the following guidelines:

Two Experiments = 20 marks

Practical record notebook = 03 marks

Viva-voce = 02 marks

Section A: Inorganic Chemistry

Qualitative semi micro analysis

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

Cations: $NH4^+$, 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^{2-}, $S_2O_3^{2-}$, NO_3^-, CH_3COO^-, Cl^-, Br^-, I^-, NO_3^-,SO_4^{2-}, PO_4^{3-}, BO_3^{3-}, $C_2O_4^{2-}$, F^-

(Spot tests should be carried out wherever feasible)

Section B: Physical Chemistry

(I) Surface tension measurement (use of organic solvents excluded).

a) Determination of the surface tension of a liquid or a dilute solution using a stalagmometer.

b) Study of the variation of surface tension of a detergent solution with concentration.

(II) Viscosity measurement (use of organic solvents excluded).

a) Determination of the relative and absolute viscosity of a liquid or dilute solution using an Ostwald's viscometer.
b) Study of the variation of viscosity of an aqueous solution with concentration of solute.

(III) Chemical Kinetics -Study the kinetics of the following reactions.

a Acid hydrolysis of methyl acetate with hydrochloric acid.
b. Saponification of ethyl acetate.

Reference Books

1. A.I. Vogel, Qualitative Inorganic Analysis, Prentice Hall, 7th Edn.
2. A.I. Vogel, Quantitative Chemical Analysis, Prentice Hall, 6th Edn. 3. B.D. Khosla, Senior Practical Physical Chemistry, R. Chand & Co.

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SEMESTER –VII/VIII

COURSE: ELECTIVE COURSE (CHEMISTRY)-3 **TOTAL CREDITS:** THEORY-03, PRACTICAL-01
PAPER: CHEMISTRY OF d- & f-BLOCK ELEMENTS & MOLECULES OF LIFE
TEACHING HOURS: THEORY-45, PRACTICAL-30

EVALUATION			
	External Exam	**Internal Exam**	**Practical**
Full Marks	**60**	15 (10 Written + 5 Attendance/Overall Class Performance)	**25**
Duration of Exam	3 Hours	1 Hour	6 Hours
Pass Marks	30 Marks		10 marks

PART 'A'

Instruction to Question Setter for
Semester Internal Examination (SIE 10+5=15 marks):
There will be two group of questions.
The Semester Internal Examination shall have two components. (a) One Semester Internal Examination Written Test (SIE) of 10 Mark. Question No.1 will be very short answer type in Group A consisting of five questions of 1 mark each. Group B will contain descriptive type two questions of five marks each, out of which any one to answer. (b) Class Attendance Score (CAS) including the behaviour of the student towards teachers and other students of the College of 5 marks.

End Semester Examination (ESE 60 marks):
There will be two group of questions. Group A is compulsory which will contain three questions. Question No.1 will be very short answer type consisting of five questions of 1 mark each. Question No.2 & 3 will be short answer type of 5 marks. Group B will contain descriptive type five questions of fifteen marks each, out of which any three are to answer.
Note: There may be subdivisions in the questions of group B.

Section A: Inorganic Chemistry

UNIT I: Transition Elements (3d series) (6 classes each of 60 minutes duration)
General group trends with special reference to electronic configuration, variable valency, colour, magnetic and catalytic properties, ability to form complexes and stability of various oxidation states.

UNIT II: Lanthanides and Actinides: (5 classes each of 60 minutes duration)
Electronic configuration, oxidation states, colour, spectra and magnetic behaviour of lanthanides and actinides. Lanthanide contraction, separation of lanthanides (ion-exchange method only).

UNIT III: Coordination Chemistry (5 classes each of 60 minutes duration)
Valence Bond Theory (VBT): Inner and outer orbital complexes of Cr, Fe, Co, Ni and Cu (coordination numbers 4 and 6). Structural and stereoisomerism in complexes with coordination numbers 4 and 6. Drawbacks of VBT. IUPAC system of nomenclature.

UNIT IV: Crystal Field Theory (4 classes each of 60 minutes duration)
Crystal field effect, octahedral symmetry. Crystal field stabilization energy (CFSE), Crystal field effects for weak and strong fields. Tetrahedral symmetry. Factors affecting the magnitude of Dq.

Section B: Organic Chemistry

UNIT V: Carbohydrates (8 classes each of 60 minutes duration)
Classification of carbohydrates, reducing and non-reducing sugars, General properties of Glucose and

Fructose, their open chain structure. Epimers, mutarotation and anomers. Determination of configuration of Glucose (Fischer proof). Cyclic structure of glucose. Haworth projections. Cyclic structure of fructose. Linkage between monosachharides, structure of disacharrides (sucrose, maltose, lactose) and polysacharrides (starch and cellulose) excluding their structure elucidation.

UNIT VI: Amino Acids, Peptides and Proteins (8 classes each of 60 minutes duration)

Classification of Amino Acids, Zwitterion structure and Isoelectric point

Overview of Primary, Secondary, Tertiary and Quaternary structure of proteins.Synthesis of simple peptides (upto dipeptides) by N-protection (t- butyloxycarbonyl and phthaloyl) & Cactivating groups and Merrifield solid phase synthesis.

UNIT VII: Enzymes and correlation with drug action (6 classes each of 60 minutes duration)

Mechanism of enzyme action, factors affecting enzyme action, Coenzymes and cofactors and their role in biological reactions, Specificity of enzyme action (Including stereospecifity).

Enzyme inhibitors and their importance, phenomenon of inhibition (Competitive and Non- competitive inhibition including allosteric inhibition).

UNIT VIII: Lipids (3 classes each of 60 minutes duration)

Introduction to lipids, classification. Oils and fats: Common fatty acids present in oils and fats, Omega fatty acids, Trans fats, Hydrogenation, Saponification value, Iodine number.

Biological importance of triglycerides, phospholipids, glycolipids, and steroids (cholesterol).

Reference Books:

1. J. C. Kotz, P. M. Treichel & J. R. Townsend: General Chemistry, Cengage Lening India Pvt. Ltd., New Delhi (2009).
2. B. H. Mahan: University Chemistry 3rd Ed. Narosa (1998).
3. R. H. Petrucci: General Chemistry 5th Ed. Macmillan Publishing Co.: New York (1985).
4. J. D. Lee: A New Concise Inorganic Chemistry, E.L.B.S.
5. F.A. Cotton & G. Wilkinson: Basic Inorganic Chemistry, John Wiley.
6. Gary Wulfsberg: Inorganic Chemistry, Viva Books Pvt. Ltd.
7. Morrison, R. T. & Boyd, R. N. Organic Chemistry, Dorling Kindersley (India) Pvt. Ltd. (Pearson Education).
8. Finar, I. L. Organic Chemistry (Volume 1), Dorling Kindersley (India) Pvt. Ltd. (Pearson Education).
9. Finar, I. L. Organic Chemistry (Volume 2), Dorling Kindersley (India) Pvt. Ltd. (Pearson Education).
10. Nelson, D. L. & Cox, M. M. Lehninger's Principles of Biochemistry 7th Ed., W. H. Freeman.
11. Berg, J. M., Tymoczko, J. L. & Stryer, L. Biochemistry 7th Ed., W. H. Freeman.
12. Ali, Hashmat, Reaction Mechanism in Organic Chemistry ,S Chand
13. Sourav Kumar,Chemistry in daily life,Crown Publishing (2025

PART 'B'

PRACTICAL COURSE CONTENTS:

End Semester Examination (ESE):

There will be one Practical Examination of 6 Hours duration. Evaluation of Practical Examination may be as per the following guidelines:

Two Experiments = 20 marks

Practical record notebook = 03 marks

Viva-voce = 02 marks

Section A: Inorganic Chemistry

1. Estimation of the amount of nickel present in a given solution as bis(dimethylglyoximato) nickel (II) or aluminium as oxinate in a given solution gravimetrically.
2. Estimation of (i) Mg or (ii) Zn by complexometric titrations using EDTA.
3. Estimation of total hardness of a given sample of water by complexometric titration.

Section B: Organic Chemistry

1. Separation of amino acids by paper chromatography
2. To determine the concentration of glycine solution by formylation method.
3. Study of titration curve of glycine
4. To determine the saponification value of an oil/fat.
5. To determine the iodine value of an oil/fat
6. Differentiate between a reducing/ nonreducing sugar.

Reference Books

1. A.I. Vogel, Qualitative Inorganic Analysis, Prentice Hall, 7th Edn.
2. A.I. Vogel, Quantitative Chemical Analysis, Prentice Hall, 6th Edn.
3. Vogel's Textbook of Practical Organic Chemistry, ELBS.
4. Ahluwalia, V.K. & Aggarwal, R. Comprehensive Practical Organic Chemistry, Universities Press.