COURSE INFORMATION SHEET

Course Code: CH24101
Course Title: Chemistry
Pre-requisite(s): Intermediate level Chemistry
Co- requisite(s):XXXXXXXXX
Credits: 4 L: 3 T: 1 P: 0
Class schedule per week: 4
Class: B.Tech.
Semester / Level: I
Branch: All
Name of Teacher:

COURSE OBJECTIVES

This course envisions to impart to students:

1.	To create concept of chemical bonding in coordination chemistry
2.	To understand the basics of stereochemistry, aromaticity and reaction mechanism of organic molecules
3.	To understand the reaction dynamics and to know different types of catalysis
4.	To apprehend the basic principles and the application of vibrational, electronic and NMR spectroscopy
5.	To develop knowledge on the physical state and electrochemistry of molecules

COURSE OUTCOMES (COs) (3 COs to 6 COs depending upon the course)

After the completion of this course, students will be able to:

CO1	Able to explain the bonding in a coordination complex
CO2	Able to explain the 3D structure, aromaticity and stereochemistry of organic molecules
CO3	Able to predict the rate, molecularity and mechanism of a simple as well as catalytic reaction
CO4	Able to explain the UV-vis, IR and NMR spectra of unknown molecules
CO5	Able to interpret the phase diagram of simple one and two component heterogeneous systems in equilibrium and the electrochemical behavior of the molecules

SYLLABUS

MODULE	(NO. OF LECTURE HOURS)
Module – I: Bonding in Coordination Complex Introduction to Chemical Bonding, Werner's Theory, Bonding in coordination complexes, Crystal Field Theory, Octahedral, Tetrahedral and Square planar complexes, CFSE, Jahn Teller theorem, Spectral, electronic and magnetic properties of coordination complexes.	**8**
Module – II: Organic Structure and Reactivity Aromaticity, Geometrical isomerism: cis–trans, E/Z, and syn-anti isomerism; Optical isomerism & Chirality; Wedge, Fischer, Newmann and Sawhorse projection formulae and interconversions; D/L, R/S nomenclature system; Conformational studies of n-butane. Addition, Elimination, Substitution and Rearrangement reaction.	**8**
Module – III: Kinetics and Catalysis Kinetics of Chain, Parallel/Competing/Side, Consecutive reactions; Fast reactions; Outline of Catalysis, Acid-base catalysis, Enzyme catalysis (Michaelis-Menten equation), Important catalysts in industrial processes: Hydrogenation using Wilkinsons catalyst, Phase transfer catalyst**.**	8
Module – IV: Spectroscopic Techniques Absorption Spectroscopy, Lambert-Beers law, Principles and applications of UV-Visible spectroscopy, Principles and applications of Vibrational spectroscopy; Introduction of NMR spectroscopy.	8
Module – V: Phase and Chemical equilibrium Phase rule: terms involved, Phase diagram of one component (Water) & two component (Pb/Ag) system & their applications; Gibbs Free energy, Van't Hoff equation and Chemical Equilibrium; Nernst Equation, Standard electrode potential, EMF measurement and its application, Batteries and Fuel Cells.	8

TEXTBOOKS:

1. Huheey, J. E., Inorganic Chemistry: Principles of Structure and Reactivity, 4 th edition, Pearson.
2. Morrison, R. N. & Boyd, R. N. Organic Chemistry, Seventh Edition, Pearson
3. Atkins, P. W. & Paula, J. Physical Chemistry, 10th Ed., Oxford University Press, 2014.

REFERENCE BOOKS:

1. Lee, J. D. Concise Inorganic Chemistry ELBS, 1991.
2. Mortimer, R. G. Physical Chemistry 3rd Ed., Elsevier (2009).
3. William Kemp, Organic Spectroscopy, 3 rd Ed., 2008 Macmillan.

GAPS IN THE SYLLABUS (TO MEET INDUSTRY/PROFESSION REQUIREMENTS)

Limited exposure to computational tools, industrial case studies, and skill-based training needed for industry readiness.

POS MET THROUGH GAPS IN THE SYLLABUS

TOPICS BEYOND SYLLABUS/ADVANCED TOPICS/DESIGN

POS MET THROUGH TOPICS BEYOND SYLLABUS/ADVANCED TOPICS/DESIGN

COURSE OUTCOME (CO) ATTAINMENT ASSESSMENT TOOLS & EVALUATION PROCEDURE

DIRECT ASSESSMENT

Assessment Tool	% Contribution during CO Assessment
Mid Sem Examination	25
End Sem Examination	50
Quiz	10
Assignment	10
Teacher's assessment	05

Continuous Internal Assessment	% Distribution
Mid Sem Examination	50
Quiz and assignment	40
Teacher's assessment	10

Assessment Components	CO1	CO2	CO3	CO4	CO5
Continuous Internal Assessment	Y	Y	Y	Y	
Semester End Examination	Y	Y	Y	Y	Y

INDIRECT ASSESSMENT

1. **Student Feedback onCourse Outcome**

COURSE DELIVERY METHODS

CD1	Lectures by use of boards/LCD projectors/OHP projectors
CD2	Tutorials/Assignments
CD3	Self- learning such as use of NPTEL materials and internets
CD4	Seminars
CD5	Laboratory experiments/teaching aids
CD6	Industrial/guest lectures
CD7	Industrial visits/in-plant training

MAPPING BETWEEN COURSE OUTCOMES AND POs and PSOs

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PSO 1	PSO 2	PSO 3
CO1	3	2	1	1	0	0	0	0	1	0	2			
CO2	3	3	2	1	0	0	0	0	1	0	2			
CO3	3	3	3	2	1	1	0	0	1	0	3			
CO4	3	2	1	3	3	0	0	0	2	0	2			
CO5	3	3	2	2	1	2	0	0	1	0	3			

Grading: No correlation – 0, Low correlation - 1, Moderate correlation – 2, High Correlation - 3

MAPPING BETWEEN COURSE OUTCOMES AND COURSE DELIVERY METHOD

Course Outcomes	Course Delivery Method
CO1	CD1, CD2, CD3
CO2	CD1, CD2, CD3

CO3	CD1, CD2, CD3
CO4	CD1, CD2, CD3
CO5	CD1, CD2, CD3

PROGRAMME EDUCATIONAL OBJECTIVES (PEOs)

PEO1 – Strong Foundation
Develop a solid base in chemistry, mathematics, and engineering fundamentals, enabling the understanding and solution of scientific and engineering problems effectively.

PEO2 – Problem Solving & Research
Enhance analytical and research skills through laboratory experiments such as titrations, kinetics, spectroscopy, and synthesis to arrive at innovative and sustainable solutions.

PEO3 – Professional Ethics
Practice safe laboratory methods, handle chemicals responsibly, and use modern tools and techniques ethically while considering sustainability and environmental protection.

PEO4 – Communication & Teamwork
Work both independently and collaboratively in teams, prepare clear reports, analyze data, and communicate results effectively in written and oral forms.

PEO5 – Lifelong Learning
Recognize the importance of continuous learning, adapt to new chemical technologies, and apply critical thinking to address emerging challenges in research, industry, and society.

PROGRAMME OUTCOMES (POs)

Chemistry Laboratory Experiments Mapped to Program Outcomes (POs)

PO1 – Engineering Knowledge
Apply knowledge of chemistry, mathematics, natural sciences, computing, and engineering fundamentals to solve analytical and experimental problems in gravimetric analysis, titrations, kinetics, spectroscopy, and synthesis.

PO2 – Problem Analysis
Identify, formulate, and analyze chemical and environmental problems such as water hardness, acid strength, kinetics of hydrolysis, and eutectic behavior using systematic experimental approaches.

PO3 – Design/Development of Solutions
Design and develop experimental methodologies for chemical synthesis (e.g., diazoamino benzene), separation of organic mixtures, and solution preparation, considering safety, sustainability, and efficiency.

PO4 – Conduct Investigations of Complex Problems
Plan and conduct investigations through gravimetric estimation, potentiometric/pH-metric

titrations, kinetics, and spectroscopic analysis; interpret experimental data to provide valid conclusions.

PO5 – Engineering Tool Usage
Utilize modern chemical instruments such as spectrophotometers, potentiometers, pH meters, FTIR, and NMR for analysis, while recognizing their scope and limitations.

PO6 – The Engineer and The World
Analyze the societal and environmental aspects of chemical problems, such as water quality (hardness), solvent use in organic separation, and safe disposal of chemical wastes, for sustainable practices.

PO7 – Ethics
Apply ethical principles in chemical experimentation, ensuring accurate reporting of data, responsible handling of reagents, safety compliance, and respect for human and environmental values.

PO8 – Individual and Team Work
Perform experiments independently and collaboratively in groups, developing teamwork and leadership skills in the laboratory setting.

PO9 – Communication
Document experimental procedures, record observations, prepare accurate lab reports, construct graphs, and present results effectively with clarity and scientific rigor.

PO10 – Project Management and Finance
Apply principles of resource management, time management, and cost-effectiveness in synthesis, separation, and quantitative estimations during laboratory experiments.

PO11 – Life-long Learning
Recognize the importance of continuous learning in chemistry by adapting to emerging tools, techniques, and technologies (e.g., advanced spectroscopy, green chemistry), and developing critical thinking for future research challenges.

PROGRAMME SPECIFIC OUTCOMES (PSOs)

1. .
2. .
3. .

Mapping of Pos and PSOs with PEOs

	PEO1	PEO2	PEO3	PEO4	PEO5
PO1	3	2	1	1	2
PO2	2	3	1	1	2
PO3	2	2	3	1	1
PO4	2	3	2	1	2
PO5	2	2	2	1	2
PO6	1	2	2	1	2
PO6	1	1	3	1	1
PO7	1	1	1	3	1
PO8	1	1	1	3	1
PO9	1	1	2	2	1
PO10	1	2	1	1	3
PO11	3	2	1	1	2
PSO1					
PSO2					
PSO3					

Grading: No correlation –0, Low correlation - 1, Moderate correlation – 2, High Correlation - 3

COURSE INFORMATION SHEET

Course Code: CH24102
Course Title: Chemistry Lab
Pre-requisite(s): Intermediate level Chemistry
Co- requisite(s):
Credits: 1 L: 0 T: 0 P: 2
Class schedule per week: 2
Class: B.Tech.
Semester / Level: I
Branch: All
Name of Teacher:

COURSE OBJECTIVES

This course enables the students to:

1.	To gain an understanding of the synthesis of organic and inorganic compounds.	
2.	To interpret and analyze spectroscopic data effectively.	
3.	To develop a strong concept of potentiometric and pH-metric titrations of acids and bases.	
4.	To understand and calculate the rate constant of chemical reactions.	
5.	To acquire knowledge of determining melting points and estimating eutectic and transition temperatures.	

COURSE OUTCOMES (COs)

After the completion of this course, students will be able to:

CO1	Able to perform the synthesis of organic and inorganic compounds.
CO2	Able to interpret and analyze spectroscopic data.
CO3	Able to carry out potentiometric and pH-metric titrations of acids and bases.
CO4	Able to determine the rate constant of chemical reactions.
CO5	Able to measure melting points and estimate eutectic and transition temperatures.

SYLLABUS (List of experiments)

1. Gravimetric estimation of Nickel using Dimethylglyoxime.

2. Determination of total Hardness of a given water Sample (Complexometric Titration).

3. Verification of Beer's Law using Fe^{3+} solution by spectrophotometer/colorimeter, and determination of the concentration of an unknown Fe^{3+} solution.

4. Preparation of Diazoamino Benzene and reporting of its melting point and yield.

5. Construction of a melting point–mass percent composition diagram for a two-component mixture and determination of its eutectic temperature.

6. Study of the kinetics of acid-catalyzed hydrolysis of ethyl acetate and evaluation of the rate constant.

7. Determination of the strength of a strong acid using potentiometric titration with a strong base.

8. Determination of the transition temperature of a given salt hydrate.

9. Separation of binary organic mixture by acid-base extraction and analysis using given FTIR and NMR spectrum.

10. Construction of a pH-titration curve for a strong acid versus a strong base

REFERENCE MATERIALS:

1. https://bitmesra.ac.in/edudepartment/content/1/140/553 (link of Lab Manual)
2. **Experimental Physical Chemistry –** B. Viswanathan, P. S. Raghavan, Narosa Publishing House (1997).
3. **Vogel's Textbook of Practical Organic Chemistry**
4. **Experiments in General Chemistry –** C. N. R. Rao, U. C. Agarwal.
5. **Experimental Organic Chemistry, Vol. 1 & 2 –** P. R. Singh, D. S. Gupta, K. S. Bajpai, Tata McGraw-Hill

GAPS IN THE SYLLABUS (TO MEET INDUSTRY/PROFESSION REQUIREMENTS)

POS MET THROUGH GAPS IN THE SYLLABUS

TOPICS BEYOND SYLLABUS/ADVANCED TOPICS/DESIGN

POS MET THROUGH TOPICS BEYOND SYLLABUS/ADVANCED TOPICS/DESIGN

COURSE OUTCOME (CO) ATTAINMENT ASSESSMENT TOOLS & EVALUATION PROCEDURE

DIRECT ASSESSMENT

Assessment Tool	% Contribution during CO Assessment
Lab Journal	30
Lab quizes	20
Progressive viva	20
End Sem Examination	30

Continuous Internal Assessment	% Distribution
Lab Journal	30
Lab quiz	10
Progressive viva	20

Assessment Components	CO1	CO2	CO3	CO4	CO5
Continuous Internal Assessment	Y	Y	Y	Y	Y
Semester End Examination	Y	Y	Y	Y	Y

INDIRECT ASSESSMENT

1. Student Feedback onCourse Outcome

COURSE DELIVERY METHODS

CD1	Introductory lecture by use of boards/LCD projectors
CD2	Laboratory experiments/ teaching aid
CD3	Self- learning such as use of NPTEL materials and internets
CD4	Seminars (discussion of experimental results and error analysis).
CD5	Group discussions/problem-solving sessions (to analyze experimental data and calculations).
CD6	Industrial/guest lectures (applications of chemical analysis techniques in industry).
CD7	Industrial visits (exposure to real chemical laboratories and processes).

MAPPING BETWEEN COURSE OUTCOMES AND POs and PSOs

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PSO 1	PSO 2	PSO 3
CO1	3	2	3	2	2	2	3	1	1	2	2			
CO2	3	2	2	3	3	2	1	1	3	2	3			
CO3	3	3	1	3	3	1	2	1	2	2	2			
CO4	3	3	1	3	2	1	1	1	1	2	3			
CO5	3	2	1	2	2	2	1	1	1	1	3			

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CO4	CD1, CD2, CD3
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