Teaching Plan for B.Sc. (Prog) Chemistry, Semester IV (Jan 24 – May 24)

Paper Title- Conductance, Electrochemistry and Chemical Kinetics.

(DSE-10, Chemistry)

Faculty Name: **Dr. Richa Tyagi**

S. No.	Month	Week	Topic
1.	Jan-24	3rd	Introduction to -Conductivity, equivalent and molar conductivity .
		4th	Detailing of equivalent and molar conductivity and their variation with dilution for weak and strong electrolytes,
2.	Feb-24	1st	Kohlrausch Law of independent migration of ions. (Detailed). Introduction to Ionic velocity, mobility.
		2nd	Detailed explanation of Ionic velocity, mobility and their determination, transference number and its relation to ionic mobility,Conductometric titrations (only acid-base).
		3rd	Concept of reversible and irreversible electrochemical cells, Standard hydrogen electrode, standard electrode potential, concept of EMF of a cell
		4th	Measurement of EMF of cell, Nernst equation and its importance,
3.	Mar-24	1st	Types of electrodes (Reference and inert electrodes), electrochemical series.
		2nd	Internal Assessment1/Practice Problems
		3rd	Thermodynamics of a reversible cell, calculation of thermodynamic properties: G, H and S from EMF data.
		4th	Mid-Semester Break
4.	Apr-24	1st & 2nd	Calculation of equilibrium constant from EMF data. pH determination using glass electrode, Potentiometric titrations-qualitative treatment (acid-base and oxidation-reduction only).
		3rd	The concept of reaction rates, effect of temperature, pressure, catalyst and other factors on reaction rates. Order and molecularity of a reaction,
		4th	Integrated rate equations for zero, first and second order reactions (derivation not required), half–life of a reaction, Concept of activation energy and its calculation from Arrhenius equation
5.	May-24	1st	Catalysis: Types of catalyst, specificity and selectivity, generalized treatment of catalyzed reactions at solid surfaces. Enzyme catalysis,.
		2nd	Michaelis-Menten mechanism, acid-base catalysis Internal Assessment 2

Course Code DSE- 10: CHEMISTRY

Course Title: Conductance, Electrochemistry and Chemical Kinetics

Total Credits: 04 (Credits: Theory-02, Practical-02)

Total Lectures: Theory- 30, Practical-60

Objectives: In this course the students will learn about electrolytic and galvanic cells, measurement of conductance and its applications, measurement of emf and its applications. The student will also learn about the reaction rate, order, activation energy and theories of reaction rates.

Learning Outcomes:

By the end of the course, the students will be able to:

- Explain the factors that affect conductance, migration of ions and application of conductance measurement.
- Understand the importance of Nernst equation, measurement of emf, calculations of thermodynamic properties and other parameters from the emf measurements.
- Understand rate law and rate of reaction, theories of reaction rates and catalysts; both chemical and enzymatic.

Unit 1: Conductance **8 Lectures**

Conductivity, equivalent and molar conductivity and their variation with dilution for weak and strong electrolytes, Kohlrausch Law of independent migration of ions, Ionic velocity, mobility and their determination, transference number and its relation to ionic mobility, Conductometric titrations (only acid-base).

Unit 2: Electrochemistry **12 Lectures**

Concept of reversible and irreversible electrochemical cells, Standard hydrogen electrode, standard electrode potential, concept of EMF of a cell, measurement of EMF of a cell, Nernst equation and its importance, types of electrodes (Reference and inert electrodes), electrochemical series.

Thermodynamics of a reversible cell, calculation of thermodynamic properties: G, H and S from EMF data. Calculation of equilibrium constant from EMF data. pH determination using glass electrode. Potentiometric titrations-qualitative treatment (acid-base and oxidation-reduction only).

Unit 3: Chemical Kinetics and Catalysis 10 Lectures

The concept of reaction rates, effect of temperature, pressure, catalyst and other factors on reaction rates. Order and molecularity of a reaction, integrated rate equations for zero, first and second order reactions (derivation not required), half-life of a reaction, Concept of activation energy and its calculation from Arrhenius equation.

Catalysis: Types of catalysis, specificity and selectivity, generalized treatment of catalyzed reactions at solid surfaces, Enzyme catalysis, Michaelis-Menten mechanism, acid-base catalysis.

Practicals: Laboratory periods: 60

1. Determination of molar conductance, degree of dissociation and dissociation constant of a weak acid.
2. Perform the following conductometric titrations: Strong acid vs strong base.
3. Perform the following conductometric titrations: Weak acid vs strong base.
4. Determination of TDS of water from different sources.
5. Determination of Soil pH of soil collected from various locations.
6. Perform the potentiometric titrations of strong acid vs strong base
7. Perform the potentiometric titrations of Weak acid vs strong base
8. Perform the potentiometric titrations of Potassium dichromate vs. Mohr's salt
9. Perform the potentiometric titrations of $KMnO_4$ vs. Mohr's salt
10. Study the kinetics of acid hydrolysis of methyl acetate with hydrochloric acid.

References:

Theory:

1. Castellan, G. W .(2004). **Physical Chemistry**. Narosa.

Teaching Plan for B.Sc. (Prog) Chemistry, Semester VI (Jan 2024 – May 2024)

Paper Title- Basic Analytical Chemistry

(SEC-2, Chemistry)

Faculty Name: **Dr. Richa Tyagi**

S. No.	Month	Week	Topic
1.	Jan-24	3rd	**Unit 1:** Introduction to analytical chemistry and its interdisciplinary nature.
		4th	Concept of sampling. Importance of accuracy, precision and sources of error in analytical measurements. Significant figures.
2.	Feb-24	1st	Presentation of experimental data and results. .
		2nd	**Unit 2:** **Analysis of soil -** Composition of soil, Concept of pH and its measurement.
		3rd	Complexometric titrations, Chelation,.
		4th	Chelating agents and use of indicators
3.	Mar-24	1st	**Unit 3:** **Analysis of water:** Definition of pure water, Sources responsible for contaminating water,
		2nd	Detailing of Water sampling methods,.
		3rd	Detailing of Water purification methods
		4th	Mid-Semester Break
4.	Apr-24	1st	Internal Assessment 1/ Practice Problems
		2nd	**Unit 4** **Chromatography** Definition and general introduction on principles of chromatography.
		3rd	Paper chromatography , Thin layer chromatography
		4th	Column chromatography
5.	May-24	1st	Ion-exchange chromatography
		2nd	Internal Assessment 2/Practice Problems

Course Code: CHEMISTRY –SEC-2
Course Title: Basic Analytical Chemistry
Total Credits: 04 (Credits: Theory-02, Practical-02)
(Total Lectures: Theory- 30, Practical-60)

Objectives:

The objective of this course is to make students aware about the importance and the concepts of chemical analysis of water and soil using separation techniques like chromatography and instrumentation techniques like flame photometry and spectrophotometry.

Learning Outcomes:

By the end of this course, students will be able to:

- Handle analytical data
- Determine composition and pH of soil, which can be useful in agriculture
- Do quantitative analysis of metal ions in water
- Separate mixtures using separation techniques
- Estimate macro nutrients using Flame photometry

Unit 1:

Introduction

Introduction to analytical chemistry and its interdisciplinary nature. Concept of sampling. Importance of accuracy, precision and sources of error in analytical measurements. Significant figures. Presentation of experimental data and results.

(Lectures: 6)

Unit 2:

Analysis of soil

Composition of soil, concept of pH and its measurement, complexometric titrations, chelation, chelating agents, use of indicators.

(Lectures: 8)

Unit 3:

Analysis of water:

Definition of pure water, sources responsible for contaminating water, water sampling methods, water purification methods.

(Lectures:8)

Unit 4:

Chromatography

Definition and general introduction on principles of chromatography. Paper chromatography, thin layer chromatography, Column chromatography and ion-exchange chromatography.

(Lectures: 8)

Practical:

(Credits: 2, Laboratory periods: 60)

Chemistry Lab-Basic analytical chemistry

1. Determination of pH of soil samples.
2. Estimation of Calcium and Magnesium ions as Calcium carbonate by complexometric titration.
3. Determination of pH, acidity and alkalinity of a water sample.
4. Determination of dissolved oxygen (DO) of a water sample.
5. Paper chromatographic separation of mixture of metal ion (Ni^{2+} and Co^{2+}).
6. To study the use of phenolphthalein in trap cases.
7. To analyze arson accelerants.
8. To carry out analysis of gasoline.
9. Estimation of macro-nutrients: Potassium, calcium and magnesium in soil samples by flame photometry.
10. Spectrophotometric determination of iron in vitamin / dietary tablets.
11. Spectrophotometric identification and determination of caffeine and benzoic acid in soft drink.
12. Determination of ion exchange capacity of anion / cation exchange resin (using batch procedure if use of column is not feasible).

References:

1. Christian, G.D. (2004), **Analytical Chemistry**, John Wiley & Sons.
2. Harris, D. C. (2007), **Exploring Chemical Analysis**, W.H. Freeman and Co.
3. Skoog, D.A.; Holler F.J.; Nieman, T.A. (2005), **Principles of Instrumental Analysis**, Thomson Asia Pvt. Ltd.
4. Svehla, G. (1996), **Vogel's Qualitative Inorganic Analysis**, Prentice Hall.
5. Mendham, J.; Denney, R.C.; Barnes, J.D.; Thomas, M.J.K. (2007), **Vogel's Chemical Analysis**, 6th Edition, Prentice Hall.