CHEMISTRY COMPONENT – DSC

DISCIPLINE SPECIFIC CORE COURSE (DSC 06)

Credit distribution, Eligibility and Pre-requisites of the Course

Course title & Code	Credits	Credit distribution of the core course			Eligibility criteria	Pre-requisite of the course (If any)
		Lecture	Tutorial	Practical/ Practice		
Analytical Techniques in Chemistry ALS CHEM DSC 06	4	2	0	2	Class 12th Pass with Science	NIL

Learning Objectives:

The learning objectives of this course are as follows:

- to make students aware of the concept of accuracy, precision, Statistical test data-F, Q and t test.
- to expose students to the laws of spectroscopy and selection rules governing the possible transitions in the different regions of the electromagnetic spectra.
- to familiarize students to different electroanalytical methods of analysis.
- to make students familiar to important separation methods like solvent extraction and chromatography.

Learning Outcomes:

By studying this course, students will be able to:

- analyse various sources of errors in chemical analysis.
- apply methods to minimize error.

- understand basic principle of instrumentation (UV-VIS spectrophotometer, Infrared spectrometer, Mass spectrometer, NMR Spectrometer).
- apply basic principles of separation techniques (chromatography and solvent extraction) and apply them to separate mixtures.
- analyse samples independently in the laboratory.

Unit 1: Qualitative and Quantitative Aspects of Analysis (4 Hours)

Errors, Accuracy and Precision. The Gaussian distribution, mean and standard deviation, confidence intervals. Normal law of distribution of indeterminate errors, statistical test of data; F, Q and t test.

Unit 2: Optical Techniques of Analysis (8 Hours)

Origin of spectra, interaction of radiation with matter, fundamental laws of spectroscopy and selection rules, Verification of Beer's-Lambert Law by using colorimeter for different solutions and its limitations. UV-Visible Spectrometry: Basic principles of instrumentation for single and double beam instruments. Determination of concentration of unknown compounds, composition of metal complexes using Job's method of continuous variation and mole ratio method.

Unit 3: Electroanalytical Techniques (6 Hours)

Classification of electroanalytical methods, basic principle of pH metric, potentiometric and conductometric titrations. Techniques used for the determination of equivalence points. Techniques used for the determination of pKa values. Application of conductance measurement: i) Ionic product of water ii) Solubility and solubility product of sparingly soluble salts.

Unit 4: Separation Techniques (6 Hours)

Solvent extraction: Classification, principle and efficiency of the technique. Chromatography: Principles of Chromatographic separations, Classification of Chromatographic techniques, Paper

Chromatography, Thin Layer Chromatography, Column Chromatography, efficiency of separation (Resolution, Efficiency of Resolution, Plate Height) Application of these techniques in analysis of biological samples.

Unit 5: Spectroscopy (6 Hours)

Basic principle of IR and NMR spectroscopy, interpretation of IR spectra of simple organic molecules with functional groups amine, amide, carbonyl, hydroxy. Chemical shift and low-resolution spectra, factors affecting chemical shift, interpretation of ^{1}H-NMR spectra of simple organic molecules like methanol, ethanol, acetaldehyde, acetone, acetic acid, aromatic protons and pesticide. Elementary discussion on Mass Spectrometry.

PRACTICAL (60 Hours)

1. Verification of Lambert-Beer's law and determination of concentration of a coloured species ($KMnO_4$, $K_2Cr_2O_7$).
2. Determine the concentration of $KMnO_4$ and $K_2Cr_2O_7$ in a mixture by using colorimeter.
3. Spectrophotometric analysis of Co^{2+} and Ni^{2+} ions in a mixture.
4. Perform the following conductometric titration

   i) Strong acid vs strong base

   ii) Weak acid vs strong base

5. Perform the following potentiometric titration

   i) Strong acid vs strong base
   ii) Weak acid vs strong base

6. Determination of isoelectric point of amino acids.

7. Separation of Co^{2+} and Ni^{2+} mixture by paper chromatography and to determine their R_f values.

8. Separation of amino acids present in the given mixture by paper chromatography and to determine their R_f values.

9. Interpretation of simple organic compounds by IR spectra. (Spectra to be provided).

10. Study and interpretation of ^{1}H-NMR spectra of simple organic compounds (Spectra to be provided).

11. Interpretation of the structure of simple pesticide molecule (two examples) from the given IR and NMR data/spectra

Essential/ Recommended readings:

1. Willard, H.H. (1988), *Instrumental Methods of Analysis*, 7th Edition, Wardsworth Publishing Company.
2. Christian, G.D. (2004), *Analytical Chemistry, 6th Edition*, John Wiley & Sons, New York.
3. Jeffery, G.H.; Bassett, J.; Mendham, J.; Denney, R.C. (1989), *Vogel's Textbook of Quantitative Chemical Analysis*, John Wiley and Sons.
4. Skoog, D.A.; Holler F.J.; Nieman, T.A. (2005), *Principles of Instrumental Analysis*, Thomson Asia Pvt. Ltd.
5. Donald L. Pavia, Gary M. Lampman, George S. kriz (2014), *Introduction to Spectroscopy***,** Thomas Press Ltd.
6. Singh, Pradeep Pratap; Ambika (2018), *Organic Spectroscopy,* Viva Books

Suggestive readings:

1. Harris, D. C. (2007), *Quantitative Chemical Analysis,6th Edition*, Freeman.
2. Khopkar, S.M. (2008), *Basic Concepts of Analytical Chemistry***,** New Age International Publisher.

Note: Examination scheme and mode shall be as prescribed by the Examination Branch, University of Delhi, from time to time.