

SEMESTER III

11.1.7. Course Code: DSC 7: ANALYTICAL CHEMISTRY3 (AC3)

Course Title: Quantitative Methods of Analysis

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

(Total Lectures: Theory- 30, Practical-60)

Objectives: The main objective of this course is to make students acquire knowledge about the basic principles underlying gravimetric and volumetric analysis, different types of titration curves, equilibria principles and environmental analysis

Learning Outcomes:

- By the end of this course, students will be able to:
 - Know the concept of volumetric and gravimetric analysis and deducing the conversion factor for determination
 - Understand the various titration curves
 - Stability of complexes
 - Know and analyze various pollutants present in environment.

Unit 1: Gravimetric Analysis

Requisites of precipitation, Nucleation, precipitation, and growth of precipitates; Particle size and filterability of precipitates; Factors influencing precipitation, Co-precipitation, post-precipitation. Super saturation, digestion, precipitation from homogeneous solution, washing of precipitate and ignition of precipitate, Brief idea about method of filtration and drying of precipitate, Use of reagents used in gravimetry (8-hydroxy quinoline (oxine) and dimethyl glyoxime (DMG)

(Lectures: 09)

Unit 2: Basic principles underlying titrimetric analysis.

- **Acid-base:** pH of strong and weak acid solutions. Buffer solutions. Henderson equations. Preparation of acidic and basic buffers. Relative strength of acids and bases from K_a and K_b values. Neutralisation-titration curve, theory of indicators, choice of indicators.
- **Theory of redox indicators:** Principle and detection of equivalence point by visual & potentiometric methods
- **Precipitation titrations** Argentometric titrations, indicators for precipitation titrations involving silver nitrate- Volhard's method., Mohr's method, Adsorption indicators.
- **Complexometric titrations:** Stability of complexes, titration involving EDTA: - direct, back, displacement and indirect determinations,. Metal ion indicators and characteristics. Application-determination of hardness of water
- Problems based on titrimetric analysis.

(Lectures: 12)

Unit 3: Introduction to Environmental Analysis

- Environmental analysis of water: colour, odour, taste, conductivity, dissolved solids, hardness, DO, COD, BOD, chlorides, sulphates, nitrates and phosphates
- Environmental analysis of air: Sampling, particulate matter, gaseous pollutants-SO_x, NO_x, CO_x, and organic pollutants
- Environmental analysis of industrial effluents-estimation of toxic metals Hg, Cd, Pb, As, radiochemical wastes

(Lectures: 09)

PRACTICALS (Credits: 02, Laboratory Periods: 60)

1. Determination of the pK_a of a weak acid by potentiometric and pH metric titrations.

2. Determination of the strength of the given ferric chloride solution by titrating it against EDTA.
3. Estimation of chloride in water by precipitation method.
4. Estimation of amount of nickel present in given solution as bis(dimethylglyoximate)nickel(II) /Aluminium as oxinate.
5. Draw the absorbance curve of bromophenol blue using a colorimeter.
6. Determination of the composition of the Fe^{3+} -salicylic acid complex in solution by Job's method (*Plot curve using excel also*).
7. Determination of the formula of the chelate formed between iron (III) and Tiron.
8. Determination of dissolved oxygen (DO) /biological oxygen demand (BOD)/chemical oxygen demand (COD) (*Use at least two water samples from different sources*)

REFERENCES:

- Willard, Merritt, Dean, Settle (2004), Instrumental Methods of Analysis, CBS Publishers & Distributors.
- Skoog, D.A.; West, D.M.; Holler, F.J.; Crouch, S.R. (2014), Fundamentals of Analytical Chemistry, Cengage Learning.
- Harris, D.C. (2015), Quantitative Chemical Analysis, W.H. Freeman & Company.
- Mendham, J., Denney, R.C., Barnes, J.D.; Thomas, M.J.K. (2000); Vogel's Quantitative Chemical Analysis, Prentice Hall.
- Manahan, S.E. (2017) Environmental Chemistry, CRC Press
- De, A.K. (2012) Environmental Chemistry, New Age International Pvt. Lt

Teaching Learning Process:

- Conventional chalk and board teaching
- Visit chemical industries to get information about the technologies and environmental pollution from industrial effluents.
- ICT enabled classes.
- Power point presentations.
- Interactive sessions, Debate.

Assessment Methods:

- Class Tests at Periodic Intervals.
- Written assignment (s) / Presentation by individual students
- End semester University Theory and Practical Examination

Keywords: Gravimetric analysis, Volumetric analysis, Centrifugation methods, Environmental analysis, Industrial effluents, Wastewater analysis.