

Teaching Learning Process:

- Conventional chalk and board teaching,
- Class interactions and discussions

Assessment Methods:

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

Keywords: Food Chemistry, Water, Carbohydrate, Vitamins and minerals, Food additives.

11.2.5. Course Code: ANALYTICAL CHEMISTRY (DSE-AC5)

Course Title: INDUSTRIAL CHEMICALS AND ENVIRONMENT

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 various processes being used in industry and to learn basic properties of gases and their industrial production, uses, storage and hazards. Manufacturing, applications, analysis and hazards of the Inorganic Chemicals, Preparation of Ultra-Pure metals for semiconducting technology, Air and Water pollution, control measures for Air and Water Pollutants, Catalyst and Biocatalyst, Energy and Environment.

Learning Outcomes:

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

- The different toxic gases and their toxicity hazards
- Safe design systems for large scale production of industrial gases.
- Manufacturing processes, handling and storage of inorganic chemicals.
- Hazardous effects of the inorganic chemicals on human beings and vegetation.
- The requirement of ultra-pure metals for the semiconducting technologies
- Composition of air, various air pollutants, effects and control measures of air pollutants.
- Different sources of water, water quality parameters, impacts of water pollution, water treatment.

Unit 1: Chemical Technology

Basic principles of distillation, solvent extraction, solid-liquid leaching and liquid-liquid extraction. An introduction into the scope of different types of equipment needed in chemical technology, including reactors, distillation columns, extruders, pumps, mills, emulgators. Introduction to clean technology.

(Lectures: 08)

Unit 2: Industrial Gases and Inorganic Chemicals

(a) Industrial Gases: Large scale production, uses, storage and hazards in handling of the following gases: oxygen, nitrogen, argon, helium, hydrogen, acetylene, chlorine, fluorine, sulphur dioxide and phosgene.

(b) Inorganic Chemicals: Manufacture, application, analysis and hazards in handling the following chemicals: hydrochloric acid, nitric acid, sulphuric acid, caustic soda, common salt, borax, bleaching powder, hydrogen peroxide, potash alum, potassium dichromate and potassium permanganate. Preparation of metals (ferrous and nonferrous) and ultra-pure metals for semiconductor technology.

(Lectures: 10)

Unit III. Environment

(a) Air Pollution: Pollutants and their sources, pollution by SO₂, CO₂, CO, NO_x, H₂S and other foul-smelling gases. Green House effect and Global warming, Ozone depletion by oxides of nitrogen, chlorofluorocarbons and Halogens, removal of sulphur from coal. Control of particulates.

(b) Water pollution and Water Quality Standards: Pollutants and their sources, Effluent treatment plants (primary, secondary and tertiary treatment). Industrial effluent from the following industries and their treatment: electroplating, textile, tannery, dairy, petroleum and petrochemicals, agro, fertilizer, *etc.* Industrial waste management, incineration of waste. Water treatment and purification (reverse osmosis, electro dialysis, ion exchange). Water quality parameters for waste water, industrial water and domestic water.

(c) Energy & Environment: Sources of energy: Coal, petrol and natural gas. Nuclear fusion / fission, solar, hydrogen, geothermal, tidal and hydel.

(Lectures: 12)

PRACTICALS (Credits: 02, Laboratory Periods: 60)

1. Percentage of available chlorine in bleaching powder.
2. Measurement of chloride, sulphate and salinity of water samples by simple titration method. (AgNO₃ and potassium chromate)
3. Estimation of total alkalinity of water samples (CO₃⁻², HCO₃⁻) using double titration method.
4. Measurement of dissolved CO₂.
5. Determination of hexavalent Chromium Cr(VI) concentration in tannery wastes/waste water sample using UV-Vis spectrophotometry technique.
6. Study of some of the common bio-indicators of pollution.
7. Estimation of SPM in air samples.
8. Preparation of borax/ boric acid.

9. Detection of constituents of Ammonium Sulphate fertilizer (Ammonium and Sulphate ions) by qualitative analysis and determine its free acidity.
10. Detection of constituents of CAN fertilizer (Calcium, Ammonium and Nitrate ions) fertilizer and estimation of Calcium content.
11. Detection of constituents of Superphosphate fertilizer (Calcium and Phosphate ions) and estimation of phosphoric acid content.
12. Detection of constituents of Dolomite (Calcium, Magnesium and carbonate ions) and determination of composition of Dolomite (Complexometric titration).

REFERENCES:

Theory

- Manahan, S. E. (2017), Environmental Chemistry, CRC Press.
- Buchel, K. H.; Moretto, H. H.; Woditsch, P. (2003), Industrial Inorganic Chemistry, Wiley-VCH.
- De, A. K. (2012), Environmental Chemistry, New Age International Pvt., Ltd.
- Khopkar, S. M. (2010), Environmental Pollution Analysis, New Age International Publisher.
- Stocchi E. (1990) Industrial Chemistry, Vol-I, Ellis Horwood Ltd. UK.
- Felder, R. M.; Rousseau, R. W. (2008) Elementary Principles of Chemical Processes, Wiley Publishers, New Delhi.
- Kent, J. A. (2007) Riegel's Handbook of Industrial Chemistry, CBS Publishers, New Delhi.

Practicals

- Vowles, P. D.; Connell, D. W. (1980), Experiments in Environmental Chemistry: A Laboratory Manual, Vol. 4, Pergamon Series in Environmental Science.
- Gopalan, R.; Anand, A.; Sugumar R. W. (2008), A Laboratory Manual for Environmental Chemistry, I. K. International.
- Svehla, G. (1996), Vogel's Qualitative Inorganic Analysis, Prentice Hall.
- Banewicz, J. J.; Kenner, C.T. Determination of Calcium and Magnesium in Limestones and Dolomites, Anal. Chem., 1952, 24 (7), 1186–1187.

Teaching Learning Process:

- Conventional chalk and board teaching,
- Class interactions and discussions
- Power point presentation on important topics.
- Visit to chemical industries to get information about the technologies, methods to check pollutants and its treatment.

Assessment Methods:

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

Keywords: Toxic gases, Water pollution, Air pollutants, Chemical Industries.