

Chemistry – III (Semester 4)

Analytical, Applied and Biochemistry

Part – 1: Analytical Chemistry

Course Objectives:

Students will acquire knowledge about sampling and their handling and preparation and results calculation and data reporting. In addition they will learn and develop understanding about the classical techniques of analytical chemistry and quality control and quality assurance

Course Contents:

Chemometrics:

Sampling, significant figures, stoichiometric calculations, measurement errors, analysis of variance (ANOVA), arithmetic mean, median, mode, standard deviation/relative standard deviation, confidence limits, Gaussian distribution, least square method, tests for significance, outliers

Quality Control and Quality Assurance:

Definitions, seven tools for quality control, the concept of quality assurance, quality assurance techniques, validations based on design qualification (DQ), installation qualification (IQ), operational qualification (OQ) and performance qualification (PQ), calibrations, monitoring and quality reviews, periodical trainings, six sigma concept, ISO standards.

Classical Analytical Methods:

Acid-base, complexometric and redox titrations, gravimetric analysis.

CHEM-111 Lab.

Calibration of volumetric glassware, electronic and analytical equipment, statistical evaluation of analytical data including linear regression analysis, constructing a calibration curve from a given analytical data using spread sheet software, determination of hardness of water using EDTA, determination of chloride in tap water sample, estimation of copper, arsenic, hydrogen peroxide and vitamin C using iodometry, gravimetric analysis, determination of barium in barium nitrate, determination of nickel in a given steel sample, determination of bicarbonates in a clinical sample using back-titration, determination of cation in a mixture by complexometric titration, studying the effect of common ions on solubility of sparingly soluble salts (e.g. AgCl / PbSO₄).

Part – 2: Applied Chemistry

Course Objectives:

The objectives of the course are to educate the students about the fundamentals of chemical industry, raw materials, manufacturing and industrial processes.

Fundamentals of Chemical Industry:

Basic principles and parameters for industrial plant unit operations and unit processes.

Chemical Industries:

Raw materials, flow sheet diagrams and unit operations and unit processes of sulphuric acid, nitric acid, hydrochloric acid, oxalic acid, formic acid, caustic soda and washing soda, cement industry, petroleum, textile, polymer and fuel industries, applications of these industries.

Part – 3: Biochemistry**Course Objectives:**

Students will gain knowledge about fundamental concepts of biochemistry as well as be able to learn about the structures, properties and functions of amino acids, proteins, carbohydrates, lipids and nucleic acids.

Introduction to Biochemistry:

Brief introduction to the scope and history of Biochemistry, molecular logic of the living organism, cell structures and their functions, origin and nature of biomolecules.

Acid–Base and Electrolyte Chemistry:

Intracellular and extracellular electrolytes, body fluids as electrolyte solutions, pH, Henderson-Hasselbalch equation and buffers, amino acids, peptides and proteins, buffer capacity, buffers of body fluids, haemoglobin as an acid-base system, renal control of acid-base, balance, acid-base disorders: acidosis, alkalosis. Hemoglobin and omeostasis, variation of Na^+ , K^+ , Cl^- in acid-base disturbances.

Carbohydrates, Lipids and Proteins:

Definition and classification, chemistry, physical and chemical properties of various classes of carbohydrates, biological functions of starch, glycogen, cellulose, and cell wall polysaccharides, acid mucopolysaccharides and proteoglycans.

Definition and classification of lipids, chemistry and biological importance of fatty acids, waxes, glycerides, phospholipids, sphingolipids, glycolipids, sterols and prostaglandins.

Significance of lipids in biological membranes and transport mechanism. Chemistry and classification of amino acids, physical and chemical properties of amino acids, biological significance of amino acids, peptides, proteins, their classification, properties and biological significance, primary, secondary tertiary and quaternary structure of proteins, denaturation of proteins.

Nucleic Acids:

Chemical composition of nucleic acids, structure and biological significance of nucleic acids, chemical synthesis of oligonucleotides, nucleic acids hydrolysis, isolation and separation of nucleic acids, introduction to recombinant DNA technology.

CHEM-131 Lab.

Qualitative and quantitative analysis of carbohydrates, lipids and proteins. Laboratory work illustrating topics covered in the lecture of Chem.131, Determination of pH, Preparation of buffers.

Enzyme catalysis, Progress curve for enzyme catalyzed reactions, Determination of K_m values. To study the effect of different factors on the rate of enzyme catalyzed reactions.

Recommended Books (Part-1):

- Christian, G. D. (2006). *Analytical Chemistry*. 6th ed., John-Wiley & Sons, New York.
- Harris, D. C. (2011). *Quantitative Chemical Analysis*, 8th ed., W. H. Freeman and Company, New York, USA.
- Kealey, D. & Haines, P. J. (2002). *Instant Notes. Analytical Chemistry*, Bios Scientific Publishers Limited, Oxford, UK.
- Matthios, O. (2007). *Chemometrics-Statistics and Computed applications in Analytical Chemistry*, 2nd ed., Wiley-VCH, Germany.
- Miller, J. & Miller, J. (2005). *Statistics and Chemometrics for Analytical Chemistry*, 5th ed., Prentice Hall.
- Mitra, A. (2008). *Fundamentals of Quality Control and Improvement*, 3rd ed., John-Wiley & Sons
- Skoog, D. A., West, P. M., Holler, F. J., & Crouch, S. R. (2013). *Fundamentals of Analytical Chemistry*, 9th ed., Brooks Cole Publishing Company.

Recommended Books (Part-2):

- Heaton, A. (1996). *An introduction to Industrial Chemistry*, 3rd ed., Chapman & Hall.
- Hede, P. D., & Bier, S.P. (2007). *Inorganic and Applied Chemistry*, Ventus publishing app.
- Kent, J. A. (2003). *Riegel's Handbook of Industrial Chemistry*, 10th ed., Kluwer Academic/ Plenum Publishers.
- Sharma, J. (2012). *Applied Industrial Chemistry*, Arise publishers & Distributors, (2012).
- Vermani, O. P. & Narula, A. K. (2008). *Applied Chemistry; Theory and Practice*, New Age International Pvt. Ltd. Publishers.

Recommended Books (Part-3):

- Guyton, A. C. & Hall, J. E. (2011). *Guyton & Hall Textbook of Medical Physiology*, 12th ed., Publishers: Saunders Elsevier. ISBN: 978-1-4160-4574-8.
- Harvey, R. A., Ferrier, DR, & Karandish S. (2010). *Lippincott's illustrated Reviews: Biochemistry*, 5th ed., and *Biochemistry Map (Med maps)* Bundle. Publisher: Lippincott Williams & Wilkins. ISBN: 1451116314, 9781451116311.
- Murray, R.M. & Harper, H.A. (2000). *Harper's Biochemistry*, 25th ed., Publisher: Appleton & Lange. ISBN: 0838536840, 9780838536841.
- Nelson, D.L. (2008). *Lehninger's Principles of Biochemistry*, 6th ed., Publisher: Macmillan Higher Education. ISBN: 149222638, 781429222631.
- Alkire, R.C., Kolb, D.M. & Lipkowski, J. *Biselectro chemistry, volume 13*, 13th ed., Publisher: Wiley-VCH Verlag GmbH & Co. ISSN: 0938-5193.
- Voet, D. & Voet, J.D. (2011). *Biochemistry*, 4th ed., illustrated. Publisher: John-Wiley & Sons Canada, Limited. ISBN: 0470917458, 9780470917459.
- Zubay, G. L. (1998). *Biochemistry*, 4th ed., illustrated, Publisher W. M. C. Brown Publishers, Digitized (2008). ISBN: 0697219003, 9780697219008.