

Programme	BS-Biotechnology	Course Code	BT. 301	Credit Hours	3(2-1)
Course Title	Analytical Chemistry and Instrumentation				
Course Introduction					
This course will transfer the basic knowledge of analytical techniques, instrumentation and principles used in biochemistry, molecular biology and biotechnology. Learning of this course will equip the students to use these techniques in different labs, industries and hospitals with good background understanding.					
Learning Outcomes					
On the completion of the course, the students will: <ul style="list-style-type: none"> • Describe the principles and techniques of common analytical instruments. • Apply analytical methods to identify and quantify chemical / biochemical substances. • Interpret data obtained from analytical techniques to solve chemical problems. 					
Course Content					
Theory Unit <ul style="list-style-type: none"> • Introduction to analytical chemistry • Introduction to various analytical techniques • Qualitative and Quantitative evaluation of an Analytes • Quality Control, Quality Assurance • Chemical Analysis • Principles and applications of various types of chromatographic techniques: Paper chromatography, Thin layer chromatography, Column chromatography, Ion exchange chromatography, Affinity chromatography, Reverse Phase chromatography, Gas chromatography • Introduction to Electrophoresis: Agarose gel electrophoresis, SDS-PAGE, Capillary Electrophoresis • Spectroscopy and spectrophotometry: UV/Visible Spectroscopy, IR-Spectroscopy, Atomic Spectroscopy, Atomic Emission Spectroscopy, Atomic Florescence Spectroscopy • NMR Spectroscopy • Introduction to Flow Cytometry • Introduction to X-ray Diffraction • General procedures and instrumentation in centrifugation, Principles of centrifugation and ultracentrifugation, Centrifugation types and instrumentation • Protein/peptide separation techniques • Cell disintegration • DNA/Protein Extraction techniques and instrumentation • Separation of proteins by fractionation • High Performance Liquid Chromatography (HPLC) • Fast protein liquid chromatography (FPLC) • MS/MS Spectroscopy 					

- Principle of MALDI-TOF , Four steps in MALDI-TOF, MALDI-TOF Mechanism, Types of MALDI-TOF
- Applications of quantitative enzyme assay, Enzyme activity, Specific activity determination
- ELISA
- Introduction and history of DNA sequencing, Sequencing gels and equipment, Sanger DNA Sequencing, Mini sequencing or single base extension (SBE) sequencing, Random sequencing, Direct sequencing, de novo and re-sequencing
- Amplification PCR
- Sequencing PCR
- Dye Terminators
- Role of PCR in DNA sequencing
- Role of fluorescent materials and capillary electrophoresis in sequencing automation instrumentation

Practical Unit-I

- Separation of proteins by chromatographic techniques, Molecular Weight Determination of Proteins
- Identification of sugars, proteins, DNA/RNA, electrolytes etc. by UV/Visible spectrophotometer
- Extraction of DNA from human blood
- PCR and estimation of size and quality of amplified DNA product by agarose gel electrophoresis DNA Sequencing electropherogram data analysis and differentiation of homozygous and heterozygous nucleotides

Textbooks and Reading Material

Textbooks.

- Kumar, H. (2022). *Advanced Techniques of Analytical Chemistry: Volume 1* (Vol. 1). Bentham Science Publishers.
- Ghosal, S., & Avasthi, A. S. (2018). *Fundamentals of bioanalytical techniques and instrumentation*. PHI Learning Pvt. Ltd..
- Birnie, G. D., & Rickwood, D. (Eds.). (2014). *Centrifugal separations in molecular and cell biology*. Butterworth-Heinemann.
- Wilson, K., Hofmann, A., Walker, J. M., & Clokie, S. (Eds.). (2018). *Wilson and Walker's principles and techniques of biochemistry and molecular biology (8th ed.)*. Cambridge university press.
- Walla, P. J. (2014). *Modern biophysical chemistry: detection and analysis of biomolecules*. John Wiley & Sons.
- Christian, G. D., Dasgupta, P. K., & Schug, K. A. (2020). *Analytical Chemistry, International Adaptation (7th ed.)*. John Wiley & Sons.
- Munshi, A. (Ed.). (2012). *DNA sequencing: methods and applications*. BoD–Books on Demand.

Teaching Learning Strategies

- Class Lecture
- Class Discussions

- Class Tutorials
- Lab Demonstration

Assignments: Types and Number with Calendar

- 1st Quiz in 4th Week of 5 marks
- 2nd Quiz in 10th Week of 5 marks
- 3rd Quiz in 14th Week of 5 marks
- 1st Assignment in 8th Week of 10 marks

Assessment

Sr. No.	Elements	Weightage	Details
1	Midterm Assessment	35%	Written Assessment at the mid-point of the semester.
2	Formative Assessment	25%	Continuous assessment includes: Classroom participation, assignments, presentations, viva voce, attitude and behavior, hands-on-activities, short tests, projects, practical, reflections, readings, quizzes etc.
3	Final Assessment	40%	Written Examination at the end of the semester. It is mostly in the form of a test, but owing to the nature of the course the teacher may assess their students based on term paper, research proposal development, field work and report writing etc.