

DISCIPLINE SPECIFIC ELECTIVE COURSE -18

Advanced Biotechniques and Bioinstrumentation

Zoo-DSE-18

CREDIT DISTRIBUTION, ELIGIBILITY AND PRE-REQUISITES OF THE COURSE

Course title & Code	Credits	Credit distribution of the course			Eligibility criteria	Pre-requisite of the course (if any)
		Lecture	Tutorial	Practical/ Practice		
Advanced Biotechniques and Bioinstrumentation Zoo-DSE-18	04	03	0	01	As per the Program Eligibility	Basic understanding of Zoology

Learning Objectives

The learning objectives of this course are as follows:

- To understand advanced techniques used for research, diagnostics, and industrial applications Biotechnology.
- To learn the principles, applications, and limitations of bioinstrumentation methods.
- To gain hands-on experience in the operation and maintenance of advanced instruments.
- To develop critical thinking to select and apply suitable techniques for solving specific biological problems.
- To learn to interpret experimental data and troubleshoot issues in instrumentation.

Learning Outcomes

By studying this course, students will be able to

- Have a better understanding of the diverse cellular processes and cellular interactions.
- To explain the principles and working mechanisms of advanced instruments in biotechnology.
- To demonstrate proficiency in operating instruments like spectrophotometers, chromatographs, and PCR machines.
- To design experiments using advanced techniques like chromatography, electrophoresis, and mass spectrophotometry.
- To analyze experimental data generated by advanced bioinstrumentation.
- To apply biotechnological tools to solve problems in diagnostics, genomics, proteomics, and drug discovery.

Syllabus of DSE-18**THEORY** **45 hrs****UNIT- 1: Spectroscopic Techniques** **10 hrs**

Principles and Applications: UV-Visible spectroscopy, Fluorescence spectroscopy, Circular Dichroism (CD). Advanced Techniques: Infrared (IR) spectroscopy, Atomic Absorption Spectroscopy (AAS), and Nuclear Magnetic Resonance (NMR).

Applications: Structure determination, protein folding studies, and biomolecular interactions.

UNIT-2: Chromatography and Electrophoresis **10 hrs**

Chromatography: Principles and applications of HPLC, Gas Chromatography (GC), and Ion Exchange Chromatography.

Electrophoresis: Polyacrylamide Gel Electrophoresis (PAGE), Agarose Gel Electrophoresis, 2D Gel Electrophoresis. Applications in genomics and proteomics.

UNIT-3: Molecular Biology Techniques **9 hrs**

Polymerase Chain Reaction (PCR): qPCR, RT-PCR, and digital PCR.

DNA Sequencing: Sanger sequencing and Next-Generation Sequencing (NGS).

UNIT 4: Imaging and Analytical Tools **16 hrs**

Microscopy: Principles and applications of Confocal Microscopy, Electron Microscopy (SEM, TEM). Mass Spectrometry (MS): Principles, instrumentation, and applications in proteomics and metabolomics. Principles, components, and applications of Biosensors in diagnostics.

PRACTICALS **30 hrs****(Laboratory periods: 15 classes of 2 hours each)**

1. Chromatography Techniques: Separation of biomolecules using Chromatography.
2. Electrophoresis Techniques: SDS-PAGE for protein separation.
3. Amplification of DNA. Gel documentation and analysis of PCR products.
4. Imaging Techniques: Demonstration of SEM/TEM.
5. Biosensors: Demonstration of glucose biosensors and ELISA techniques.

Project related to topics covered in Theory/ project report based on visit to labs/institutions/industry.

Essential/Recommended readings

1. Principles and Techniques of Biochemistry and Molecular Biology by Keith Wilson and John Walker, 7th Edition (2010), Cambridge University Press.
2. Biophysical Chemistry: Principles and Techniques by Upadhyay, Upadhyay, and Nath, Revised Edition (2020), Himalaya Publishing.
3. Introduction to Spectroscopy by Donald L. Pavia et al., 5th Edition (2015), Cengage Learning.
4. Bioinstrumentation by John G. Webster, 1st Edition (2004), Wiley-Interscience.

Suggestive readings

1. Fundamentals of Analytical Chemistry by Douglas A. Skoog et al., 9th Edition (2013), Cengage Learning.
2. Molecular Biology of the Gene by James D. Watson et al., 7th Edition (2013), Pearson.
3. Chromatography: Principles and Instrumentation by B.K. Sharma, Revised Edition (2007), Goel Publishing House.

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