Gyanmanjari Innovative University

Syllabus
Gyanmanjari Science College
Semester-7 (B.Sc.)

Subject: Bioanalytical Techniques- BSCMB17402

Type of course: Major

Prerequisite: Basic knowledge of Biochemistry and Cell Biology with fundamental laboratory concepts.

Rationale: It provides critical knowledge and hands-on skills in using advanced instruments for the analysis, measurement, and manipulation of biological systems. These subjects bridge the gap between biological sciences by equipping students with the tools needed to conduct experiments, process data, and analyze biomolecules in research and industry settings. Understanding the principles and applications of bioanalytical instruments like spectrophotometers, chromatographs, and electrophoresis systems is fundamental for students pursuing careers in microbiology, pharmaceuticals, medical diagnostics, and bioengineering.

Teaching and Examination Scheme:

Teaching Scheme			Credits	Examination Marks					Total Marks
				SEE		CCE			
CI	T	P	C	Theory	Practical	MSE	LWA/V	ALA	
3	0	2	4	75	25	30	20	50	200

Legends: CI-Class Room Instructions; T – Tutorial; P - Practical; C – Credit; ESE - End Semester Examination; MSE- Mid Semester Examination; V – Viva; CA - Continuous Assessment; ALA- Active Learning Activities.

3 Credits * 25 Marks = 75 Marks (each credit carries 25 Marks) Theory
1 Credits * 25 Marks = 25 Marks (each credit carries 25 Marks) Practical
SEE 100 Marks will be converted in to 50 Marks
CCE 100 Marks will be converted in to 50 Marks
It is compulsory to pass in each individual component.

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Course Content:

Unit No	Course content	Hrs	% Weightage
1	**Analytical Techniques and Separation Methods in Biochemistry** • Measurements of pH, Conductivity, EDTA, Acid Base and Dichromate titrations. • Principles and applications of ultracentrifugation, ultrafiltration, precipitation, and equilibrium dialysis; Horizontal and vertical electrophoresis. • Native and SDS Polyacrylamide gel electrophoresis.	10	25
2	**Chromatography** • Basic principles and applications of Paper chromatography • TLC • Gas Chromatography • Size exclusion chromatography • Ion-exchange chromatography • Affinity chromatography • Reverse phase chromatography • HPLC • FPLC	10	25
3	**Principles and Applications of Spectroscopic and Structural Analysis Techniques** • Basic Principles and Applications of UV/Visible absorption, CD, Raman, Infrared, Fluorescence and Atomic Absorption Spectroscopy • Basic Principle, instrumentation, and applications of Nuclear Magnetic Resonance & ESR, X-Ray Crystallography. • Mass Spectrometry: MALDI-TOF, LC-MS & GC-MS	15	25
4	**Advanced imaging techniques in microscopy** • Live cell imaging, • Confocal microscopy and sample preparation for fluorescence microscopy, • High content/throughput screening: Basics of SEM and Specimen preparation for SEM, Basics of TEM and Specimen preparation for TEM	10	25

Continuous Assessment:

Sr. No	Active Learning Activities	Marks
1	**Student Seminar** Students will prepare a presentation on clinical applications of electrophoresis techniques and present in class and upload presentations on the GMIU web Portal.	10
2	**Problem-Solving Exercise** Faculty will provide students with an unknown mixture of amino acids. Students are required to perform Thin Layer Chromatography (TLC) to separate the components of the mixture. Based on the results, they will calculate the Rf values and identify the amino acids present. Students must then upload a photograph of the chromatogram along with detailed calculations and results on the GMIU web portal.	10
3	**Conceptual Assignments** Students will prepare comparative charts of spectroscopic techniques based on principle, instrumentation, and applications and upload charts on the GMIU web Portal.	10
4	**Research-Oriented Assignment** Students will prepare to review a **recent research paper** (simplified level) using advanced microscopy and upload it on GMIU web portal.	10
5	**Attendance**	10
	Total	**50**

Suggested Specification table with Marks (Theory):75

Distribution of Theory Marks **(Revised Bloom's Taxonomy)**						
Level	Remembrance (R)	Understanding (U)	Application (A)	Analyze (N)	Evaluate (E)	Create (C)
Weightage	20%	40%	30%	10%	-	-

Note: This specification table shall be treated as a general guideline for students and teachers. The actual distribution of marks in the question paper may vary slightly from above table.

Course Outcome:

After learning the course, the students should be able to:	
CO1	Understand and apply basic biochemical analytical and separation techniques, and interpret experimental results for biomolecule analysis.
CO2	Gain knowledge of various chromatographic techniques and their applications in separation, purification, and analysis of biomolecules.
CO3	Develop an understanding of spectroscopic and structural techniques and their role in determining the properties and structure of biomolecules.
CO4	Recognize and explain advanced microscopy techniques and their application in visualizing biological structures at cellular and subcellular levels.

List of Practical:

Sr. No.	Descriptions	Unit No.	Hrs.
1.	Preparation of buffer solutions and measurement of pH using pH meter.	1	2
2.	Estimation of acidity in given samples.	1	2
3.	Estimation of alkalinity in given samples.	1	2
4.	Determination of water hardness using EDTA titration.	1	2
5.	Estimation of chloride ions by titration method.	1	2
6.	Separation of dyes using TLC technique.	2	4
7.	Separation of mixtures using Thin Layer Chromatography.	2	4
8.	Study of absorption spectra of biomolecules (DNA by DPA).	3	2
9.	Determination of λmax of given compounds using UV–Visible spectrophotometer.	3	4
10.	Demonstration of live cell imaging techniques (virtual lab).	4	2
11.	Identification of cell structure in plant and animal cells under microscope.	4	4
Total		30	

Instructional Method:

The course delivery method will depend upon the requirement of content and the needs of students. The teacher, in addition to conventional teaching methods by black board, may also use any tools such as demonstration, role play, Quiz, brainstorming, MOOCs etc.

From the content 10% topics are suggested for flipped mode instruction.

Students will use supplementary resources such as online videos, NPTEL/SWAYAM videos, e-courses, Virtual Laboratory

The internal evaluation will be done on the basis of Active Learning Assignment

Practical/Viva examination will be conducted at the end of semester for evaluation of performance of students in the laboratory.

Reference Books:

1. An Introduction to Practical Biochemistry by Plummer.
2. Environmental science and Biotechnology: Theory and techniques by A. G. Murugesan and C. Rajakumari.
3. Instrumental methods of chemical analysis by B. K. Sharma.
4. Microscopy for students by J. D. Casartelli, McGraw, Hill pub.
5. Principles and techniques of biochemistry and molecular biology (6th edition) by Keith Wilson andJohn walker, Cambridge Edition.
6. Principles of Instrumental Analysis by Douglas A. Skoog, F. James Holler, and Stanley R. Crouch
7. Handbook of Bioinstrumentation by M. M. S. K. Kumar
8. Modern Bioinstrumentation by M. S. Baghery
9. Bioinstrumentation by John G. Webster