Semester VII

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 Techniques in Biochemical Research (BCH-DSC-19)	**4**	**2L**		**2P**	**Class XII with Science and Biology**	**-**

Learning Objectives

The objective of the course is to provide students with a sound background of the latest techniques used in biochemistry research and to provide them with an understanding of the principles underlying these techniques. The course is designed to impart laboratory skills in the form of practical exercises so that students can apply this knowledge to augment their research acumen and improve their understanding of the subject.

Learning outcomes

After completion of the course students will:

- Students will acquire knowledge about the principles and applications of latest methods used to analyze nucleic acids and proteins.
- Students will learn about the principle and applications of microscopy and various cell biology techniques. Students will also be exposed to various methods of labeling DNA, proteins and whole cells and their applications in research.
- Combine different biochemical methods to address a complex biological question.

- The course will also provide them an opportunity for hands-on-experience to develop their laboratory skills expected of any biochemist working in a research lab.

SYLLABUS OF DSC-19

BCH-DSC-19: ADVANCED TECHNIQUES IN BIOCHEMICAL RESEARCH

Semester – VII

Theory

Credits: 2 **Total Hours: 30**

UNIT I: Methods for Analysis of Nucleic Acids **No. of hours: 14**

Introduction to hybridization methods and labeling (Biotinylation, Fluorescent tags etc): Southern hybridization, *In situ* hybridization. Binding of nucleic acids with protein: Electrophoretic Mobility Shift Assay (EMSA), Chromatin immunoprecipitation (ChIP). Gene expression analysis: Reporter assays - example luciferase assay, semi-quantitative RT-PCR and quantitative real time PCR (qRT-PCR), DNA Microarrays and NGS.

UNIT II: Methods for Analysis of Proteins **No. of hours: 09**

Protein-Protein Interaction: Immunoprecipitation, Yeast two hybrid, Quantitative Proteomics: 2D protein gel electrophoresis, 2D-DIGE, Structural Analysis: Mass Spectrometry, MS/MS, CD Spectra and X Ray Crystallography.

UNIT III: Microscopy Based Techniques **No. of hours: 04**

Fluorescence microscopy, Confocal microscopy, Scanning electron microscopy, Transmission electron microscopy.

UNIT IV: Cell Biology Techniques **No. of hours: 03**

Flow cytometry, FACS, BrDU assay, Annexin V assay and TUNEL assay

2.3 Practical:

Credit: 2 **Total Hours: 60**

1. Southern Blotting
2. RT-PCR /qRT-PCR
3. SDS PAGE and Western Blotting
4. Virtual Lab for EMSA
5. Virtual lab on 2D-DIGE
6. Virtual lab on Microarray
7. Tour of a State-of-the-art Instrumentation Facility

2.4 Essential readings:

1. Green, M. R., & Sambrook, J. (2012). *Molecular cloning: A laboratory manual* (4th ed., Vol. 1-3). Cold Spring Harbor, NY: Cold Spring Harbor Laboratory Press.
2. Wilson, K., & Walker, J. (Eds.). (2010). *Principles and techniques of biochemistry and molecular biology* (7th ed.). Cambridge: Cambridge Univ. Press.
3. Ausubel, F.M. et al. (2012). *Current protocols in molecular biology*. New York: John Wiley & Sons.
4. Bisen, P. S., & Sharma, A. (2013). *Introduction to instrumentation in life sciences*. Boca Raton: CRC Press.
5. Bonifacino, J. S., Dasso, M., Lippincott-Schwartz, J., Hartford, J. B., & Yamada, K. M. (Eds.). (1999). *Current protocols in cell biology*. New York: John Wiley.

6. Coligan, J. E., Dunn, B. M., Ploegh, H. L., Speicher, D. W., & Wingfield, P. T. (1995).
Current protocols in protein science. New York: John Wiley & Sons.
7. Levine, S., & Johnstone, L. (2008). *The ultimate guide to your microscope*.
New York: Sterling Pub.
8. Schimmel. (2013). *Biophysical Chemistry*. MacMillan Higher Education.

Suggested readings:

1. Golemis, E., & Adams, P. D. (2005). *Protein-protein interactions: A molecular cloning manual* (2nd ed.). Cold Spring Harbor, NY: Cold Spring Harbor Laboratory Press.
2. Sheehan, D. (2010). *Physical biochemistry: Principles and applications* (2nd ed.). Chichester: Wiley-Blackwell.

3. Teaching Learning Process and Assessment Methods

Facilitating the Achievement of Course Learning Outcomes**

Unit No.	Course Learning Outcomes	Teaching and Learning Activity	Assessment Tasks
I	The student will learn about the methods used in analysis and manipulation of nucleic acid	Classroom teaching with visual aids, power point presentations, videos, discussions on applications	Quizzes, assignments and analytical problem- solving questions, paper presentations

II	The student will understand about the various techniques involving protein-protein interactions, their separation, and structural characterization	Classroom teaching with visual aids, power point presentations, experimental data from journals, 3D models, discussions	Assignments, class tests, analytical questions. Students will be asked to analyze and present papers on protein-protein interactions.
III	The students will get familiar with microscopy-based techniques and their application	Presentations, classroom teaching, audio and visual aids, trip to a facility. MOOCs will be used.	Assignments, class tests, class presentations, Mid-term assessment
IV	The students will understand the basics and application of various techniques in the field of cell biology	Powerpoint presentations, trip to a facility to show instruments, audio & visual aids. Special lecture will be arranged by expert in cell biology techniques.	Assignments, class tests, class presentations

(Assessment tasks enlisted here are indicative in nature)**

4. Keywords

Southern Blotting, Colony hybridization, EMSA, Western Blotting, Immuno-precipitation, Pull down assay, FACS, Flow Cytometry