Course title: Biotechnology laboratory – Part 3			
Course code: BBP 107	**No. of credits:** 7	**L-T-P:** 0-0-210	**Learning hours:** 210
Pre-requisite course code and title (if any): None			
Department: Department of Biotechnology			
Course coordinator: Dr Chaithanya Madhurantakam	**Course instructor:** Dr Chaithanya Madhurantakam /Prof. Anandita Singh / Prof. Shashi Bhushan Tripathi/ Dr. Souren Paul		
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Course type: Core	**Course offered in:** Semester 3		

Course description:

The objective of this laboratory course is to introduce students to experiments related to biotechnology. The course is designed to teach students the utility of various experimental methods in biotechnology in a problem-oriented manner. The list of experiments given in each module is representative and includes experiments. Part A will be common for both the streams. Part B1 is only for Microbial Biotechnology stream whereas Part B2 is only for Plant Biotechnology stream. The instructor may choose experiments for student's laboratory training as per requirements.

Course objectives:

1. To provide training on standard as well as advanced techniques in the field of molecular biology, biochemistry, microbiology and plant biology.
2. To introduce the students to various techniques of bioinformatics used to analyze DNA, RNA and protein sequences
3. To train the students in designing experiments with appropriate controls.

Course contents

Module	Topic	L	T	P
Suggested experiments				
	PART A: Common to both streams			150
	1. Searching sequences with BLAST in GenBank (NCBI) database 2. Multiple sequence alignment using ClustalW/MUSCLE 3. Phylogenetic analysis of proteins and DNA sequences using MEGA 4. Processing of fastq files by FastQC/FastP/FastX/Trimmomatic for quality, trimming etc. 5. Formatting of data files on Galaxy platform 6. Designing of PCR primers with Primer2/Batchprimer3 7. Homology modelling of proteins 8. Analysis of molecular data using Corehunter or PowerCore-Core collections 9. Genotyping of mapping populations with codominant markers 10. Analysis of marker segregation and Chi-square test 11. Construction of linkage map from SNP data using JoinMap 12. QTL mapping in mapping populations using SNP marker data 13. Analysis of GWAS using SNP data 14. Protein Separation Techniques- Purification of target protein using IMAC 15. Protein Separation Techniques- Purification of target protein using Ion Exchange Chromatography-I 16. Protein Separation Techniques- Purification of target protein using Ion Exchange Chromatography-II 17. Protein Separation Techniques- Purification of target protein using Gel Exclusion Chromatography-I			

	18. Protein Separation Techniques- Purification of target protein using Gel Exclusion Chromatography-II 19. Analysis of purified protein through SDS PAGE and quantification of purified protein 20. Salting out method to purify a recombinant target protein 21. Packing the chromatographic column for protein purification method			
	PART B1: Microbial Biotechnology			60
	1. Isolation of endophytic bacteria from different plants 2. Isolation of microbes from soil and rhizosphere 3. 18S rRNA/ ITS sequencing for identification of fungal isolates 4. In-silico analysis: Identification of binding cavity on the surface of a pathogenic protein and docking with potential ligands-I 5. In-silico analysis: Identification of binding cavity on the surface of a pathogenic protein and docking with potential ligands-II 6. In-silico analysis: Analysis of protein-antibody complex			
	PART B2: Plant Biotechnology			60
	1. Designing of primers for miRNA quantification 2. Designing of guide RNA for CRISPR/Cas9 genome editing 3. Pollen viability testing by staining and pollen germination 4. Emasculation and controlled crosses to develop F1 hybrids 5. Screening for disease resistance (Viral, bacterial, and fungal) in plants 6. Screening for salt/ heavy metal tolerance in plants 7. Analysis of morphological data with ImageJ software			

Evaluation criteria:

1. Attendance: 5%
2. Preparation of lab record(s) throughout the semester: 25%
3. End semester evaluation: 70% (Following components would be included)
   a) Spotting: 15 %
   b) Viva-voce: 15 %
   c) Experiment(s) assigned on the day of the exam: 40%

Learning outcomes:

1. Ability to conduct experiments with adequate safety precautions.
2. Capacity to compare and evaluate various approaches in solving a given experimental problem.
3. Ability to design and interpret molecular biology experiments.
4. Designing experiments with critical thinking, creativity and using a problem-solving approach
5. Proficiency in defining a research problem, drawing logical inferences from results and documenting outcomes in systematic manner.

Pedagogical Approach: Wet lab experiments, demonstrations, calculations, computer based analytical methods used in analysis of DNA, RNA and protein data, writing of experimental results and analysis report, visits to different research facilities.

Skill Set:

1. Able to work in biotechnology lab and perform experiments
2. Able to analyses experimental data and critical thinking.

Employability:

1. Academic and industrial research
2. Industries based on biotechnology, pharmacy, and agriculture.

Materials-

1. Study material and laboratory protocol will be provided by course instructor.
2. "Biochemistry Laboratory: Modern Theory and Techniques" Rodney Boyer, second Edition, Pearson Education, 2012.
3. "Analytical Techniques in Biochemistry and Molecular Biology" Rajan Katoch, Springer, 2011.
4. "DNA and protein sequence analysis. A Practical approach" Bishop M.J., Rawlings C.J. (Eds.)1997.

Website

1. https://nptel.ac.in/

Journals

1. Peer reviewed relevant scientific journals.

Advanced Reading Material

Will be provided by instructor if require.

Additional information (if any)

List of experiments given in each module are representative, instructor may choose any of them for student's laboratory training as per requirements.

Student responsibilities

1. Class attendance.
2. Study of course materials as specified by the instructor.
3. Regular submission of given class assignments.

Course Reviewers

1. Professor Bijoy Neog, Professor, Department of Life Sciences, Dibrugarh University, Assam
2. Dr. Tapan K Mondal, Principal Scientist, ICAR-NIPB, Pusa Campus, New Delhi
3. Dr. Rupesh Deshmukh, Associate Professor, Plaksha University, Mohali, Punjab