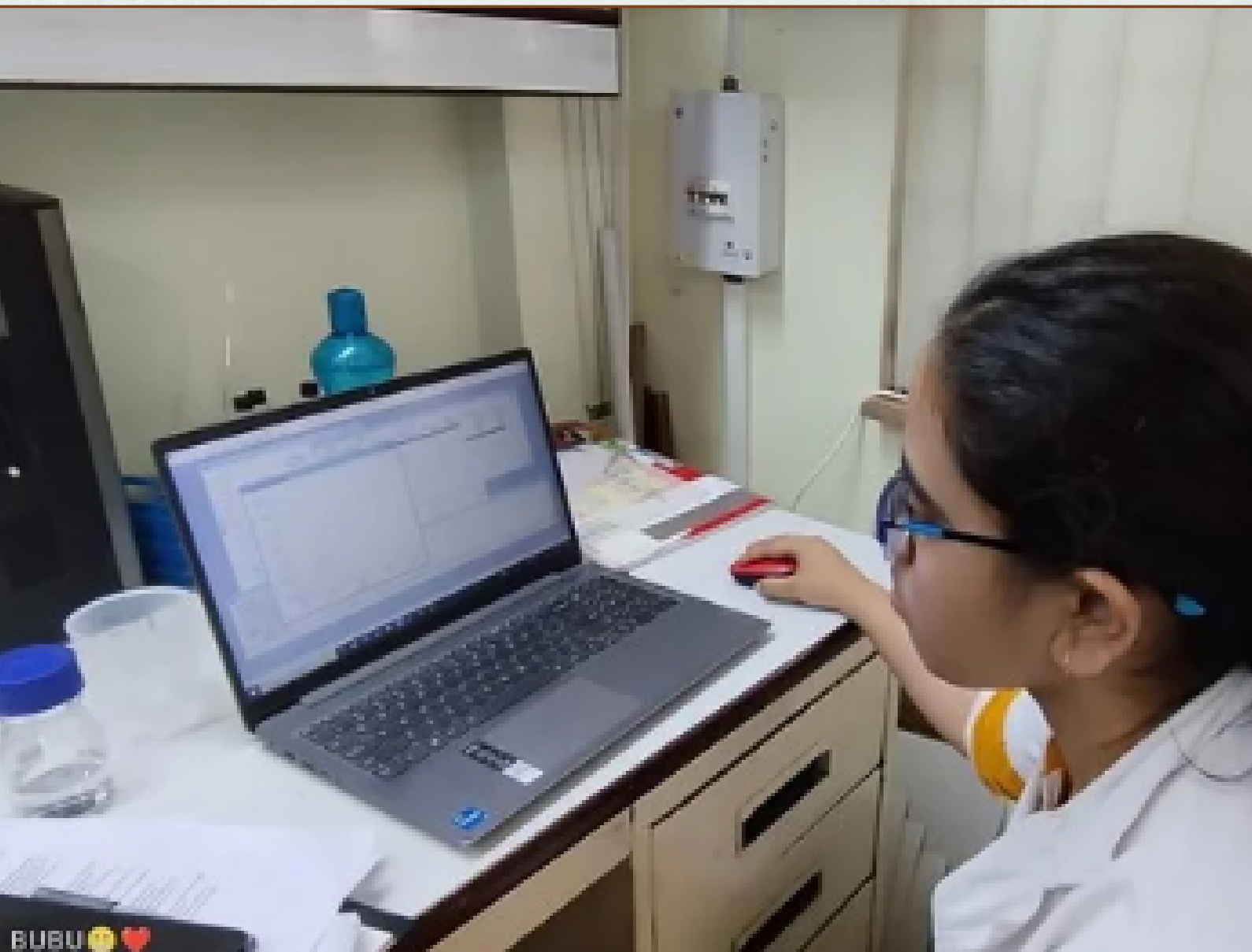


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Workshop Steps

Genomics

3 Lectures

- Introduction to Genomics – Foundations and Fundamentals (Lecture 1)
- Genomics Technologies and Applications (Lecture 2)
- Advanced Genomics Concepts (Lecture 3)

Transcriptomics

5 Lectures

- Introduction to Transcriptomics (Lecture 1)
- Technologies for Transcriptomic Profiling (Lecture 2)
- Transcriptomic Data Generation and Preprocessing (Lecture 3)
- Analysing Transcriptomic Data (Lecture 4)
- Advanced Topics and Future Directions (Lecture 5)

Proteomics

7 Lectures

- Introduction to Proteomics & Gel-Based Techniques (Lecture 1)
- Methods in proteomics (Lecture 2)
- Gel-Free Proteomics Techniques (Lecture 3)
- Qualitative & Quantitative proteomics (Lecture 4)
- Applications of Proteomics (Lecture 5-6)
- Data Acquisition Strategies & Software Tools (Lecture 7)

Metabolomics

6 Lectures

- Introduction to Metabolomics (Lecture 1)
- Experimental Design & Sample Preparation (Lecture 2)
- Analytical Techniques in Metabolomics (Lecture 3)
- Data Processing & Statistical Analysis (Lecture 4)
- Biological Interpretation & Pathway Analysis (Lecture 5)
- Applications, Case Studies & Future Trends (Lecture 6)





Workshop Schedule

GENOMICS

Date	Day	Time	Topics
9th Aug	Sat		Introduction to Genomics – Foundations and Fundamentals
10th Aug	Sun		Genomic Technologies and Applications
15th Aug	Fri		Advanced Genomic Concepts

TRANSCRIPTOMICS

Date	Day	Time	Topics
16th Aug	Sat	5:00-6:00 pm	Introduction to Transcriptomics
17th Aug	Sun		Technologies for Transcriptomic Profiling
23rd Aug	Sat		Transcriptomic Data Generation and Preprocessing
24th Aug	Sun		Analysing Transcriptomic Data
30th Aug	Sat		Advanced Topics and Future Directions





Workshop Schedule

PROTEOMICS

Date	Day	Time	Topics
5th Sep	Fri	5:00-6:30 pm	Introduction to Proteomics & Gel-Based Techniques
6th Sep	Sat		Methods in proteomics
12th Sep	Fri		Gel-Free Proteomics Techniques (Ex- Serum Proteomics)
13th Sep	Sat		Qualitative & Quantitative proteomics
19th Sep	Fri		Applications of Proteomics
20th Sep	Sat		Data Acquisition Strategies & Software Tools

METABOLOMICS

Date	Day	Time	Topics
4th Oct	Sat	5:00-6:00 pm	Introduction to Metabolomics
5th Oct	Sun		Experimental Design & Sample Preparation
10th Oct	Fri		Analytical Techniques in Metabolomics
11th Oct	Sat		Data Processing & Statistical Analysis
17th Oct	Fri		Biological Interpretation & Pathway Analysis
18th Oct	Sat		Applications, Case Studies & Future Trends



GENOMICS

Lecture 1: Introduction to Genomics – Foundations and Fundamentals

Outline

- Definition and Scope of Genomics
 - Difference between genetics and genomics
 - Subfields: structural, functional, comparative, and epigenomics
- Historical Milestones
 - Human Genome Project
 - Next-Generation Sequencing (NGS)
- Genome Organization
 - Chromosomes, genes, exons/introns, non-coding DNA
 - Prokaryotic vs eukaryotic genome structure
- Tools & Techniques Overview
 - DNA sequencing
 - Microarrays

Lecture 2: Genomics Technologies and Applications

Outline

- Sequencing Technologies
 - Sanger sequencing
 - NGS platforms (Illumina, PacBio, Oxford Nanopore)
- Bioinformatics Basics
 - Genome assembly, annotation
 - Introduction to databases: NCBI, Ensembl, UCSC Genome Browser
- Applications
 - Genomics selection in animal and plant breeding
 - Disease diagnosis and precision medicine
 - Comparative genomics in evolution and biodiversity

Lecture 3: Advanced Genomics Concepts

Outline

- Functional Genomics
 - Transcriptomics, proteomics, metabolomics
 - RNA-seq, gene expression profiling
- Epigenomics and Gene Regulation
 - DNA methylation, histone modification
 - Non-coding RNAs
- Genome Editing and Future Trends
 - CRISPR-Cas systems
 - Synthetic biology and genome synthesis
- Ethical, Legal, and Social Issues (ELSI)
 - Data privacy
 - Gene editing in humans and animals





TRANSCRIPTOMICS

Lecture 1: Introduction to Transcriptomics

Objective: Overview of transcriptomics and its importance in biology

Lecture 2: Technologies for Transcriptomic Profiling

Objective: Tools and methods used to generate transcriptomic data

Lecture 3: Transcriptomic Data Generation and Preprocessing

Objective: How raw transcriptomic data is produced and prepared for analysis

Lecture 4: Analysing Transcriptomic Data

Objective: Overview of core analytical techniques for interpreting transcriptomic data

Lecture 5: Advanced Topics and Future Directions

Objective: Cutting-edge methods and real-world applications





PROTEOMICS

Lecture 1: Introduction to Proteomics & Gel-Based Techniques

What is Proteomics?

- Overview of proteomics and its significance in biological research.

Lecture 2: Methods in proteomics?

From Gene to Protein: The Central Dogma

- Understanding the flow from DNA to RNA to protein and its relevance in proteomics.

Gel-Based Proteomics Methods (Ex- Plant Proteomics)

- Introduction to two-dimensional gel electrophoresis (2D-GE) and its applications.

Lecture 3: Gel-Free Proteomics Techniques (Ex- Serum Proteomics)

- Exploring liquid chromatography-mass spectrometry (LC-MS/MS) and its advantages.

Case Study: Serum Proteomics Applications

- Real-world examples of gel-free proteomics in clinical settings.

Lecture 4: Qualitative & Quantitative proteomics

Lecture: Quantitative Proteomics: Label-Free vs. Label-Based Methods

- Comparison of quantitation strategies including SILAC, TMT, and iTRAQ.

Hands-On: Sample Preparation for Quantitative Proteomics

- Techniques for preparing samples for both label-free and labeled quantitation.

Lecture 5: Applications of Proteomics

- Post-Translational Modifications

Lecture: Studying Post-Translational Modifications (PTMs)

- Focus on phosphorylation and techniques like Phospho-proteomics /phospho-enrichment analysis.

Lecture 6: Applications of Proteomics

Lecture: Applications of Proteomics in Biomarker Discovery

- Strategies for identifying disease biomarkers using proteomic approaches.

Case Study: Biomarker Identification Workflow

- Step-by-step walkthrough of a biomarker discovery project.

Lecture 7: Data Acquisition Strategies & Software Tools

Data-Dependent Acquisition (DDA) vs. Data-Independent Acquisition (DIA)

- Understanding the principles and differences between DDA and DIA methods.

Lecture: Software Tools in Proteomics

- Introduction to software such as MaxQuant, Proteome Discoverer, and Skyline.





METABOLOMICS

Lecture 1: Introduction to Metabolomics

What is Metabolomics?

- Definition, Scope, and Applications

Metabolomics in Systems Biology

- Role in Omics Sciences (Genomics, Proteomics, and Transcriptomics)

Types of Metabolomics Approaches (Targeted vs. Untargeted)

Metabolite Classes & Biochemical Pathways

Lecture 2: Experimental Design & Sample Preparation

Importance of Experimental Design in Metabolomics

- Replication, Randomization, and Sample Size Considerations

Sample Collection & Storage Strategies

Tissue, Biofluid, and Plant Metabolite Extraction Protocols

Lecture 3: Analytical Techniques in Metabolomics

Introduction to Analytical Platforms

- Mass Spectrometry (MS)
- Nuclear Magnetic Resonance (NMR) Spectroscopy

Chromatographic Techniques for Metabolite Separation

- Gas Chromatography (GC)
- Liquid Chromatography (LC)

GC-MS and LC-MS Workflow Demonstration

- Sample Injection, Instrument Settings, Data Acquisition

Lecture 4: Data Processing & Statistical Analysis

Raw Data Processing - Peak Detection, Deconvolution, Normalization

Metabolite Identification Strategies

- Spectral Libraries & Databases (PUBCHEM, ChemSpider, HMDB, KEGG)
- Retention Time & Tandem MS (MS/MS)

Statistical Approaches for Metabolomics Data analysis -

- Data processing through data filtration and Normalization,
- Analytical pathways [Univariate Analysis- t-test, ANOVA, Volcano plot; Multivariate Analysis- PCA (Principal Component Analysis), PLS-DA (Partial Least Squares Discriminant Analysis); Cluster Analysis- Dendrogram]

Data Preprocessing & Multivariate Analysis using MetaboAnalyst

Lecture 5: Biological Interpretation & Pathway Analysis

Metabolic Pathway Mapping & Functional Insights

Integration with Other Omics Data (Proteomics, Transcriptomics)

Metabolite Biomarker Discovery

Lecture 6: Applications, Case Studies & Future Trends

Metabolomics in Agriculture & Plant Sciences

Clinical & Biomedical Applications of Metabolomics

Industrial Applications: Food, Pharma, and Environmental Sciences





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