

Training Module (120 Days)

Title: *Comprehensive Laboratory Training Program: Advanced Skills in Microbiology, Molecular Biology, Biochemistry, and Applied Biotechnology*

Phase 1 | Laboratory Foundation and Quality Systems

- Refresher on Good Laboratory Practices (GLP).
- Advanced laboratory management: inventory tracking, calibration, and preventive maintenance.
- Documentation logbooks, batch records, and electronic data management.
- Advanced sterilization protocols.
- Chemical safety, waste segregation, and biosafety level classification.
- Introduction to *Lean Laboratory Concepts* and error minimization strategies.

Phase 2 | Advanced Microbiology

- Microbial growth kinetics and generation time calculations.
- Quantitative microbiology: viable counts, and CFU-to-OD600 correlation.
- Antibiotic sensitivity testing: Kirby–Bauer method.
- MIC: performing broth microdilution with data interpretation and error analysis.
- Preparation and cryopreservation of bacterial cultures.

Phase 3 | Molecular Biology

- High-yield plasmid and genomic DNA extraction using silica column systems.
- Primer designing, gradient PCR, and optimization strategies.
- Agarose and polyacrylamide gel electrophoresis (comparison and troubleshooting).
- Restriction enzyme digestion.
- Transformation in *E. coli*.
- RNA isolation, quantification (A260/A280 ratio).
- Reverse Transcription PCR (RT-PCR) and introduction to Real-Time PCR (qPCR).

Phase 4 | Biochemistry

- Recombinant protein expression in *E. coli* – from induction to inclusion body solubilization.
- Protein purification by affinity chromatography (Ni-NTA column).
- Protein quantification using Bradford assay.
- SDS-PAGE for purity analysis.
- Dialysis, and concentration optimization.

Phase 5 | Applied Biotechnology & Innovation

- LAMP-based diagnostics and isothermal amplification overview.
- DNA extraction from blood samples.
- Bioinformatics primer: using NCBI BLAST, multiple sequence alignment, and gene annotation.

Phase 6 | Professional Development

- Data analysis and graphical presentation using Excel/GraphPad.
- Scientific communication, technical reports, and lab notebooks.
- Ethics in biotechnology research and intellectual property basics.
- Industry preparedness: CV building
- Final evaluation through presentation, viva.