

LESSON PLAN

Discipline: B.Tech in Biotechnology

Semester: 6th

Subject: BTPE3009 – Bioreactor Design and Analysis

Semester Duration: Dec 2025 – April 2026

Name of the Teaching Faculty: Dr. Gayatri Nahak

Week	Class Day	Theory Topics
1st	1st	Introduction to bioreactors: definition, scope and industrial applications
	2nd	Classification of bioreactors: batch, fed-batch, continuous
	3rd	Types based on operation: aerobic, anaerobic, microbial, mammalian
2nd	1st	Bioreactor components: vessel design and materials
	2nd	Impellers, spargers and agitation systems
	3rd	Sterilization methods and aseptic operation
3rd	1st	Monod equation: derivation and assumptions
	2nd	Substrate utilization kinetics
	3rd	Case study: microbial growth dynamics
4th	1st	Batch bioreactor design equations
	2nd	Growth kinetics and substrate limitation
	3rd	Productivity calculations
5th	1st	Fed-batch bioreactors and feeding strategies
	2nd	Dynamic mass balance
	3rd	Industrial applications
6th	1st	Continuous bioreactors: chemostat concept
	2nd	Steady-state analysis
	3rd	Washout condition
7th	1st	Oxygen transfer: importance and mechanism
	2nd	KLa estimation methods
	3rd	Factors affecting oxygen transfer
8th	1st	Power consumption in agitation
	2nd	Mixing and aeration
	3rd	Scale effects on mass transfer
9th	1st	Rheology: Newtonian fluids
	2nd	Non-Newtonian fluids
	3rd	Effect on mixing
10th	1st	Immobilized enzyme systems
	2nd	Diffusion limitations
	3rd	Applications
11th	1st	Heat transfer in bioreactors
	2nd	Cooling systems
	3rd	Thermal profiling
12th	1st	Scale-up principles
	2nd	Reynolds number and similarity
	3rd	Industrial challenges
13th	1st	Advanced bioreactors: airlift
	2nd	Membrane and packed-bed
	3rd	Photobioreactors

14th	1st	Sensors: pH, DO, temperature
	2nd	PID control
	3rd	Automation
15th	1st	Non-ideal reactors
	2nd	Modeling
	3rd	Simulation
16th	1st	Case studies
	2nd	Revision
	3rd	Discussion