

Bioprocess engineering basic principles

Material and energy balances, fluid flow and residence time distribution, mass and heat transfer, enzymatic and cellular kinetics

Online course: organized on-demand

Course fee: 400 € per session

Course content

8 sessions: sessions can be taken separately

Effort: 4 - 8 h per session

COURSE OBJECTIVE

The course provides a comprehensive overview of the scientific basis of bioprocess engineering. It covers the essential concepts and methods for bioprocess simulation, scale-up, and design.

The course offers a combination of methodological presentations, exercises, and case study problems.

INSTRUCTOR

Jean-Marc Engasser, BioProcess Digital

DIGITAL LEARNING

- Learning platform with course resources
- Recorded slideshow presentations
- Case studies on spreadsheets templates with guides
- Online collective or one-to-one tutoring

COURSE PROGRAM

Session 1: Material balances

- Initial-final and instantaneous mass balances. Principle of mass conservation
- Use of material balances for kinetic analysis, simulation, and sizing of bioreactors

Session 2: Energy balances

- Initial-final and instantaneous energy balances. Mechanical energy and heat
- Use of energy balances for energy consumption evaluation and temperature simulation

Session 3: Fluid flow in bioprocesses

- Principle of momentum conservation and transfer. Newtonian and non-newtonian fluids. Laminar and turbulent flows
- Application to flow in pipes and tanks agitation. Evaluation of energy consumptions.

Session 4: Residence time distribution

- Residence time distribution (RTD) concept. Experimental RTD analysis and flow models
- Influence of RTD on continuous bioreactor and sterilizer sizing

Session 5: Mass transfer

- Mass transfer rate laws by diffusion and convection. Concept of mass transfer resistances
- Kinetic analysis and simulation of solute diffusion in solids, and oxygen transfer in bioreactors

Session 6: Heat transfer

- Heat transfer rate laws by conduction, convection, and radiation. Concept of heat transfer resistances
- Evaluation of heat transfer rates and temperature profiles across solids

Session 7: Enzymatic bioconversion kinetics

- Kinetic laws for enzymatic reactions and enzyme denaturation. Influence of temperature
- Kinetic analysis and simulation of enzymatic bioconversions in bioreactors

Session 8: Microbial or cellular transformation kinetics

- Kinetic laws of cellular growth, substrates consumption, and metabolites production
- Kinetic analysis and simulation of cellular transformations in bioreactors