



#### ONLINE COURSE

On-demand

#### COURSE FEE

350 € per session

#### COURSE ORGANIZATION

Course divided in 8 sessions

Sessions can be taken individually

Sessions scheduling: suggested one per week

Effort: 4 - 8 h per session

#### COURSE DESCRIPTION

This advanced course in fermentation engineering focuses on the digital scale-up and optimization of microbial processes, through an in-depth case study of glutamic acid production. Participants will learn methodologies in kinetic analysis, process modeling and simulation, scale-up strategies, and optimal operational design. The course integrates upstream and downstream operations, aiming to maximize annual glutamate output or minimize production costs.

#### INSTRUCTOR

Jean-Marc Engasser, BioProcess Digital

#### DIGITAL LEARNING

- Learning platform with course resources
- Live or recorded slideshow videos
- Fermentation project on spreadsheets templates with self-corrections and guides
- Online collective or one-to-one tutoring

### COURSE PROGRAM

#### PART 1: KINETIC ANALYSIS AND SIMULATION MODEL DEVELOPMENT

##### Session 1: Kinetic analysis of bacteria growth

At the laboratory, evaluation of the rates of bacteria growth and sugar consumption in batch and continuous modes

##### Session 2: Kinetic analysis of oxygen consumption and transfer

At the laboratory, determination of the oxygen consumption rate, of the oxygen solubility and air to medium transfer rate

##### Session 3: Kinetic analysis of metabolites production

At the laboratory, evaluation of the rates of metabolites production and sugar consumption after induction

##### Session 4: Fermentation simulation model construction on spreadsheet

Modeling-simulation of the bacteria growth and metabolism in the laboratory batch fermentor

#### PART 2: DIGITAL SCALE-UP AND OPTIMIZATION

##### Session 5: Batch fermentation scale-up and production optimization

Scale-up of the fermentation simulation model. Optimization of the batch fermentation operation for highest production

##### Session 6: Batch fermentation cost optimization

Cost evaluation of the fermentation process. Optimization of the batch fermentation operation for lowest production cost

##### Session 7: Fed-batch fermentation optimization

Optimal operation of the fed-batch fermentations for reduced co-metabolites excretion and lowest cost

##### Session 8: Fermentation intensification by oxygen-enriched air

Optimization of the fed-batch fermentor, aerated with oxygen-enriched air, for increased production