ChE-320

Bioreactor modeling and simulation

Hatzimanikatis Vassily

Cursus	Sem.	Type
Biotechnology minor	E	Opt.
Chemical Engineering	BA6	Obl.
HES - CGC	E	Obl.

Language of teaching	English
Credits	3
Session	Summer
Semester	Spring
Exam	During the semester
Workload	90h
Weeks	14
Hours	**4 weekly**
Courses	1 weekly
TP	3 weekly
Number of positions	

Summary

The course of Bioreactor modeling and simulation focuses on the principles of algorithmic design and analysis of biochemical reactors. The application of these designed reactors would be in the production line of the of pharmaceutical, biotech and chemical industries.

Content

• Introduction to the enzyme and microbial kinetics
• Modeling and simulation of bioreactors
  • • Design of Batch reactors
  • • Design of Continuous reactors
  • • Design of Fed-batch reactors
• Application of chemical engineering design principles
  • • Mass and energy balance
  • • Mass transfer
  • • Process control

Keywords

Bioreactor, enzymatic reactions, design and modeling, optimization

Learning Prerequisites

Required courses

Biochemical engineering
Introduction to chemical engineering

Important concepts to start the course

Modeling
Differential equations

Learning Outcomes

By the end of the course, the student must be able to:

- Realize the kinetic of enzymatic reactions
- Assess / Evaluate the tools and techniques for design of bioprocesses
- Apply the basic MATLAB programming tools for modeling of enzymatic/microbial phenomena
- Analyze the biochemical processes
- Visualize the results obtained through modeling
- Model a bioreactor

Transversal skills

- Access and evaluate appropriate sources of information.
- Continue to work through difficulties or initial failure to find optimal solutions.
- Write a scientific or technical report.
- Demonstrate the capacity for critical thinking
- Keep appropriate documentation for group meetings.
- Set objectives and design an action plan to reach those objectives.

Teaching methods

The course is given in a computer room. The students form groups of 3. The background theory is given in slide presentation. Afterwards the students are assisted to solve the exercises of the project by using MATLAB. Special workshops of relevant toolboxes of MATLAB might take place.

Expected student activities

Each group collaborates to effectively solve the exercises of the project and produce every 2nd week project reports focusing on the background theory of design and analysis of biochemical reactors.

Assessment methods

There will be 5 project given throughout the semester each one containing 2 to 3 problems for implementing algorithmic techniques and solving problems in MATLAB environment.
Grading will be based on the successfulness of completion of the problems of all the projects. A breakdown of the grading is given as follows:
Exercises: 4/6
Code format, Clarity of presentation of results: 2/6
Bonus: +0.5/6

Supervision

Office hours	Yes
Assistants	Yes
Forum	No

Resources

Bibliography

Biological Reaction Engineering: Dynamic Modeling Fundamentals with Simulation Examples, I. J. Dunn, E. Heinzle, J. Ingham, and J. E. Prenosil, Ed. Wiley-Vch.
Biochemical Engineering Fundamentals, J. E. Bailey and D. F. Ollis Ed. McGraw-Hill Science.

Ressources en bibliothèque

- Biological reaction engineering : dynamic modelling fundamentals with simulation examples / Dunn
- Biochemical engineering fundamentals / Bailey

Websites

- http://â#¢ Biological Reaction Engineering / Dunn
- http://â#¢ Biochemical Engineering Fundamentals / Bailey