66219 - Biochemical Engineering

Información del Plan Docente

Academic Year	2016/17
Academic center	110 - Escuela de Ingeniería y Arquitectura
Degree	531 - Master's in Chemical Engineering
ECTS	6.0
Course	1
Period	Second semester
Subject Type	Optional
Module	---

1.Basic info

1.1.Recommendations to take this course

1.2.Activities and key dates for the course

2.Initiation

2.1.Learning outcomes that define the subject

2.2.Introduction

3.Context and competences

3.1.Goals

3.2.Context and meaning of the subject in the degree

3.3.Competences

3.4.Importance of learning outcomes

4.Evaluation

5.Activities and resources

5.1.General methodological presentation

The learning process has been proposed to encourage the student continued work and participation, and it focuses on the theoretical and practical aspects to understand, analyze and apply the acquired knowledges to solve real problems. In the lectures, the subject theoretical bases will develop, solving some model problems. The sessions of problems and cases, and laboratory practices, are the effective complement to the lectures, allowing verify the compression of matter by the student. In addition, these sessions help the student to acquire a point of view more applied. Finally, tutored work will complement the above.

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5.2.Learning activities

The subject "Biochemical Engineering" requires a dedication by students of about 150 h, equivalent to 6 ECTS. The learning process is based on the following schedule of teaching and learning activities:

- Participative theoretical lectures (35 h)
- Questions and exercises sessions (16 h)
- Laboratory sessions (9 h)
- Programmed works in small student groups, supervised by the teacher (14 h)
- Personal study (70 h)
- Assessment tests (6 h)
- Individual tutorials throughout the course

5.3.Program

Chapter 1. Introduction to biochemical reaction engineering.

Composition of organic matter. Enzymes and microorganisms of industrial interest. Characteristics of biological reactions. Biochemical products and processes. Kinds of industrial bioreactors.

Chapter 2. Kinetics of enzyme catalysed reactions.

Reactions with one substrate: General model and Michaelis-Menten and Briggs-Haldane approximations. Reversible reactions. Reactions with several substrates. Cooperativity: Hill model. Types and kinetic effects of inhibition. Influence of pH and temperature. Enzyme deactivation. Immobilization of enzymes and biocatalysts. Effects of immobilization on the mass transfer resistances. External and internal effectiveness factors.

Chapter 3. Design and operation of enzymatic bioreactors.

Ideal bioreactors: Batch reactor, fed-batch reactor, continuous stirred tank reactor (CSTR), CSTR in series, plug-flow reactor. Productivity and optimization of ideal reactors. Effect of enzyme inhibition and deactivation. Comparison of bioreactors.

Chapter 4. Microbial growth kinetics.

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Stoichiometry, yield and reaction rate. Kinetics of substrate consumption and product formation. Phases of cellular growth. Non-structured models. Substrate limited growth: Monod model. Other kinetic models. Effects of inhibition. Diauxic growth. Environmental effects. Thermal death kinetics. Introduction to structured kinetic models.

Chapter 5. Design of microbial fermenters.

Types of reactors: Batch and Fed-batch reactors. Continuous stirred tank: Chemostat. Chemostat with recycle. Chemostats in series. Plug flow fermenter. Multiphase fermenters. Comparison and selection of bioreactors.

5.4.Planning and scheduling

Theoretical and exercise lectures and lab sessions are given following the schedule established by EINA before the beginning of the current academy course. Every teacher will inform the students about individual tutorial schedule. Other activities will be planned as a function of the number of students early enough.

The planning and approximate distribution of theoretical lessons and corresponding questions and exercises sessions is the following:

Chapter 1. Introduction to biochemical reaction engineering. (2 h)

Chapter 2. Kinetics of enzyme catalysed reactions. (10 h)

Chapter 3. Design and operation of enzymatic bioreactors. (16 h)

Chapter 4. Microbial growth kinetics. (8 h)

Chapter 5. Design of microbial fermenters. (15 h)

5.5.Bibliography and recomended resources

BB	Bailey, James E.. Biochemical engineering fundamentals / James E. Bailey, David F. Ollis . - 2nd ed. New York [etc.] : McGraw-Hill, cop. 1986
BB	Díaz, Mario. Ingeniería de bioprocesos / Mario Díaz Madrid : Paraninfo, cop. 2012
BB	Ingeniería bioquímica / Francesc Gòdia Casablancas y Josep López Santín (Editores) ; Carles Casas Alvero ... [et al.] Madrid : Síntesis, D.L. 1998
BC	Blanch, Harvey W.. Biochemical engineering / Harvey W. Blanch, Douglas S. Clark New York [etc.] : Marcel Dekker, cop. 1997
BC	Cornish-Bowden, Athel. Fundamentals of enzyme kinetics / Athel Cornish-Bowden . -

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BC	Cutlip, Michael B.. Problem solving in chemical and biochemical engineering with POLYMATH, Excel, and MATLAB / Michael B. Cutlip, Mordechai Shacham . - 2nd ed. Upper Saddle River [New Jersey] : Prentice Hall, cop. 2008
BC	Doran, Pauline M.. Bioprocess engineering principles / Pauline M. Doran Oxford : Academic Press, cop. 2013
BC	Dutta, Rajiv. Fundamentals of biochemical engineering / Rajiv Dutta Berlin : Springer ; New Delhi : Ane Books India, cop. 2008
BC	Illanes, Andrés. Problem solving in enzyme biocatalysis / Andrés Illanes, Lorena Wilson and Carlos Vera Chichester (United Kingdom) : John Wiley & Sons, cop. 2014
BC	McDuffie, Norton G.. Bioreactor design fundamentals / Norton G. McDuffie Boston [etc.] : Butterworth-Heinemann, cop. 1991
BC	Moser, Anton. Bioprocess technology : kinetics and reactors / Anton Moser ; translated by Philip Manor . - Rev. and expanded translation New York : Springer, cop. 1988
BC	Shuler, Michael L.. Bioprocess engineering : basic concepts / Michael L. Shuler, Fikret Kargi . - 2nd ed. Harlow, Essex : Pearson, cop. 2014