Universidad Zaragoza

Academic Year/course: 2021/22

66219 - Biochemical Engineering

Syllabus Information

Academic Year: 2021/22
Subject: 66219 - Ingeniería bioquímica
Faculty / School: 110 - Escuela de Ingeniería y Arquitectura
Degree: 531 - Master's in Chemical Engineering
ECTS: 6.0
Year: 2 and 1
Semester: Second semester
Subject Type: Optional
Module:

1. General information

2. Learning goals

3. Assessment (1st and 2nd call)

4. Methodology, learning tasks, syllabus and resources

4.1. Methodological overview

The methodology followed in this course is oriented towards achievement of the learning objectives. It encourages the student continue work and participation, and it focuses on the theoretical and practical aspects to understand, analyze and apply the acquired knowledge to solve real problems.

In the lectures, the theoretical bases will be developed in combination to some model problem-solving. The sessions of problems and cases, laboratory practice sessions, and guided assignments are the effective complement to the lectures, allowing to verify the understanding of the course contents.

4.2. Learning tasks

The course "Biochemical Engineering" requires a dedication of 150 hours, equivalent to 6 ECTS. It includes the following learning tasks:

- Participative lectures (32 h)
- Practice sessions of questions and exercises (19 h)
- Laboratory sessions (9 h)
- Guided assignments in small student groups, supervised by the teacher (16 h)
- Study (70 h)
- Assessment tests (4 h)
- Individual tutorials throughout the course

4.3. Syllabus

The course will address the following topics:

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

- Composition of organic matter. Enzymes and microorganisms of industrial interest. Characteristics of biological

reactions. Biochemical products and processes. Types of industrial bioreactors.

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

- 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.

Topic 3. Design and operation of enzymatic bioreactors (12 h).

- 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.

Topic 4. Microbial growth kinetics (6 h).

- 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.

Topic 5. Design of microbial fermenters (12 h).

- 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.

Topic 6. Industrial bioprocesses (18 h).

- Introduction to enzymatic and microbial bioprocesses. Downstream porcessing. Industrial enzymes. Examples of industrial bioprocesses.

4.4. Course planning and calendar

Further information concerning the timetable, classroom, office hours, assessment dates and other details regarding this course, will be provided on the first day of class or please refer to the EINA website.

4.5. Bibliography and recommended resources

http://biblos.unizar.es/br/br_citas.php?codigo=66219&year=2019