Bioprocess simulation and analysis is a continuation of the upstream and downstream topics. In fact, it is not only focused in the deeper understanding of each upstream and downstream unit, but also in the full integration of all steps needed to build up an entire bioprocess. Often, different alternatives of a single bioprocess step or a completely different bioprocess are available and feasible. SuperPro Designer (Intelligent LTD software) is a usefulness tool to simulate the different alternatives of bioprocesses in order to manufacture a specific product, and enables the biotechnologist to make decisions about the most convenient bioprocess design, based mainly in the outcome of economic, environmental and social sustainability. Overall, this subject aims to put all together the knowledge learnt in the prior courses and pretends to integrate this knowledge by means of designing a case of study chosen by the student itself. It is a very practical-oriented subject.

**COMPETENCES** (of the course placed in relation to the pre-assigned competences in the subject matter)

- That students develop those learning skills necessary to undertake further studies with a high degree of autonomy. (CB5)
- Be able to assess the impact of their professional activity on the sustainable development of society. (T3)
- Be able to incorporate contemporary aspects related to the exercise of their profession. (T5)
- Be able to understand and apply advanced knowledge of Biosciences and Engineering to the field of Biotechnology. (E3)
- Be able to integrate the knowledge and tools of biotechnology for their application to different industrial sectors that use, develop or produce biotechnological products or processes. (E6)

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PREVIOUS REQUIREMENTS * (modules, subject matters, courses or knowledge necessary for the follow-up of the subject. State previous courses required to be completed)

Fundamentals of Process Engineering, Bioreactors and Downstream Processes

CONTENTS (List the content of the course, with up to two level detail)

1. Introduction
   1.1. Processes in Biotechnology
   1.2 Introduction to SuperPro Designer®
2. Bioprocess simulation and analysis
   2.1. Bioprocess simulation
   2.2. Economical sustainability analysis
   2.3. Environmental sustainability analysis
   2.4. Social sustainability analysis
3. Main aspects involved in Bioprocesses
   3.1. Product or application
   3.2. Substrates (Media)
   3.3. Biocatalyst
   3.4. Bioreactor
   3.5. Downstream / Purification
4. Examples: Study cases.

METHODOLOGY

LEARNING ACTIVITIES * (Complete the table relating activities, workload in ECTS credits, and competences.)

<table>
<thead>
<tr>
<th>Learning Activities</th>
<th>ECTS Credits</th>
<th>Competences</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lectures</td>
<td>1,2</td>
<td>B5, T5, E3, E6</td>
</tr>
<tr>
<td>Case and Problem-Solving Sessions</td>
<td>0,2</td>
<td>B5, T3, E3, E6</td>
</tr>
<tr>
<td>Seminars</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Practical and Lab Work</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Presentations</td>
<td>0,2</td>
<td>B5, T3, E3</td>
</tr>
<tr>
<td>Personal Study</td>
<td>3,3</td>
<td>B5, E3</td>
</tr>
<tr>
<td>Assessment Tasks (Exams, Continuous Assessment...)</td>
<td>0,1</td>
<td>B5, E3</td>
</tr>
<tr>
<td><strong>TOTAL</strong></td>
<td><strong>5,0</strong></td>
<td><strong>B5, T3, T5, E3, E6</strong></td>
</tr>
</tbody>
</table>

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TEACHING METHODOLOGY (justify the teaching methodology in relation to the competences and course contents. Between 100 and 200 words)

- **Lectures** - Presentation and explanation of contents by a teacher (possibly including demonstrations).
- **Case and Problem-Solving Sessions** - Resolution of exercises and problems, and exposition / discussion of cases by a teacher with the active participation of students.
- An example of a bioprocess will be proposed for each student and the Student must search for the information needed in order to carry out the complete design, the relevant simulations and the analysis of the alternatives. The student will present the whole project in front of the classmates and share their design and analysis (oral presentation).
- **Personal study activities** - Personal work of the student necessary to acquire the competences of each subject matter and to assimilate the knowledge exposed in lectures, cases, and problem-solving sessions, using the recommended reference materials. They also include the preparation of tasks related to the other activities, and the preparation of exams.
- **Assessment Tasks** - Oral and / or written tests made during the academic period of a course, or once it has finished (final exams, follow-up controls).

ASSESSMENT

ASSESSMENT METHODS * (Complete the table relating assessment methods, competences, and weight percentage in the course qualification)

<table>
<thead>
<tr>
<th>Assessment methods</th>
<th>Weight</th>
<th>Competences</th>
</tr>
</thead>
<tbody>
<tr>
<td>Final Exam</td>
<td>45%</td>
<td>B5, T5, E3, E6</td>
</tr>
<tr>
<td>Midterm Exam/s</td>
<td>-</td>
<td></td>
</tr>
<tr>
<td>Continuous Assessment Activities</td>
<td>15%</td>
<td>B5, T5, E3, E6</td>
</tr>
<tr>
<td>Reports and Presentations</td>
<td>35%</td>
<td>B5, E3</td>
</tr>
<tr>
<td>Lab or Field Work</td>
<td>-</td>
<td></td>
</tr>
<tr>
<td>Projects</td>
<td>-</td>
<td></td>
</tr>
<tr>
<td>Host Student Evaluation</td>
<td>-</td>
<td></td>
</tr>
<tr>
<td>Participation</td>
<td>5%</td>
<td>T3, T5</td>
</tr>
</tbody>
</table>

LEARNING OUTCOMES (Explanation of the student's achievements that allow the assessment of competences, relating them to the competences and the assessment methods)

- The subject aims to enable students to integrate the knowledge learned throughout the different courses and from the different subjects, and use them for the design, simulation and analysis of a biotechnological process (case studio chosen by

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themselves), in a way that allows them to connect the knowledge gained from different disciplines and put it in context. (DB5, T5, E6).

- Students must be able to carry out the corresponding analyzes of economic, environmental and social sustainability of bioprocesses, and learn the different methods used to quantify, by means of indicators when needed, the impact of the decisions made during the design of the bioprocess in each of the three areas of analysis (T3, E3).
- The student must be aware of the role as a biotechnologist and also of the competences that he/she should cover as a biotechnologist in its discipline when being part of a multidisciplinary team (T5, T3).

QUALIFICATION (Explanation of the qualification system)

The qualification of the subject will consider the grading obtained in the Continuous Assessment Activities (AS), of the Reports and presentations (TP), of the Participation (P) and of the final exam (EF).

The qualification of the Continuous Assessment Activities (AS, 15% of the final grade) will be based on the resolution of a questionnaire (control). The minimum grade of 3.5 out of 10 is necessary in order to be able to take the final exam.

The qualification of the Reports and Presentations (TP, 35% of the final grade) will correspond to the evaluation of the projects proposed during the course. The presentation of all the activities, within the deadline established, with a minimum grade of 4 out of 10 is mandatory to be able to take the final exam. Delivering work after the deadline is equivalent to no presentation, unless is justified properly.

The qualification of the participation (P, 5% of the final grade) is awarded by the lecturer at the end of the subject taking into account the level of participation that the student has had in the overall of the activities of the subject.

The final exam (EF, 45% of the final grade) aims to assess the synthesis of the subject (a minimum of 4 out of 10 must be obtained in the final exam).

The final grade (CF) of the subject will be calculated using the following equation:

\[ CF = 0.45 \ EF + 0.15 \ AS + 0.35 \ TP + 0.05 \ P \]

The qualifications of AS, TP and P will be maintained in case of taking a second call within the same year, as well as the equation proposed by the evaluation of the CF.

In subsequent calls the CF will correspond to the final exam grade.

\[ CF = EF \]

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ASSESSMENT OF THE COMPETENCES (Describe the grading system for each competence in relation with the assessment tasks)

The assessment of the competences B5 and T3, the final grade of the subject will be used as the indicator.
The assessment of the E3 competence, the average of the AS grading and the final exam grade used will be as indicator.
The assessment of the competences T5 and E6, the grade of Reports and Presentations (TP), that corresponds mainly to the project developed and presented, will be used as an indicator.

BIBLIOGRAPHY (Recommended and accessible to the student.)

Principal:

Complementaria

DOCUMENT HISTORY

PREVIOUS REVISIONS (Indicate date and author / s, first the most recent one)

CURRENT REVISION (Indicate date and author / s)
21st March 2019, Dr. Martí Lecina

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COURSE: BIOPROCESS SIMULATION AND ANALYSIS

SUBJECT MATTER: Bioprocess Engineering
MODULE: Optional Subjects
PROGRAM: Degree in Biotechnology

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