COURSE: BIOCATALYSIS AND BIOTRANSFORMATIONS

SUBJECT MATTER: Biocatalysis
MODULE: Bioprocess Engineering
PROGRAM: Degree in Biotechnology

GENERAL FEATURES *
Type: ☐ Basic training, ☑ Compulsory, ☐ Elective
☐ Final Degree Project, ☐ Practicum
Duration: Semestral Semester / s: 7
Number of ECTS credits: 5
Language / s: Spanish, Catalan

DESCRIPTION

SHORT DESCRIPTION AND JUSTIFICATION (of the meaning of the course in relation to the studies. Between 100 and 200 words)

The use of biocatalysts, used either as isolated enzymes or whole microbial cells, offers a remarkable arsenal of highly selective transformations for synthetic organic chemistry. During the last decades, this methodology has become an indispensable tool for asymmetric synthesis, not only at an academic level, but also at an industrial scale. This course of biocatalysis and biotransformations provides a basic introduction on the use of biocatalysts, principles of stereoselective transformations, properties of enzymes and kinetics of different types of reactions, and enzymatic technology such as the use of enzymes in organic solvents and immobilization techniques.

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

- That students know how to apply their knowledge to their work or vocation in a professional manner, and have acquired the competencies that allow them to elaborate and defence arguments as well as to solve problems within their area of study. (CB2)
- 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 understand and apply advanced knowledge of Biosciences and Engineering to the field of Biotechnology. (E3)
- Be able to use tools, systems or processes to carry out the activities in the field of Biotechnology according to the established requirements. (E4)
- 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)

Structure and Function of Biomolecules; Protein Engineering

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

1.- Introduction to biocatalysis and biotransformations
2.- Enzymes in organic solvents
3.- Enzyme immobilization
4.- Biotransformations. Cells as bioreactors
5.- Bioreactors and modes of operation in biocatalysis and biotransformations
6.- Enzymatic reactions. Mechanisms and applications
7.- Enzymatic reactions in tandem. Coupled systems. Regeneration of cofactors
8.- Applications of enzymes as active ingredients
9.- Applications of biocatalysis and biotransformations in the pharmaceutical industry
10.- Presentations on monographic topics.

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>1,3</td>
<td>CB2, CB5, T3, E3, E4, E6</td>
</tr>
<tr>
<td>Case and Problem-Solving Sessions</td>
<td>0,1</td>
<td></td>
</tr>
<tr>
<td>Seminars</td>
<td>0,1</td>
<td></td>
</tr>
<tr>
<td>Practical and Lab Work</td>
<td>-</td>
<td></td>
</tr>
<tr>
<td>Presentations</td>
<td>0,1</td>
<td></td>
</tr>
<tr>
<td>Personal Study</td>
<td>3,3</td>
<td></td>
</tr>
<tr>
<td>Assessment Tasks (Exams, Continuous Assessment...)</td>
<td>0,1</td>
<td></td>
</tr>
<tr>
<td><strong>TOTAL</strong></td>
<td><strong>5,0</strong></td>
<td></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)

The subject is taught in class, combining lectures by the teacher and discussion seminars of the questionnaires and problems that complement each chapter of the subject. The subject is organized into chapters by thematic concepts.

- The teaching material of each chapter (slides, scientific articles and exercises) will be accessible through the virtual campus a few days before the beginning of each chapter.
- At the beginning of the subject, students are given the class schedule by topics and dates of the "seminars".
- During the course, two seminars will be held in which the "questionnaires of concepts and questions" of the chapters developed up to now will be discussed.
- It is essential that students consult the bibliography regularly using the "questionnaires of concepts and questions" as a working guide. These questionnaires will be delivered to the teacher at the end of each seminar *.
  * Students will attend the seminar with two copies of the solved questionnaire. One to be corrected in class and the other (uncorrected) that will be self-graded at the end of the seminar and delivered to the teacher.
- Each student will prepare an individual work on a monographic subject assigned by the teacher that will be delivered in writing and presented in class (Power Point presentation, 10 min) according to the assigned calendar.

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>40%</td>
<td>CB2, CB5, T3, E3, E4, E6</td>
</tr>
<tr>
<td>Midterm Exam/s</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Continuous Assessment Activities</td>
<td>35%</td>
<td>CB2, CB5, T3, E3, E4, E6</td>
</tr>
<tr>
<td>Reports and Presentations</td>
<td>20%</td>
<td>CB2, CB5, T3, E3, E4, E6</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>E6</td>
</tr>
</tbody>
</table>

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

- The student must demonstrate knowledge of the fundamentals of biocatalysis and its applications. (→ CB2)
- The student must demonstrate learning skills with a high degree of autonomy to develop further studies in the applications of biocatalysis (→ CB5)
- The student must demonstrate his knowledge on the impact of his professional activity on the sustainable development of society (→ T3)
- The student must demonstrate proficiency to identify, formulate and solve problems of biocatalysis and biotransformations (→ E3)
- The student must demonstrate the ability to use tools, systems or processes in the field of biocatalysis and biotransformations (→ E4)
- The student must demonstrate that he is able to integrate the knowledge and tools of biocatalysis to apply them to the different industrial sectors (→ E6)

QUALIFICATION (Explanation of the qualification system)

<table>
<thead>
<tr>
<th>Evaluation methods</th>
<th>Weight</th>
</tr>
</thead>
<tbody>
<tr>
<td>FE: Final exam</td>
<td>40%</td>
</tr>
<tr>
<td>FA: Follow-up activities</td>
<td>35%</td>
</tr>
<tr>
<td>RP: Reports and presentations</td>
<td>20%</td>
</tr>
<tr>
<td>P: Participation</td>
<td>5%</td>
</tr>
</tbody>
</table>

- The qualification of the follow-up activities (FA, 35% of the final grade) will be calculated as a simple average of the activities carried out during the course, consisting of the resolution of the questionnaires of each chapter that are organized in 2 deliveries at the end of the 2 discussion seminars throughout the course. The submission of all the completed questionnaires is mandatory in order to be able to take the final exam. The qualifications of the follow-up activities will not be reported during the course.

- The qualification of the Reports and presentations (RP, 20% of the final grade) will correspond to the report of a monographic subject that will be presented as a written report and/or as a presentation in class. The presentation of the report/presentation is mandatory in order to be able to take the final exam.

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

- The final exam (FE, 40% of the final grade) aims to assess the synthesis of the subject.

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The final grade (FG) of the subject will be calculated with the following formula: \( FG = 0.4 \text{ FE} + 0.35 \text{ FA} + 0.20 \text{ RP} + 0.05 \text{ P} \).
To calculate the final grade according to the previous formula, the following must be fulfilled:

a) The final exam grade must be equal to or greater than 4.5
b) All "questionnaires of concepts and questions" must have been delivered
c) The monographic report has to be delivered.

If the grade of the final exam is lower than 4.5, the mark of the subject is that of the final exam. In second call, the evaluation criteria are the same.

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

For the evaluation of competence CB2, the final exam grade (FE, 70%) and overall score of the follow-up activities (FA, 30%) will be used as indicator.
For the evaluation of competence CB5 the indicator used will be the grade of Reports and presentations (RP, 100%).
For the evaluation of competence T3 the indicator used will be the grade of Reports and presentations (RP, 100%).
For the evaluation of competence E3, the indicator used will be the final exam grade (FEF, 70%) and overall score of the follow-up activities (FA, 30%).
For the evaluation of competence E4, the final exam grade (FE, 50%) and the grade of Reports and presentations (RP, 50%) will be used as an indicator.
For the evaluation of competence E6, the final exam grade (FE, 50%) and the grade of Reports and presentations (RP, 50%) will be used as indicator.

**BIBLIOGRAPHY** (Recommended and accessible to the student.)


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DOCUMENT HISTORY

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

CURRENT REVISION (Indicate date and author / s)
March 22, 2019, Dr. Antoni Planas

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