**COURSE: PROTEIN ENGINEERING**

**SUBJECT MATTER:** Biochemistry  
**MODULE:** Biochemistry  
**PROGRAM:** Degree in Biotechnology

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**GENERAL FEATURES** *

Type: ☐ Basic training, ☑ Compulsory, ☐ Elective  
☐ Final Degree Project, ☐ Practicum

Duration: Semestral  
Number of ECTS credits: 5  
Language / s: Spanish, Catalan

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**DESCRIPTION**

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

Natural evolution has provided an enormous diversity of proteins with specialized functions. Biotechnology makes use of this functional diversity for diverse applications. The purpose of protein engineering is to know the structure-function relationships of proteins (with special significance in enzymes) in order to modify their properties for specific functions of biotechnological interest (biocatalysts, biomaterials, etc.). This course provides students with the conceptual and methodological foundations of protein engineering as a fundamental tool in biotechnology. This subject includes the concepts and examples of protein engineering that will be complemented in the subsequent subject of “Biocatalysis and Biotransformations”.

**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 defend arguments as well as to solve problems within their area of study (CB2)
- 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)

**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, Recombinant DNA technology

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

1.- Catalysis and enzymatic kinetics
2.- Structure of proteins and structural motifs
3.- Protein biophysics
4.- Folding, stability and solubility
5.- Objectives and strategies in protein engineering
6.- Mutagenesis and enzymatic redesign
7.- Directed evolution
8.- Methods of selection and functional screening
9.- Metagenomics
10.- Synthetic biology

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>1,4</td>
<td>B2, E3, E4</td>
</tr>
<tr>
<td>Case and Problem-Solving Sessions</td>
<td>0,1</td>
<td>B2, E3, E4</td>
</tr>
<tr>
<td>Seminars</td>
<td>0,1</td>
<td>B2, E3, E4</td>
</tr>
<tr>
<td>Practical and Lab Work</td>
<td>-</td>
<td>B2, E3, E4</td>
</tr>
<tr>
<td>Presentations</td>
<td>-</td>
<td>B2, E3, E4</td>
</tr>
<tr>
<td>Personal Study (Exams, Continuous Assessment...)</td>
<td>3,3</td>
<td>B2, E3, E4</td>
</tr>
<tr>
<td>Assessment Tasks</td>
<td>0,1</td>
<td>B2, E3, E4</td>
</tr>
<tr>
<td>TOTAL</td>
<td>5,0</td>
<td>B2, E3, E4</td>
</tr>
</tbody>
</table>

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, 4 seminars will be held in which the "questionnaires of concepts and questions" of the chapters developed so far will be discussed.

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- 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 do an individual work on a monographic subject assigned by the teacher that will be delivered in writing according to the assigned calendar.
- At the end of the course, a seminar on general integration of the subject and preparation of the final exam will be given.

## 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>B2, E3, E4</td>
</tr>
<tr>
<td>Midterm Exam/s</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Continuous Assessment Activities</td>
<td>35%</td>
<td>B2, E3, E4</td>
</tr>
<tr>
<td>Reports and Presentations</td>
<td>20%</td>
<td>E3, E4</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>E3</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 student must demonstrate knowledge of the fundamentals of structure and function of proteins, their properties and applications as biocatalysts, and the concepts and methodologies of protein engineering. (→ B2)
- The student must demonstrate proficiency to identify, formulate and solve protein engineering problems (→ E3)
- The student must demonstrate the ability to assess the impact of Biochemistry and Biosciences, and in particular of genetic and protein technologies in the sustainable development of society (→ E4)

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QUALIFICATION

<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, consisting of the resolution of the questionnaires of each chapter that are organized in 4 deliveries at the end of the 4 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 an individual work on a monographic subject that will be delivered in writing. The presentation of the work 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 subject.

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

The final grade (FG) of the subject will be calculated with the following formula: FG = 0.4 FE + 0.35 FA + 0.20 RP + 0.05 P.

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

If the grade of the final exam is lower than 4.5, the grade 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 E3 the indicator used will be the grade of Reports and presentations (RP, 100%).
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.

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BIBLIOGRAPHY (Recommended and accessible to the student.)

- Stryer, Bioquímica, Reverté
- Protein Engineering Handbook Hardcover by Stefan Lutz (Editor), Uwe Theo Bornscheuer (Editor), ISBN-13: 978-3527331239

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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