240EQ011 - Biotechnology

Coordinating unit: 295 - EEBE - Barcelona East School of Engineering
Teaching unit: 713 - EQ - Department of Chemical Engineering
Academic year: 2018
Degree: MASTER'S DEGREE IN CHEMICAL ENGINEERING (Syllabus 2012). (Teaching unit Compulsory)
MASTER'S DEGREE IN CHEMICAL ENGINEERING (Syllabus 2012). (Teaching unit Compulsory)
ECTS credits: 6
Teaching languages: Catalan, Spanish

Teaching staff
Coordinator: Núria Saperas Plana
Others: Núria Saperas Plana
Jordi Bou Serra

Degree competences to which the subject contributes

Specific:
1. Easily integrate technical team and creative interdisciplinary any chemical company or research center.
2. Designing products, processes, systems and services for the chemical industry as well as the optimization of other already developed technology based on various areas of chemical engineering, understanding of processes and transport phenomena, separation operations and engineering chemical reactions, nuclear, electrochemical and biochemical.

Teaching methodology

Half of the credits will consist in lecture classes and the other half in practical classes.

Learning objectives of the subject

Biotechnology has a multidisciplinary nature that integrates both engineering and sciences. In this sense, our aim is to provide the future engineers with the knowledge ant tools that allows them to understand and correctly interact with the other professionals that they can find in a biotechnological industry (biochemists, microbiologists, enzymologists, etc.).

Study load

<table>
<thead>
<tr>
<th>Study load</th>
<th>Hours</th>
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<tbody>
<tr>
<td>Total learning time: 150h</td>
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<tr>
<td>Hours large group:</td>
<td>27h</td>
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<tr>
<td>Hours medium group:</td>
<td>0h</td>
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<tr>
<td>Hours small group:</td>
<td>27h</td>
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<tr>
<td>Guided activities:</td>
<td>0h</td>
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<tr>
<td>Self study:</td>
<td>96h</td>
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</table>
# 1. Introduction. What is biotechnology? Main areas of application of biotechnology. Historical development of biotechnology.

**Learning time:** 2h 30m  
Theory classes: 1h  
Self study: 1h 30m

**Description:**  
Introduction. What is the biotechnology? Main areas of application of the biotechnology. Development of the biotechnology

**Specific objectives:**  
Have a global vision of the different fields of application of the biotechnology and the role which the engineer can play

# 2. Organization and chemical composition of the cell.

**Learning time:** 3h 30m  
Theory classes: 1h 30m  
Self study: 2h

**Description:**  
Types of cell organization. Procaryotic and eukaryotic cell. Procariotic and eukaryotic of interest in biotechnology. Chemical composition of the living beings

**Specific objectives:**  
Know that the living material has an organization and a chemical composition very different to the inert matter and that the cell is its structural and functional unit


**Learning time:** 6h  
Theory classes: 2h 30m  
Self study: 3h 30m

**Description:**  
Classification of lipids, structure and function. Structure and function of carbohydrates. Monosaccharides and polysaccharides. Examples of biomedical interest and/or biotechnological

**Specific objectives:**  
Know the structure and function of the main types of lipids and carbohydrates
<table>
<thead>
<tr>
<th>4. Amino acids, peptides and proteins. Enzymes.</th>
<th>Learning time: 11h</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Description:</strong> Function of the proteins. Amino acids. Peptide bonds. Structural levels of the proteins. Fibrous and globular proteins. Enzymes. Introduction to the enzyme kinetics. Inhibiting enzymatic. Enzyme modulators</td>
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</tr>
<tr>
<td><strong>Related activities:</strong> Activities 1, 2 and 3</td>
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<tr>
<td><strong>Specific objectives:</strong> Know the structure and function of the proteins. Know that the enzymes are biochemical catalysts of changing nature and know its main properties and action mechanisms</td>
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<table>
<thead>
<tr>
<th>5. Nucleic acids. Structure and function.</th>
<th>Learning time: 6h 30m</th>
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<tbody>
<tr>
<td><strong>Description:</strong> Structure of the nucleic acids. Replication, transcript and translation of the DNA</td>
<td></td>
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<tr>
<td><strong>Related activities:</strong> Activity 3</td>
<td></td>
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<tr>
<td><strong>Specific objectives:</strong> Know the different types of nucleic acids and its structure. Understand the relation between the structure and the function of the DNA as a carrying molecule of hereditary information</td>
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<tr>
<th>6. Genetic engineering.</th>
<th>Learning time: 3h 30m</th>
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<tbody>
<tr>
<td><strong>Description:</strong> Technology of the recombinant DNA. General stages in the introduction of a new gene and its expression. Some concrete examples and exercises to be solved</td>
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<tr>
<td><strong>Related activities:</strong> Activity 3</td>
<td></td>
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<tr>
<td><strong>Specific objectives:</strong> Acquire some basic knowledge about the technology of the recombinant DNA</td>
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</table>
### 7. Metabolism. General view and regulation.

**Learning time:** 3h 30m  
- Theory classes: 1h 30m  
- Self study: 2h

**Description:**  
Concept and types of metabolism. Catabolism and anabolism. Aerobic and anaerobic respiration. Main types of fermentations of industrial interest. Metabolic regulation.

**Specific objectives:**  
Know the main concepts related to the metabolism, which on the biochemical side is about fermentation and which are the main fermentations of industrial interest. Understand the need to regulate the metabolism and that its knowledge can sometimes be used to increase productivity in a certain process.

### 8. Industrial culture of microorganisms.

**Learning time:** 9h  
- Theory classes: 3h 30m  
- Self study: 5h 30m

**Description:**  
Objectives of the fermentation industry. Types of culture of microorganisms. General structure of the fermentation process. Bioreactors.

**Related activities:**  
Activities 3 and 4

**Specific objectives:**  
Know the main types of industrial culture of microorganisms and its possible objectives. Know the general structure of a fermentation process and which are its main elements. Know the main control elements of a bioreactor. Know some of the main types of bioreactors.

### 9. Enzymatic technology

**Learning time:** 3h 30m  
- Theory classes: 1h 30m  
- Self study: 2h

**Description:**  

**Specific objectives:**  
Know the main fields of application of the industrial production of enzymes. Know the advantages offered by the microorganisms as enzym sources against the sources of animal or plant origin. Know the different techniques of immobilization of enzymes and its advantages.
## 10. Recovery of products

### Description:
Inline process issue: separation of insoluble, cell disruption, concentration and product purification, stabilization.

### Specific objectives:
Have a global vision of the following steps to make in the recovery and purification of a biotechnological product as well as the most common unit operations.

### Learning time:
- Theory classes: 1h 30m
- Self study: 2h

## 11. Specific applications

### Description:
Application of the biotechnology in different areas: food industry, power production from biomass, biotechnology and environment.

### Specific objectives:
Know the application fields of the biotechnology in the food industry, specially in the case of the fermented beverages. Know the different ways of energy use of the biomass (bioethanol, biogas,...) Know the role of the biotechnology both in the protection (biologic treatments of the waste) as in the restoration (bioremediation) of the environment.

### Learning time:
- Theory classes: 9h
- Self study: 13h 30m
### Planning of activities

| 1. WORKSHOP | **Hours:** 7h 30m  
Laboratory classes: 3h  
Self study: 4h 30m |
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<tbody>
<tr>
<td><strong>Description:</strong></td>
<td>Workshop about the experimental techniques. resolution of exercises and cases.</td>
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<tr>
<td><strong>Support materials:</strong></td>
<td>Guideline</td>
</tr>
<tr>
<td><strong>Specific objectives:</strong></td>
<td>Know the basics of the experimental techniques which will be used along the lab sessions. Apply that knowledge to solve numerical problems or practical cases</td>
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| 2. PRACTICE 1 | **Hours:** 27h  
Laboratory classes: 9h  
Self study: 18h |
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<tr>
<td><strong>Description:</strong></td>
<td>Purification of a protein of commercial interest from an animal tissue</td>
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<tr>
<td><strong>Support materials:</strong></td>
<td>Guideline</td>
</tr>
<tr>
<td><strong>Specific objectives:</strong></td>
<td>Familiarize the students with a big number of experimental techniques (extraction of proteins, centrifugation, precipitation, chromatography, electrophoresis of proteins,...) yet not isolated practices, disjointed, but following a logic sequence, integrated towards a final objective</td>
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| 3. PRACTICE 2 | **Hours:** 15h  
Theory classes: 6h  
Self study: 9h |
<table>
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<tbody>
<tr>
<td><strong>Description:</strong></td>
<td>Purification of a protein of animal origin from a genetically modified bacteria by the students</td>
</tr>
<tr>
<td><strong>Support materials:</strong></td>
<td>Guideline</td>
</tr>
<tr>
<td><strong>Descriptions of the assignments due and their relation to the assessment:</strong></td>
<td>Written report</td>
</tr>
<tr>
<td><strong>Specific objectives:</strong></td>
<td>the same way as the previous case, the aim is to get the students to familiarize with a good number of experimental techniques related to the current practice (genetic engineering, culture of microorganisms, cell disruption, electrophoresis of nucleic acids) yet in an integrated way and as a mean to achieve a final objective</td>
</tr>
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### 4. VISITS

**Description:**
Visit to three companies/biotechnology facilities

**Support materials:**
Guideline

**Specific objectives:**
Approach the real practice to those theory aspects studying in class

### Qualification system

\[
NF = 0.6 \times \left( \frac{NE1 + NE2}{2} \right) + 0.2 \times \left( \frac{NEC1 + NEC2}{2} \right) + 0.2 \times \left( \frac{NP1 + NP2}{2} \right)
\]

NF: Final qualification  
NE1, NE2: Qualification of the two exams.  
NEC1, NEC2: Qualification of the exercises of continuous assessment  
NP1, NP2: Qualification of the practical sessions.  

The students will be able to access the re-assessment test that meets the requirements set by the EEBE in its Assessment and Permanence Regulations (https://eebe.upc.edu/ca/estudis/normatives-academiques/documents/eebe-normativa-avaluacio-i-permanencia-18-19-aprovat-je-2018-06-13.pdf)

### Bibliography

**Basic:**