

# Separation Processes IB

**Calendar:** 4th semester

**Contact Hours:** T: 30,0; TP:15,0; OT:15,0

## **Intended learning outcomes of the curricular unit:**

The curricular unit of Separation Process IB aims to provide unit operations of separation/purification used in biologic and related industries, providing students with the knowledge to design separation equipment.

Students must acquire the following competences: Identify the basic principles governing the different separation processes; Choose the most appropriate processes for a given separation; Design certain separation equipment and assess the influence of operating conditions in the final separation.

## **Syllabus:**

1. Introduction: Stages of a separation process. 2. Movement of fluids through porous beds: Darcy's, Kozeny and Ergun Eq. 3. Fluidization: Minimum speed of fluidization. 4. Operations of Solid-Liquid Separation (suspended solids): (i) Filtration at constant flow and constant pressure. Design filters. (ii) gravitational sedimentation. Sedimentation velocity; Stokes Law; Design of sedimentation tank; (ii) centrifuging. Stokes law applied, equivalent settling area, types of centrifuges. Equations for centrifuge's design. 5. Solvent extraction: Extraction with organic solvents or supercritical fluids. 6. Protein Precipitation: Methods - Addition of salts, pH control in isoelectric point, addition of non-ionic polymers, addition of solvents, addition of polyelectrolyte and addition of metal ions. 7. Cell rupture: Rupture Methods - Physical Methods, Chemical Methods, enzymatic, osmotic shock. 8. Concentration of product. Drying and freeze drying

## **Demonstration of the syllabus coherence with the curricular unit's intended learning outcomes.**

The curricular unit of Separation Process IB aims to provide the students with competences relating with unit operations of separation/purification used in biologic and related industries. Considering the state before, the curricular unit structure was established in such a way that the first three chapters' subjects is important generic and basic information to study the separation operations that will be lectured in the following chapters.

4th and 5th chapters' subjects are the solid/liquid separation operations and the solvent extraction, respectively. Here very important separations methods considering biotechnological industries for these type of operations are lectured, such as the filtrations, gravitational sedimentation and centrifuging, for the solid/liquid separations methods, while for the extraction the use of organic solvent and supercritical fluids are studied in detailed.

The protein precipitation methods play a very important role in biotechnological industry as separation operations and are presented in 6th chapter. That is an important reason for these subjects to be lectured with some details in this chapter. It will be studied an appreciable amount of separations methods such as salts addition, pH control, non-ionic polymers, solvent use, polyelectrolyte and metal ions additions.

The cell rupture methods are also very important for the biotechnological industries and are lectured in the 7<sup>th</sup> chapter. In this chapter some of these particular methods are specified in more detailed, such is the case for physical, chemical, enzymatic and osmotic shock methods. Finally, the 8th chapter subjects are related with drying and freeze drying and are presented with some detail.

## **Teaching methodologies (including evaluation):**

Theoretical material will be presented, to promote the involvement and participation of all students, developing their reasoning skills and stimulating their critical thinking. Materials about the subjects lectured will be available for consultations on Moodle. Online mini-tests will be weekly proposed to evaluate the subjects taught in the previous week. It will be expected some guided technical visits allowing for the consolidation of the themes taught. At any time students can contact the teacher via the platform Moodle.

The assessment consists of 20% for the practical component (mini-tests) and 80% of the theoretical component (final exam).

**Demonstration of the teaching methodologies coherence with the curricular unit's intended learning outcomes.**

The curricular unit of Separation Process IB aims to provide the students with competences relating with unit operations of separation/purification used in biologic and related industries. The teaching methods are consistent with the objectives of the course since the realization of individual minitest and weekly by the students allows students to inculcate the autonomy and capacity to solving problem and analyse and project / design of separation equipment.