PONTIFICIA UNIVERSIDAD CATÓLICA DE CHILE
SCHOOL OF ENGINEERING
DEPARTAMENT OF CHEMICAL ENGINEERING AND BIOPROCESSES
ABET COURSE SYLLABI

IIQ 2673 BIOSEPARATIONS

Credits and contact hours: 10 UC credits / 10 hours (3 h. Lectures; 1,5 h. Labs and 5,5 h. Independent learning experiences)

Instructor's name: José Manuel del Valle

Course coordinator's name To be defined

Textbook: Harrison, R.G., P. Todd, S.R. Rudge & D.P. Petrides. 2003. 'Bioseparations Science and Engineering'. Oxford University Press, New York, NY, EE.UU. (660.6 B616s 2003)

Course Catalog Description: Bioseparations presents in a rigorously way the basic principles of selected processes and specially adapted for the isolation and purification of active principles from biological materials. Specifically, we review in detail the cell disruption processes and mechanical separation of suspended solid material; concentration and purification processes of primary and secondary metabolites and other bioactive compounds using semipermeable membranes, solvents or precipitating agents, and adsorbents; and polishing processes by crystallization and dehydration. These contents enable the student to identify and preliminary design the equipment used in processes sequences to obtain a desired product with a satisfactory compromise between performance, productivity and product purity.

Prerequisite Courses: IIQ2022 Unit Operations II y/o IIQ2032 Unit Operations III, o Professor authorization

Co-requisite Courses: None

Status in the Curriculum: Minimum course

Course Learning Outcomes:

1. Integrate critic and proactively the downstream processes in a fermenter in a biotech company.
2. Know the bases and principles of downstream processes of the fermenter and industrial equipment used for obtaining raw or highly purified products from fermented broths.
3. Set physical models to obtain quantitative relationships between operating conditions and performance of a process or separation equipment.
4. Sizing equipment that meets an appropriate compromise between yield and purity of a selected active ingredient.

Relation of Course to ABET Criteria:

h. Broad education necessary for global, economic, environmental and societal context

i. Recognition of the need for, and an ability to engage in life-long learning

k. Techniques, skills, and modern tools for engineering practice.

Topics covered:

1. Cell structure and cell disruption: cell disruption and effects on bioactivity. Breaking processes classification according to their mechanism. Mechanical methods of rupture. Non-mechanical methods of cell disruption.
2. Separation processes of based solid sedimentation and centrifugation. Sedimentation Basics. Separation equipment.
3. Size exclusion separation processes. Basics of filtration. Material balances and design equations for conventional filtration processes. Adaptation of the design equations for compressible cake filter, continuous operation, and centrifugal filtration.
1. Characterization of particle removal mechanisms. Membrane separation processes basics. Main mechanisms for flow through membranes. Models for permeate flux and membrane fouling. Filters and membranes surfaces regeneration. Filtration and membrane separation equipment. Classification and characterization of membrane operation system.
4. Liquid-liquid extraction processes and precipitation. Basics of liquid-liquid extraction. Equipment characterization and extraction processes. Basics of precipitation. Action mechanisms of precipitating agents. Macromolecules precipitation modeling. Solvents and precipitants. Specially adapted processes for the biotechnology industry. Description and escalations of extraction and precipitation equipment.
5. Adsorption processes and chromatography. Basics of adsorption and chromatography. Interfacial mass transfer and dispersion phenomena in packed beds. Modes of operation characterization. Adsorbents and eluents. Mathematical modeling of adsorption and chromatographic separation processes. Description of systems and scaling of columns and packing.
6. Crystallization processes. Basics of crystallization. Process Steps.
2. Selecting crystallization systems and equipment. Equipment: description and selection. Processes design and scaling.
7. Drying processes. Basics of isotherms of "sorption" and water activity. Matter and energy balances in drying. Using psychometric chart in direct drying. Drying stages and modeling. Differentiation of contact types. Spray drying. Lyophilization.
8. Processes synthesis. Flowcharts and heuristic rules. Primary stages of recovery, intermediate recovery, and final purification. Process analysis.

PONTIFICIA UNIVERSIDAD CATÓLICA DE CHILE
SCHOOL OF ENGINEERING
DEPARTAMENT OF CHEMICAL ENGINEERING AND BIOPROCESSES
ABET COURSE SYLLABI