UNIVERSITÀ
DEGLI STUDI DI MILANO-BICOCCA

COURSE SYLLABUS

Process Engineering

2223-1-F0802Q060

Aims

The goal of the course is to enable students to master those unit operations that are involved in the field of process engineering, with main application in the industrial biotechnology and chemical sectors.

At the end of the course the student will have gained knowledge of process plants and unit operations; she/he will have a deep understanding of the principles and of the chemical-physical phenomena at the basis of the considered unit operations; she/he will have to be able to understand the common diagrams daily used by the process engineer; the student will have to know how to perform an economic analysis of a process plant.

The student will be able to apply the knowledge mentioned in 1) to different problems in process engineering. In particular, she/he will have the capability of analysing and solving basic problems of separation units (as flash and distillation, adsorption, chromatography, membrane filtration, centrifugation, extraction, sedimentation, precipitation) and of heat transfer units by employing simplified models based on material and heat balances and on equilibrium expressions. Moreover, the student will have the capability of identify the best unit operation for a given separation on the basis of the properties of the mixture to be treated and to estimate its cost.

The student will be able to process and apply the knowledge to solve problems related to process engineering.

The student will have to be able to clearly explain the strategies used for solving problems and to communicate the results, with use of appropriate scientific vocabulary.

At the end of the course the student will be able to apply the acquired knowledge to find solutions to problems referring to fields different from the one presented during the course, also by employing new sources (books, journal papers).

Contents

1. Introduction

2. Diagrams and material and energy balances

3. Operations in process engineering (bioreactors and chemical reactors, operations for product separation and recovery and energy and matter transportation phenomena)

4. Economic analysis

Detailed program

1. Introduction

Introduction to industrial and chemical processs, bioproducts, bioseparations, unit operations, continuous and batch operations, schemes, choice of the best sequence, review of variables and units of measurements, ideal gases.

2. Diagrams and material and energy balances

Diagrams. Block Flow Diagram, Process Flow Diagram (PFD), Piping and Instrumentation Diagram (P&ID).
Material and energy balances. Law of mass conservation, material balance for steady-state and unsteady-state processes, energy balance, determination of the enthalpy, procedures for calculation for process scheme resolution.

3. Operations in process engineering

Bioreactors and chemical reactors. Batch, fed-batch and continuous operation, configurations, material of construction, monitoring of fermentation, practical considerations.
Operations for product separation and recovery. flash and distillation, adsorption, chromatography, membrane filtration, centrifugation, extraction, sedimentation, precipitation.
Heat transfer unit. Unit, mechanism of heat transfer, basic calculations for the design of the heat transfer unit. Steady and dynamic process simulation.

4. Economic analysis

Methodologies for estimation of investment and operating costs.

Prerequisites

Background. None.

Prerequisites. None.

Teaching form

The course is based on lectures, supported by PowerPoint slides, and exercises, based on case studies.

A visit to the laboratories and to a virtual Crude Distillation Unit at Dipartimento di Chimica, Università degli Studi di Milano (after approval of Consiglio di Coordinamento Didattico) is scheduled.

Textbook and teaching resource

Slides available at the e-learning platform of the course.

Semester

First semester

Assessment method

The final evaluation of learning will be obtained through a written test, with one exercise and with questions about all the topics covered during the course. During the examination the student will have to demonstrate a full understanding of the course topics and to be able to clearly explain the acquired knowledge. The mark is on a thirtieths basis.

Office hours

Contact: on demand by mail to the lecturer.

Sustainable Development Goals

INDUSTRY, INNOVATION AND INFRASTRUCTURE