UNIVERSITÀ
DEGLI STUDI DI MILANO-BICOCCA

COURSE SYLLABUS

Process Engineering

2526-1-F0803Q060

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

The lecturer for the 2025/2026 academic year will be assigned after the call for applications closes. Therefore, this Syllabus is a draft and will be updated by the new lecturer.

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

Teaching form

The course is delivered through in-person lectures supported by PowerPoint presentations and practical exercises based on case studies carried out in the classroom.

An educational visit is also planned to the laboratories of the “Giulio Natta” Department of Chemistry, Materials and Chemical Engineering at the Politecnico di Milano for a virtual tour of a Crude Distillation Unit plant (subject to approval by the Teaching Coordination Council).

Textbook and teaching resource

The slides and the materials used in class will be made available on the course’s e-learning platform.

Semester

First semester

Assessment method

The final exam is a written test including one exercise and questions covering all course topics. During the exam, the student must demonstrate understanding of the material and the ability to present the acquired knowledge clearly. The grade is given on a thirty-point scale.

Office hours

Office hours: by appointment upon email request to the instructor.
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Sustainable Development Goals

CLEAN WATER AND SANITATION | AFFORDABLE AND CLEAN ENERGY | INDUSTRY, INNOVATION AND

INFRASTRUCTURE | RESPONSIBLE CONSUMPTION AND PRODUCTION