UNIVERSITÀ
DEGLI STUDI DI MILANO-BICOCCA

COURSE SYLLABUS

Plants and Processes for Sustainable Chemical Processing

2627-2-F7603Q006-F7603Q00601

Aims

The course aims to provide students with a broad and practical framework for understanding the technological, economic, regulatory and environmental challenges associated with sustainable industrial activities.
Given the breadth of the subjects involved — from chemical plants and industrial processes to economics and sustainability — the course does not aim to provide an in-depth treatment of individual technologies. Instead, it aims to provide students with a “map” of the main concepts, tools and issues that will enable them to approach new and complex problems in their future professional activities.
The course therefore focuses less on memorising technical details and more on developing the ability to analyse problems, identify the relevant information, evaluate possible solutions and continue learning independently.

Let chemists to understand the language of economics, economists to understand chemistry, and both to interact with engineers.

Contents

The course covers five interconnected areas:
1 Industrial Plants and Processes (4h)
Overview of chemical plant, equipment and technology

2 Economics and Management of Production Processes (4h).
Overview of management techniques and tools for manufacturing companies: production cost calculation, production planning, financial resource planning, and optimization techniques and tools.

3 H ealth, Safety and Environmental overview on main Regulation (4h).
Introduction to main HSE regulation of production plant

4 Sustainability and the Transition towards Renewable and Circular Resources (12).

In 2004 US Dept of Energy published one of the most famous and frequently cited reports in the history of green industrial chemistry: “Top Value Added Chemicals from Biomass...” Starting from the document, successes and failures will be analyzed, and students—drawing on the skills they have acquired—will be asked to formulate their own analyses of the failures and attempt to propose innovative solutions.
Last but not least, some sessions will feature professionals presenting real-world case studies, as well as potential visits to production sites.

Detailed program

Industrial Plants and Processes (4h)

Brief review of thermodynamic formulas and units of measurement

Main technologies and equipment used in the chemical industry.

Chemical processes design tools: P&I, BFD, PFD charts

Examples

Economics and Management of Production Processes (4h)

Production planning and resource management.

Brief description of management tools for manufacturing industries (what are MRP, MRP II and ERP).

Production costs, fixed and variable costs and break-even analysis.

Production planning principles overview: Bottleneck analysis, push and pull production systems, Make-to-Stock and Just-in-Time approaches.

Health, Safety and Environmental overview on main Regulation (2h)

Enviromental regulation: introduction to European Directives: 2008/1/CE and EU 2010/75/UE and 96 (italian D.Lgs 152/2026)

Chemical Risck assestment: European Directive 2012/18/UE “Seveso III” (italian D.Lgs 105/2015)

Safety: European Framework 89/391/CEE (italian D.Lgs 81/08).

Transport of Hazardous chemical regulation .

Analysis of major industrial and technological accidents.

Sustainability and the Transition towards Renewable and Circular Resources

2004 US Dept Of Energy document: from refinery to biorefinery concept.

Were we are now

What went wrong?

What have we learned?

And now what is the plan?

The principles of Green Chemistry.

Emerging sustainable chemical technologies: mechanochemistry, micellar chemistry, photochemistry.

Sustainable polymers and biodegradable materials.

Plastic recycling

Food waste as a potential alternative to oil and gas

Greenwashing and the communication of sustainability.

Individual responsibility and the systemic impact of industrial and personal choices.

Prerequisites

Teaching form

Textbook and teaching resource

Semester

I semester (October - January)

Assessment method

Office hours

Sustainable Development Goals

QUALITY EDUCATION | INDUSTRY, INNOVATION AND INFRASTRUCTURE | RESPONSIBLE CONSUMPTION AND PRODUCTION