# PROCESS DESIGN AND INTEGRATION

## 4 ECTS


## AGH University of Science and Technology

## Course responsible: Jan Górski, D.Sc., Assoc Prof.


**Course overview**

This course is focused on the selection of processing steps and their interconnection into a complete system to transform materials into final products. The course will deliver effective tools for integration and optimisation of unit chemical processes. It will provide the design of effective processes which will achieve savings on cost, energy usage and emissions. The aim of this course is to give the students a better understanding the technical aspects and new tools for better planning the future and more clean technologies based on accessible resources and effective coupling the unit operations. Students develop valuable skills, including use of design and modelling software such as Matlab, Hysys, ChemCAD and AspenPlus. The lab portion of the class provides the students with working experience and applications on computer-aided simulation of chemical engineering systems. The course is built of two main parts: lectures and computer laboratory-project

Lectures will concern the following subjects: Introduction to process design (process analysis and simulation, synthesis and optimization, equipment selection and design, process integration). Analysis of mass and energy flows (substance, energy and exergy balances), mass and energy integration (thermodynamic, design, and economic-optimization aspects, targeting process performance, pinch-point analysis), detailed design and optimization of heat exchangers and energy conversion equipment, process economics and environmental aspects will be discussed.

Computer laboratory- project is carried out by groups of two students each. By this the students are able to practice with the engineering software tools (Testherm, ASPENPlus, Matlab, Thermofluids and others), and solve some applied problems such:

- 1. Prediction of thermodynamic and transport properties and balancing example processes
- 2. Computer simulation and control of selected reactions chemical kinetics
- 3. Optimization techniques – methods and practical application example
- 3. Heat exchanger (HEX) design - Analysis of heat and mass transfer processes
- 4. Application the “Pinch Point” method for optimization of HEX’s system.
- In this part each student will prepare an individual project (topics for analysis the other particular cases are accessible for demand).

In the preparatory period the students are consulted (on campus or, on demand by distance e-learning). Class updates and frequent announcements regarding class meetings, homework, and exams will be transmitted via email. The main topics on teaching material will be available at the following website: http://home.agh.edu.pl/~jgorski

**Outcome of the course**

After this course the student should be able to:

- evaluate overall mass targets (fresh usage, waste discharge, yield, etc.) for a given process
- manipulate design and operating variables to optimize process performance
- synthesize direct recycle networks
- screen and synthesize networks of mass exchangers
- evaluate targets for minimum heating and cooling utilities
- screen and select mass and heat utilities
- use ASPEN Plus to simulate various scenarios of units and groups of units.
- use simulation to analyze process performance, identify opportunities, troubleshoot problems, and recommend changes
- apply different techniques to estimate fixed cost, operating cost, and profitability criteria
- prepare a typical design report.

**Course coordinator & teachers**

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