

# Heat exchangers with or without phase transition and simultaneous heat and mass transfer



ECTS  
5 credits



Component  
INSTITUT  
NATIONAL  
DES SCIENCES  
APPLIQUEES  
TOULOUSE



Number of  
hours  
68h

## Presentation

### Description

Programme (detailed contents):

\*TEMA standards, multi-tubular, plate exchangers, stirred vessels, condensers, boilers, evaporators (software Aspen HTFS), and their utilisation. Parallel, counter current, cross-flow, multi-pass heat exchanger

\* Design procedure

Local and overall heat transfer coefficients, exchange area, logarithmic mean temperature difference LMTD. Pressure drop.

Efficiency. Different exchanger geometries will be considered.

\*Condensation, application to the design of industrial condensers of different types of vapour mixtures.

\*Boiling, evaporation, multiple effects evaporators

\*Unit operations involving simultaneous mass and heat transfer: design of a cooling tower, dehumidification tower, air conditioner, extension to systems using other vapour than steam. Drying, design of dryers.

Organisation:

Lectures, tutorials and lab-work.

### Objectives

At the end of this module, the student will have understood and be able to explain (main concepts):

- the different types of heat exchangers, condenser, evaporators and other contactors carrying out both heat and mass transfer (cooling tower, humidification-dehumidification process, air conditioning systems, drying equipments,..)
- the mass and heat transfer mechanisms in these equipments
- the notion of efficiency
- film-wise and drop-wise condensation, the characteristics of the condensation of single or mixed vapours with or without incondensable compounds
- the different mechanisms of boiling
- the concept of local coefficient and overall heat transfer coefficient

- the concept of simultaneous mass/heat transfer and their application to engineering especially for handling the system Air/Water/Steam

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## Place

➤ Toulouse

The student will be able to:

- select the adequate technology of the heat exchanger depending on the process requirement
- establish mass and energy balances on heat exchanger (continuous or batch, with or without phase change)
- establish simultaneous mass and energy balances
- design exchangers of all type: determine the local and overall transfer coefficient, evaluate its performance and its variation with a change of operating conditions
- use software such as ASPEN HTFS to design the heat exchanger
- design unit operations involving simultaneous transfers, such as cooling tower, dehumidification tower, air conditioners, dryers.
- provide basic elements useful for the design of furnaces

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## Pre-requisites

Thermal transfers and reactors

Fluid properties and mass transfer

Thermodynamics

## Useful info