Spring semester

Heat exchangers with or without phase transition and simultaneous heat and mass transfer	5 credits	68h
Processes & energy	5 credits	42h
Project for research introduction	5 credits	12h
Metrology Environnement and Risks	6 credits	67h
Improving autonomy and building a professional project	4 credits	39h
Communicating within organizations	6 credits	75h

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

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

Pre-requisites

Thermal transfers and reactors

Fluid properties and mass transfer

Thermodynamics

Useful info

Place

Toulouse

Processes & energy

ECTS
5 credits

Component
INSTITUT NATIONAL DES SCIENCES APPLIQUEES TOULOUSE

Number of hours
42h

Presentation

Description

Programme (detailed contents):

- the global context of production and processing energy

- processes for power generation,

- renewable energies : wind, solar and biogas,

- steam power cycles: Carnot cycle with superheat, reheat and withdrawals (cycle with maximum theoretical efficiency). Application to nuclear plants. Cogeneration systems. Size and optimization of the plant (energy and exergy efficiency)

- refrigeration cycles from reverse Carnot cycle without change of state to the real cycle of refrigerating machines with change of state.

- the absorption chillers. Size and optimization of the plant (energy and exergy efficiency)

- the gas liquefaction. Cycle at maximum theoretical efficiency, Linde and Claude cycles. Presentation facilities for liquefying air and separating components. Special facilities for hydrogen and helium.

Organisation:

Lectures, tutorials and lab work. This modules includes visiting of: a wind farm, a nuclear power plant (Golfech) and a landfill site (Montech)

Objectives

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

- the world context of power-generating systems, which produces a net power output from a fossil, nuclear or renewable energy source.

- the legal and technical context of the various forms of renewable energy (wind, solar photovoltaic, biomass ...),

- the different thermodynamic cycles associated to the power generation systems, the refrigeration and heat pump systems and the gas liquefaction.

- the use of energy and exergy balances for these thermodynamic systems in order to optimize their operation

The student will be able to:

- design a given steam power plant, including the choice of working fluid temperatures, pressures and the determination of fluid working flows plus the pre-sizing of compressors and turbines

- design a refrigeration system, including the choice of working fluid temperatures, pressures and the determination of fluid working flows plus the preliminary design of compressors and expansion devices,

- design a gas liquefaction plant

- participate in the implementation of a wind energy area development and a site photovoltaic,

- participate in the implementation of a biogas network.

Pre-requisites

Thermodynamics.

Useful info

Place

Toulouse

Project for research introduction

ECTS
5 credits

Component
INSTITUT NATIONAL DES SCIENCES APPLIQUEES TOULOUSE

Number of hours
12h

In brief

Teaching language(s): Français, Anglais

Presentation

Description

Program:

- the national research structures

- the principles of patent right

- how to perform a relevant literature review on a subject

- identification of a problem and scientific approach to solve it

- participation to a current research project in a laboratory

- health and safety rules in a research laboratory

Project management: definition and organization

- content (clearly define the limits and tasks)

- deadlines (with prioritization of tasks, Gantt chart)

- HR (assign tasks to people with skills, communication, team management)

- risk analysis, cost estimation.

Organization:

Conferences. Lectures and tutorials on literature survey.

Supervised research project performed in group of 3 students on current projects of the laboratory, by using the project management approach. Presentation of the project results in a poster session.

Objectives

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

- the approach and tools for a good literature and patent survey

- how to develop a scientific work

- the health and safety rules in a research laboratory

- the basic methods for project management

- the organisation of the public research in France

- principles of patent right

The student will be able to:

- to delimit and deepen a scientific research project

- to draw an up-to-date inventory of knowledge on this topic and to identify the international leading research teams

- to propose and to experimentally perform a scientific approach to address a problem based upon the previous literature survey with respect to health and safety rules

- to share and communicate the results with a common scientific formalism (paper, poster)

- to perform a project management approach

Pre-requisites

Literature survey basic knowledge.

Project management.

Scientific knowledge in relation to the research project.

Useful info

Place

Toulouse

Metrology Environnement and Risks

ECTS
6 credits

Component
INSTITUT NATIONAL DES SCIENCES APPLIQUEES TOULOUSE

Number of hours
67h

Presentation

Description

Law and Regulations in Environment

Environment Process Safety

- Dispersion of pollutants - modeling, risk assessment methods on the environment,

- Characterization and classification of wastes, waste management (treatment and storage sectors), common and radioactive wastes, environmental impact of wastes .

- Notions about the main categories of risk in Chemical Engineering: calculating probabilities of effects induced on human, toxicity, different types of explosions, thermal-runaway. Methods and devices for protection .

Metrology for Environment

- quality of measurements (accuracy, detection and quantification thresholds, robustness, repeatability, reproducibility)

- Metrology for measuring environmental impacts and / or processes design

Organisation:

Law in Environment (lectures 10h tutorials 5h)

Environment Process Safety (30h)

Environment (15h lectures / TD)

Process savety 15h including 10h lectures and 5h tutorials

Research project combining law and environmental risks (80h Estimated personal work)

Metrology for Environment (during lectures 3.75h tutorials 5h Labworks 24h)

measurement tools applied to the characterization of complex matrices or media (NTK analyzers, COD, gas, on-line UV, ionic chromatography ...). Meaning of quantities in the fields of environment and processing methods.

Quality of measurements: accuracy, reproducibility, detection and quantification thresholds. Statistical analysis of the measurements and for data calculations.

Application to the analyses of compounds in complex solutions, offline and online measurements for compounds in both liquid and gas phases, characterizations of aerobic and anaerobic biological degradation (determination of kinetic and stoichiometric parameters).

Objectives

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

-the principles of environmental laws in France , and what tools to access legal informations

- the choice of suitable and argued measurements either for the analysis of environmental impacts or to process design

- what are the main environmental issues and principles of waste management

- the main risks in the process industry and mechanisms linked to accidents

The student will be able to:

AA1 : find and use legal informations (from legacy context) related to environmental law (ICPE , TGAP , environmental impacts, ...)

AA2 : choose and apply relevant method (s) in order to characterize the compounds and / or pollutants in complex environments or matrix doing a critical analysis of the methodology and the experimental results

AA3 : analyze a case of risk for Environment , to identify the categories of impacts, to describe pollution from the origin (=source) to the environmental targets

AA4 : analyze a situation of industrial risk, to identify and to calculate physico-chemical parameters of the involved phenomena and to propose technical solutions

Pre-requisites

The whole Chemical Engineering course.

Useful info

Place

Toulouse

Improving autonomy and building a professional project

ECTS
4 credits

Component
INSTITUT NATIONAL DES SCIENCES APPLIQUEES TOULOUSE

Number of hours
39h

Presentation

Objectives

Construire une équipe projet, Approfondir ses connaissances,

Investir le métier, les domaines d'activité, les fonctions.

L'étudiant devra être capable de :

- d'analyser avec les autres un problème posé (Identifier le problème, définir les axes d'approche dans un bilan interactif : organisation, physique, technique, stratégique, motivation, confiance...

- de décider ensemble (permettre à tout le monde d'exprimer son avis, ajuster et réguler sa conduite en fonction de l'analyse collective),

- d'identifier les ressources du groupe (sens critique, repérage des points forts et faibles de chacun).

Place

Toulouse

Useful info

Communicating within organizations

ECTS
6 credits

Component
INSTITUT NATIONAL DES SCIENCES APPLIQUEES TOULOUSE

Number of hours
75h

Presentation

Objectives

The classes given in French will focus on :

- How to react to society's demand for technical and scientific information

- How to foster critical thinking in order to give appropriate answers when questioned about such issues

- How to communicate effectively in the workplace

The classes given in English will focus on the specific linguistic characteristics of English used in such contexts in order for the students to understand and master them.

The students will also be made aware of the specificity of professional communication within the English-speaking world

Module L2

The objectives, defined in reference to the CEFRL for the 5 language activities, depend on the language studied - Chinese, German, Spanish - and the level of the student.

They can be consulted on :

https://moodle.insa-toulouse.fr/course/view.php?id=44

In certain cases, students may be authorised to follow an English module instead of another language.

Pre-requisites

For classes in English : mastery of general English.

Useful info

Place

Toulouse