ME-451

Advanced energetics

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Cursus	Sem.	Type
Energy Management and Sustainability	MA1, MA3	Opt.
Energy minor	H	Opt.
Mechanical engineering	MA1, MA3	Opt.
Systems Engineering minor	H	Opt.

Language of teaching	English
Credits	5
Session	Winter
Semester	Fall
Exam	Oral
Workload	150h
Weeks	14
Hours	**5 weekly**
Courses	3 weekly
Exercises	2 weekly
Number of positions	

Summary

Methods for the rational use and conversion of energy in industrial processes : how to analyse the energy usage, calculate the heat recovery by pinch analysis, define heat exchanger network, integrate heat pumps and cogeneration units and realise exergy analysis of energy conversion systems.

Content

Rational use and conversion of energy in industrial processes.

Methodology for the energy efficiency audit of industrial processes. Principles of the exergy analysis of industrial processes and energy conversion systems. Principles of the process integration using the pinch analysis method. Identification of the process efficiency improvement options. Optimal integration of the energy conversion systems. Thermo-economic evaluation of energy savings options. Application to one industrial process case study.

Keywords

Energy efficiency, heat recovery, Energy conversion, Exergy analysis, Pinch analysis, Industrial processes

Learning Prerequisites

Recommended courses

- Master the concepts of mass, energy, and momentum balance, E1 (Thermodynamique et énergétique I)
- Compute the thermodynamic properties of a fluid, E2 (Thermodynamique et énergétique I)
- Master the concepts of heat and mass transfer, E3 (Heat and mass transfer)
- Understand the main thermodynamic cycles, E5 (Thermodynamique et énergétique II)
- Calculate and design heat exchangers, E15 (heat and mass transfer)
- Notion of optimization (Introduction à l'optimisation différentiable)

Important concepts to start the course

basics of thermodynamics : heat and mass conservation principles, basic thermodynamic cycles, basics of heat transfer

Learning Outcomes

By the end of the course, the student must be able to:

- Explain and apply the concepts of thermodynamic efficiency, E6
- Establish the flow diagram of an industrial process and calculate the corresponding energy and mass balance, E22
- Analyse the energy and exergy efficiency of industrial energy systems, E23
- Explain the principles and limitations of the main energy conversion technologies, E7
- Understand the challenges related to energy: resources, energy services, economic and environmental impacts, E9

Transversal skills

- Assess progress against the plan, and adapt the plan as appropriate.
- Write a scientific or technical report.
- Set objectives and design an action plan to reach those objectives.
- Use a work methodology appropriate to the task.
- Communicate effectively, being understood, including across different languages and cultures.
- Access and evaluate appropriate sources of information.
- Make an oral presentation.
- Design and present a poster.

Teaching methods

The course is organised as theoretical sessions and the resolution of a real case study to be realised in a team project.

Expected student activities

- Active participation to the lecture
- Project realisation as a team work

Assessment methods

The real case study will be reported. An oral exam will concern the application of the theory in the case study.

Resources

Bibliography

All the material can be downloaded from the moodle website (http://moodle.epfl.ch/course/view.php?id=141). Printed version of the lecture notes can be ordered.

Ressources en bibliothèque

- Thermodynamics and energy systems analysis / Borel

Moodle Link

- http://moodle.epfl.ch/course/view.php?id=141

Videos

- https://portal.klewel.com/watch/nice_url/advanced-energetics/