66226 - Energy Optimization

Información del Plan Docente

Academic Year	2017/18
Faculty / School	110 - Escuela de Ingeniería y Arquitectura
Degree	531 - Master's in Chemical Engineering
ECTS	6.0
Year	
Semester	Half-yearly
Subject Type	Optional
Module	---

1.General information

1.1.Introduction

1.2.Recommendations to take this course

1.3.Context and importance of this course in the degree

1.4.Activities and key dates

2.Learning goals

2.1.Learning goals

2.2.Importance of learning goals

3.Aims of the course and competences

3.1.Aims of the course

3.2.Competences

4.Assessment (1st and 2nd call)

4.1.Assessment tasks (description of tasks, marking system and assessment criteria)

5.Methodology, learning tasks, syllabus and resources

5.1.Methodological overview

The methodology followed in this course is oriented towards achievement of the learning objectives. It is based on participation and the active role of the student favors the development of communication and decision-making skills. A wide range of teaching and learning tasks are implemented, such as lectures, guided assignments, laboratory sessions, autonomous work, and tutorials.

Students are expected to participate actively in the class throughout the semester.

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Classroom materials will be available via Moodle. These include a repository of the lecture notes used in class, the course syllabus, as well as other course-specific learning materials.

Further information regarding the course will be provided on the first day of class.

5.2.Learning tasks

The course includes the following learning tasks:

- **Lectures** (30 hours, two hours per week). Explanation of the theory of the syllabus and solving of "model" problems.
- **Practice sessions** (15 hours, 1 hour per week). In these classes, students solve problems supervised by the teacher. Problems or case studies will be related to the theoretical part explained in lectures.
- **Laboratory sessions** (15 hours). 5 sessions of 3 hours each, where the student applies the contents studied in lectures and problem sessions. These will be made individually or in pairs and will be supervised by teachers. The assessment of the work informs of the student's level of achievement of the programmed learning objectives.
- **Guided assignment** (20 hours). 1 or 2 activities will be proposed during the course, which will be supervised and done individually. The proposed activities should be developed, expanded, documented, and solved based on the concepts seen in the classroom cases. A report will be made and assessed.
- **Study** (60 hours). It is recommended to study continuously throughout the semester.
- **Evaluation tests** (10 hours). A final exam will be conducted to evaluate the theoretical and practical knowledge gained by the student.

5.3.Syllabus

The course will address the following topics:

1. Physical fundamentals. Modeling and simulation of energy systems.
2. Exergy analysis. Diagnosis of the operation of equipment and plants.
3. Economic fundamentals. Principles and criteria for economic evaluation.
4. Mathematical programming. Optimality conditions and their economic significance. Techniques and optimization programs. Optimal design of equipment and plants.
5. Synthesis process. Polygeneration systems.
6. Energy integration. Heat exchange networks. Cogeneration and optimum heat recovery. Heat pumps and refrigerating machines. Thermal energy storage (heat and cold). Use of renewable energy.
7. Introduction to Thermoeconomics. Thermoeconomic and life cycle analysis of energy systems.

5.4.Course planning and calendar

Further information concerning the timetable, classroom, office hours, assessment dates and other details regarding this course, will be provided on the first day of class or please refer to the EINA website.

The laboratory sessions will be scheduled depending on the number of students and will be previously announced. The 5 sessions will focus on practical cases of:

- Modeling and simulation with Engineering Equation Solver (EES)
- Refrigeration cycles: selection of refrigerant an comparison of cycles
- Performance analysis of a gas turbine combined cycle
- Process optimization with linear and nonlinear programming
- Optimization and synthesis of processes with mixed integer programming

The report of the laboratory work must be submitted in the next lab session, except the last one before Christmas.

The students prepare a supervised assignment at the end of the course by applying the acquired knowledge. Three

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examples of assignments are:

- Exergy analysis of a cogeneration system
- Optimum design of a network of heat exchangers
- Optimal operation of a plant for energy services

5.5.Bibliography and recommended resources

BB	Biegler, L.T.. Systematic methods of chemical process design / L.T. Biegler, I. E. Grossmann, and A.W. Westerberg Upper Saddle River : Prentice Hall, cop. 1997
BB	Knopf, F.C. Modeling, analysis and optimization of process and energy systems / Knopf, FC Wiley, 2012
BB	Kotas, T.J.. The exergy method of thermal plant analysis / T.J. Kotas . - 1st ed. London [etc.] : Butterworths, 1985
BB	Putman, Richard E.. Industrial energy systems : analysis, optimization and control / Richard E. Putman New York : American Society of Mechanical Engineers, cop. 2004
BC	Analysis, synthesis, and design of chemical processes / Richard Turton ... [et al.] . - 2nd ed., repr. with revisions Upper Saddle River, New Jersey : Prentice Hall, 2003
BC	Diwekar, Urmila M.. Introduction to applied optimization / Urmila M. Diwekar Norwell, Mass : Kluwer Academic Publishers, cop. 2003
BC	Edgar, Thomas F.. Optimization of chemical processes / Thomas F. Edgar, David M. Himmelblau, Leon S. Lasdon . - 2nd ed. Boston [etc.] : McGraw-Hill, 2001
BC	Floudas, Christodoulos A.. Nonlinear and mixed-integer optimization : fundamentals and applications / Christodoulos A. Floudas New York [etc.] : Oxford University Press, 1995
BC	Product and process design principles : synthesis, analysis, and evaluation / Warren D. Seider ... [et al.] . - 3rd ed. Hoboken [New Jersey] : John Wiley and Sons, cop. 2010
BC	Sieniutycz, Stanislaw. Energy optimization in process systems [recurso electrónico] / Stanislaw Sieniutycz, Jacek Jeżowski . - 1st ed. 1st ed.
BC	Smith, R.. Chemical process design and integration / Robin Smith Chichester [etc.] : John Wiley & Sons, cop. 2005
BC	Stoecker, Wilbert F.. Design of thermal systems / W.F. Stoecker . - 3rd. ed. New York : McGraw-Hill, cop. 1989

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