Course guide
240388 - 240IEN35 - Hydrogen Technologies

Last modified: 05/06/2024

Unit in charge: Barcelona School of Industrial Engineering
Teaching unit: 724 - MMT - Department of Heat Engines.

Degree: MASTER'S DEGREE IN INDUSTRIAL ENGINEERING (Syllabus 2014). (Optional subject).

Academic year: 2024 **ECTS Credits:** 4.5 **Languages:** Catalan

LECTURER

Coordinating lecturer: Elisabet Mas de les Valls

Others: Elisabet Mas de les Valls
Maria Serra
Vicente de Medina

TEACHING METHODOLOGY

LEARNING OBJECTIVES OF THE SUBJECT

At the end of the course, the student will be able to:
1. Justify the advantages and disadvantages of hydrogen as an energy vector
2. Identify the advantages and limitations of the main hydrogen technologies
3. Carry out power and energy balances for an electrolyser, a fuel cell and a hydrogen engine
4. Integrate the different hydrogen technologies in a system model

STUDY LOAD

Type	Hours	Percentage
Laboratory classes	13,5	33.33
Theory classes	27,0	66.67

Total learning time: 40.5 h

CONTENTS

Hydrogen economy and systems

Description:
Hydrogen will be introduced as an energy vector and its contribution to the economy of the electricity market will be analysed. In the same way, the added value of hydrogen as a raw material and as a fuel, and its contribution to the economy of the chemical market will be shown, including the possibility of capturing CO2.
After this general introduction, the different hydrogen production technologies will be reviewed to finish integrating different hydrogen production and use technologies in a numerical model of a hydrogen plant.

Specific objectives:
The objective is that, upon completion of this topic, students:
1. Identify the foundations and utility of hydrogen as an energy vector and as a raw material.
2. Be able to describe the different hydrogen production technologies.
3. Know how to integrate the different hydrogen technologies in a system model.
4. Evaluate the efficiency of different arrangements of hydrogen plants.

Full-or-part-time: 10h 30m
Practical classes: 6h
Laboratory classes: 4h 30m

Electrolisers

Description:
After a brief review of the state of the art in electrolysers, we will proceed to propose mass and energy balances of an electrolyser, test its performance through experimental tests and model the electrolyser in order to integrate it in the hydrogen plant model of the subject.

Specific objectives:
The objective is that, upon completion of this topic, students:
1. Know the basic principles of electrolysers
2. Know the different types of electrolyzers, their degree of maturity and their limitations
3. Know how to set up mass and energy balances in an electrolyser and check them experimentally.
4. Know how to model an electrolyser

Full-or-part-time: 10h
Practical classes: 4h
Laboratory classes: 6h

Fuel Cells

Description:
After introducing the fundamentals of fuel cells, their general characteristics and types, the fundamental parts of a fuel cell will be described: Electrolytes, electrodes, bipolar plates, etc.
The different uses of fuel cells will be analyzed and a fuel cell model will be integrated into a model of a hydrogen plant.

Specific objectives:
The objective is that, upon completion of this topic, students:
1. Know the main characteristics of fuel cells, types and applications
2. Understand the thermodynamic principles of fuel cells and their mathematical expressions
3. Know the structure and components of PEM fuel cells
4. Know how to model a PEM fuel cells

Full-or-part-time: 10h
Practical classes: 4h
Laboratory classes: 6h

Hydrogen combustion

Description:
The topic will begin by studying the main characteristics of hydrogen that make it a unique substance in its storage, then studying its combustion and the necessary adaptations so that an internal combustion engine can work with hydrogen.
A model of a hydrogen engine will be integrated into a model of a hydrogen plant.

Specific objectives:
The objective is that, upon completion of this topic, students:
1. Know the basic principles of hydrogen accumulation
2. Know the basic principles of hydrogen combustion
3. Know how to propose mass and energy balances in a hydrogen engine and verify them experimentally.
4. Know the necessary adaptations so that a MACI engine can work with hydrogen.
5. Know how to model a hydrogen engine

Full-or-part-time: 10h
Practical classes: 4h
Laboratory classes: 6h

GRADING SYSTEM